GR 6307
Public Economics and Development

2. Taxation:
Raising Revenues with Tax Evasion and Informality

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Outline

Motivating Facts

Taxation in Developing Countries: Big Picture

Tax Evasion: Theory and Evidence from Rich Countries

Taxing Individuals in Developing Countries

Taxing Firms in Developing Countries

International Taxation and Developing Countries

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.

SUSTAINABLE DEVELOPMENT GOAL 17

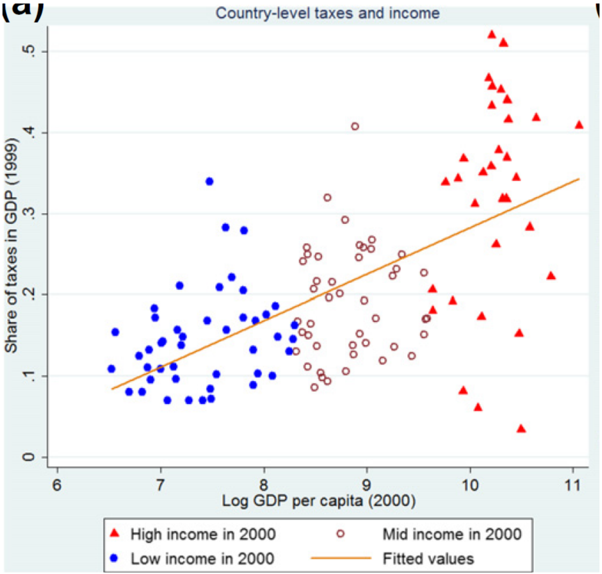
Strengthen the means of implementation and revitalize the global partnership for sustainable development

TARGETS

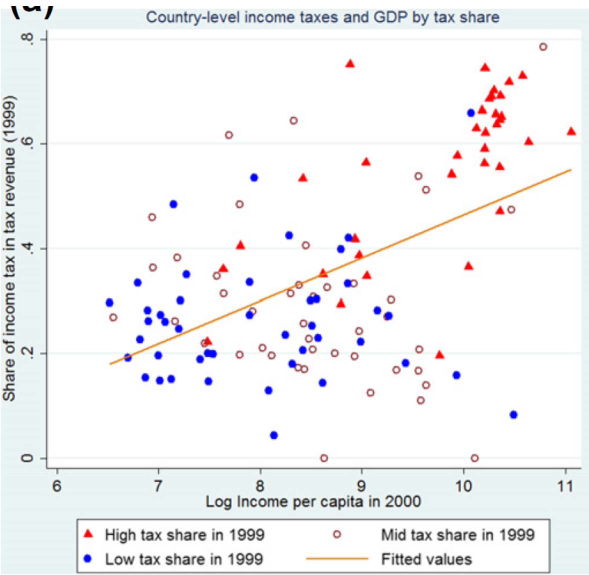
FINANCE

17.1 Strengthen domestic resource mobilization, including through international support to developing countries, to improve domestic capacity for tax and other revenue collection

Motivating Facts: Besley & Persson (2013)



Motivating Facts: Besley & Persson (2013)



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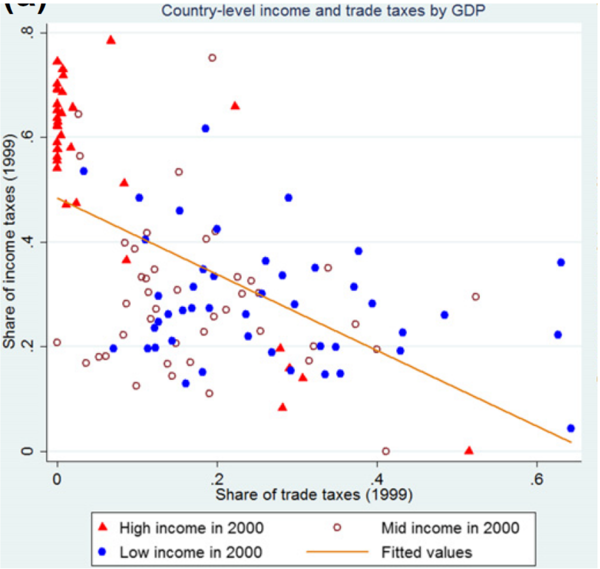

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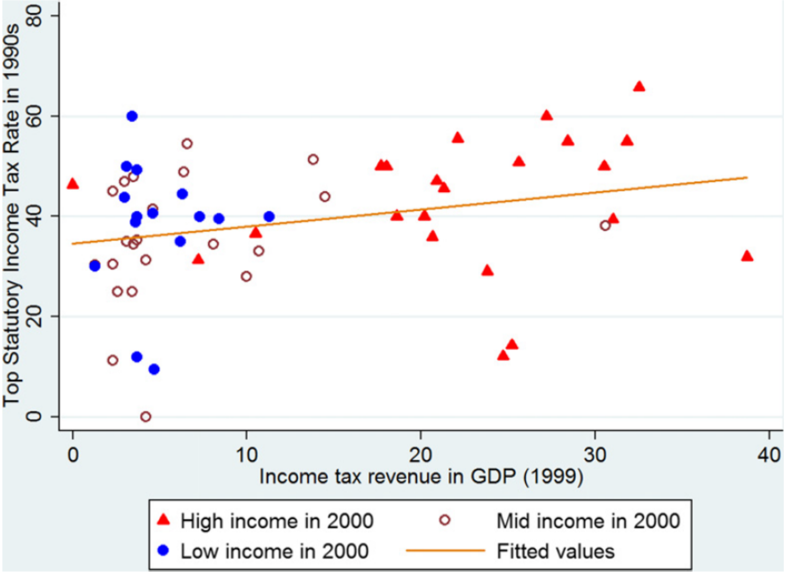
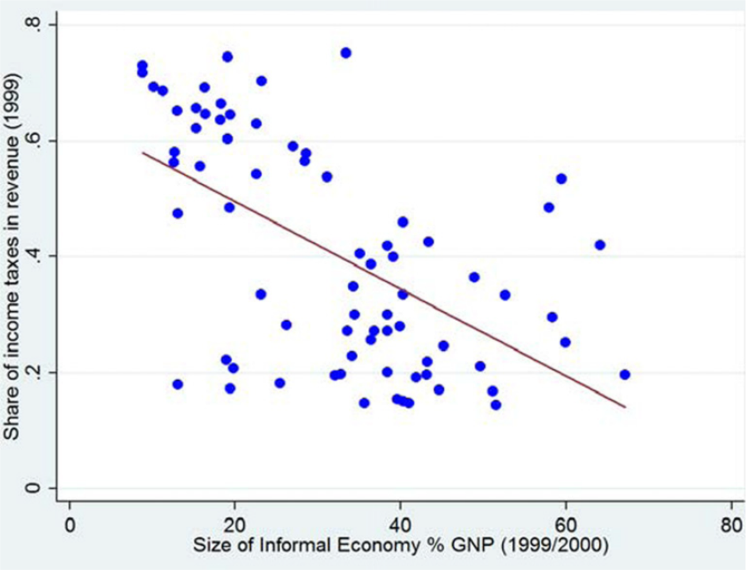


Motivating Facts: Besley & Persson (2013)



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

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Taxation in Developing Countries: Big Picture

Besley & Persson (2013 Handbook of Public) *Taxation and Development*

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

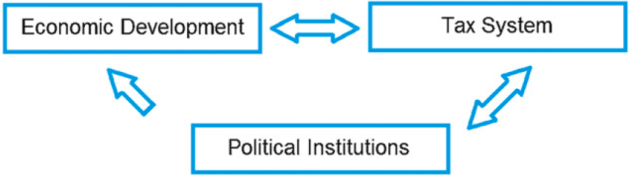

Figure 3 Extended approach.

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 $x_{n,s}^J$
- Non-rival and non-excludable public good g_s
- Labor supply L_s^J
- pre-tax prices $p_{n,s}$ and wage ω_s^J

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

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

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

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

$$b_s\left(\lambda_s^{I_s}, \boldsymbol{\tau}_s\right) = \left[B\left(\boldsymbol{t}_s^*\left(\lambda_s^{I_s}, \boldsymbol{\tau}_s\right), \boldsymbol{\tau}_s\right) + R_s - m_s - g_s^*\left(\lambda_s^{I_s}, \boldsymbol{\tau}_s\right)\right]$$

Besley & Persson (2013): Political Turnover

- Now the incumbent chooses fiscal capacity to maximize

$$W^{I}\left(\boldsymbol{\tau}_{1}, R_{1}-\mathcal{F}\left(\boldsymbol{\tau}_{1}, \boldsymbol{\tau}_{2}\right)\right)+(1-\gamma) W^{I}\left(\boldsymbol{\tau}_{2}, R_{2}\right)+\gamma W^{O}\left(\boldsymbol{\tau}_{2}, R_{2}\right)$$

- Optimal choice satisfies

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

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

- 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

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- Allingham & Sandmo 1972 (& Yitzhaki 1974) *Income Tax Evasion: A Theoretical Analysis*
- Chetty (AEJ:Pol 2009) *Is the Taxable Income Elasticity Sufficient to Calculate Deadweight Loss? The Implications of Evasion and Avoidance*
- Kleven, Knudsen, Kreiner, Pedersen & Saez (Ecma 2011) *Unwilling or Unable to Cheat? Evidence from a Tax Audit Experiment in Denmark*
- Alstadsæter, Johannesen & Zucman (AER 2019) *Tax Evasion and Inequality*
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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

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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

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

- Social Welfare

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

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

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

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

Tax Evasion: Theory and Evidence from Rich Countries

- Allingham & Sandmo 1972 (& Yitzhaki 1974) *Income Tax Evasion: A Theoretical Analysis*
- Chetty (AEJ:Pol 2009) *Is the Taxable Income Elasticity Sufficient to Calculate Deadweight Loss? The Implications of Evasion and Avoidance*
- Kleven, Knudsen, Kreiner, Pedersen & Saez (Ecma 2011) *Unwilling or Unable to Cheat? Evidence from a Tax Audit Experiment in Denmark*
- Alstadsæter, Johannesen & Zucman (AER 2019) *Tax Evasion and Inequality*
- Artavanis, Morse & Tsoutsoura (QJE 2016) *Measuring Income Tax Evasion using Bank Credit: Evidence from Greece*

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 $e > \overline{y}_s$
  3. $p(e)$ increases rapidly around $e = \overline{y}_s$

Kleven et al. (2011): Model

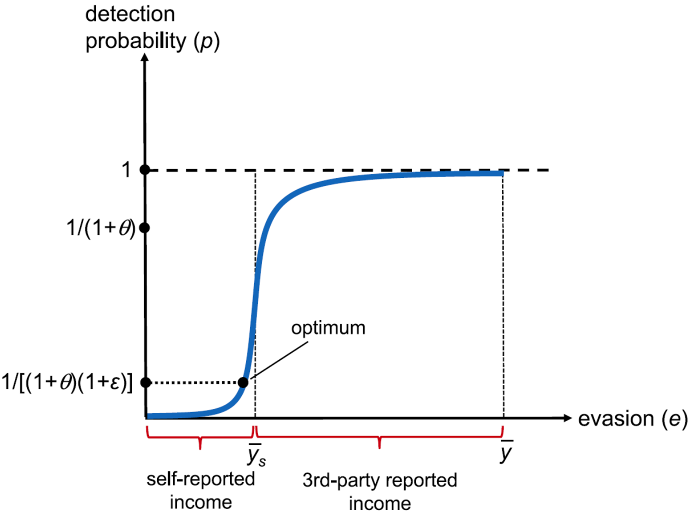


FIGURE 1.——Probability of detection under third-party reporting.

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

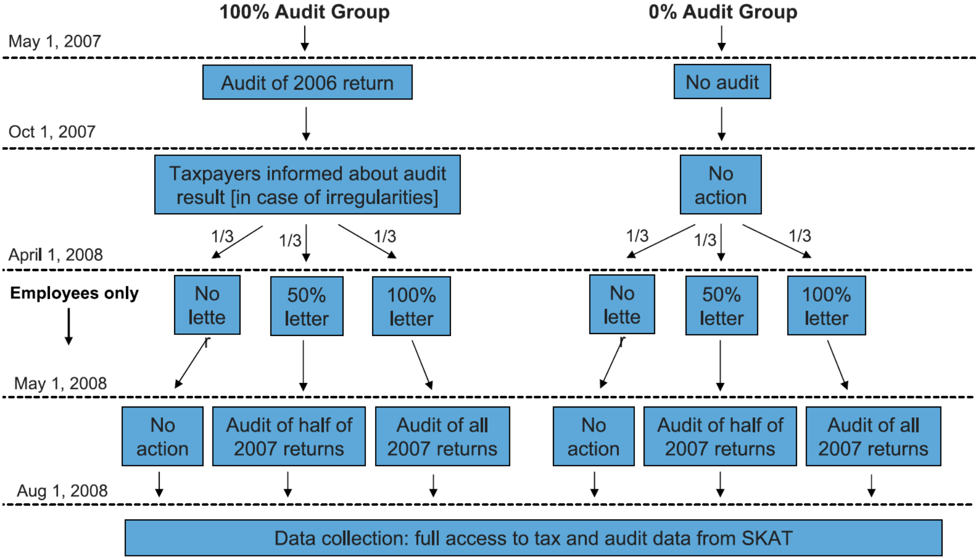
A. Income Concepts

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)

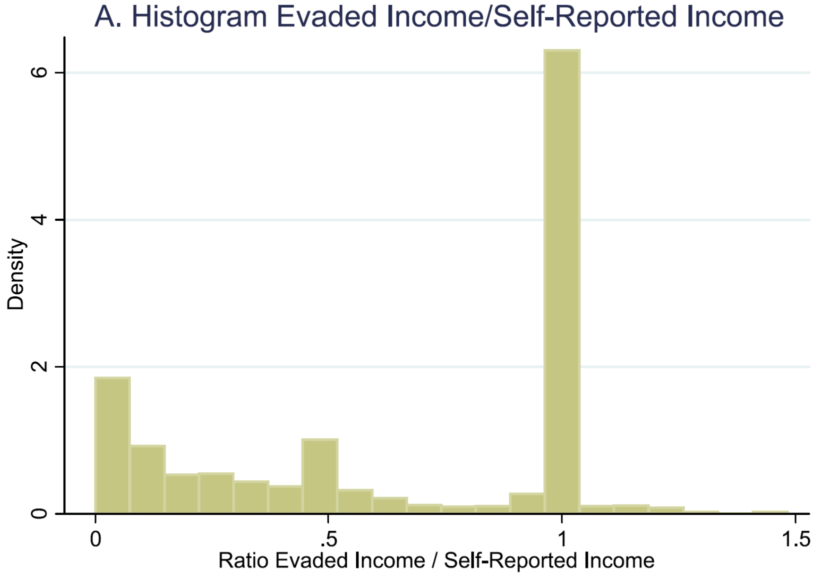
Kleven et al. (2011): Audit Results (2)

		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)

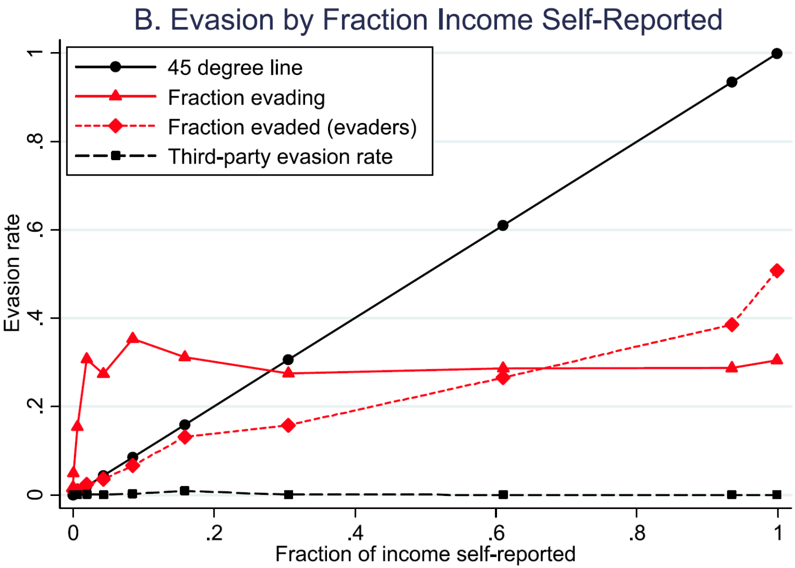
Kleven et al. (2011): Audit Results (3)

		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)

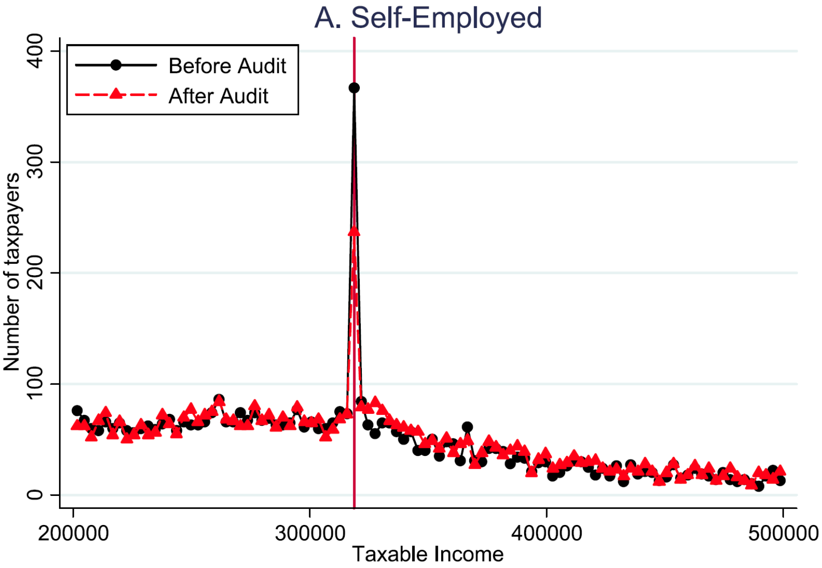
Kleven et al. (2011): Audit Results (4)



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: Total Income	Self-Reported Income	Third-Party Reported Income	IV Effect of Audit Adjustment on Income Change
	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

Tax Evasion: Theory and Evidence from Rich Countries

- Allingham & Sandmo 1972 (& Yitzhaki 1974) *Income Tax Evasion: A Theoretical Analysis*
- Chetty (AEJ:Pol 2009) *Is the Taxable Income Elasticity Sufficient to Calculate Deadweight Loss? The Implications of Evasion and Avoidance*
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- Alstadsæter, Johannesen & Zucman (AER 2019) *Tax Evasion and Inequality*
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Alstadsæter et al. (2019): Overview

- Who evades taxes? Is it the ultra-rich (panama papers) or the poor (self-employed/benefit fraud)?
- Combine financial leaks, amnesties, and tax data in Scandinavia to study distribution of evasion.
- Find that
  - evasion is higher amongst the rich (25-30% vs 3% in the overall population)
  - evasion and avoidance aren't good substitutes
- Provide a model of tax evasion intermediaries to rationalize results
- Implies that
  - high fiscal returns to clamping down on evasion
  - measured wealth inequality understated

