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):
  
  Any second-best optimal tax system maintains production efficiency

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

- 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-efficient vs. revenue-efficient tax instruments

- In the context of firm taxation in Pakistan, our contribution is:
  - Stylized model on the optimal production-revenue efficiency trade-off
  - Quasi-experimental evidence on the importance of evasion
  - Link model & evidence to quantify optimal policy
Quasi-Experimental Setting

- **Minimum Tax in Pakistan**: firms whose profits tax liability falls below a 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
  - Kink changes real and evasion incentives differentially
  - Facilitates a novel method for estimating tax evasion
  - Empirical strategy is based on a bunching approach

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

Introduction

Conceptual Framework

Empirical Methodology

Empirical Results
  Bunching Evidence
  Estimating Evasion

Policy Implications
Stylized Framework

- Two decisions for the firm:
  - How much to produce? Produce output $y$ at cost $c(y)$
  - How much to report? Declare cost $\hat{c}$ at (expected) penalty $g(\hat{c} - c(y))$

- Two tax instruments for the government:
  - Tax rate and tax base
  - Tax liability:
    \[ T = \tau \times [y - \mu\hat{c}] \]

- Two extreme alternatives:
  - $\mu = 1$: profit tax (narrow base, high rate)
  - $\mu = 0$: turnover tax (broad base, low rate)
Firm Behavior: Real vs Evasion Responses

- Effective tax rate \( \omega = \tau \frac{1-\mu}{1-\tau \mu} \) vs. Evasion incentives \( \rho = \tau \mu \)

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

- Two extremes:
  - **Profit tax** (\( \mu = 1 \)): production efficient (\( \omega = 0 \)), but revenue-inefficient (\( \rho = \tau \pi \))
  - **Turnover tax** (\( \mu = 0 \)): production inefficient (\( \omega = \tau y \)), but revenue-efficient (\( \rho = 0 \))

- Optimal combination of tax rate and base depends on the importance of evasion responses vs. production responses
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Policy Implications
(Stylized) Minimum Tax Scheme

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

  $$T = \max \{ \tau_\pi (y - c); \tau_y y \} \text{ with } \tau_\pi \gg \tau_y$$

- 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

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

Density

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

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

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

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

\( \text{kink} \)

\( \text{smooth density under profit tax } \tau \)

\( \text{Density} \)

\( \text{Profit Rate } (y - \bar{c})/y \)

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

\( \tau y / \tau \pi \)
Bunching at the Minimum Tax Kink

Density

Profit Rate \( \frac{y - c}{y} \)

\[ c'(y) = 1 - \tau y \]
\[ g'(c-c) = 0 \]

\[ c'(y) = 1 \]
\[ g'(c-c) = \tau \]

bunching at minimum tax kink

y \downarrow, (c-c) \downarrow

\( \tau \)

\( \tau_{\pi} \)

Profit Rate \( \frac{y - c}{y} \)
Minimum Tax Kink Ideal for Eliciting Evasion

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

- **Evasion response:**
  - Firms choose evasion based on $\rho$
  - At the kink, $\rho$ 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**
  - Robust to generalizations; output evasion, distortions due to profit tax, other distortions due to turnover tax

Introduction  Conceptual Framework  Empirical Methodology  Empirical Results  Policy Implications
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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Introduction

Conceptual Framework

Empirical Methodology

Empirical Results
  Bunching Evidence
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Policy Implications
Bunching Results

High rate firms

2006/07/09

High rate kink

0.5% turnover tax 35% profit tax

Reported Profit as Percentage of Turnover

Binsize 0.214.

Density

0.02 0.04 0.06 0.08

0 0.04 0.06 0.08

0 0.02 0.04 0.06

-5 0 1.43 2.5 5 10

High rate firms

Bunching Results

High rate firms

2006/07/09

High rate kink

0.5% turnover tax 35% profit tax

Reported Profit as Percentage of Turnover

Binsize 0.214.
Bunching Results

High vs low rate firms

Reported Profit as Percentage of Turnover

2006/07/09

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

Density

Reported Profit as Percentage of Turnover

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

Density

Binsize 0.204.

Reported Profit as Percentage of Turnover

2006/07/09 kink
2010 kink

Variation across time: 2006/07/09 vs 2010

Heterogeneity
Outline

Introduction

Conceptual Framework

Empirical Methodology

Empirical Results
  - Bunching Evidence
  - Estimating Evasion

Policy Implications
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

Estimation Details
Estimating Evasion

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

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

Low rate firms  High rate firms  Counterfactual
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
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Introduction

Conceptual Framework

Empirical Methodology

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Policy Implications
Policy Implications

- Large loss of revenues under profit tax due to evasion by incorporated firms
  - our estimates suggest that two thirds of profit tax revenues are foregone
  - returns to better tax enforcement seem high

- Clear trade-off between raising the rate or raising the base
  - our estimates are sufficient to characterize this trade-off
  - due to the large evasion response, a profit tax base is suboptimal when taxed at 35 percent
  - further increase in the tax base is desirable when decreasing the tax rate

- Caveat: Welfare analysis is partial
Trade-off: Tax Rate vs. Tax Base

\[ \begin{align*}
  t & = 0.005 \\
  p & = 0.35
\end{align*} \]
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
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 – 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

- By turnover

High rate firms, 2006/07/09

Reported Profit as Percentage of Turnover

Binsize 0.214.
Heterogeneity

Heterogeneity – by interest payments over turnover

High rate firms, 2006/07/09

Binsize 0.214.

Reported Profit as Percentage of Turnover

Below median  Above median

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.

Back
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