Production vs Revenue Efficiency With Limited Tax Capacity
Theory and Evidence From Pakistan

Michael Best, Anne Brockmeyer, Henrik Kleven, Johannes Spinnewijn, Mazhar Waseem

London School of Economics

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Production Efficiency

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

- **Important 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
Production Efficiency vs Revenue Efficiency

- Production Efficiency Theorem assumes perfect tax enforcement
  → This is 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, our contribution is:
  - 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
Quasi-Experimental Setting

- **Minimum Tax in Pakistan**: firms whose profits tax liability falls below an (endogenous) threshold are taxed on turnover
  - The policy is motivated by tax compliance

- **Non-standard kink** where both the tax rate and the tax base change
  - Empirical strategy is based on a bunching approach
  - Kink changes real and evasion incentives differentially
  - Facilitates a novel method for estimating tax evasion

- **Wide applicability** of our approach since such minimum tax schemes are used in many developing countries
Related literature


- **Optimal tax policy with enforcement problems**: Emran and Stiglitz (2005), Gordon & Li (2009), Kleven et al. (2009)

- **Estimating tax evasion**: Andreoni et al. (1998), Slemrod (2007), Kleven et al. (2011)

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 yields

\[
\begin{align*}
    c'(y) &= 1 - \omega \\
    g'(\hat{c} - c(y)) &= \tau \mu
\end{align*}
\]

- Production wedge $\omega = \tau \frac{1 - \mu}{1 - \tau \mu}$:
  - $\omega = 0$ for a profit tax $\mu = 1$ [production efficiency]
  - $\omega = \tau$ for a turnover tax $\mu = 0$ [production inefficiency]
Proposition [Production Inefficiency]

With **perfect tax enforcement**, the firm’s profit is the optimal tax base, i.e., $\mu = 1$.

With **imperfect tax enforcement**, we have:

1. Optimal tax base is in between profits and turnover, $\mu \in (0, 1)$
2. Optimal tax system satisfies

$$\frac{\tau}{1 - \tau} \times \left. \frac{\partial \omega}{\partial \tau} \right|_{\text{in } \mu} (\mu) = \left. \hat{c} - c \right|_{\text{in } \mu} (\mu) \times \left. \frac{\epsilon \hat{c} - c, \tau \mu}{\epsilon y, 1 - \omega} \right|_{\text{in } \mu}$$
Outline

Introduction

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Empirical Results
  Bunching Evidence
  Estimating Evasion

Policy Implications
(Stylized) Minimum Tax Scheme

- Combination of profit tax \((\mu = 1)\) and turnover tax \((\mu = 0)\):
  \[ T = \max \{ \tau_\pi (y - c); \tau_y y \}. \]

- Firms switch between the two taxes depending on profit rate \(p\),
  \[ \tau_\pi (y - c) = \tau_y y \iff p \equiv \frac{y - c}{y} = \frac{\tau_y}{\tau_\pi}. \]

- Kink: tax base and marginal tax rate change discontinuously, but tax liability is continuous
Bunching at the Minimum Tax Kink

\[ c'(y) = 1 \]
\[ g'(\delta - c) = \tau_\pi \]

**Diagram:**
- Density on the y-axis.
- Profit Rate \((y - \hat{c})/y\) on the x-axis.
- Smooth density under profit tax \(\tau_\pi\).
Bunching at the Minimum Tax Kink

\[ c'(y) = 1 - \tau_y \]
\[ g'(\hat{c} - c) = 0 \]
\[ g'(\hat{c} - c) = \tau_\pi \]

Density

Profit Rate \( (y - \hat{c}) / y \)

\( y \downarrow, (\hat{c} - c) \downarrow \)