Alstadsæter et al. (2019): Data

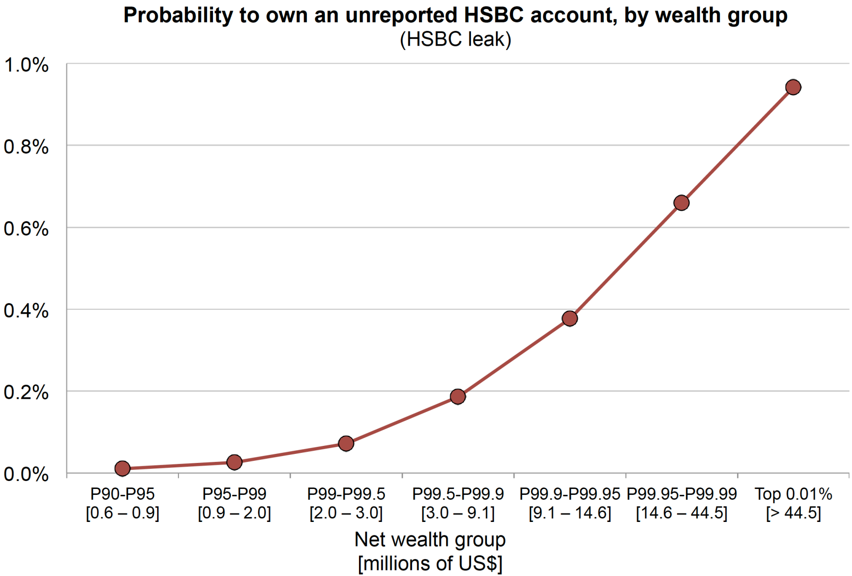
1. HSBC Switzerland Leak
   1.1 In 2007, an engineer at HSBC Private Bank Switzerland leaked details of 30,142 clients' accounts to French tax authorities.
   1.2 Contains beneficial ownership information linking owners to wealth even if held through shell companies
   1.3 HSBC a big player in offshore wealth management.
   1.4 Link to Scandinavian tax data: Match 520 households who did not declare the accounts.
2. Panama Papers Leak
   2.1 2016 leak of names & addresses of owners of shell companies created by Mossack Fonseca
   2.2 Match to 165 taxpayers in Norway & Sweden
3. Tax Amnesty Participants in Norway and Sweden
   3.1 1,422 in NO; 6,811 in SE
4. Tax microdata from Denmark, Norway & Sweden

Alstadsæter et al. (2019): Wealth Distribution

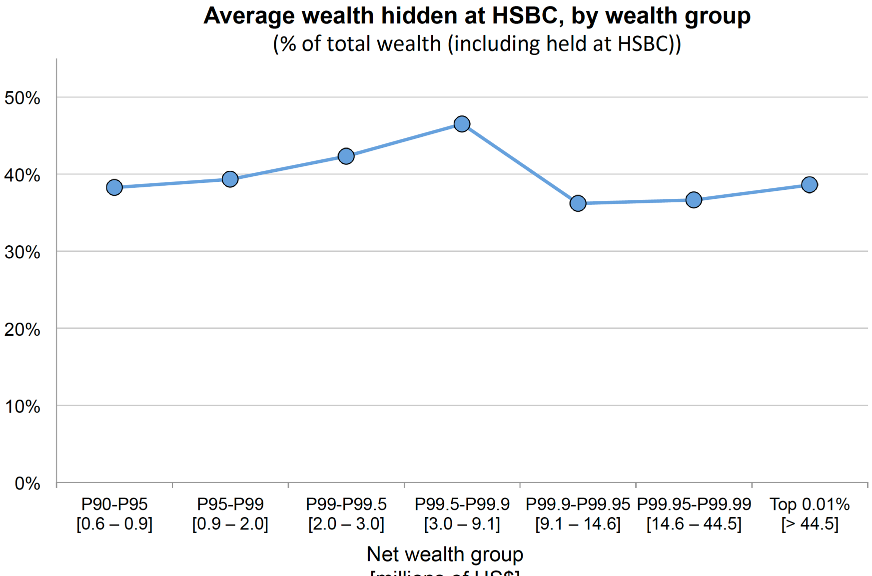
- Construct full distribution of wealth
- Distribute aggregate wealth in national accounts amongst households

1. 3rd-party reports from banks, insurers etc of end-of-year market value of clients' wealth
2. land/real-estate assets valued using transaction prices
3. Impute non-coporate business assets and unlisted equities by capitalizing business/dividend income on tax returns

Alstadsæter et al. (2019): Leaks Results

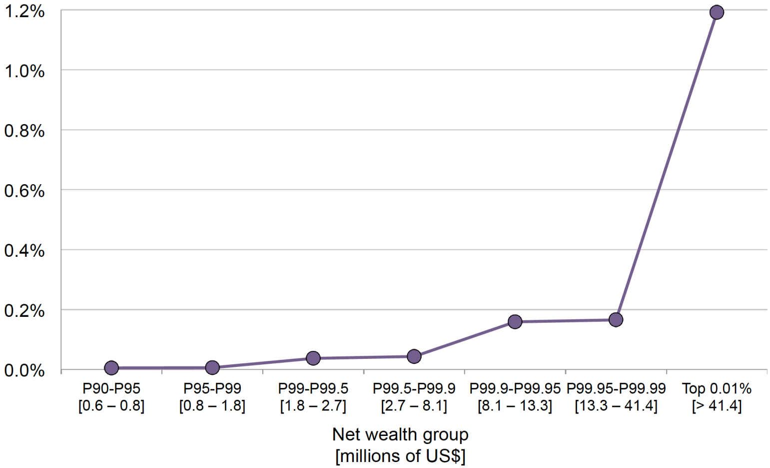


Alstadsæter et al. (2019): Leaks Results



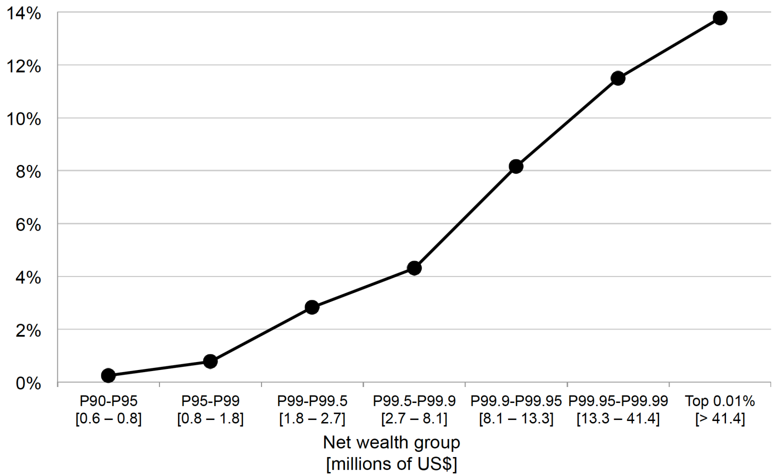
Alstadsæter et al. (2019): Leaks Results

Figure 4: Probability to appear in the Panama Papers, by wealth group



Alstadsæter et al. (2019): Amnesty Results

Figure 5: Probability to use a tax amnesty, by wealth group

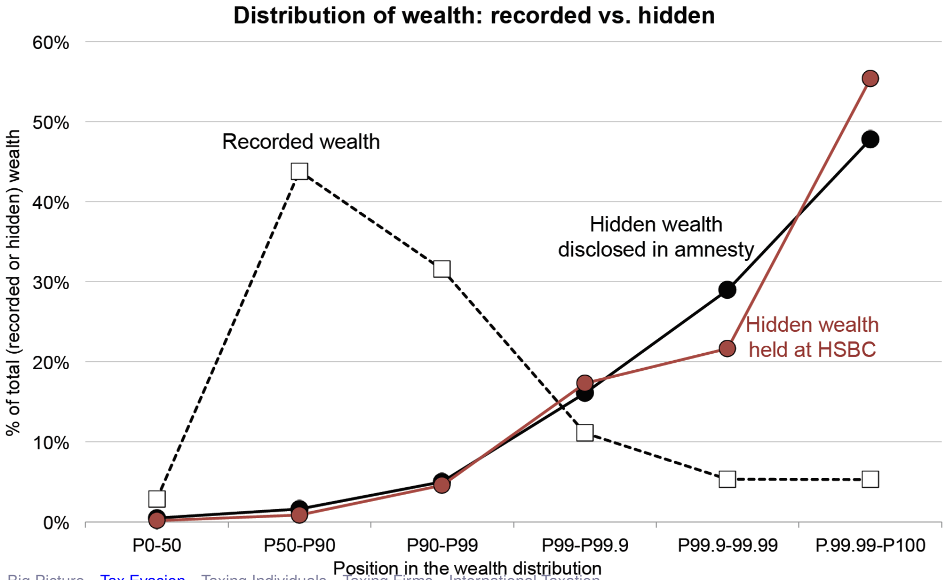


Alstadsæter et al. (2019): Tax Evasion

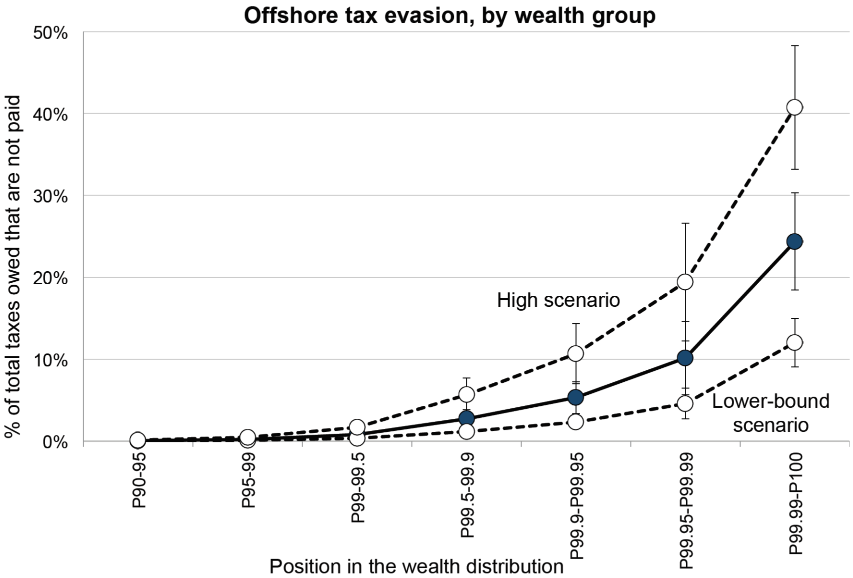
- Can we use this to try and estimate how much tax is missing from each group?
- Their approach:

1. Estimate total amount of offshore wealth
   - Zucman (2013) estimates \$5.6 trn of offshore wealth in the world. Use Swiss bilateral bank deposit data to allocate to Scandinavian countries. $\rightarrow$1.6% of Scandinavian wealth is in tax havens.
2. Estimate distribution of offshore wealth across wealth groups
   - Use distributions in leak/amnesty data.
3. Estimate how much offshore wealth is hidden vs declared
   - To match aggregates and HSBC investigations assume 10% is reported
4. Compute amount of taxes due on hidden wealth
   - Assume 4.5% taxable rate of return plus tax simulator to estimate tax due.

Alstadsæter et al. (2019): Wealth Distribution

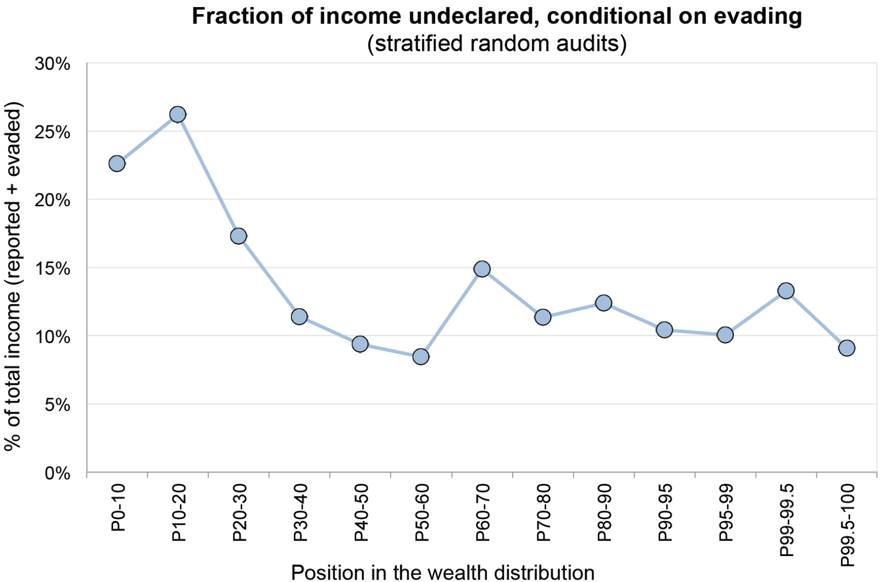


Alstadsæter et al. (2019): Tax Evaded

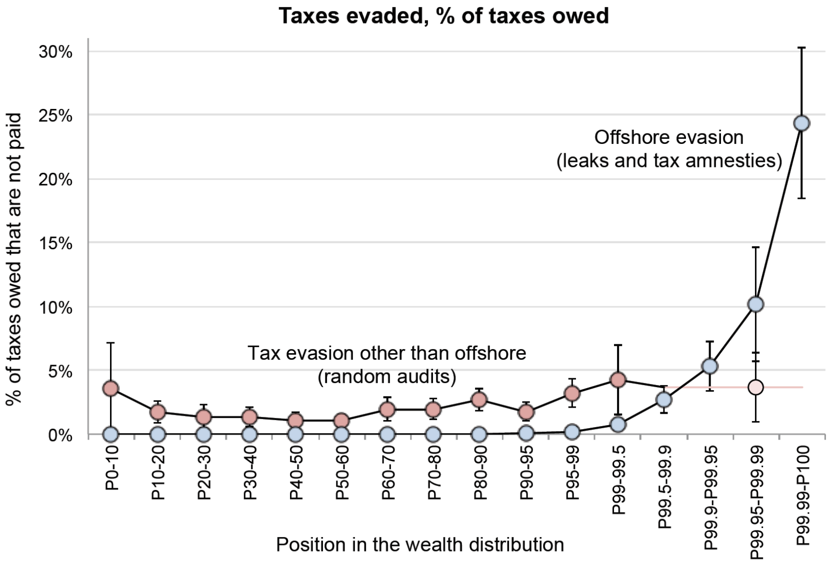


Alstadsæter et al. (2019): Random Audits Comparison

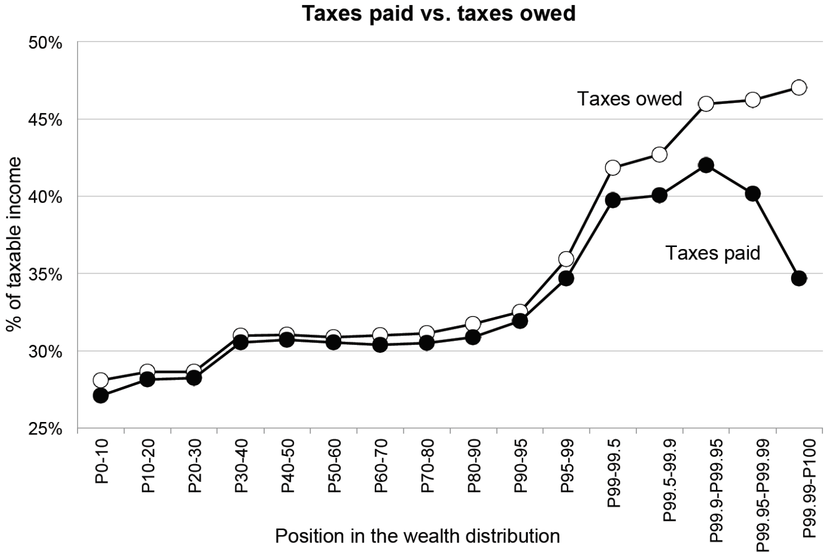
Alstadsæter et al. (2019): Random Audits Comparison



Alstadsæter et al. (2019): Total Tax Evasion



Alstadsæter et al. (2019): Effective Tax Rates



Alstadsæter et al. (2019): Model

- Allingham-Sandmo model would predict less evasion by wealthy, they have higher probability of detection
- Extend the model to have a bank providing evasion services.
- Households have wealth $y \sim f(y)$ and wtp θ per dollar of hidden wealth.
- Bank serves s clients. Detected w/pr λs and pays fine of ϕ per dollar of assets it manages. Charges price $p(y)$

$$\pi = \int yp(y)\, s(y)\, f(y)\, dy - \lambda s \phi \int ys(y)\, f(y)\, dy$$

- Monopolist $\rightarrow$ optimal price $p^*(y) = \theta$ (why?)

Alstadsæter et al. (2019): Model

- Now profits are
$$\pi = \theta k(s) - \lambda s \phi k(s)$$
where $k(s)$ is wealth of s wealthiest households
- So profit-maximizing s^* satisfies
$$\theta = \left(1 + \frac{1}{\epsilon_k(s^*)}\right) \phi \lambda s^*$$
where $\epsilon_k(s) = sk'(s)/k(s)$
- *Proposition 1: the wealthiest s^* households evade at price θ. All others do not evade.*

Alstadsæter et al. (2019): Model

- Assume further that $f(y)$ is pareto with parameter $a > 1$ $\left(F(y) = 1 - \left(\underline{y}/y\right)^a\right)$ then we can state

- *Proposition 2: The share s^* of households who evade taxes (i) falls with the probability of detection λ (ii) falls with the penalty rate ϕ, and (iii) falls as wealth becomes more unequally distributed (i.e. as the Pareto coefficient falls)*

- NB that even though the number of evaders drops when inequality rises, the fraction of total wealth that is hidden increases.

Outline

Tax Evasion: Theory and Evidence from Rich Countries

- Allingham & Sandmo 1972 (& Yitzhaki 1974) *Income Tax Evasion: A Theoretical Analysis*
- Chetty (AEJ:Pol 2009) *Is the Taxable Income Elasticity Sufficient to Calculate Deadweight Loss? The Implications of Evasion and Avoidance*
- Kleven, Knudsen, Kreiner, Pedersen & Saez (Ecma 2011) *Unwilling or Unable to Cheat? Evidence from a Tax Audit Experiment in Denmark*
- Alstadsæter, Johannesen & Zucman (AER 2019) *Tax Evasion and Inequality*
- Artavanis, Morse & Tsoutsoura (QJE 2016) *Measuring Income Tax Evasion using Bank Credit: Evidence from Greece*

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 $\rightarrow$estimate Engel curve
  - Applying inverse Engel curve to other households $\rightarrow$ 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*
- $\Rightarrow$ 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 $SE_i = I\{\text{self-employed}\}$:

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

- So estimate

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

  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%

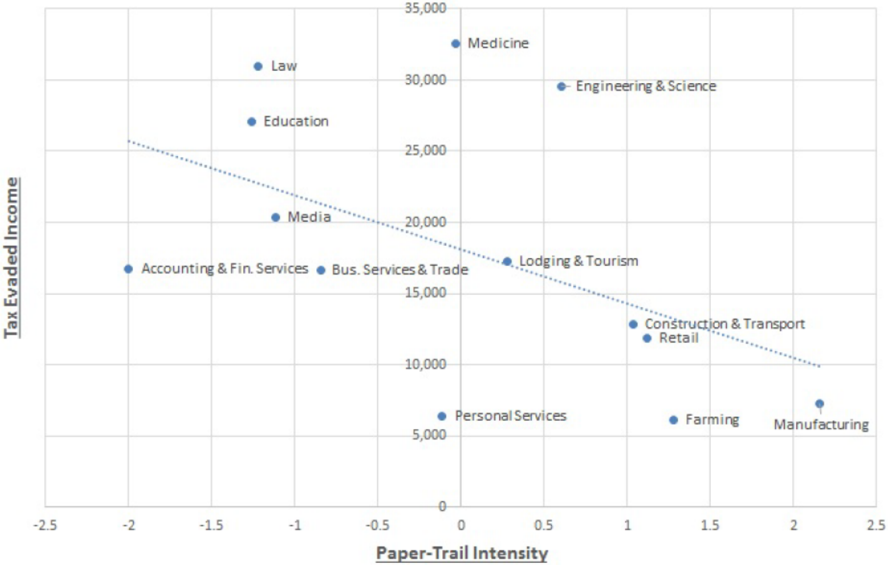
Artavanis *et al.* (2015): Results

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

Artavanis *et al.* (2015): Results



Outline

Motivating Facts

Taxation in Developing Countries: Big Picture

Tax Evasion: Theory and Evidence from Rich Countries

Taxing Individuals in Developing Countries

Taxing Firms in Developing Countries

International Taxation and Developing Countries

Outline

Taxing Individuals in Developing Countries

- Jensen (WP 2019) *Employment Structure and the Rise of the Modern Tax System*
- Bachas, Gadenne & Jensen (WP 2020) *Informality, Consumption Taxes and Redistribution*
- Bergeron, Tourek & Weigel (2021) *The State Capacity Ceiling on Tax Rates: Evidence from Randomized Tax Abatements in the DRC*

