

Tax Administration vs Tax Rates

Evidence from Corporate Taxation in Indonesia

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- This view implies that – if countries are optimizing – changes to the tax system may have small net effects
 - Additional efforts to improve administration will have low returns net of costs
 - High elasticities of taxable income → raising rates would have limited revenue gains and high deadweight burdens

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 - Taxpayer administration reform in 2007
 - Corporate taxes tend to be very skewed, so few taxpayers pay most tax. So most countries have the largest taxpayers served by special tax offices with much higher staff-to-taxpayer ratios (Lemgruber et al 2015; Alumnia and Lopez-Rodriguez 2018).
 - What are the returns in a developing country setting?
 - Indonesia implemented this idea at the regional office, with creation of “Medium Tax Offices” (MTOs) to serve largest ~330 taxpayers in each region (~4 percent).
 - We study the impact on firms when MTOs are first created, using matched differences-in-differences to compare treated and non-treated firms.

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 - We study the impact on firms when MTOs are first created, using matched differences-in-differences to compare treated and non-treated firms.
 - **Find:** affected firms’ tax payments increase by 128% on average in the 6 years after moving to MTO, across a range of taxes (VAT, CIT, etc). Effects on tax payments and gross income increase over time.

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 - Tax rate reforms in 2008-2009
 - Pre-2008 system: progressive CIT with marginal rate based on taxable income (*profits*). Top marginal rate 30%.
 - Post-2008 system: flat CIT, but with discounts based on gross revenue (*revenue*). Top marginal rate 28% in 2009 and 25% from 2010 on.
 - Estimate elasticity of taxable income by instrumenting for change in CIT using pre-period revenues and tax schedule change (a la Gruber and Saez 2002 and others).

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 - **Find:** ETI of 0.59. A bit higher than US (0.2; Gruber and Rauh); similar to Germany (0.6; Dwenger and Steiner). Smaller than small firms in Costa Rica (3; Bacchas forthcoming).

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- Benchmark improved administration effect to counterfactual tax rate increase using the ETI estimate.
 - **Find:** Increase in corporate income tax payments alone is equivalent to raising tax rate on those firms by 23 pp (i.e. from 30 percent to 53 percent).

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 - **Find:** improved administration flattens firm size / enforcement relationship

Outline of Talk

- Framework
- Improved Tax Administration
- Changes in Tax Rates
- Shifting Enforcement Patterns
- Conclusion

Standard framework: enforcement and tax rates

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 - Suppose enforcement α depends on firm size, i.e. $\alpha(l)$
 - Then additional 'enforcement tax' on firm growth given by $\alpha'(l)$

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 - Suppose enforcement α depends on firm size, i.e. $\alpha(l)$
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- We will empirically examine three of these parameters in the data – $(\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha})$, $\epsilon_{1-\tau}$, and $\alpha'(l)$
 - This will allow us to compare tax administration changes to change in tax rates
 - Note will we not observe $\frac{dc}{d\alpha}$, but can do bounds given we observe other parameters

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 - Top 1% of taxpayers in each region account for 54% of tax payments.
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 - Average of 330 taxpayers per office – about the top 4% of taxpayers in each region, assigned roughly based on pre-period gross income and taxable income (exact Excel sheets lost) [Figure](#)
 - Substantially higher staffing ratios than Primary Tax Offices – 3-4 times as many Account Representatives and 4-5 times as many Auditors per corporate taxpayer, and no individual taxpayers [Table](#)

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- Focus on 13 (out of 19) regions where MTOs created in 2007.
 - Primary tax offices also reorganized to follow identical org chart in 2007. This experiment therefore captures intensity of supervision, holding org structure fixed.
 - Largest wave of MTO creation is in 2007, after small number of pilots in 2004-2006. [Table](#)
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- Identification: matched diffs-in-diffs, matching taxpayers based on pre-period (2005) gross and taxable income.

Tax Administration Research Design

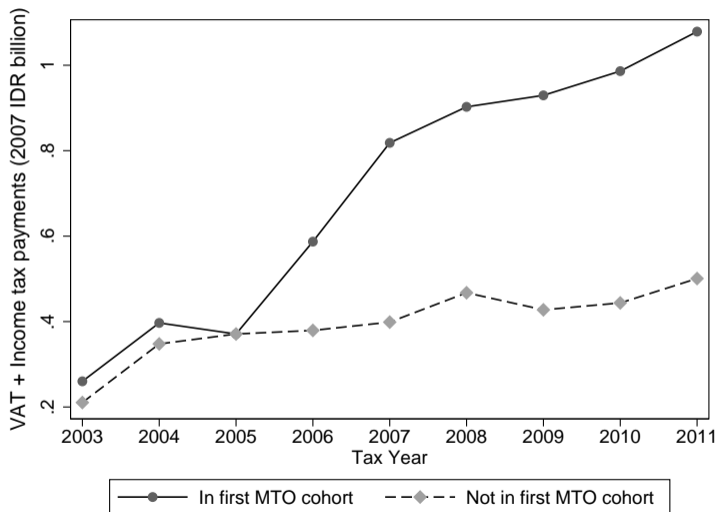
- Key challenge: MTO firms are generally larger than PTO firms.
 - Assignment based on on gross income, tax payments, and possibly other variables.
 - Excel sheets used for assignment not retained, so cannot reproduce formula exactly or do RD.
 - We therefore match taxpayers based on gross income and tax payments in 2005 (last year unaffected by MTO) so that weighted sample is balanced. [Details](#)
- Then estimate reduced form effect of MTO assignment with weighted differences-in-differences:

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

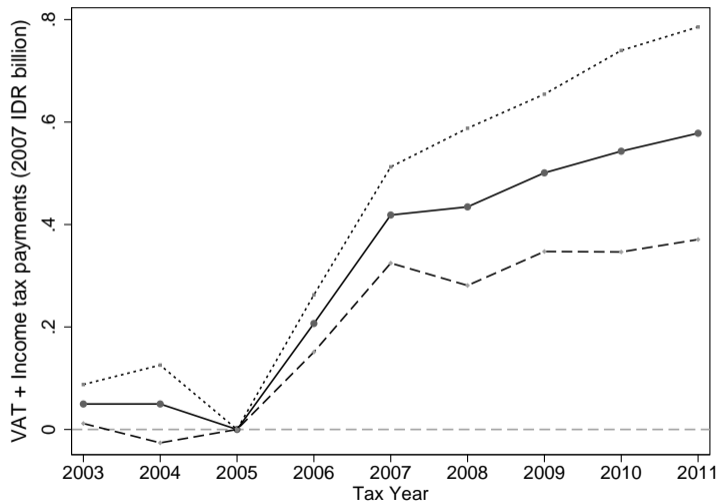
where M_{iFC} indicates firm i was in the first cohort of firms assigned to the MTO