\( \tau_y / \tau_\pi \)

kink

smooth density under profit tax \( \tau_\pi \)
Bunching at the Minimum Tax Kink

Density

\[ c'(y) = 1 - \tau_y \]
\[ g'(\bar{c} - c) = 0 \]

\[ c'(y) = 1 \]
\[ g'(\bar{c} - c) = \tau_\pi \]

bunching at minimum tax kink
Minimum Tax Kink Ideal for Eliciting Evasion

- **Real output response:**
  - Firms choose real output based on \(1 - \omega\)
  - At the kink, production wedge \(\omega\) changes from 0 to \(\tau_y (\approx 0)\)
    \[\Rightarrow\] almost no variation and therefore limited real response

- **Evasion response:**
  - Firms choose evasion based on \(\tau \mu\)
  - At the kink, \(\tau \mu\) changes from \(\tau_\pi (\gg 0)\) to 0
    \[\Rightarrow\] large variation and therefore large evasion response

- **Bunching at the minimum tax kink identifies (mostly) evasion:**
  \[
  \Delta \hat{p} = \left[ \frac{\hat{c}}{y} - c'(y) \right] \frac{\Delta y}{y} - \frac{\Delta (\hat{c} - c)}{y} \\
  \approx \frac{\tau_y}{\tau_\pi} \frac{2}{\varepsilon_y,1-\omega} - \frac{\tau_y}{\tau_\pi} \frac{(\hat{c} - c)}{\hat{\Pi}} \varepsilon_{\hat{c}-c,\tau \mu}
  \]
Robustness of Identification

- **Distortionary profit tax**
  - if $\omega$ is positive under profit tax, minimum tax may increase real incentives
    $\Rightarrow$ firms under minimum tax *move away* from the threshold

- **Distortionary output tax**
  - low $\tau_y$ introduces small distortion for individual firm, not necessarily for the economy as a whole (e.g., cascading)
    $\Rightarrow$ general equilibrium effects *do not affect bunching*

- **Output evasion**
  - if firms can underreport output, lower rate under minimum tax decreases output evasion
    $\Rightarrow$ bunching identifies *differential* evasion
Data

- **Administrative data** from FBR Pakistan

- **All corporate tax returns from 2006-2010** (about 15,000 returns per year)

- New electronic data collection system in place for this time period

- In each year, about half of the firms are turnover taxpayers and half of them are profit taxpayers
Variation in Kink

- **Variation in profit tax rate** $\tau_\pi$ across firms:
  - High rate of 35%, low rate of 20%
    [depends on incorporation date, turnover, capital, #employees]

- **Variation in turnover tax rate** $\tau_y$ 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%
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Bunching Results

High rate firms

2006/07/09

0.5% turnover tax  35% profit tax

High rate kink

Density

Reported Profit as Percentage of Turnover

Binsize 0.214.

High rate firms

Introduction  Conceptual Framework  Empirical Methodology  **Empirical Results**  Policy Implications
Bunching Results

High vs low rate firms

2006/07/09

High rate kink
Low rate kink

0.5% turnover tax
35% profit tax
20% profit tax

Density

Reported Profit as Percentage of Turnover

Binsize 0.214.
Bunching Results

Variation across time: 2006/07/09 vs 2008

High rate firms

0.5% turnover tax
35% profit tax

2006/07/09 kink
No kink in 2008

Binsize 0.214.
Bunching Results

Variation across time: 2006/07/09 vs 2010

High rate firms

0.5% turnover tax in 2006/07/09
1% turnover tax in 2010
35% profit tax

Binsize 0.204.