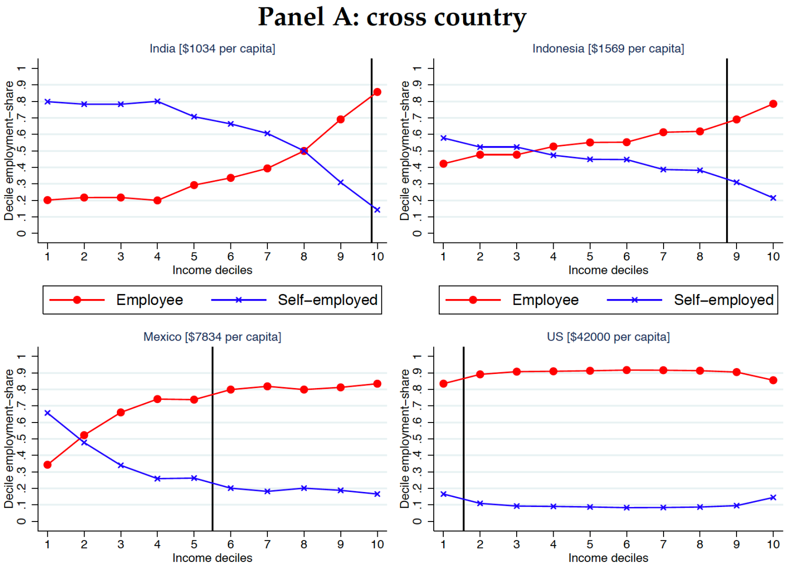
Jensen (2019): Overview

- 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

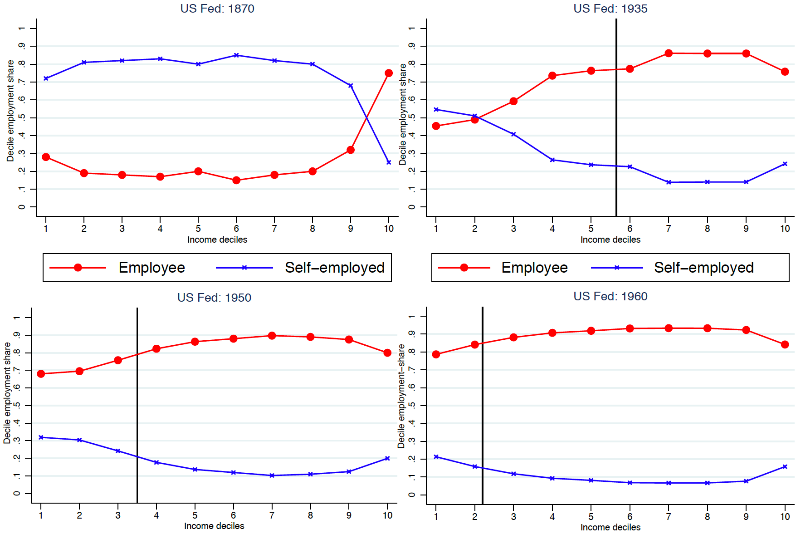
1. Household microdata from 90 countries around the world containing
   - information on type of work
   - earnings information (not expenditure proxies)
2. Historical data on the US
   - Census microdata 1950–2010
   - 1870 & 1935 from historians (Williamson & Lindert)
   - state income tax schedules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

Jensen (2019): Stylized Facts

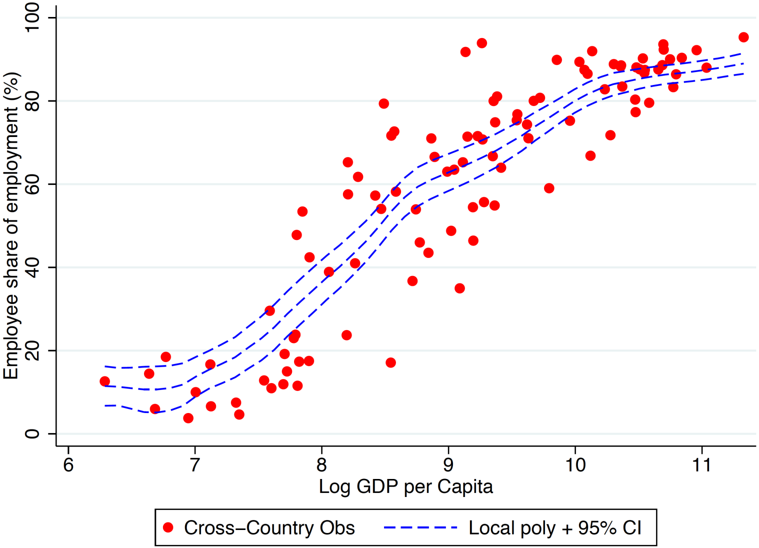


Jensen (2019): Stylized Facts

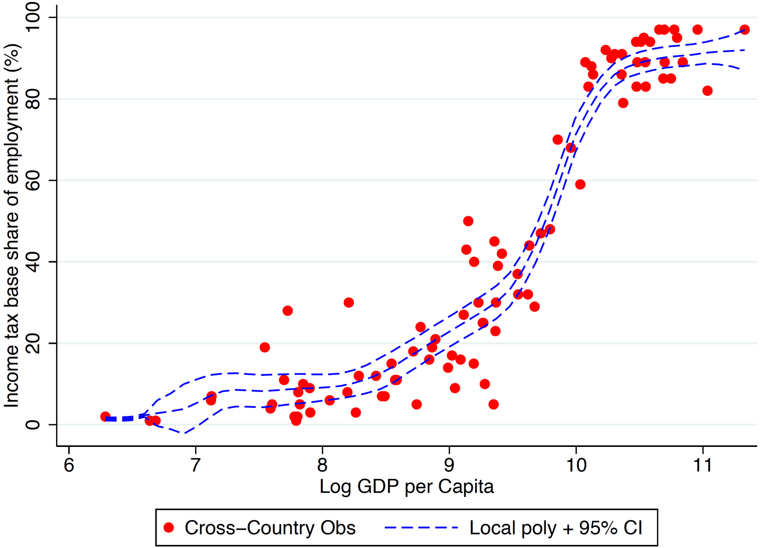
Panel B: within country over time US 1870-1960



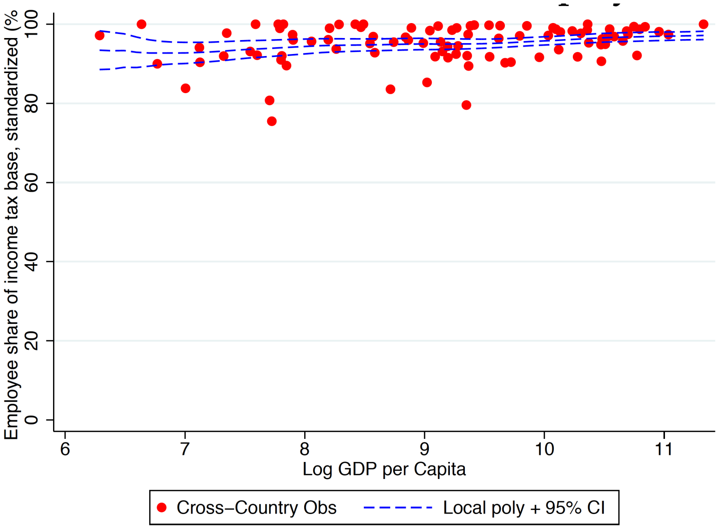
Jensen (2019): Stylized Facts



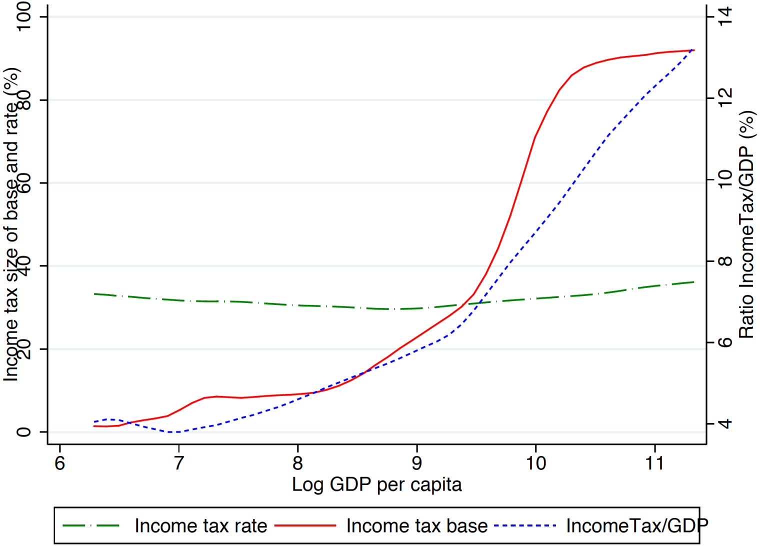
Jensen (2019): Stylized Facts



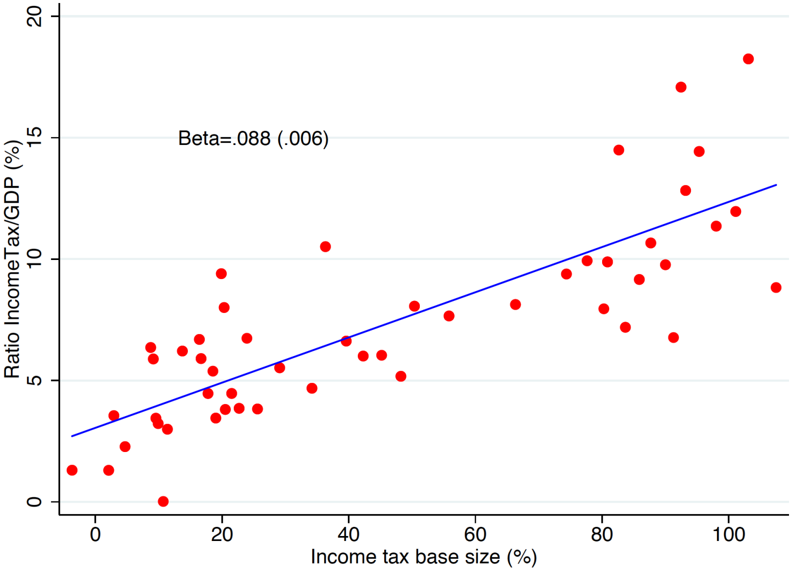
Jensen (2019): Stylized Facts



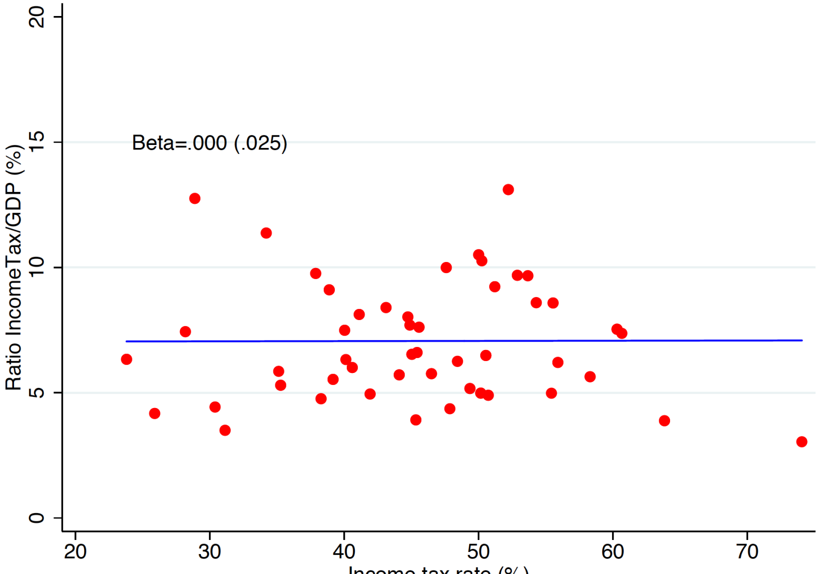
Jensen (2019): Stylized Facts



Jensen (2019): Stylized Facts



Jensen (2019): Stylized Facts



Jensen (2019): Causal Evidence

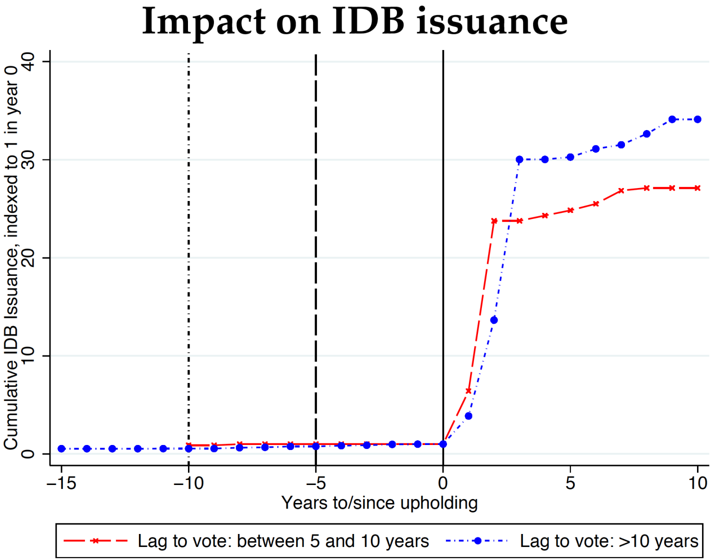
- These cross-country and over-time patterns are compelling, but are they causal?
- Do countries move their tax thresholds *because* they have fewer self-employed workers?
- Use timing of implementation of Industrial Development Bonds.
- Each state votes on whether to issue a bond. However, not implemented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

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

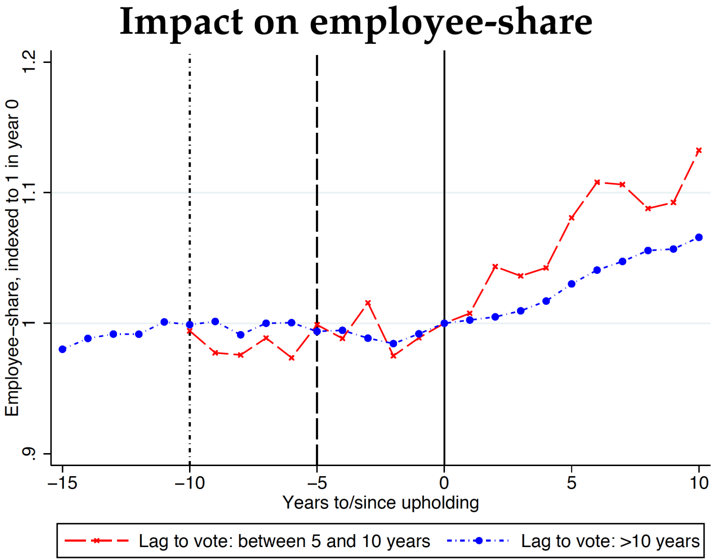
- Argue that mechanism is change in fiscal enforcement cost. Heterogeneity: with(out) Exchange of Information (EOI) w/ IRS.

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

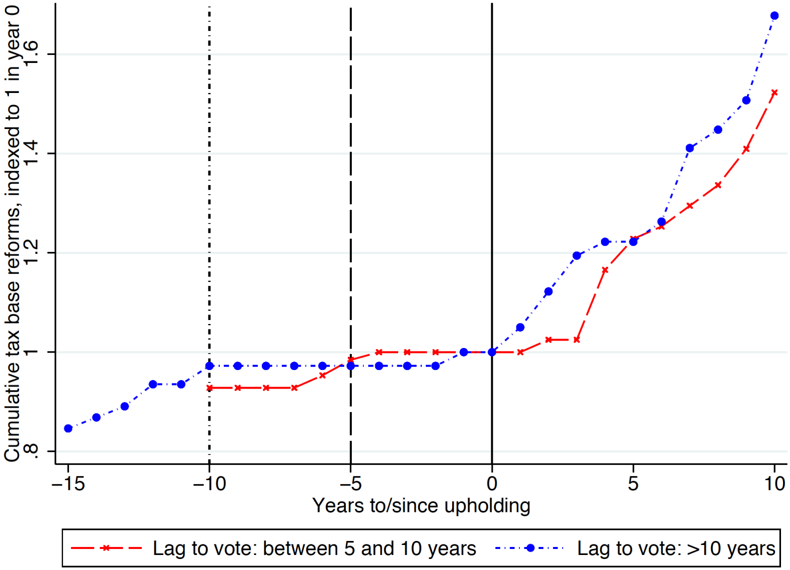
Jensen (2019): Results



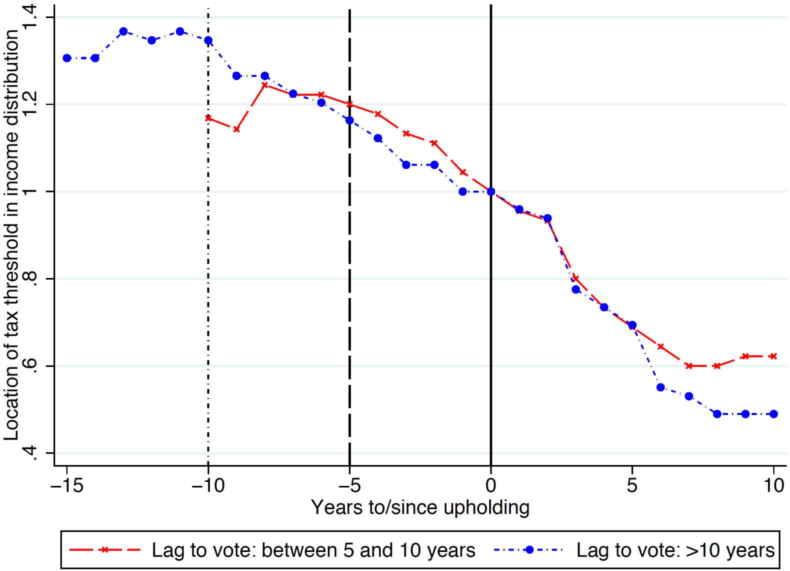
Jensen (2019): Results



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

Taxing Individuals in Developing Countries

- Jensen (WP 2019) *Employment Structure and the Rise of the Modern Tax System*
- Bachas, Gadenne & Jensen (WP 2020) *Informality, Consumption Taxes and Redistribution*
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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

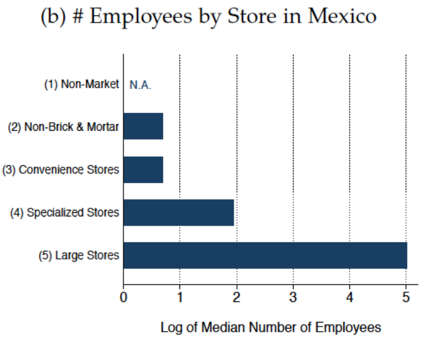
Bachas et al. (2020): Data

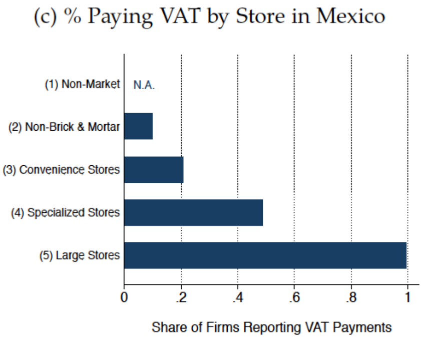
- Look across the world for household survey datasets that satisfy
  1. nationally representative
  2. consumption data from open diaries
  3. Records *store type* (this is the one that binds in practice)
- $\Rightarrow$data from 31 countries on 400K+ households