- Compute event study version of above by estimating separate coefficients β_t for each year
- Some additional control firms move to MTO starting in 2009. Therefore estimate IV version of above, instrumenting for M_{it} with $M_{iFC} \times 1_{t>2005}$. [First stage](#)

Impacts on Tax Revenue



Impacts on Tax Revenue



Magnitudes

Table 1: MTO treatment effect on Tax Payments, Reported Income, and Tax Collection Rate
(Figures in 2007 IDR billion)

	MTO treatment effect				
	Treated post-treatment counterfactual (3)	Reduced Form (4)	IV (5)	IV effect as % of	
				Post-treatment counterfactual (6)	Post-treatment total outcome (7)
<i>Panel A: Tax Payments</i>					
VAT	0.27	0.240 (0.050)	0.371 (0.078)	137%	5.8%
Corporate Income Tax	0.06	0.032 (0.008)	0.051 (0.013)	87%	4.8%
Other income taxes	0.09	0.055 (0.013)	0.087 (0.020)	100%	4.8%
Total	0.41	0.340 (0.062)	0.525 (0.096)	128%	5.7%

Magnitudes

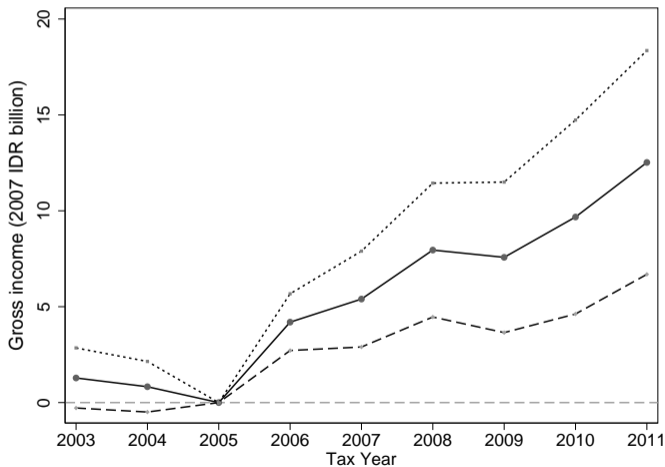
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 - For affected taxpayers, tax payments increase by 128%!
 - Extrapolating (in levels) to all MTO firms in Indonesia -> approx Rp. 40 trillion (\$4.0 billion) over 6 years.
- Key parameter is net revenues:
 - IV estimate of increased tax revenue effect: IDR 525 million / year
 - Difference in administrative costs per taxpayer: IDR 3.36 million / year. Two orders of magnitude smaller! [Details](#)
 - So net revenues gain is IDR 521 million / year

Reported incomes

- Effects appear on top-line (gross-incomes), not just bottom line



Results

- MTO leads to top-line increases in reported gross revenues – not just increased collections
 - Gross incomes (revenues) increase by 76%
 - Costs also increase as well by similar amounts (80%) [Table](#)
 - Profit margin remains unchanged [Table](#)
 - No change in collection rate (CIT paid / CIT due) [Table](#)

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- Also find increases in reported permanent workers (21%), total wage bill (24%), and total average yearly wage (17%)
- Implications
 - Consistent with either new business being brought 'on the books' or firm growth
 - Not just increased collections or increased scrutiny of deductions

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- Moreover, these effects appear to grow over time

	2 years post-MTO	6 years post-MTO	p-val
Total tax revenue	59% increase	128% increase	0.055
Gross income	41% increase	120% increase	0.007

- No increase in MTO enforcement – if anything staff - taxpayer ratios falling, not rising

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- On net suggests tax administration improvements can have large effects, even in developing countries

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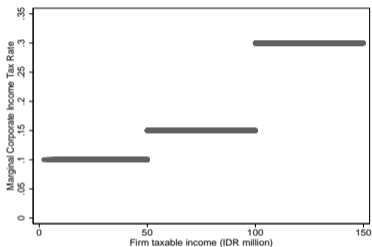
Tax Rate Reform

- Goal: estimate ETI
- Reform: Corporate income taxation prior to 2008:
 - Progressive taxation based on *taxable income*, with three bins (10%, 15%, 30%)
- Corporate tax reform in 2009:
 - Flat tax of 28% taxable income in 2009, lowered to 25% in 2010
 - Flat tax rate reduced (for all taxable income), as a function of *gross income*, using formula

$$\tau_{it} = \begin{cases} \frac{r_t^*}{2} & \text{if } g_{it} < \text{Rp. 4.8 bil.} \\ \frac{r_t^*}{2} \left(\frac{4.8 \text{ billion}}{g_{it}} \right) + r_t^* \left[1 - \left(\frac{4.8 \text{ billion}}{g_{it}} \right) \right] & \text{if Rp. 4.8 bil.} \leq g_{it} < \text{Rp. 50 bil.} \\ r_t^* & \text{if } g_{it} \geq \text{Rp. 50 bil.} \end{cases}$$

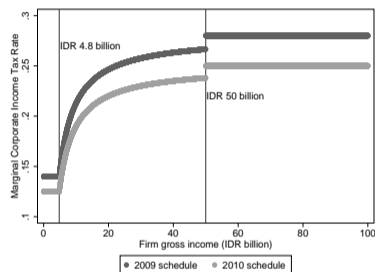
2009 Corporate Income Tax Rate Reform

Before 2009



- MTR based on **Taxable Income**
- Rates: 10%, 15%, 30%
- Thresholds: Rp 50mi and Rp 100 mi

After 2009



- MTR based on **Gross Income**
- Rates:
 - 14% to 28% (2009 on)
 - 12.5% to 25% (2010 on)
- Thresholds: Rp 4.8 bi and Rp 50 bi