Bunching Results

0.5% turnover tax in 2006/07/09
1% turnover tax in 2010
35% profit tax

Binsize 0.204.
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Estimating Evasion

High rate firms – 2006/07/09

Bunching = 4.44 (.1)

Reported Profit as Percentage of Turnover

Low rate firms

High rate firms

Counterfactual

Polynomial degree 5. Binsize .214

Low rate firms

High rate firms

Counterfactual

Polynomial degree 5. Binsize .214

Estimation Details
Estimating Evasion

High rate firms – 2006/07/09

Bunching = 4.44 (.1)
Without evasion: Output elasticity $[e] = 133.3$ (4)

Reported Profit as Percentage of Turnover

Polynomial degree 5. Binsize .214
Estimating Evasion

High rate firms – 2006/07/09

Bunching = 4.44 (.1)

Without evasion: Output elasticity \[ e \] = 133.3 (4)

With evasion: Evasion rate change = 66.7% (2.0) \[ e=0 \]
66.2% (2.0) \[ e=1 \]
64.2% (2.0) \[ e=5 \]

Reported Profit as Percentage of Turnover

Polynomial degree 5. Binsize .214

Low rate firms High rate firms Counterfactual
Estimating Evasion

Low rate firms – 2006/07/09

Bunching = 2.0 (.2)
Without evasion: Output elasticity \[ e \] = 34.3 (3.3)
With evasion: Evasion rate change = 17.1% (1.6) \([e=0]\)
16.6% (1.6) \([e=1]\)
14.6% (1.6) \([e=5]\)

Density

Reported Profit as Percentage of Turnover

Polynomial degree 5. Binsize .214
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Optimal Tax Rule in (Partial) Framework

\[ \frac{\tau}{1 - \tau} \times \frac{\partial \omega}{\partial \tau} (\mu) \simeq \frac{\Delta (\hat{c} - c)}{\hat{\Pi} (\mu)} / \varepsilon y, 1 - \omega \]
Trade-off: Tax Rate vs. Tax Base

![Graph showing the trade-off between tax rate and tax base](image)

- Tax Rate vs. Tax Base
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- Empirical Results
- Policy Implications
Conclusion

- Robustness of tax policy results in context of developing countries is underexplored
- Use quasi-experimental variation & admin data to analyze behavioral responses to minimum tax
- Large evasion responses we estimate for Pakistan justify deviations from a production-efficient profit tax
- Returns to better tax enforcement are high; two thirds of profit tax revenues seem foregone due to evasion by incorporated firms
Empirical Methodology

- Estimate counterfactual density following Chetty et al (2011):

\[ d_j = \sum_{l=0}^{q} \beta_l (z_j)^l + \sum_{k=z_L}^{z_U} \gamma_k \cdot 1[z_j = k] + v_j. \]

- Estimate excess mass:

\[ b = \frac{\sum_{k=z_L}^{z_U} \hat{\gamma}_k}{\sum_{k=z_L}^{z_U} \hat{d}_k / N_k} \]

- Excess mass indicates the profit rate change $\Delta p$ for marginal buncher.
Heterogeneity in evasion rates

Theory predicts more evasion among firms that are

- **small** in number of employees (Kleven et al, 2009):
  - Collusive evasion is more sustainable in a small group
  - Proxy for firm size: salary payments, turnover

- less dependent on **financial intermediation** (Gordon & Li, 2009)
  - Access to formal credit creates a paper trail
  - Proxy for credit needs: interest payments (scaled by turnover)

- selling to **final consumers** (e.g, Pomeranz, 2013)
  - Paper trail is lacking for transactions with final consumers
  - Compare “retailers” and “non-retailers”
Heterogeneity

Heterogeneity – by salary over turnover

High rate firms, 2006/07/09

Binsize 0.214.

Density

Reported Profit as Percentage of Turnover

Below median  Above median

Binsize 0.214.

Below median  Above median
Heterogeneity

Heterogeneity – by turnover

High rate firms, 2006/07/09

Density

Reported Profit as Percentage of Turnover

Below median  Above median

Binsize 0.214.
Heterogeneity

Heterogeneity – by interest payments over turnover

High rate firms, 2006/07/09

Reported Profit as Percentage of Turnover

Binsize 0.214.
Heterogeneity

Heterogeneity – by sector

High rate firms, 2006/07/09

Reported Profit as Percentage of Turnover

Retailers  Non-retailers

Binsize 0.214.

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