Bachas et al. (2020): Proxy For Informality

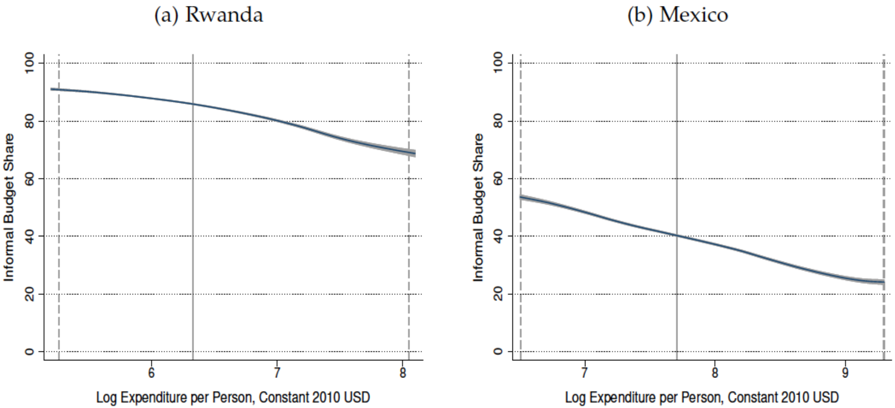
- Proxy for informality using the place of purchase
- 5 categories of store:
  1. non-market consumption (eg home production)
  2. non brick-and-mortar stores
  3. corner/convenience stores
  4. specialized stores (e.g. clothing stores)
  5. large stores (supermarkets, department stores etc)
- Working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

Bachas et al. (2020): Proxy for Informality





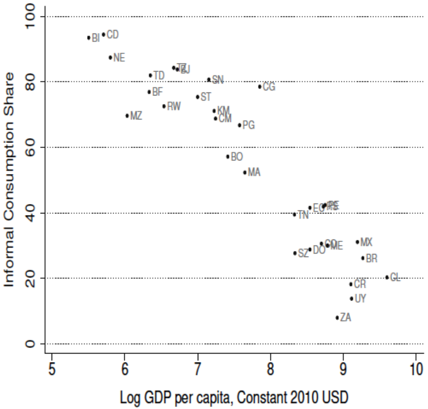
Bachas et al. (2020): Informality Engel Curves



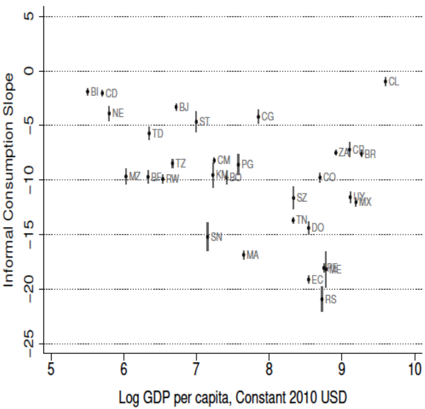
1. Intercept higher in poorer country
2. Negative, roughly constant slope

Bachas et al. (2020): Informality Engel Curves

(a) Informal Budget Share



(b) Informality Engel Curve Slope



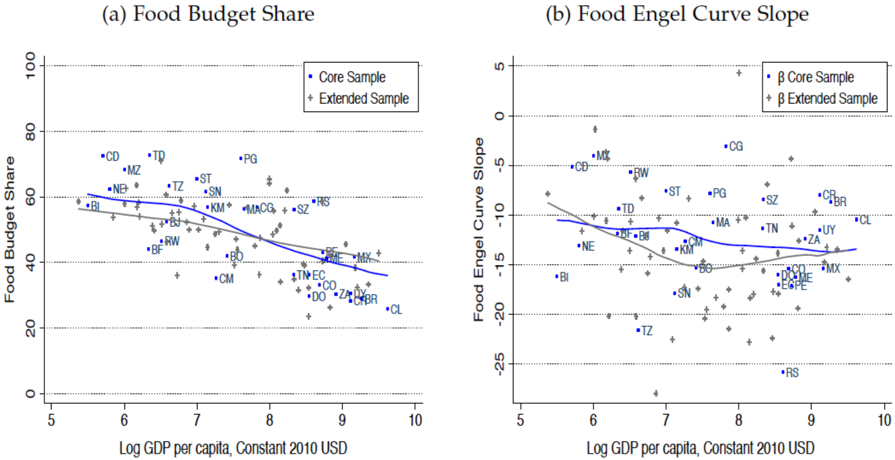
- $ShareInformal_i = \beta \ln\left(expenditure_i\right) + \varepsilon_i$

Bachas et al. (2020): Informality Engel Curves

Specification: Avg. of 31 Countries	Main (1)	(2)	Geography (3)	(4)	(5)	Product Codes (6)	(7)	(8)	All (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

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

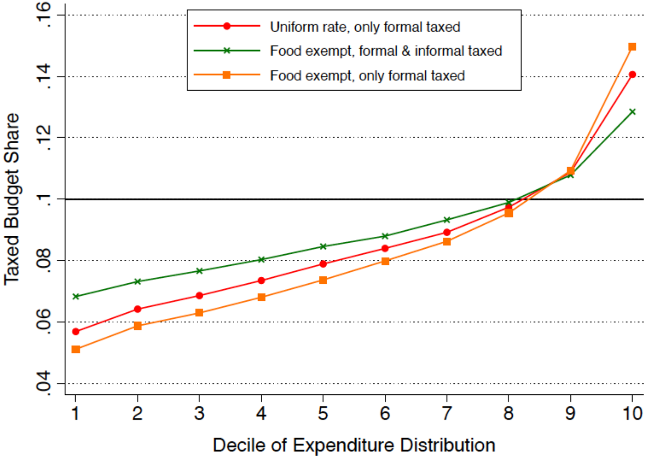
Bachas et al. (2020): Food Engel Curves



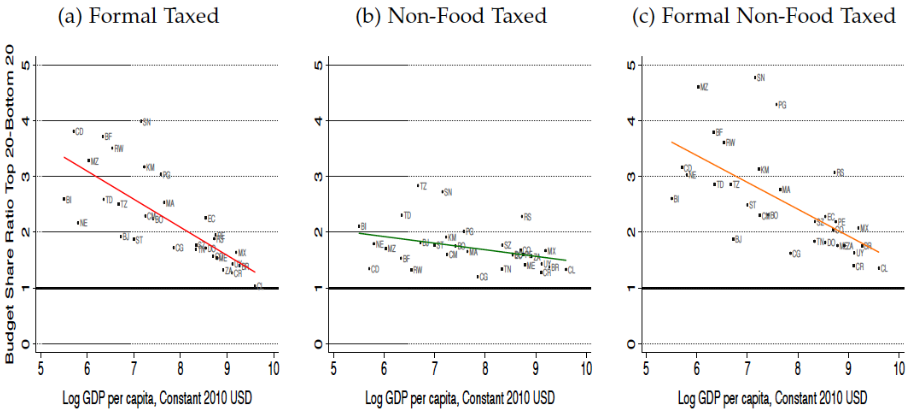
- Can we approximate informality-targeting by just exempting food? Depends how steep the food engel curve is.

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:

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

    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.

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

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

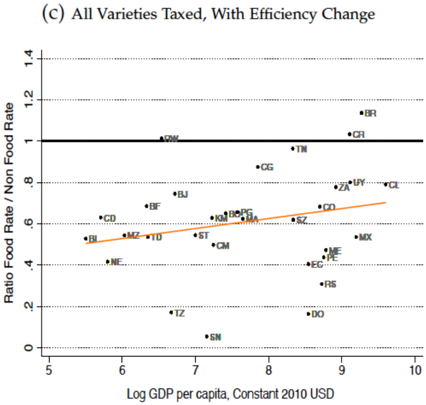
$$\frac{\partial \tau^*}{\tau^*} = \frac{\int_i \left(\bar{g} - g^i\right) \phi^i \frac{s_1^i}{s_1} \left(\frac{\partial s_{1i}}{s_1^i} - \frac{\partial s_1}{s_1}\right) di}{\int_i \left(\bar{g} - g^i\right) \phi^i \frac{s_1^i}{s_1} di} + \frac{\partial \epsilon_1}{\epsilon_1}$$

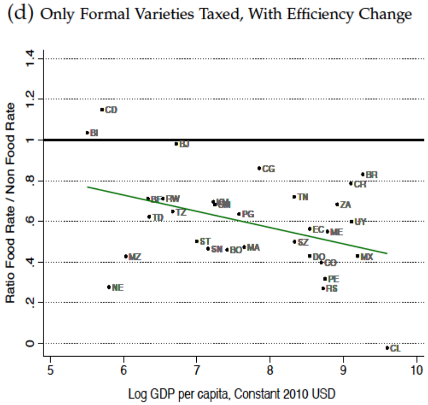
- Proposition:
  - *The redistribution gain from taxing all products uniformly is decreasing over the development path as long as i) the formal Engel curve is upward sloping, ii) the aggregate formal budget share increases more than the slope of the formal Engel curve.*
  - *The efficiency cost of taxing 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





Outline

Taxing Individuals in Developing Countries

- Jensen (WP 2019) *Employment Structure and the Rise of the Modern Tax System*
- Bachas, Gadenne & Jensen (WP 2020) *Informality, Consumption Taxes and Redistribution*
- Bergeron, Tourek & Weigel (2021) *The State Capacity Ceiling on Tax Rates: Evidence from Randomized Tax Abatements in the DRC*

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:

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

  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
-

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

- 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 idiowyncratic 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?

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

- 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

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

  yields maximizing rate

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

- Also consider quadratic specification

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

  with accompanying maximizing rate

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

Bergeron, Tourek & Weigel (2021): Results

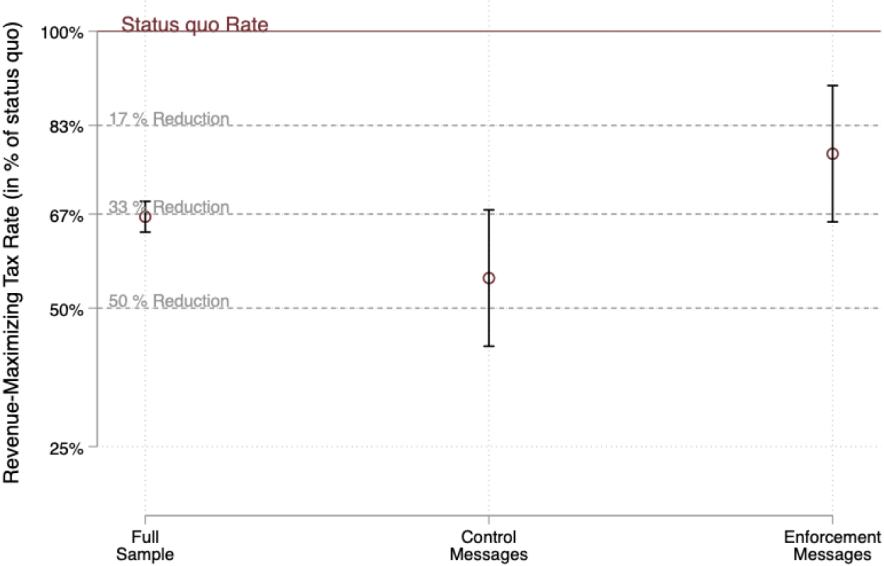
	Linear Specification		Quadratic Specification	
	(1)	(2)	(3)	(4)
Panel A: Effect of Tax Rates on Tax Compliance				
Tax Rate (in % of status quo)	-0.154***	-0.152***	-0.410***	-0.391***
	(0.008)	(0.008)	(0.080)	(0.077)
Tax Rate Squared (in % of status quo)			0.171***	0.160**
			(0.051)	(0.049)
Constant	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

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

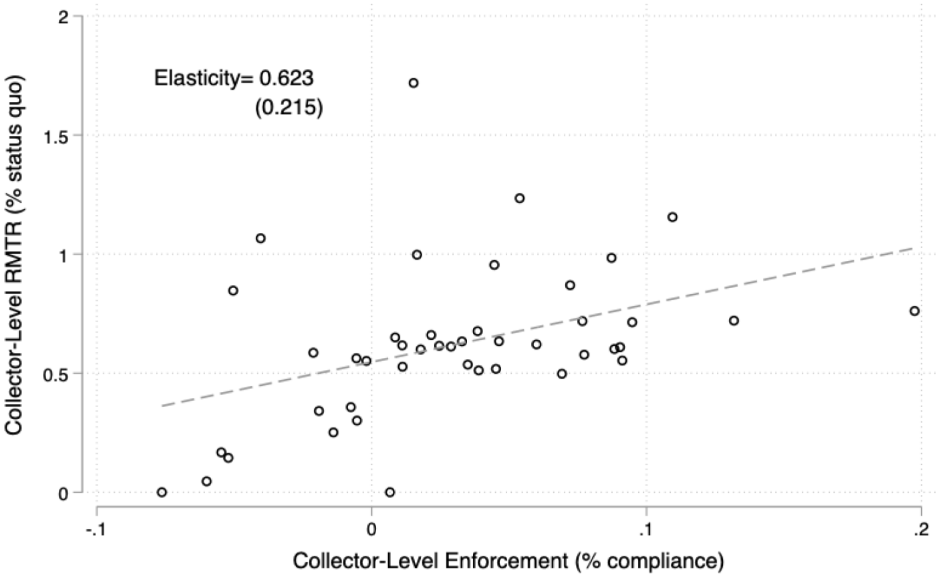
- Now can estimate collector-specific RMTRs:

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

yielding RMTRs

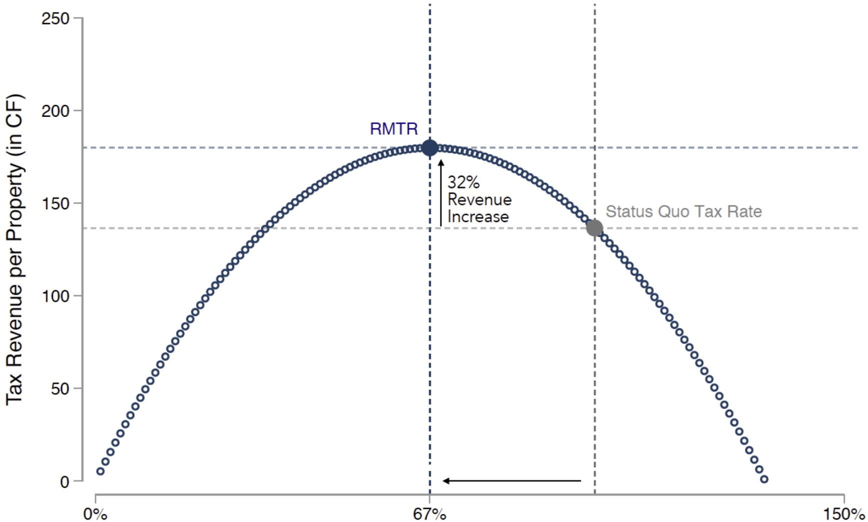
$$T_c^* = \frac{\beta_c^0}{-2 \times \beta_c^1}$$

Bergeron, Tourek & Weigel (2021): Results



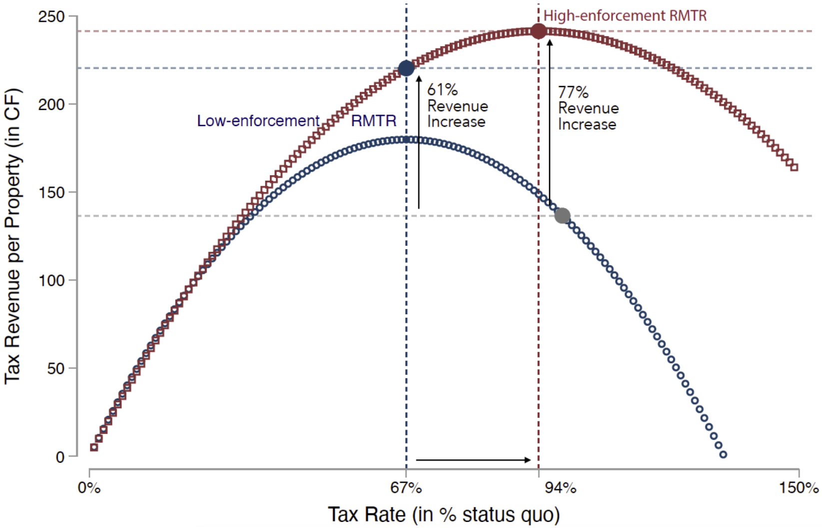
Bergeron, Tourek & Weigel (2021): Laffer Curve

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

Motivating Facts

Taxation in Developing Countries: Big Picture

Tax Evasion: Theory and Evidence from Rich Countries

Taxing Individuals in Developing Countries

Taxing Firms in Developing Countries

International Taxation and Developing Countries

Outline

Taxing Firms in Developing Countries

- Pomeranz (AER 2015) *No Taxation Without Information: Deterrence and Self-Enforcement in the Value Added Tax*
- Naritomi (2018) *Consumers as Tax Auditors*
- Best, Brockmeyer, Kleven, Spinnewijn & Waseem (JPE 2015) *Production vs Revenue Efficiency With Limited Tax Capacity: Theory and Evidence From Pakistan*
- Basri, Felix, Hanna & Olken (2020) *Tax Administration vs. Tax Rates: Evidence from Corporate Taxation in Indonesia*

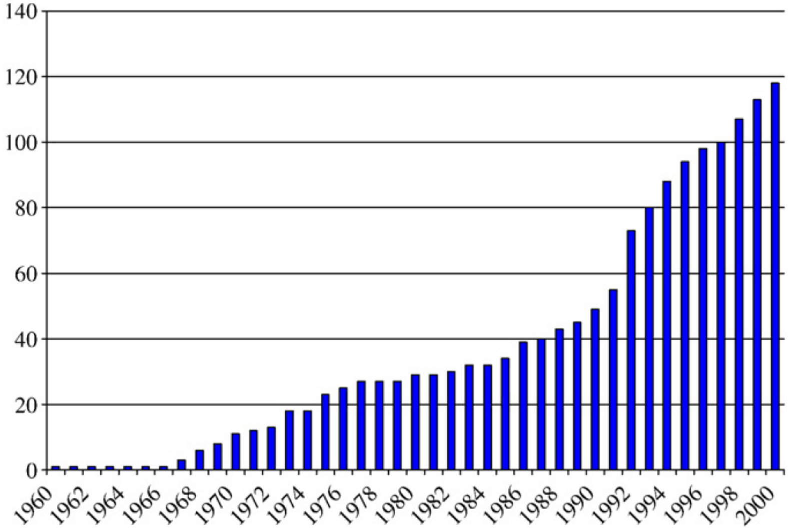
Various Ways to Tax Sales

- **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 ↑

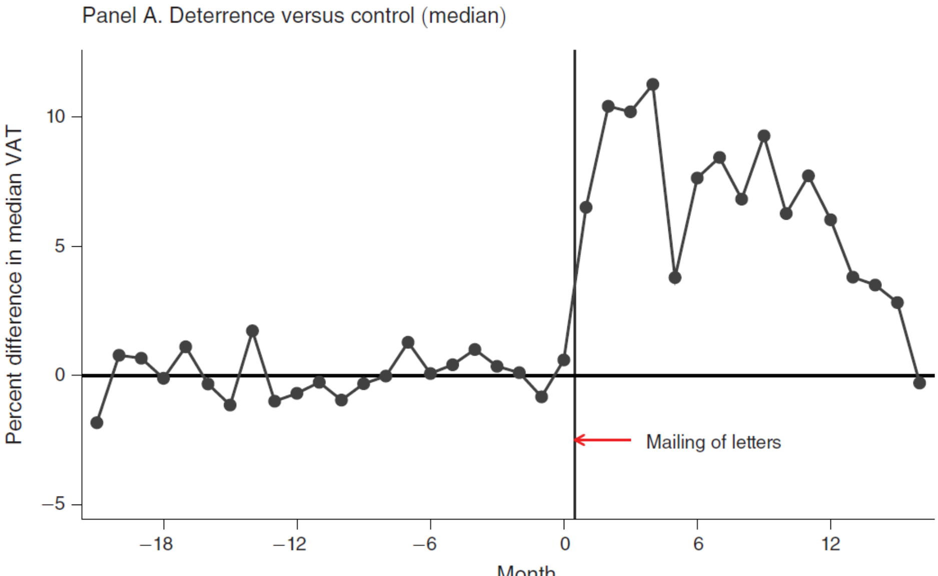
Pomeranz (2015): Experiment 1-Threat of Audit Letters