Notch



Research Design

- Exploit switch from MTR based on taxable income to MTR based on gross income
 - This leads to very different tax rate changes as a function of the combination of taxable and gross income Variation in the Data

- Exploring our panel data structure, we estimate ε according to:

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

where

- z_{it} is taxpayer i 's reported taxable income at time t .
- g_{it} is taxpayer i 's reported gross income at time t .
- τ_{it} is taxpayer i 's marginal tax rate at time t .
- two tax changes, so can include firm fixed effects (δ_i) and time fixed effects (δ_t)
- can alternatively include sector and MTO fixed effects
- Instrument with $\ln \left(\frac{1 - \tau_{it+1}^C}{1 - \tau_{it}^C} \right)$, where τ_{it}^C is taxpayer i 's predicted MTR at year t using period 0 data

Estimates

Table 3: Estimated Elasticity of Taxable Income w.r.t. the Net-of-Tax Rate

<i>Panel A: First Stage</i>			
Instrument: Reform-induced change in marginal tax rate			
	All taxpayers (1)	Separate by MTO status	
		MTO (2)	Not MTO (3)
Endogenous:	0.980	0.981	0.982
$\Delta \ln(\text{Net-of-tax rate})$	(0.010)	(0.018)	(0.010)
F-statistic	3,629.32	1,112.23	3,250.73
<i>Panel B: IV (ETI estimates)</i>			
Outcome:	0.590	0.348	0.779
$\Delta \ln(\text{Taxable Income})$	(0.198)	(0.379)	(0.216)
P-value of difference			0.322
Taxpayer FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Robustness

Some implications

- We estimate an ETI of 0.59
 - Somewhat more elastic than US (0.2; Gruber and Rauh (2007)) but similar to Germany (0.6; Dwenger and Steiner (2012))
- Implications
 - Assuming a constant elasticity, revenue-maximizing to tax rate $\frac{1}{1+a\epsilon}$ is 56 percent. Substantially more room to raise revenues.
 - Can calculate excess dead-weight burden

$$-\frac{dB}{dR} = \frac{\epsilon\tau a}{1 - \tau - \epsilon\tau\rho} = 0.51$$

- I.e., each dollar of taxes raised raises burden of 0.51 on taxpayers.
- Point estimates suggest ETI is lower with more enforcement, but different not statistically significant

Comparing tax rates to tax administration

- Recall counterfactual from theory:
 - How much would τ have to be raised to generate same amount of revenue as generated by tax administration increase?
 - Put another way, how much could government lower τ to keep total revenue unchanged?
- To compute these, given estimates of ε and dR_{MTO} , we can compute:

$$\frac{d\tau}{d\alpha}\Big|_R = - \frac{\overbrace{\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha}}^{\text{Total MTO effect}}}{\underbrace{N(z^m - \bar{z})}_{\text{Total income subject to raise}} \left[\underbrace{1 - \left(\frac{\tau}{1 - \tau} \right) \varepsilon}_{\text{Behavioral effect}} \right] \rho}$$

- Suppose we are in the 2006 3-tired Corporate MTR schedule.
- Calibrate with $\bar{z} = \text{Rp } 100 \text{ million}$. $N = \mathbb{1}\{z > \bar{z}\}$, z reported 2006 taxable income, $z^m = E[z|z > \bar{z}]$, $\rho = \left(\frac{z^m}{z^m - \bar{z}} \right)$ and $\tau = 30\%$

Results

Table 4: Counterfactual CIT income tax increases to match MTO effects

	MTO IV treatment effect (IDR billion) (1)	MTR raise needed to generate MTO effect on total revenue	
		Taxing MTO taxpayers (2)	Taxing all taxpayers (3)
Corporate Income Tax	0.064	23 pp	6 pp
Total Income Taxes	0.180	xx	17 pp

Welfare

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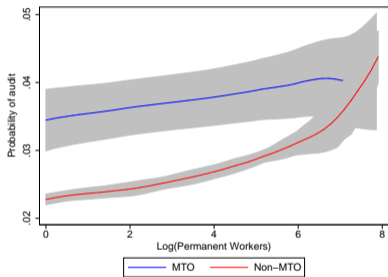
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 - That grow substantially over time
- To explore why we delve into the mechanisms of how MTO changed enforcement
- In particular, can change in slope $\alpha(l)$ function potentially explain why MTO raises revenue without necessarily deterring firm growth?

How does the MTO change α ?

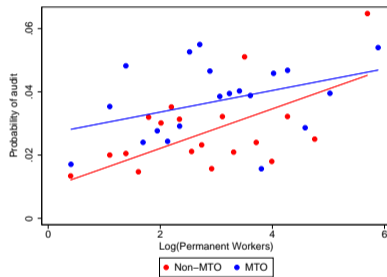
- Recall theory, with enforcement $\alpha(l)$
 - MTO presumably increases $\alpha(l)$ somewhere
 - Key question for distortions is whether it makes a' flatter or steeper
- Taking this to the data – we observe a few types of enforcement actions (nb: this is a subset, not the universe)
 - Administrative data on every formal audit, VAT underpayment letter, and VAT collection letter for 2009-2011
 - Examine how these depend on firm size, for firms both MTO and PTO
- Estimate relationship between enforcement actions and firm size non-parametrically
 - Continue to use balancing weights based on MTO assignment.

Results

Probability of audit



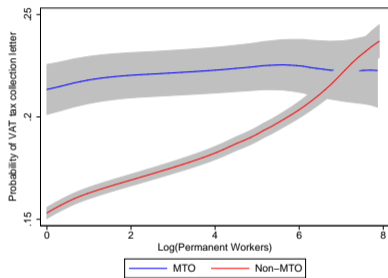
Local linear regression



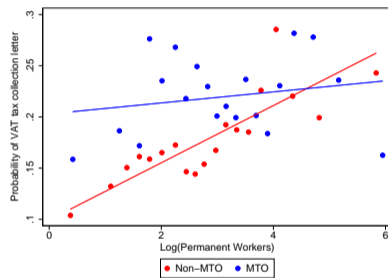
Equal size bins

Results

Probability of VAT underpayment letter



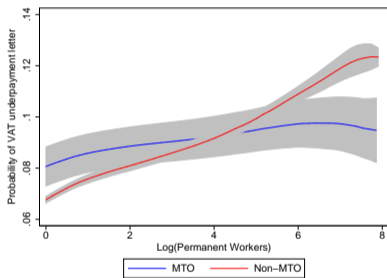
Local linear regression



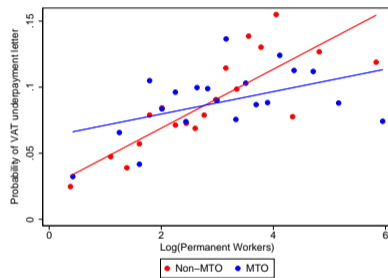
Equal size bins

Results

Probability of VAT tax collection letter



Local linear regression



Equal size bins

Taking stock

- This paper examined whether discrete changes in tax administration and tax rates can raise large amounts of revenue in developing countries – and the tradeoffs between these two approaches
- Exploiting major reforms in corporate tax policy in Indonesia, we:
 - Found that administration reform had very large effects on tax revenues
 - Raising same amount of revenue from increases in CIT alone would have required raising MTR by 23 percentage points
- Administration reform may have been particularly effective through making enforcement $\alpha(l)$ less size-dependent
- Suggests tax administration reforms can be as important, if not more, than reforms to tax rates

MTO Rollout

Table A.2.: Indonesia's Medium Taxpayer Offices

MTO	Included in Analysis?	Creation Year	Overseen Provinces or Districts
KPP Madya Jakarta Pusat	No	2004	DKI Jakarta (Center)
KPP Madya Batam	No	2005	Riau
KPP Madya Pekanbaru	No	2006	Riau Islands
KPP Madya Denpasar	No	2006	Bali
KPP Madya Tangerang	No	2006	Banten
KPP Madya Bekasi	No	2006	West Java
KPP Madya Jakarta Barat	Yes	2007	DKI Jakarta (West)
KPP Madya Jakarta Selatan I	Yes	2007	DKI Jakarta (South)
KPP Madya Jakarta Timur	Yes	2007	DKI Jakarta (East)
KPP Madya Jakarta Utara	Yes	2007	DKI Jakarta (North)
KPP Madya Bandung	Yes	2007	West Java
KPP Madya Semarang	Yes	2007	Central Java
KPP Madya Surabaya	Yes	2007	East Java
KPP Madya Sidoarjo	Yes	2007	East Java
KPP Madya Malang	Yes	2007	East Java
KPP Madya Balikpapan	Yes	2007	East Kalimantan
KPP Madya Makassar	Yes	2007	South, Southeast, and West Sulawesi
KPP Madya Palembang	Yes	2007	South Sumatra and Bangka Belitung Islands
KPP Madya Medan	Yes	2007	North Sumatra

Entropy Balancing Weights

- Loss function $h(w_i)$ distance metric.
- They use the Kullback (1959) entropy divergence criteria, defined by

$$h(w_i) = w_i \log\left(\frac{w_i}{q_i}\right)$$

where q_i is the base weight, in this case uniform $q_i = \frac{1}{N}$

- Weights are the solution to Lagrangian

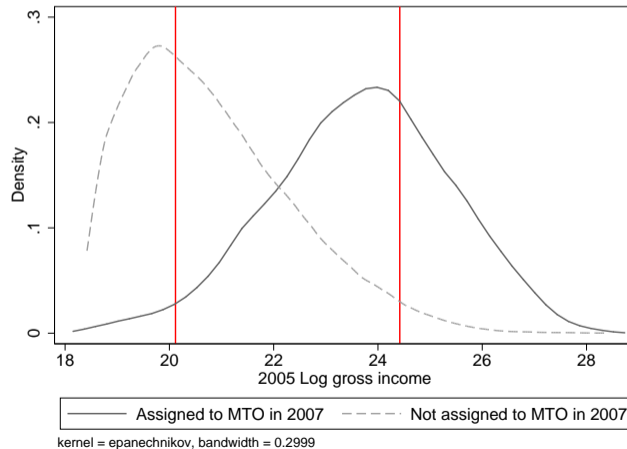
$$\min \sum_i w_i \log\left(\frac{w_i}{q_i}\right) + \sum_r \lambda_r \left(\sum_i w_i X_i^r - m^r \right)$$

where r indexes which moment to match, and subject to condition that all weights are non-negative and weights sum to 1.

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Common Support

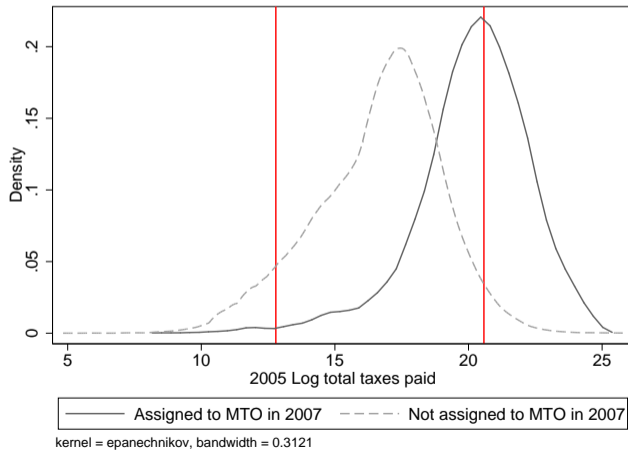
Gross Income

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Common Support

Total taxes paid

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MTO first stage

Table A.4.: First stage of MTO regression

Instrument:	Treatment: Taxpayer in MTO in current year (1)
(Assigned to MTO in 2007) x (Year > 2005)	0.647 (0.008)
F-statistic	6,412.0

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MTO robustness

Robustness to weighting schemes

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Table A.8: Robustness to alternative weighting schemes