- 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

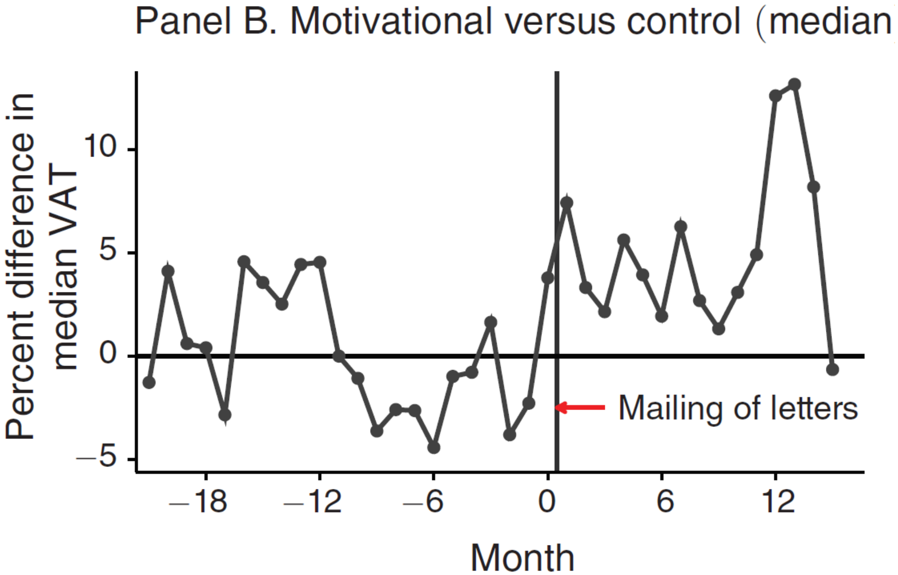
Pomeranz (2015): Experiment 2-Spillovers

- 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

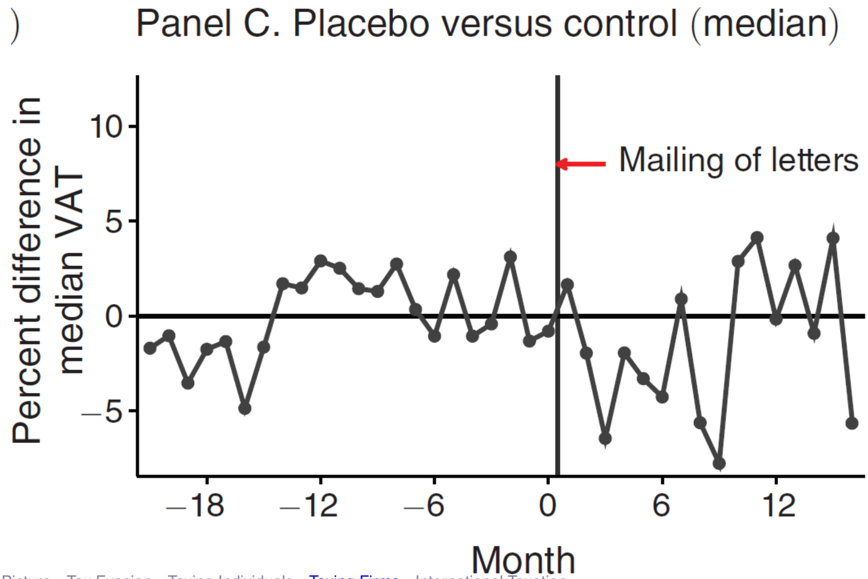
Pomeranz (2015): Experiment 1 Results



Pomeranz (2015): Experiment 1 Results



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

Taxing Firms in Developing Countries

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- Best, Brockmeyer, Kleven, Spinnewijn & Waseem (JPE 2015) *Production vs Revenue Efficiency With Limited Tax Capacity: Theory and Evidence From Pakistan*
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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

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

- The MC (LHS) is higher: $d_c \geq d$
- The MB (RHS) is lower: $\kappa\left(\alpha\right) \geq 0$.
- 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 $\left(Y^{**} - Y^{*}\right)/Y^{*} > \alpha/\left(1-\alpha\right)$

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

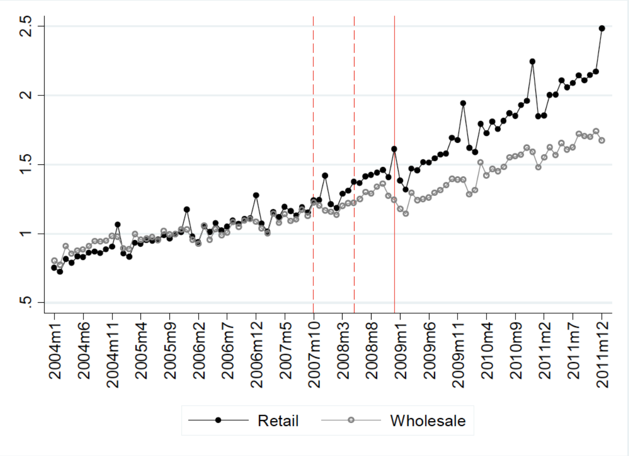
- Timeline:
  - NFP rolled out 10/2007–12/2008
  - Rebates every 6 months from 4/2009
  - Lotteries ~15th of every month from 12/2008

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

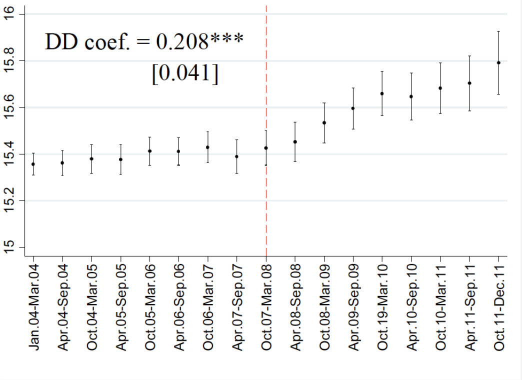
Naritomi (2018): Results

- Firm Sales. Compare retailers to wholesalers.



a. Raw data: reported revenue changes

Naritomi (2018): Results



b. Difference coefficients for 6-month time bins

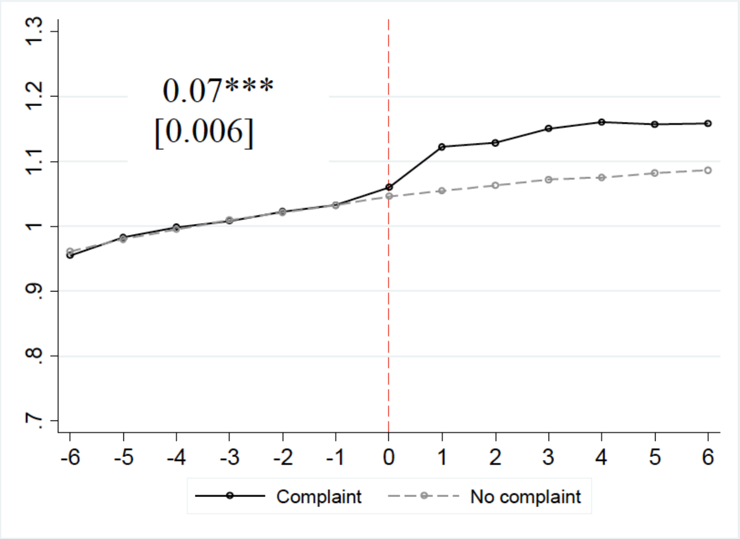
- Aggregate firm data to 7-digit-sector $\times$ 6-months. Run

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

Naritomi (2018): Results

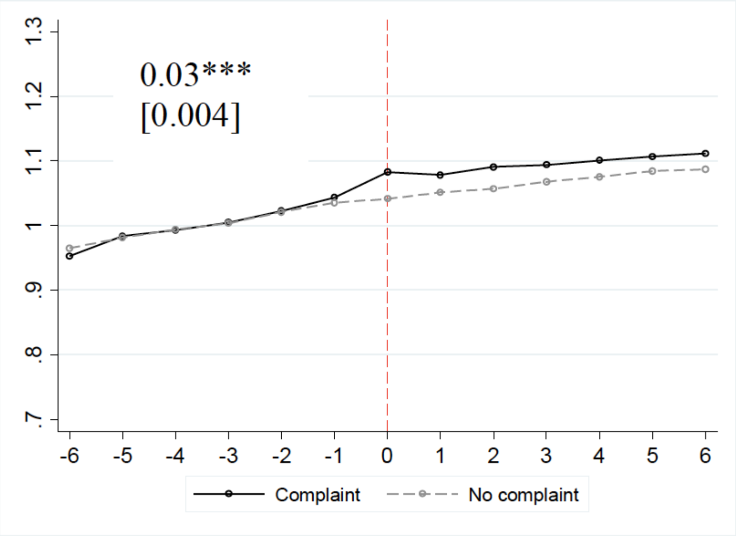
	log Reported Revenue				
	[1]	[2]	[3]	[4]	[5]
DD (Post Oct 07 * Retail)	0.254***				
	[0.0722]				
DD * Large firms		0.253***			
		[0.0732]			
DD * Small firms		0.350***			
		[0.0511]			
DD * High volume of different consumers			0.246***		
			[0.0705]		
DD * Low volume of different consumers			0.0329		
			[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



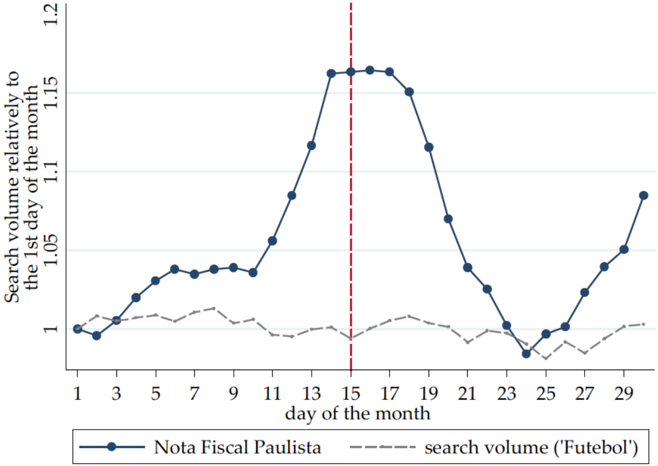
a. Changes in the number of receipts issued

Naritomi (2018): Whistleblower Results



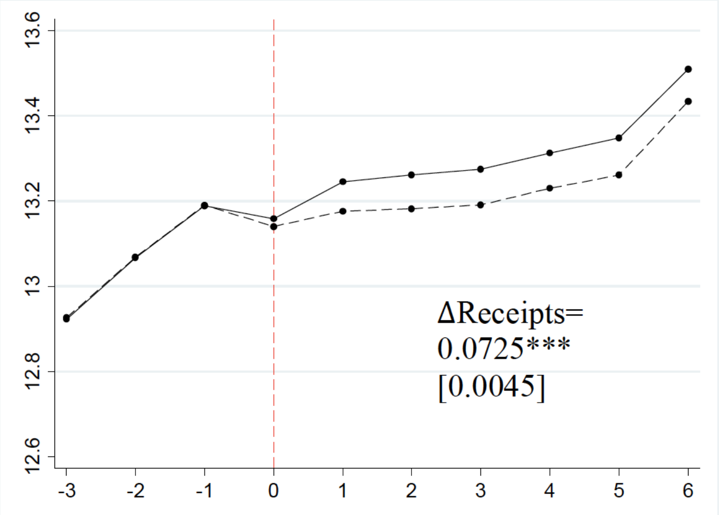
b. Changes in reported revenue

Naritomi (2018): Lottery Salient?



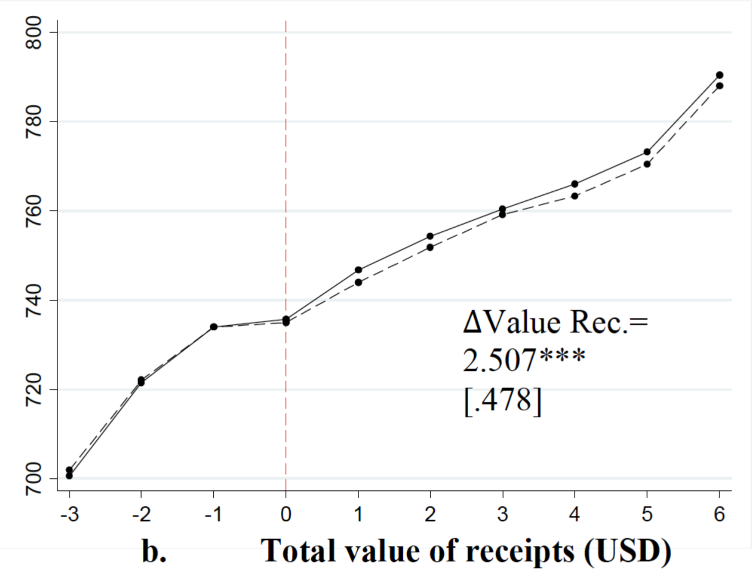
a: Timing of lottery results - Google searches for *Nota Fiscal Paulista*.

Naritomi (2018): Lottery Event Study Results

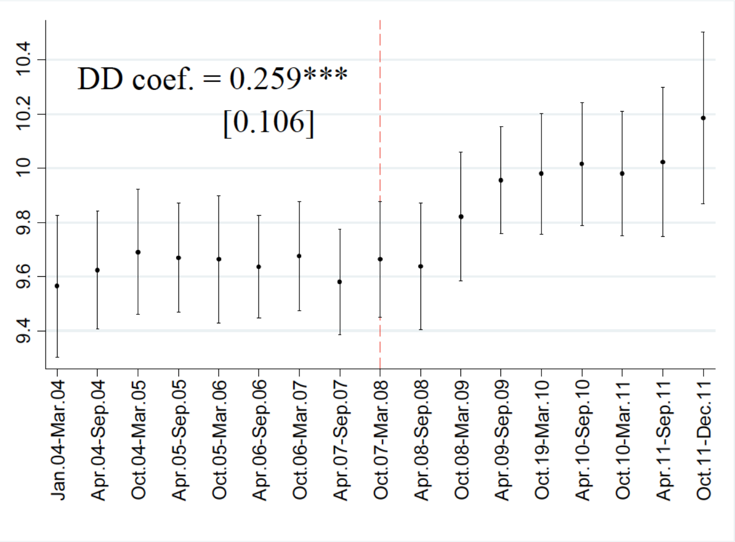


a. Number of receipts

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	Log of Tax Liability	Positive tax liability
	[1]	[2]	[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	Log of Reported Inputs	Log of Reported Value Added	Positive Value Added
	[1]	[2]	[3]	[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

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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

$$y_B = F\left(l_B, y_A\right)$$

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

- Intermediates

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

***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

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

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

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

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

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

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

- 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 ($\mu = 0$):

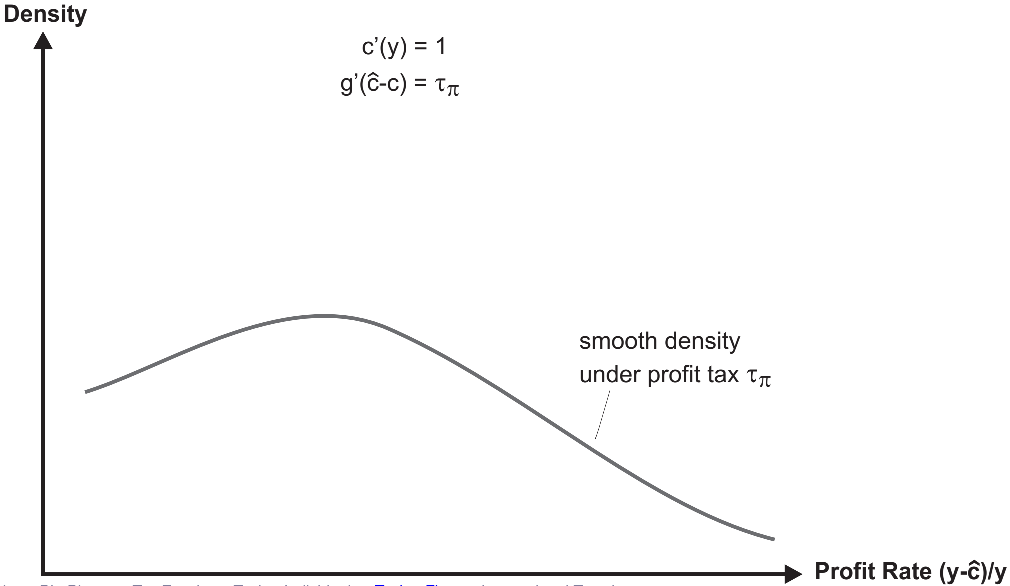
$$T = \max\left\{\tau_\pi\left(y - c\right); \tau_y y\right\}.$$

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

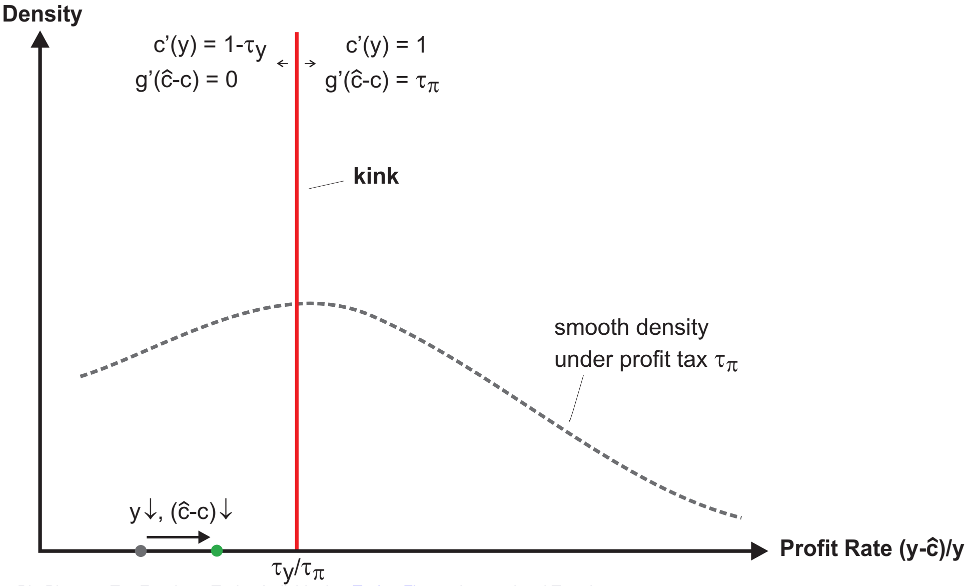
$$\tau_\pi\left(y - c\right) = \tau_y y \quad \Leftrightarrow \quad \hat{\pi} \equiv \frac{y - c}{y} = \frac{\tau_y}{\tau_\pi}.$$

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

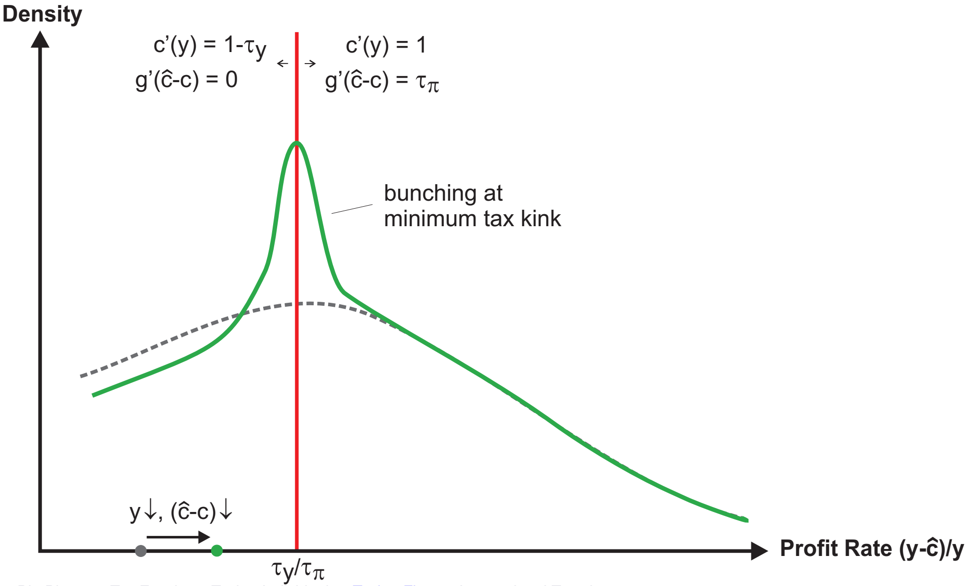
Best *et al.* (2015): Bunching at the Minimum Tax Kink



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:**

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

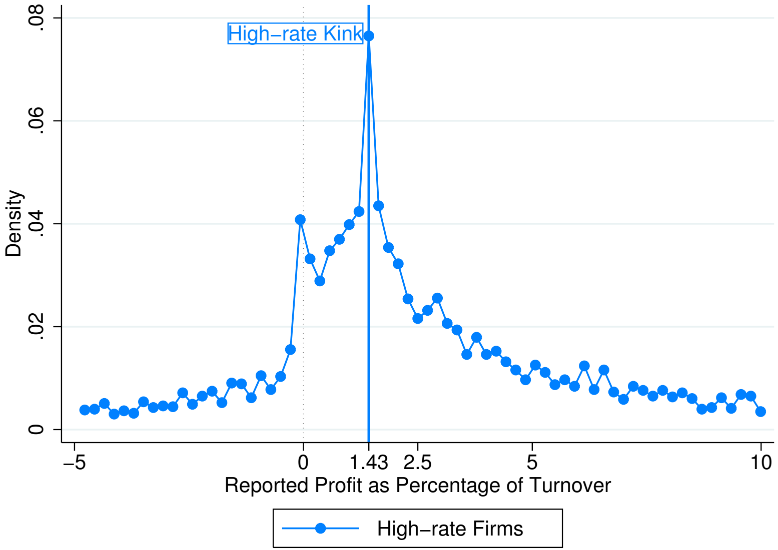
Best *et al.* (2015): Data

- 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

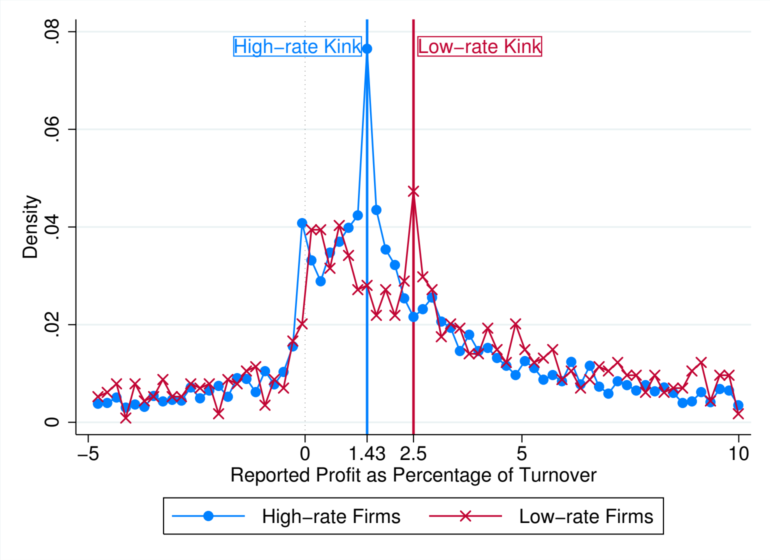
Best *et al.* (2015): Variation in Minimum Tax Kink

- **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%

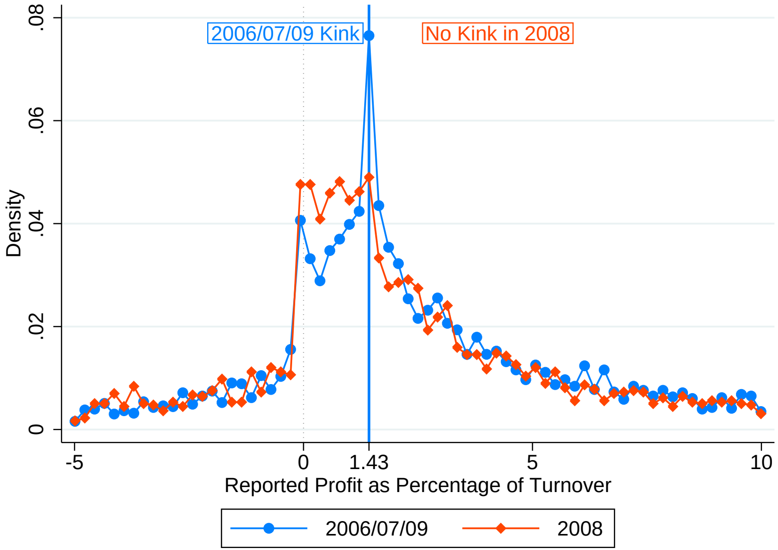
Best *et al.* (2015): Bunching Evidence



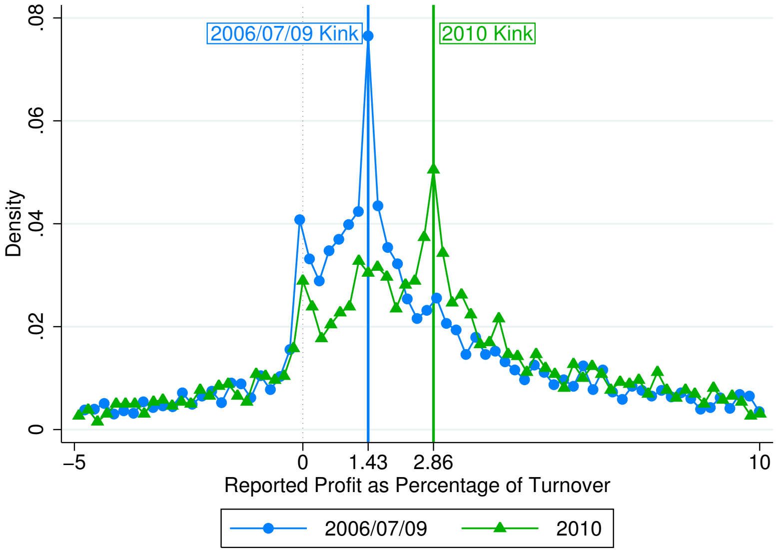
Best *et al.* (2015): Bunching Evidence



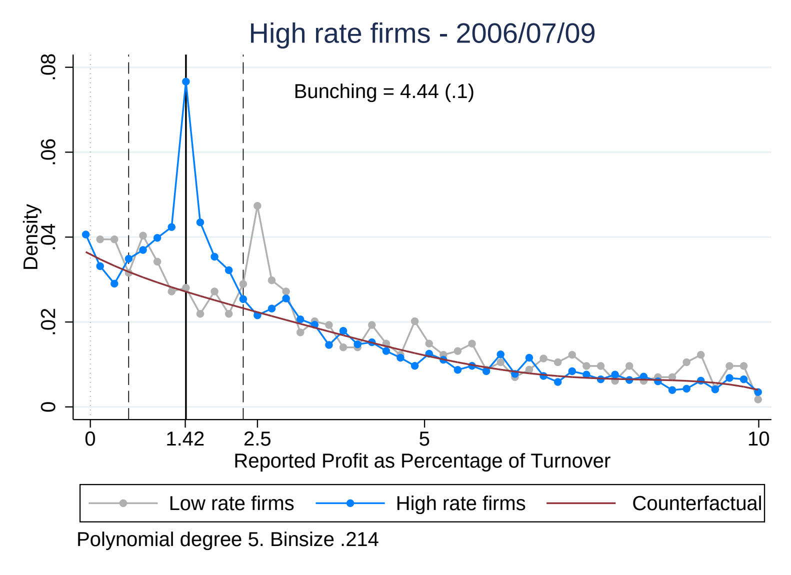
Best *et al.* (2015): Bunching Evidence



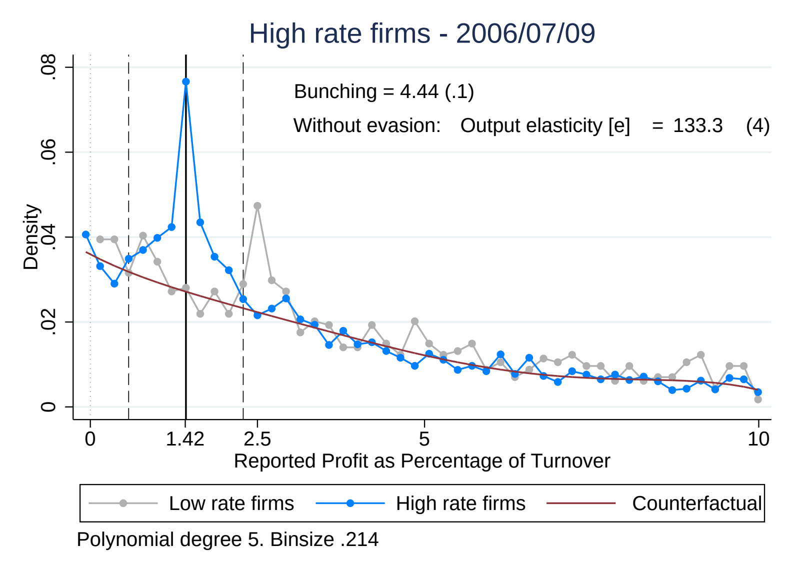
Best *et al.* (2015): Bunching Evidence



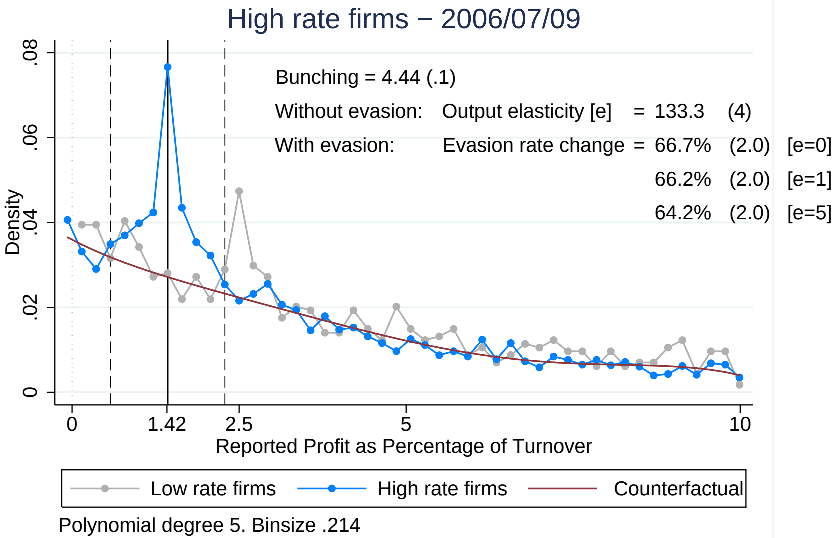
Best *et al.* (2015): Estimating Evasion



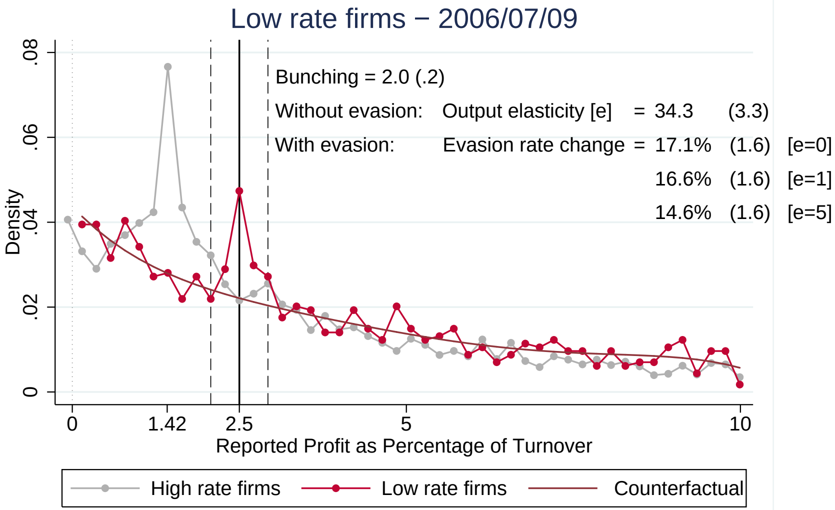
Best *et al.* (2015): Estimating Evasion



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



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



Polynomial degree 5. Binsize .214

Best *et al.* (2015): Robustness

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

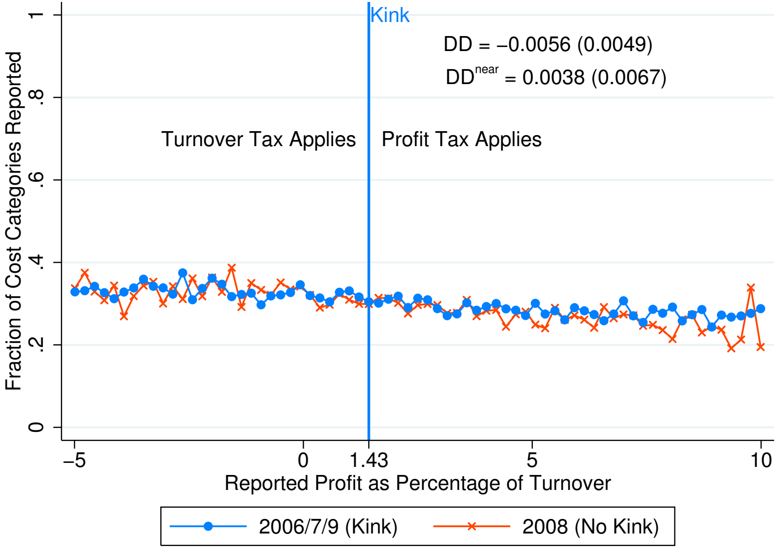
    $\Rightarrow$ firms move away from the kink and **create a hole**
- **Output evasion**
  - If firms can underreport output, the turnover tax reduces output evasion (due to $\tau_y < \tau_\pi$) in addition to cost evasion

    $\Rightarrow$ 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

Taxing Firms in Developing Countries

- Pomeranz (AER 2015) *No Taxation Without Information: Deterrence and Self-Enforcement in the Value Added Tax*
- Naritomi (2018) *Consumers as Tax Auditors*
- Best, Brockmeyer, Kleven, Spinnewijn & Waseem (JPE 2015) *Production vs Revenue Efficiency With Limited Tax Capacity: Theory and Evidence From Pakistan*
- Basri, Felix, Hanna & Olken (2020) *Tax Administration vs. Tax Rates: Evidence from Corporate Taxation in Indonesia*

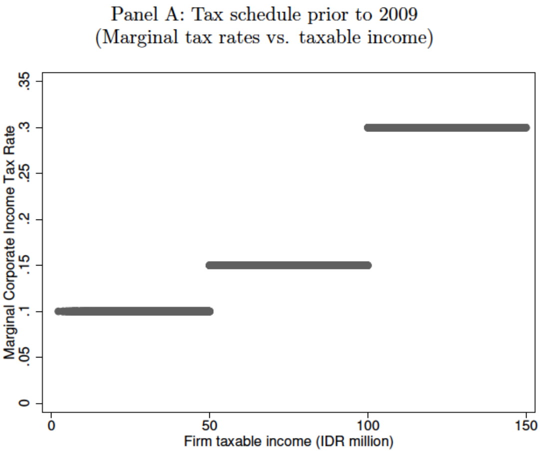
Basri et al (2020): Overview

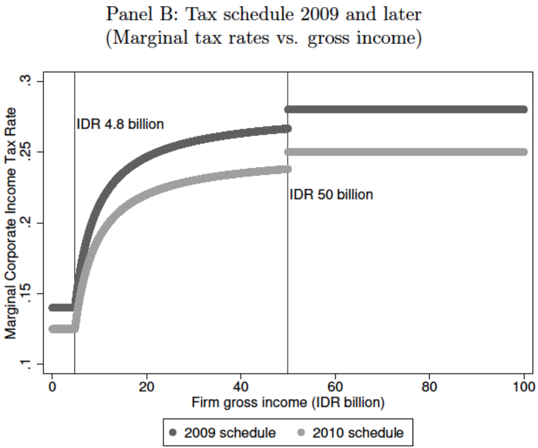
- Motivation
  - We've seen several papers now on how to use enforcement techniques to improve compliance and raise revenue
  - We also saw one paper (Best et al. 2015) on how to use policy design (bases, rates) to improve compliance and raise revenue
  - Say that you have to choose between improving 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





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 $\uparrow$)

Basri et al (2020): Welfare

- Social welfare is

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

- 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 $\left.\frac{d\tau}{d\alpha}\right|_R$ 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

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

  with $m' > 0$
- Now firms evade up until

$$\underbrace{y_l^e(\alpha) - c(y_l^e(\alpha)) - \alpha m(z)\, b(y_l^e(\alpha))\, h(l^*)}_{\text{profit from evading on marginal line}} = \underbrace{(1-\tau)\, y^p - (1-\tau\mu)\, c(y^p)}_{\text{profit from not evading on marginal line}}$$
$$\underbrace{- m'(z)\,(y^p - \mu c(y^p)) \int_0^{l^*} \alpha b(y_l^e(\alpha))\, h(l)\, dl}_{\text{loss from higher evasion costs on evaded lines}}$$

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:

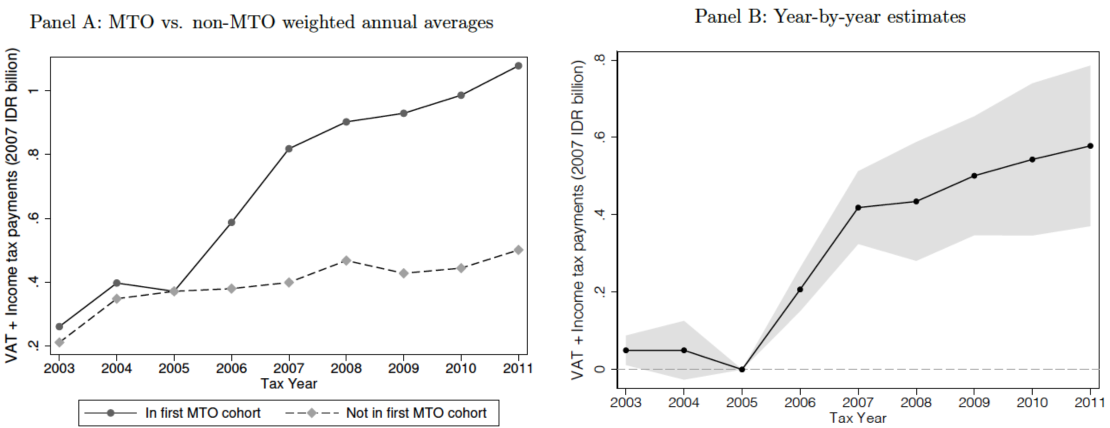
$$Y_{it} = \alpha + \beta^{RF} \left(M_{iFC} \times 1_{t>2005} \right) + \delta_t + \delta_i + \epsilon_{it}$$

  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:

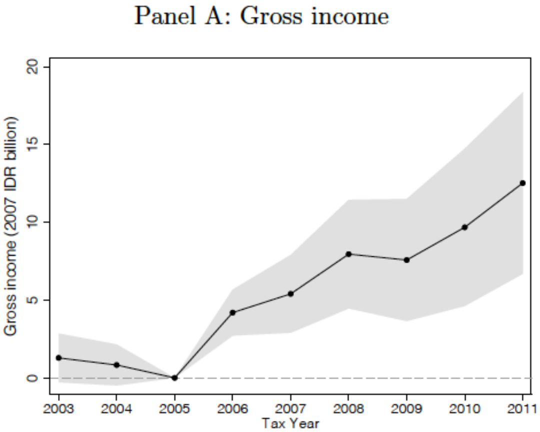
$$Y_{it} = \alpha + \beta^{IV} M_{it} + \delta_t + \delta_i + \epsilon_{it}$$

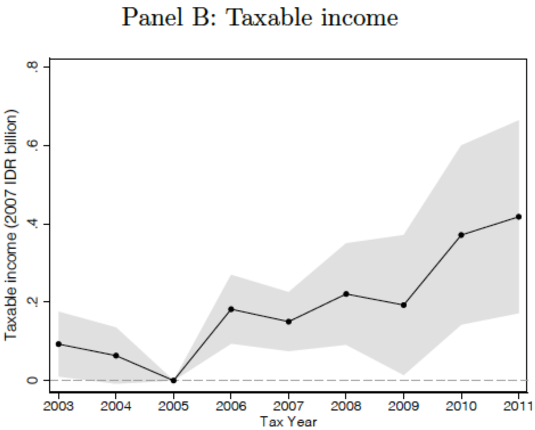
  where instrument for actual MTO status M_{it} with $M_{iFC} \times 1_{t>2005}$