	Robustness to weighting method and matched years				
	Main specification	No weights	IPW 2005	Entropy 2003-2005	IPW 2003-2005
	(1)	(2)	(3)	(4)	(5)
Sample size	20,858	60,354	20,650	11,372	11,259
Treated sample size	1,479	4,094	1,465	824	816
<i>Panel A: Tax payments (2007 IDR billion)</i>					
Total tax payments	0.525 (0.096)	1.551 (0.147)	1.115 (0.448)	0.579 (0.132)	0.685 (0.136)
VAT	0.371 (0.078)	0.712 (0.096)	0.838 (0.355)	0.428 (0.107)	0.497 (0.092)
Corporate Income Tax	0.051 (0.013)	0.557 (0.068)	0.036 (0.009)	0.053 (0.018)	0.024 (0.006)
Other income taxes	0.087 (0.020)	0.312 (0.033)	0.225 (0.094)	0.086 (0.025)	0.155 (0.050)

MTO robustness

Robustness to sample restrictions

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Table A.9: Robustness to alternative sample restrictions

	Main specification (1)	Robustness to sample restriction:		
		No gross income restriction (2)	1st-99th common support (3)	Adding 2005 and 2006 MTOs (4)
Sample size	20,858	24,683	38,017	26,828
Treated sample size	1,479	1,279	2,033	1,788
<i>Panel A: Tax payments (2007 IDR billion)</i>				
Total tax payments	0.525 (0.096)	0.448 (0.111)	0.263 (0.243)	0.327 (0.068)
VAT	0.371 (0.078)	0.331 (0.090)	0.163 (0.185)	0.231 (0.056)
Corporate Income Tax	0.051 (0.013)	0.028 (0.011)	0.033 (0.052)	0.031 (0.008)
Other income taxes	0.087 (0.020)	0.075 (0.022)	0.046 (0.055)	0.055 (0.013)

Tax Returns - Item by Item Effects

Table A.6.: Detailed effects of MTO on corporate income tax returns
(Figures in 2007 IDR billion)

	Weighted means			MTO effect	
	Pre-treatment		Treated post-treatment counterfactual	Point estimate (IV)	Clustered SE (5)
	Untreated (1)	Treated (2)			
Gross income	13.03	13.03	12.04	9.131	(2.181) ***
- Cost of sales	10.37	10.17	9.35	7.636	(2.029) ***
- Other expenses	2.16	2.42	2.04	1.126	(0.229) ***
<i>Net income from business</i>	0.69	0.49	0.59	0.427	(0.160) ***
+ Net income from side business	0.04	0.01	-0.04	-0.009	(0.081)
<i>Total domestic commercial net income</i>	0.73	0.50	0.55	0.416	(0.144) ***
+ Total foreign commercial net income	0.00	0.00	0.00	0.004	(0.009)
<i>Total commercial net income</i>	0.73	0.50	0.56	0.404	(0.149) ***
- Non-taxable inc. and inc. subject to final tax	0.89	0.52	0.22	0.975	(0.473) **
+ Total positive fiscal adjustment	0.55	0.42	0.16	0.843	(0.448) *
- Total negative fiscal adjustment	0.03	0.03	0.22	-0.124	(0.121)
<i>Fiscal net income</i>	0.31	0.37	0.37	0.304	(0.092) ***
- Compensation for fiscal loss carried forward	0.02	0.03	0.03	-0.012	(0.020)
<i>Taxable Income</i>	0.39	0.46	0.50	0.238	(0.072) ***
<i>Total corporate income tax due</i>	0.09	0.12	0.13	0.065	(0.020) ***

Impacts on Collections

	Treated post-treatment counterfactual (3)	MTO treatment effect			
		Reduced Form (4)	IV (5)	IV effect as % of	
				Post-treatment counterfactual (6)	Post-treatment total outcome (7)
<i>Panel B: Reported Income</i>					
Gross income	12.04	5.754 (1.375)	9.131 (2.181)	76%	4.1%
Taxable income	0.50	0.150 (0.045)	0.238 (0.072)	47%	3.1%
Corporate Income Tax due	0.13	0.041 (0.012)	0.065 (0.020)	51%	3.3%
Profit margin (net income/ gross income)	0.07	0.001 (0.002)	0.001 (0.003)	1%	0.1%
<i>Panel C: Tax Collection Rate</i>					
CIT Paid / CIT Due	0.69	0.012 (0.132)	0.020 (0.216)	3%	0.2%

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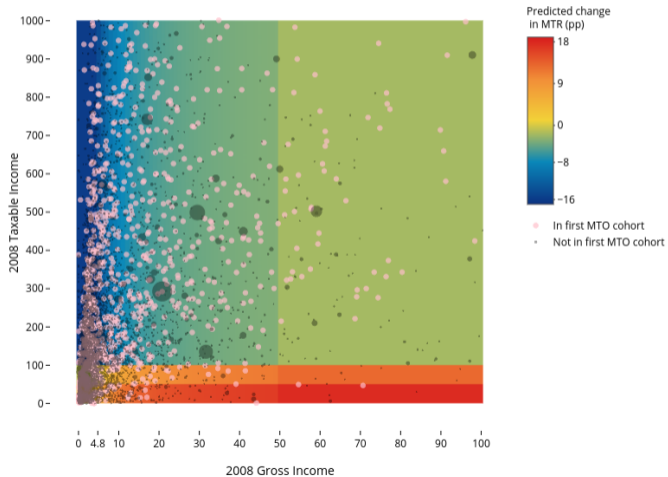
Tax Office Staffing Over Time

Table A.1: Tax Office Staffing

	Medium Taxpayer Offices (MTO)				Non-MTO tax offices in same regions			
	2008 (1)	2009 (2)	2010 (3)	2011 (4)	2008 (5)	2009 (6)	2010 (7)	2011 (8)
Taxpayers-to-staff ratios								
Taxpayers per Auditor	18	24	23	21	107	107	115	125
Taxpayers per AR	17	26	25	20	56	105	93	80
Taxpayers per staff	4	6	6	6	10	16	17	17
Auditors								
Total auditors	329	370	366	361	1,109	1,667	1,643	1,591
Has college degree	0.79	0.79	0.84	0.90	0.74	0.64	0.70	0.75
Female	0.07	0.07	0.07	0.06	0.09	0.09	0.09	0.09
Years in DGT	8.6	9.1	10.1	11.1	7.8	7.7	8.7	9.7
Monthly salary (2007 IDR 000s)	6,227	5,920	5,616	5,880	6,066	5,470	5,167	5,295
Account Representatives								
Total ARs	349	341	341	369	2,101	1,862	2,057	2,494
Has college degree	0.83	0.86	0.85	0.81	0.70	0.70	0.68	0.70
Female	0.16	0.17	0.23	0.23	0.27	0.32	0.31	0.32
Years in DGT	8.3	9.2	9.9	10.4	7.9	9.0	9.6	9.8
Monthly salary (2007 IDR 000s)	4,502	4,426	4,237	4,279	4,490	4,417	4,114	4,073