Basri et al (2020): Enforcement Effects

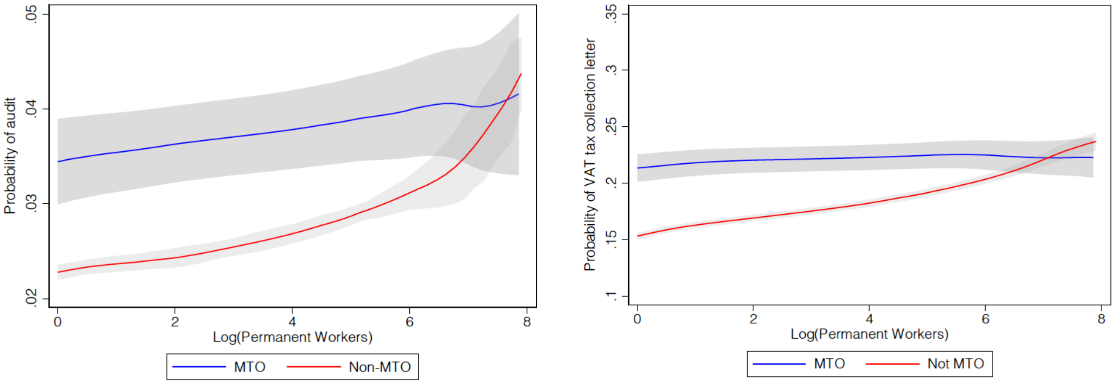


Basri et al (2020): Enforcement Effects





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 $\ln\left((1-\tau_{it+1})\,/\,(1-\tau_{it})\right)$ 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

Motivating Facts

Taxation in Developing Countries: Big Picture

Tax Evasion: Theory and Evidence from Rich Countries

Taxing Individuals in Developing Countries

Taxing Firms in Developing Countries

International Taxation and Developing Countries

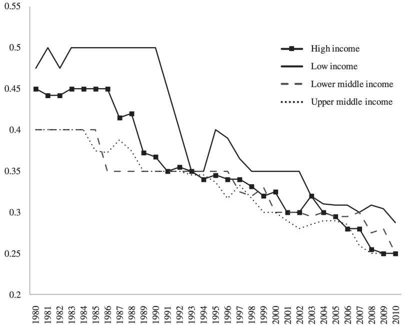
Outline

International Taxation and Developing Countries

- Tørsløv, Wier & Zucman (2018) *The Missing Profits of Nations*
- Fisman & Wei (JPE 2004) *Tax Rates and Tax Evasion: Evidence from "Missing Imports" in China*
- Sequeira (AER 2016) *Corruption, Trade Costs, and Gains from Tariff Liberalization: Evidence from Southern Africa*

Tørsløv, Wier & Zucman (2018): Overview

- Corporate tax rates have been falling globally (Keen & Konrad, 2013)



- How much are profits shifted across borders in response to differences in corporate tax rates?
- How much would reported profits in US/EU LMICs increase if there was tax harmonization?

Tørsløv, Wier & Zucman (2018): Overview

- Use new macroeconomic data "Foreign Affiliates Statistics". Break down national accounts into foreign-owned vs local firms
- Find that foreign firms are systematically more profitable than local firms in tax haven countries, but not in other countries.
- Due mostly to above-normal returns to capital not to shifting of capital across countries.
- Calculate that around 40% of profits earned outside of parent country are shifted to tax havens.
- EU countries are the primary losers. Implies rise in capital share actually about twice what the statistics report.
- US companies do this the most aggressively
- Tax haven countries are gaining lots of revenue (increase in tax base larger than loss from low rates)

Tørsløv, Wier & Zucman (2018): Profit Ratios

- Interested in the ratio of pre-tax corporate profits to wages: π
- Corporate output is divided between workers and capital owners: $Y = F(K, AL) = rK + wL$
- Define capital share as $\alpha = rK/Y$, then ratio of operating surplus to wages is $\alpha/(1-\alpha)$
- Corporations pay a share p of operating surplus in interest, so $\pi = (1-p) \cdot \alpha/(1-\alpha)$
- All numbers net of depreciation since it's tax deductible.
- Calculate these numbers separately for foreign π_f and local π_l firms
- $\Rightarrow$ \$11.5 trillion of corporate profits. 15% (\$1.7tn) made in affiliates of foreign firms. Of this, 36% (\$600bn) shifter to tax havens.

Tørsløv, Wier & Zucman (2018): Tangible Capital vs Shifting

- High π_f can come about because
  1. Paper profits are being shifted
  2. Capital share is high and elasticity of substitution between K and L is high
- Profit shifting =
  - transfer pricing (sell goods and services within the multinational at tax-advantageous prices)
  - tax-advantageous borrowing within the firm (hi tax borrows from low tax affiliate)
  - Locating intangible capital in low tax jurisdictions that then receive royalties/interest/revenues)

Tørsløv, Wier & Zucman (2018): Tangible Capital vs Shifting

- $d\pi/d\left(K/AL\right)$ depends on the elasticity of substitution between capital and labor σ.
  - If $\sigma > 1$ then high capital $\rightarrow$ high π
  - But if $\sigma < 1$ then high capital makes MPK low and $\rightarrow$ low π

$$\pi_f = \left(\frac{K}{wL}\right)_f \cdot r_f \cdot (1 - p_f)$$

- r_f is the measured return to capital. Includes both marginal product and excess returns (including profit shifting). Under assumptions about σ can decompose.
- Specifically, assume:
  - π_l not affected by profit shifting.
  - $\sigma = 1$
  - α varies across countries

$\Rightarrow$ difference betwen π_f and π_l within a given country measures inward profit shifting

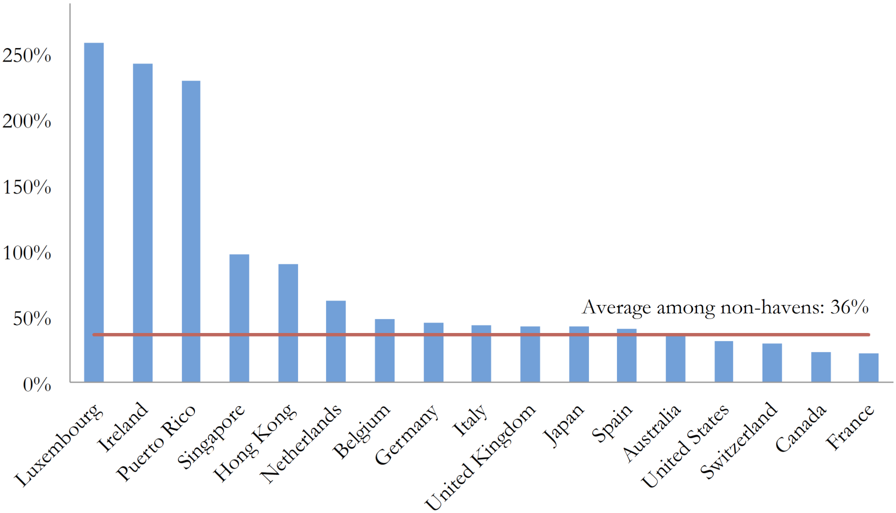
Tørsløv, Wier & Zucman (2018): Reallocating Shifted Profits

- If all countries had the same tax rate, where would all the profits be?
- Allocate shifted profits proportionally to
  - *bilateral* service exports (focus on intellectual property rights, HQ services, financial services)
  - intra-group interest receipts

  reported in the balance of payments of tax haven countries.
- Since 2009 balance of payments is available bilaterally, permitting this exercise.

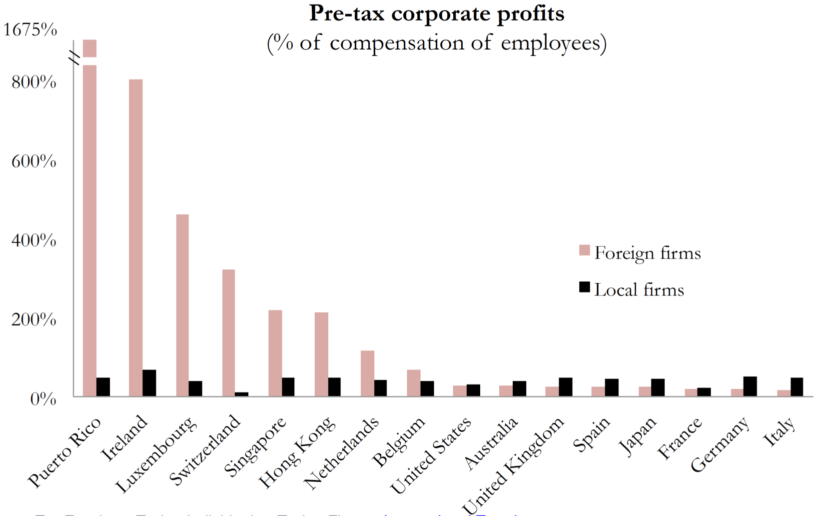
Tørsløv, Wier & Zucman (2018): Results: Profitability

Figure 3: Pre-tax Corporate Profits (% Compensation of Employees)

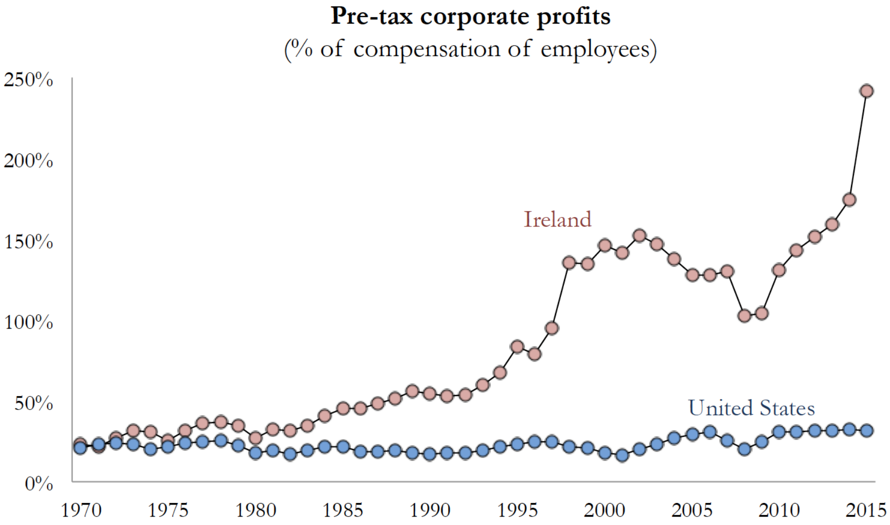


Tørsløv, Wier & Zucman (2018): Results: Profitability

Figure 4: Profitability in Foreign vs. Local Firms



Tørsløv, Wier & Zucman (2018): Results: Profitability



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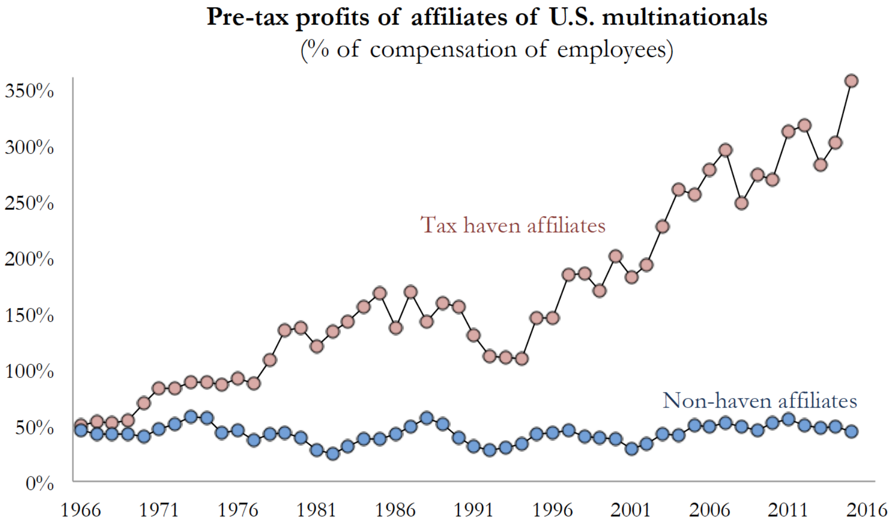
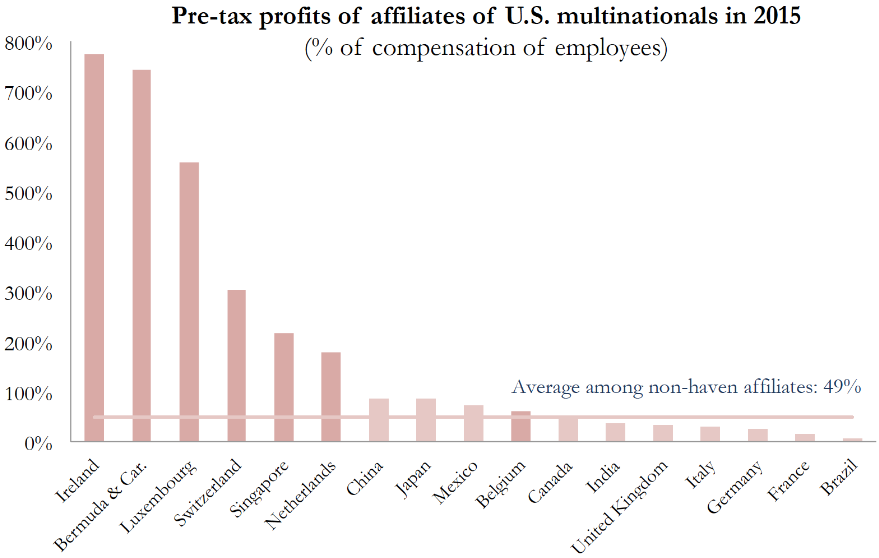
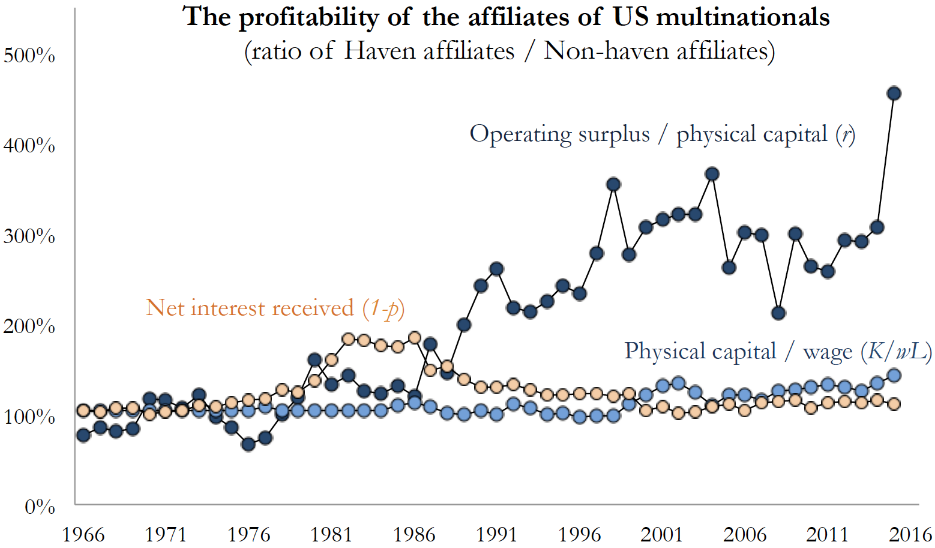


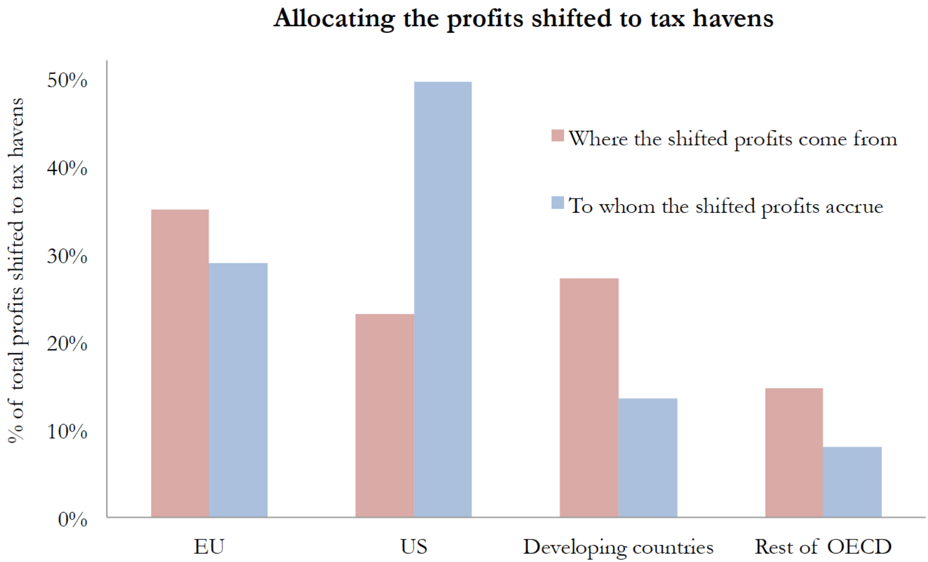
Tørsløv, Wier & Zucman (2018): Results: Profitability



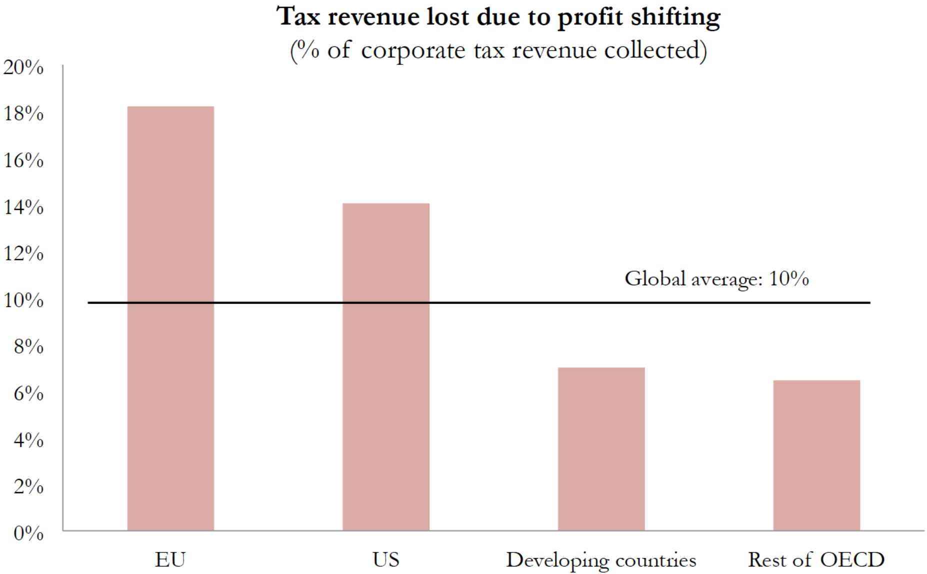
Tørsløv, Wier & Zucman (2018): Capital vs Shifting