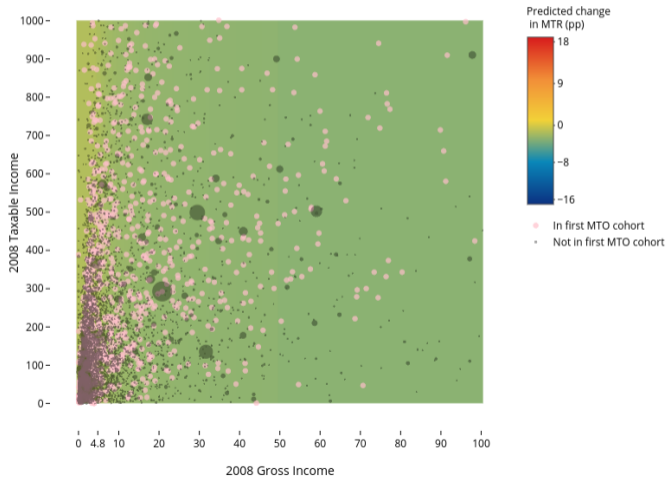
Variation in Tax Changes

2008-2009 Schedule Change

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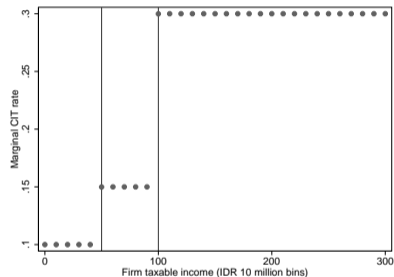
Variation in Tax Changes

2009-2010 Schedule Change

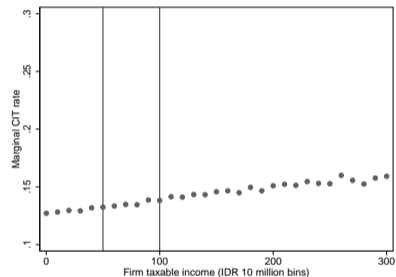
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MTR as function of taxable income, before and after tax change

Before 2009



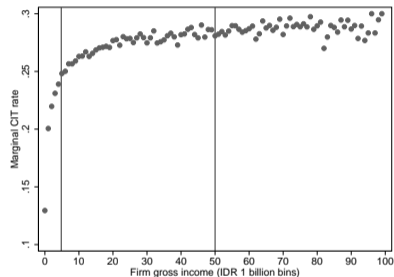
2010 and later



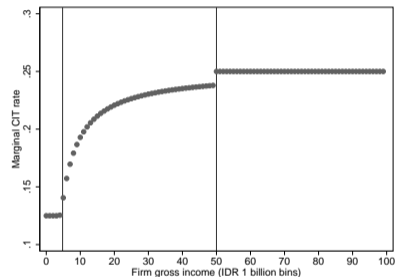
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MTR as function of gross income, before and after tax change

Before 2009



2010 and later



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Corporate ETI robustness

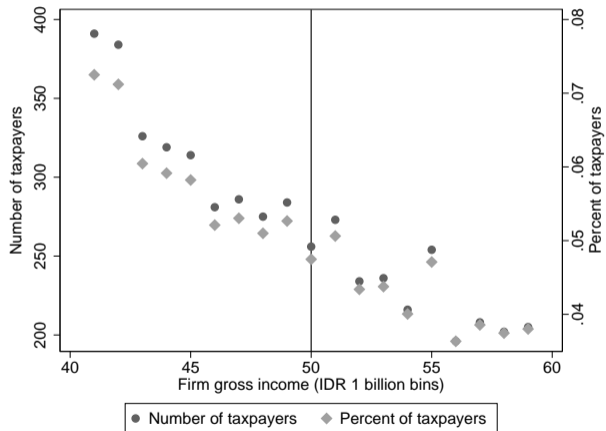
Table A.11: Robustness of ETI estimates

	<i>Panel A: First Stage</i>			
	Unweighted regressions	Construct instrument using predicted gross income	No taxpayer fixed effect	Use 2008-2009 change only
	All (1)	All (4)	All (7)	All (10)
Endogenous:	0.985	0.916	0.962	0.955
$\Delta \ln(\text{Net-of-tax rate})$	(0.003)	(0.016)	(0.008)	(0.009)
F-statistic	56,315	1,149	4,813	4,792
	<i>Panel B: IV (ETI estimates)</i>			
Outcome:	0.661	0.587	0.964	0.951
$\Delta \ln(\text{Taxable Income})$	(0.073)	(0.206)	(0.265)	(0.320)
Year FE	Yes	Yes	Yes	No
Taxpayer FE	Yes	Yes	No	No
Sector FE	No	No	Yes	Yes
MTO dummy	No	No	Yes	Yes

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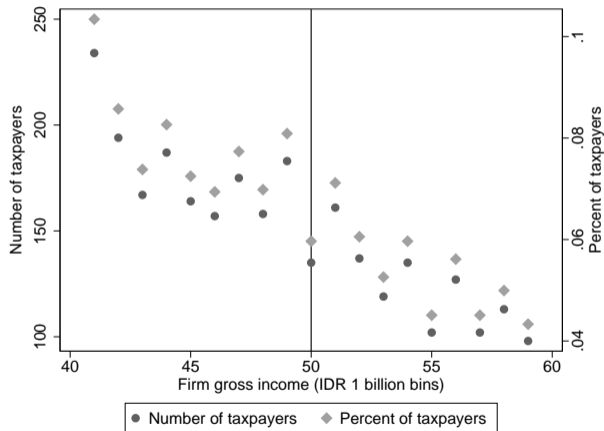
Bunching at the notch?

Before notch introduced



Bunching at the notch?

After notch introduced



Administrative Costs

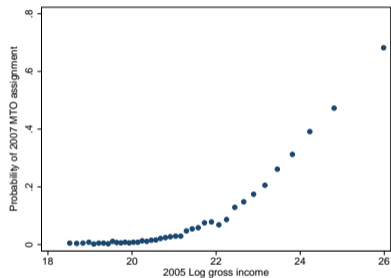
Table A.5.: Administrative Costs

	PTO	MTO
<i>Total budget (IDR billions)</i>		
Staff	525.9	51.2
Goods + Capital	376.8	19.3
Total	902.7	70.5
<i>Number of Corporate taxpayers</i>	341,620	15,047
<i>Cost per corporate taxpayer</i>	0.00132	0.00468

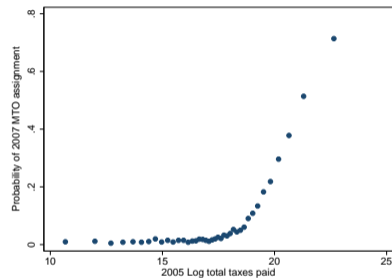
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Probability of MTO assignment

2005 Gross Income



2005 Taxes Paid



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Changes in Enforcement

Cross-sectional estimates

Table 6: Enforcement, Firm Size, and the MTO: Cross-Sectional Evidence

	Outcome		
	Audited (1)	Received VAT Collection (2)	Received VAT Underpayment (3)
<i>Panel A: Measuring firm size as permanent workers</i>			
Assigned to MTO in 2007	0.054 (0.016)	0.106 (0.016)	0.042 (0.011)
Ln(Permanent Workers)	0.014 (0.005)	0.028 (0.004)	0.023 (0.003)
Ln(Perm. Workers) x Assigned to MTO in 2007	-0.014 (0.006)	-0.022 (0.006)	-0.013 (0.004)
Years	2009-2011	2006-2011	2006-2011
Year FE	Yes	Yes	Yes
Firm FE	No	No	No

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Changes in Enforcement

Differences-in-differences

Table 7: Enforcement, Firm Size, and the MTO: Difference-in-Differences Evidence

	Outcome	
	Received VAT Collection Letter (1)	Received VAT Underpayment (2)
<i>Panel A: Measuring firm size as permanent workers</i>		
Assigned to MTO in 2007 x (Year>2005)	0.069 (0.024)	0.067 (0.016)
Ln(Perm. Workers)	0.042 (0.013)	0.020 (0.014)
Ln(Perm. Workers) x Assigned to MTO in 2007	-0.004 (0.016)	0.006 (0.015)
Ln(Perm. Workers) x Assigned to MTO in 2007 x (Year>2005)	-0.026 (0.007)	-0.022 (0.005)
Years	2003-2011	2003-2011
Firm FE	Yes	Yes
Year FE	Yes	Yes

Framework

- Consider a taxpayer who solves

$$\max_{l,e} (1 - \tau) (Af(l) - \gamma wl - e) - (1 - \gamma) wl - c(e, \alpha) + e$$

Framework

- Consider a taxpayer who solves

$$\max_{l,e} (1 - \tau) (Af(l) - \gamma wl - e) - (1 - \gamma) wl - c(e, \alpha) + e$$

- Define taxable income as $z = Af(l) - \gamma wl - e$. Social welfare in this context is given by:

$$W = \underbrace{(1 - \tau)z - (1 - \gamma)wl - c(e, \alpha) + e}_{\text{firm post-tax profits}} + v(\tau z - a(\alpha))$$

where $v \geq 1$ is the marginal value of government funds and $a(\alpha)$ are administration costs.

Framework

- Consider a taxpayer who solves

$$\max_{l,e} (1 - \tau)(Af(l) - \gamma wl - e) - (1 - \gamma)wl - c(e, \alpha) + e$$

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where $v \geq 1$ is the marginal value of government funds and $a(\alpha)$ are administration costs.

- Change in tax rates:
 - Taking derivative w.r.t. τ and applying the envelope theorem, impact of a change in tax rates on welfare is given by:

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

- The fact that taxation is distortionary (i.e., $\gamma < 1$) is why $\varepsilon \neq 0$.
- Key parameter to estimate is $\varepsilon_{1-\tau}$

Tax administration

$$W = \underbrace{(1 - \tau)z - (1 - \gamma)wl - c(e, \alpha)}_{\text{firm post-tax profits}} + e + v(\tau z - a(\alpha))$$

- Change in tax administration:

- Taking the derivative with respect to tax enforcement α and applying envelope theorem:

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

- Note that we do not observe the change in private compliance costs $-\frac{dc}{d\alpha}$.
 - We can, however, estimate the $\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha}$ - change in net government revenue.
 - Can use this to bound how large $-\frac{dc}{d\alpha}$ would have to be.

Comparing tax administration and tax rates

- Key calculation: the tax change such that government revenue is the same after a marginal change in tax administration (i.e. a change in α):

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

Comparing tax administration and tax rates

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

- Note this is a function of the two parameters we will estimate
 - Change in administration: $\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha}$
 - ETI: $\varepsilon_{1-\tau}$

Comparing tax administration and tax rates

- Key calculation: the tax change such that government revenue is the same after a marginal change in tax administration (i.e. a change in α):

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- Note this is a function of the two parameters we will estimate
 - Change in administration: $\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha}$
 - ETI: $\varepsilon_{1-\tau}$
- Welfare impacts of marginal shift from tax rates to tax administration

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

- Since all but $-\frac{dc}{d\alpha}$ is observed, can use this to think about bounds

Size-dependent enforcement

- In above framework, enforcement costs don't depend on firm size $c(e, \alpha)$

Size-dependent enforcement

- In above framework, enforcement costs don't depend on firm size $c(e, \alpha)$

- Firm solves

$$\max_{l, e} (1 - \tau) (Af(l) - \gamma wl - e) - (1 - \gamma) wl - c(e, \alpha) + e$$

- So firm's production given by

$$Af'(l) = \gamma w + \frac{(1 - \gamma)w}{1 - \tau}$$

- Note first-best is $Af'(l) = \gamma w$, but taxes distortionary if $\gamma < 1$.