Tørsløv, Wier & Zucman (2018): Results: Reallocating Shifted Profits



Tørsløv, Wier & Zucman (2018): Results: Reallocating Shifted Profits



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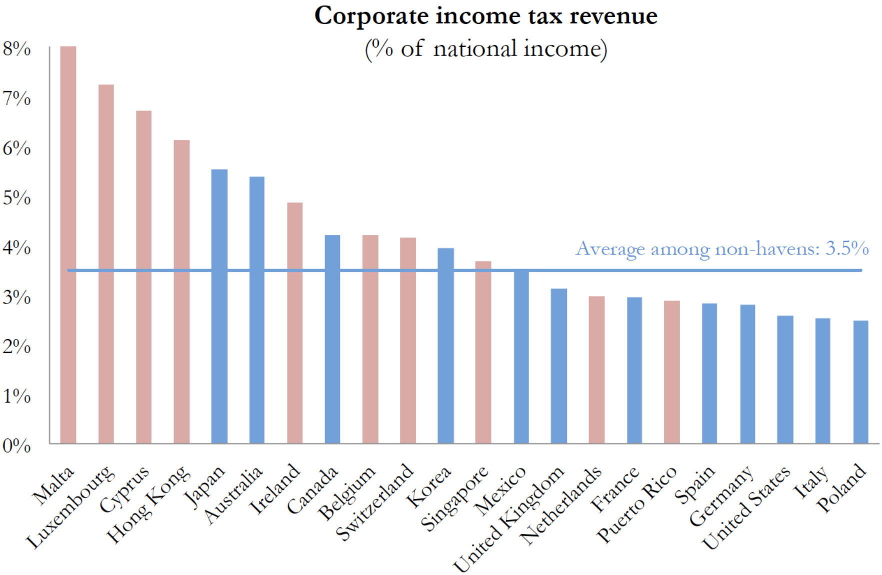

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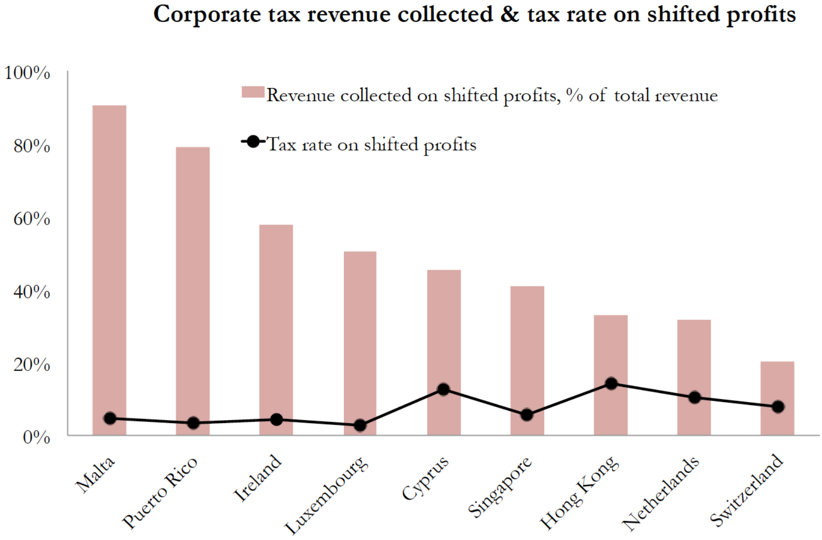

Outline

International Taxation and Developing Countries

- Tørsløv, Wier & Zucman (2018) *The Missing Profits of Nations*
- Fisman & Wei (JPE 2004) *Tax Rates and Tax Evasion: Evidence from "Missing Imports" in China*
- Sequeira (AER 2016) *Corruption, Trade Costs, and Gains from Tariff Liberalization: Evidence from Southern Africa*

Fisman & Wei (2004): Overview

- How does tax evasion respond to tax rates?
  - Theoretically ambiguous (e.g. Allingham-Sandmo dependence on risk preferences)
  - Hard to measure evasion directly
- Here: Direct (noisy) measure of evasion: Difference between amount exported to China from Hong Kong (reported by HK) and the amount imported to China from Hong Kong (reported by China).
  - Correlate evasion gap with tax rates in China
  - Diff in Diff around reforms to tariffs in China in 1997
- Conclusion: Evasion very sensitive to tax rates.

Fisman & Wei (2004): Data

- Data on trade flows from WB World Integrated Trade Solution (WITS) database.
- Trade flows (Value and quantity) at 6-digit-product-origin-destination-year level.
- gap_value=$\log$ (export_value)-$\log$ (import_value)
- Focus on variation *within* 4-digit HS-codes in tariff rates.
- Add in Chinese VAT rates

Fisman & Wei (2004): Basic Results

$$\log(\text{export\_value}_k) - \log(\text{import\_value}_k) = \alpha + \beta \text{tax}_k + e_k$$

TABLE 5
EFFECT OF TAX RATES ON EVASION (Measured in Value)

	REGRESSION						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Tax rate	2.93	2.46	3.21	3.57	2.98	2.61	3.4
	(.74)	(.67)	(.87)	(.89)	(.81)	(.79)	(.96)
Constant	−1.31	−1.04	−1.31	−1.48	−1.29	−1.12	−1.46
	(.29)	(.23)	(.30)	(.31)	(.29)	(.27)	(.34)
Excluding outliers?	no	yes	no	no	yes	yes	yes
Excluding products lacking tax on similar products?	no	no	yes	no	no	yes	yes
Excluding products lacking observations on quantities?	no	no	no	yes	yes	no	yes
Observations	1,663	1,639	1,470	1,102	1,087	1,450	968
R^2	.020	.017	.022	.031	.025	.017	.029

NOTE.—The dependent variable is log(value of exports from Hong Kong to China) − log(value of imports to China from Hong Kong). Robust standard errors are in parentheses, accounting for clustering of standard errors by four-digit HS.

Fisman & Wei (2004): Substitution

- Stronger incentives to misclassify items if similar products face higher rates. $\rightarrow$ Include avg (tax_o), average of other products in same 4-dig group.

INCORPORATING THE AVERAGE TAX ON SIMILAR PRODUCTS
Dependent Variable: Log(Value of Exports from Hong Kong to China) − Log(Value of Imports to China from Hong Kong)

	REGRESSION				
	(1)	(2)	(3)	(4)	(5)
Tax rate		6.07	5.31	8.32	7.46
		(1.37)	(1.25)	(1.56)	(1.42)
Tax on similar products	2.62	−3.16	−2.98	−4.65	−4.45
	(.90)	(1.39)	(1.33)	(1.58)	(1.53)
Constant	−1.09	−1.20	−1.02	−1.56	−1.33
	(.034)	(.31)	(.28)	(.38)	(.35)
Excluding outliers?	no	no	yes	no	yes
Excluding products lacking observations on quantities?	no	no	no	yes	yes
Observations	1,470	1,470	1,450	981	968
R^2	.014	.025	.020	.041	.035

NOTE.—Robust standard errors are in parentheses, accounting for clustering of standard errors by four-digit HS.

Fisman & Wei (2004): Quantities v Values

- Replace LHS with quantities

Evasion in Physical Quantities
Dependent Variable: Log(Quantity of Exports from Hong Kong to China) − Log(Quantity of Imports to China from Hong Kong)

	Regression					
	(1)	(2)	(3)	(4)	(5)	(6)
Tax rate	1.13	1.14	.69		8.37	8.12
	(.93)	(1.11)	(.83)		(2.20)	(1.77)
Tax on similar products				.08	−7.93	−8.31
				(1.13)	(2.23)	(1.84)
Constant	−1.05	−1.08	−.92	−.68	−.85	−.65
	(.33)	(.40)	(.30)	(.40)	(.40)	(.36)
Excluding products lacking observations on avg(tax_*o*)?	no	yes	no	yes	yes	yes
Excluding outliers?	no	no	yes	no	no	yes
Observations	1,102	981	1,082	981	981	962
R^2	.003	.002	.001	.000	.015	.019

Note.—Robust standard errors are in parentheses, accounting for clustering of standard errors by four-digit HS.

Fisman & Wei (2004): Diff in Diff

- Use changes in Chinese tariff rates in 1997

TABLE 10

TAX AND EVASION IN FIRST DIFFERENCES, 1997–98

	DEPENDENT VARIABLE: Change in Gap_Value between 1997 and 1998		DEPENDENT VARIABLE: Change in Gap_Qty between 1997 and 1998	
	(1)	(2)	(3)	(4)
Change in tax rate	1.71	5.60	1.88	5.78
	(.85)	(1.92)	(1.48)	(2.91)
Change in tax on similar products		−3.97		−4.72
		(2.30)		(3.55)
Constant	.036	.01	.11	.05
	(.060)	(.063)	(.08)	(.091)
Observations	1,617	1,430	1,042	938
R^2	.004	.008	.002	.005

NOTE.—Robust standard errors are in parentheses, accounting for clustering of standard errors by four-digit HS.

Outline

International Taxation and Developing Countries

- Tørsløv, Wier & Zucman (2018) *The Missing Profits of Nations*
- Fisman & Wei (JPE 2004) *Tax Rates and Tax Evasion: Evidence from "Missing Imports" in China*
- Sequeira (AER 2016) *Corruption, Trade Costs, and Gains from Tariff Liberalization: Evidence from Southern Africa*

Sequeira (2016): Overview

- How does behavior (trade volumes) respond to taxes (tariffs)?
- Existing literature finds small effects. Puzzling.
- This paper:
  - When people are evading the tariffs, changing their levels doesn't matter that much.
  - However, tariff liberalization increases honest reporting and transfers (bribes) to public officials.

1. Trade-flow data yields elasticity of trade to tariffs of 0.1
2. Firm-level data confirms no impact on intensive or extensive margins
3. Bribe data shows bribes change when tariffs change.

Sequeira (2016): Aggregate Trade Flows

- Context: Trade between Mozambique and South Africa.
- Mozambique joined Southern African Development Community (SADC) in 1992. Implies big changes in tariffs up to 2015 to harmonize with trade bloc.
- Affects some products but not others.

Table 1—Comparability of Trade Patterns and Product Characteristics across Treatment and Control Products, Prior to the 2008 Tariff Change

	Treatment products		Comparison products		Difference t-test/χ^2 p-value
	Mean	SD	Mean	SD	
Panel A. Patterns of trade ($N = 4{,}660$)					
Share of imports (quantities)	38.1	492.5	241.2	5244.4	0.20
Share of imports (value)	22.2	237.2	33.84	341.2	0.19
Unit value	4.82	53.7	6.21	83.3	0.51
Panel B. Product characteristics ($N = 265$)					
Shipment value per ton (USD)	44,027	179,869	410,508	2,959,621	0.25
Number of containers per shipment	7.99	2.606	7.4	3.173	0.10
Bulk cargo (non-containerized)					0.94
Rauch product classification					0.01

Sequeira (2016): Aggregate Trade Flows

- Diff in Diff across products/time to estimate trade elasticity.

$$\text{logImportShare}_{it} = \alpha_0 + \alpha_1 \text{logTariffRate}_{it} + \mu_t + \gamma_i + \epsilon_{it}$$

TABLE 2—TARIFF LIBERALIZATION AND IMPORT VOLUMES, 2006–2014: AGGREGATE IMPORT FLOWS

	log share import volumes			
	Fixed effects (1)	First differences (2)	Long differences (3)	Instrumental variable (4)
Panel A. 2 SLS Estimate				
log tariff rate	−0.016			−0.097
	(0.027)			(0.050)
Δ log tariff rate		−0.010	−0.076	
		(0.019)	(0.018)	
Panel B. First stage dep. var. log tariff rate				
Lagged log tariff rate (one period)				0.841
				(0.042)
Lagged log tariff rate (two periods)				−0.085
				(0.011)
Baseline tariff rate 2006				−0.040
				(0.002)
Kleibergen-Paap Wald *F*-statistic				207.09
Observations	21,520	16,353	13,022	15,326
Mean of dependent variable	1.094	1.051	1.055	1.130

Sequeira (2016): Firm-Level Responses

- Use panel of 190 firms in 2006 & 2010 (before after big reform in 2008)
- Extensive margin:

$$\text{D.ImportStatus}_k = \alpha_0 + \alpha_1 \text{D.Tariff}_k + \alpha_3 \mathbf{X}_k + \omega_i + \epsilon_k$$

  where
  $\text{D.ImportStatus}_k \in \{\text{Stop importing, continue domestic sourcing, begin importing}\}$,
  ω_i are industry FEs
- Intensive margin:

$$\text{D.PctgImportedInput}_k = \alpha_0 + \alpha_1 \text{D.Tariff}_k + \alpha_3 \mathbf{X}_k + \omega_i + \epsilon_k$$

TABLE 4—TARIFF LIBERALIZATION AND IMPORT VOLUMES, 2006–2010: FIRM-LEVEL DATA

	Extensive margin change in import status			Intensive margin change in pctg of imp. input		
	Ordered probit			Ordinary least squares		
	(1)	(2)	(3)	(4)	(5)	(6)
Δ log tariff rate	–0.113	–0.106	–0.091	–0.738	0.689	1.681
	(0.079)	(0.136)	(0.160)	(2.306)	(3.927)	(4.936)
Firm size		0.539	0.534		10.127	9.355
		(0.229)	(0.238)		(7.212)	(7.154)
Ethnicity of owner		0.188	0.187		7.388	5.681
		(0.187)	(0.178)		(7.430)	(6.839)
Foreign firm		0.456	0.436		15.155	14.250
		(0.329)	(0.269)		(14.330)	(12.665)
Age of establishment		–0.016	–0.018		–0.400	–0.431
		(0.009)	(0.009)		(0.251)	(0.242)
log baseline tariff 2006		0.046	0.036		7.059	5.170
		(0.170)	(0.174)		(4.933)	(5.223)
Controls						
Industry fixed effects	No	No	Yes	No	No	Yes
Observations	160	117	117	160	117	117
p-value of joint significance of FE		0.000			0.000	

Sequeira (2016): Corruption-Trade Gaps

- Use similar strategy to Fisman & Wei (2004)

$$\text{logTradeGap}_{it} = \gamma_1 \text{TariffChangeCategory}_i \times \text{POST}_t + \mu_1 \text{POST}_t + \gamma_2 \text{TariffChangeCategory}_i + \beta_2 \text{BaselineTariff}_i + \epsilon_{it}$$

TABLE 5—TRADE GAPS AND TARIFF LEVELS, 2006–2014

	log trade gap					
	Quantity (1)	Value (2)	Unit value (3)	Quantity (4)	Value (5)	Unit value (6)
log tariff	0.201	0.055	−0.013			
	(0.042)	(0.035)	(0.010)			
Treated products × POST				−0.493	−0.083	0.022
				(0.097)	(0.077)	(0.031)
Treated products				0.308	−0.092	0.104
				(0.243)	(0.219)	(0.087)
POST				0.385	0.118	0.394
				(0.086)	(0.068)	(0.028)
log baseline tariff				0.245	0.271	−0.051
				(0.114)	(0.098)	(0.043)
Observations	21,884	21,884	21,861	21,884	21,884	21,861
Mean of dependent variable	0.273	0.213	2.176	0.273	0.213	2.178
R^2	0.187	0.165	0.675	0.170	0.155	0.422

Sequeira (2016): Corruption-Bribe Payments

- Random sample of >1,000 shipments at port of Maputo

	Pre-tariff change	Post-tariff change	
	2007	2008	2011–2012
Probability of paying a bribe (percent)	80	26	16
Avg bribe amount per ton (Metical 2007, CPI adjusted)	2,164 (7,800)	280 (963)	494 (2,746)
Primary bribe recipient	Customs (97%)	Customs (84%)	Customs (72%)
Primary reason for bribe payment	Tariff evasion (61%)	Congestion (59%)	Congestion (38%)
Ratio of bribe amount to tariff duties saved [0–1]*	0.07 (0.13)	0.028 (0.09)	0.008 (0.02)
Average clearing time for all shipments (days)	2.6 (2.2)	2.6 (1.3)	2.6 (3.6)
Average clearing time with the payment of a bribe (days)	2.6 (2.3)	2.2 (1.0)	2.4 (3.1)
Average clearing time without the payment of a bribe (days)	1.9 (1.2)	2.7 (1.4)	2.6 (3.7)
Average clearing time with bribe payment for tariff evasion (days)	2.7 (2.4)	2.4 (1.0)	2.4 (1.8)

Sequeira (2016): Corruption-Bribe Payments

TABLE 7—BRIBES BEFORE AND AFTER THE TARIFF CHANGE: BY SHIPPER AND PRODUCT CHARACTERISTICS

	Pre-tariff change	Post-tariff change	Difference *p*-value
Panel A. Probability of paying a bribe (percent)			
Large firm	96	16	0.000
Medium to small firm	67	18	0.000
Agricultural product	13	12	0.739
Differentiated product	77	18	0.000
Pre-inspected shipment	68	10	0.000
Panel B. Amount of bribe paid per ton (Mtn, CPI adjusted)			
Large firm	3,373	150	0.004
	(1,419)	(75)	
Medium to small firm	3,882	503	0.000
	(1,711)	(85)	
Agricultural product	1,404	615	0.144
	(922)	(143)	
Differentiated product	2,062	537	0.000
	(623)	(90)	
Pre-inspected shipment	2,597	661	0.000
	1,136	130	

Table 8—Difference-in-Differences: Determinants of the Probability of Paying a Bribe

	Probability of paying a bribe [0–1] linear probability model			
	(1)	(2)	(3)	(4)
Tariff change category × POST	−0.429	−0.296		
	(0.131)	(0.120)		
Tariff change category	0.448	0.357		
	(0.111)	(0.099)		
Tariff reduction × POST			−0.025	−0.021
			(0.008)	(0.007)
Tariff reduction			0.024	0.022
			(0.005)	(0.009)
POST	−0.089	−0.555	−0.111	−0.686
	(0.106)	(0.203)	(0.116)	(0.241)
Differentiated product	0.065	0.018	0.032	−0.076
	(0.078)	(0.102)	(0.071)	(0.109)
Agricultural product	0.026	−0.221	0.046	0.041
	(0.030)	(0.096)	(0.029)	(0.030)
Pre-shipment inspection	−0.010	0.061	0.003	0.087
	(0.010)	(0.061)	(0.020)	(0.07)
Perishable product	−0.047	0.260	−0.052	0.137
	(0.067)	(0.109)	(0.064)	(0.124)
Large firm	0.058	0.161	0.066	0.172
	(0.047)	(0.055)	(0.051)	(0.066)
log shipment value per ton	0.014	−0.035	0.017	−0.034
	(0.008)	(0.011)	(0.008)	(0.013)

	log bribe amount paid							
	Ordinary least squares				Hurdle model			
					logit	Negative binomial	logit	Negative binomial
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tariff change category × POST	−3.748	−2.928			−30.735	−0.079		
	(1.075)	(0.944)			(1.995)	(0.459)		
Tariff change category	3.632	3.156			30.704	−0.916		
	(0.953)	(0.803)			(1.898)	(0.436)		
Tariff reduction × POST			−0.225	−0.191			−2.996	−0.089
			(0.058)	(0.064)			(0.174)	(0.031)
Tariff reduction			0.200	0.191			2.969	−0.042
			(0.042)	(0.0478)			(0.171)	(0.0260)
POST	−0.678	−3.449	−0.864	−4.652	−0.392	−0.633	−0.371	−0.426
	(0.867)	(1.818)	(0.944)	(2.152)	(0.639)	(0.179)	(0.634)	(0.200)
Differentiated product	0.545	−0.121	0.303	−0.925	−0.0450	0.188	−0.104	0.304
	(0.648)	(0.849)	(0.603)	(0.876)	(0.660)	(0.423)	(0.643)	(0.427)
Agricultural product	0.161	−1.968	0.343	0.337	0.356	0.583	0.327	0.229
	(0.285)	(0.931)	(0.265)	(0.243)	(0.365)	(0.563)	(0.355)	(0.494)
Pre-shipment inspection	−0.227	0.376	−0.137	0.641	−0.122	−0.550	−0.102	−0.595
	(0.208)	(0.628)	(0.197)	(0.712)	(0.215)	(0.182)	(0.207)	(0.189)
Perishable product	−0.084	3.400	−0.119	2.299	−0.551	0.311	−0.711	0.768
	(0.616)	(0.845)	(0.586)	(0.949)	(1.147)	(0.787)	(1.167)	(0.748)
Large firm	0.600	1.593	0.662	1.708	1.137	0.270	1.198	0.277
	(0.389)	(0.486)	(0.431)	(0.585)	(0.610)	(0.391)	(0.618)	(0.393)
log shipment value per ton	0.130	−0.221	0.152	−0.217	0.160	−0.037	0.158	−0.035
	(0.074)	(0.079)	(0.073)	(0.095)	(0.088)	(0.079)	(0.088)	(0.077)