Size-dependent enforcement

- In above framework, enforcement costs don't depend on firm size $c(e, \alpha)$
 - Firm solves

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- Now suppose cost of evasion is $c(e, \alpha(l))$, i.e. a function of firm size

Size-dependent enforcement

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$$Af'(l) = \gamma w + \frac{(1 - \gamma)w}{1 - \tau}$$

- Note first-best is $Af'(l) = \gamma w$, but taxes distortionary if $\gamma < 1$.
- Now suppose cost of evasion is $c(e, \alpha(l))$, i.e. a function of firm size
 - Then firm decision is

$$Af'(l) = \gamma w + \underbrace{\frac{(1 - \gamma)w}{1 - \tau}}_{\text{distortionary effects of taxation}} + \underbrace{\frac{1}{1 - \tau} \frac{dc}{d\alpha} \alpha'(l)}_{\text{enforcement tax}}$$

Size-dependent enforcement

- In above framework, enforcement costs don't depend on firm size $c(e, \alpha)$
 - Firm solves

$$\max_{l, e} (1 - \tau) (Af(l) - \gamma wl - e) - (1 - \gamma) wl - c(e, \alpha) + e$$

- So firm's production given by

$$Af'(l) = \gamma w + \frac{(1 - \gamma)w}{1 - \tau}$$

- Note first-best is $Af'(l) = \gamma w$, but taxes distortionary if $\gamma < 1$.
- Now suppose cost of evasion is $c(e, \alpha(l))$, i.e. a function of firm size
 - Then firm decision is

$$Af'(l) = \gamma w + \underbrace{\frac{(1 - \gamma)w}{1 - \tau}}_{\text{distortionary effects of taxation}} + \underbrace{\frac{1}{1 - \tau} \frac{dc}{d\alpha} \alpha'(l)}_{\text{enforcement tax}}$$

- Additional 'enforcement tax' generated by slope of $a(l)$ function
 - Suggests impact of increasing α depends both on level and *derivative* of $\alpha(l)$
 - Improved administration could raise revenue *and* reduce distortions if it mostly flattens $\alpha(l)$
 - We will estimate change in $\alpha(l)$ in the data

Reported employment

- Increases in permanent workers (21%), total wage bill (24%), and total average yearly wage (17%)

Table 2: MTO treatment effect on Reported Employment

	Treated post-treatment counterfactual (3)	MTO treatment effect			
		Reduced Form (4)	IV (5)	IV effect as % of	
				Post-treatment counterfactual (6)	Post-treatment total outcome (7)
Total workers	162.53	6.960 (12.032)	12.646 (21.865)	8%	0.7%
Permanent workers	49.19	5.705 (3.309)	10.365 (6.009)	21%	1.5%
Temporary workers	113.34	1.256 (11.650)	2.281 (21.168)	2%	0.2%
Total wage bill (2007 IDR billion)	1.37	0.182 (0.077)	0.330 (0.139)	24%	1.7%
Permanent workers	0.92	0.106 (0.055)	0.193 (0.100)	21%	1.5%
Temporary workers	0.44	0.075 (0.053)	0.136 (0.097)	31%	2.1%
Average yearly wage (2007 IDR million)	15.04	1.296 (0.561)	2.390 (1.031)	16%	1.0%
Permanent workers	17.25	1.537 (0.307)	2.855 (0.571)	17%	1.1%
Temporary workers	7.79	0.160	0.325	4%	0.4%

Enforcement

- Can estimate these in regression form as well
- Cross-section

$$Y_{it} = \alpha + \beta_1 M_{iFC} + \beta_2 l_{it} + \beta_3 M_{iFC} \times l_{it} + \delta_y + \epsilon_{it}$$

where l is firm size; same matching weights as before.

- For VAT enforcement letters, observe pre-MTO data as well, so can run weighted diffs-in-diffs

$$Y_{it} = \alpha + \gamma_1 l_{it} + \gamma_2 M_{iFC} \times l_{it} + \gamma_3 M_{iFC} \times \mathbf{1}_{t>2005} + \gamma_4 M_{iFC} \times l_{it} \times \mathbf{1}_{t>2005} + \delta_y + \delta_i + \epsilon_{it}$$

- Results suggest that MTO led to higher, but flatter, $\alpha(l)$ function. [Table - CS](#) [Table - D-inD](#)
- Could explain level revenue increases but without slowing firm growth (or even leading to higher rate of firm growth subsequently)

Increase enforcement or increase rates?

- Recall framework suggests using this revenue-neutral counterfactual to think about welfare (Keen and Slemrod 2017) :
 - Consider the counterfactual where we improve administration and cut rates to keep government revenue (net of administration costs) constant.
 - Is welfare higher?

- Evaluate

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

where

- $\left(\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha} \right)$ is the change in revenue due to MTO, net of administrative costs
- $\varepsilon_{1-\tau}$ is the ETI
- $\frac{dc}{d\alpha}$ is the change in private compliance costs

Increase enforcement or increase rates?

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

- We do not observe change in private compliance costs $\frac{dc}{d\alpha}$
- But, holding $\frac{dc}{d\alpha}$ fixed, improving tax administration is likely to be a good idea when
 - $\left(\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha} \right)$ is large – i.e. net gains from improvement enforcement are large
 - and when ε is large – i.e. behavioral elasticity w.r.t. tax rates are non-trivial
- Both turn out to be true in our context
 - In particular $\frac{1}{1 - \frac{\tau}{1-\tau} \rho \varepsilon} = 1.51$, so true even if revenue gains from enforcement only 66 of additional compliance costs induced by MTO.

Matching

- Restrict to common support (i.e. 97.5th / 2.5th percentiles; 99th / 1st percentile, etc).
 - Figure
 - Robustness
- Match on 2005 gross income and tax payments using 'entropy balancing' weights (Hainmuller 2012)
 - Computes exact weights (for the untreated group) so that weighted sample matches pre-treatment characteristics of treated group.
 - Chooses the set of weights that achieves balance that minimally deviates from uniform weights. - Details
 - These methods provide better balance than propensity score methods when propensity score isn't exact (Athey and Imbens 2017).
 - Show robustness to conventional inverse-probability weighted propensity score matching. - Robustness
- Results balanced not just on levels (matched), but also on similar pre-trends (not matched) and similar on other non-matched variables.