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

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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
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
Novel Quasi-Experimental Approach

- **Minimum Tax Scheme**: firms are taxed on either profits or turnover (lower tax rate on turnover) depending on which tax liability is larger
  - This production inefficient policy is motivated by tax compliance

- **Non-standard kink** where both the tax rate and the 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 since such schemes are ubiquitous
Contributions to Previous Literature


- **Optimal taxation 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)

- **Corporate taxation**: Hassett & Hubbard (2002), Auerbach et al. (2010), Devereux et al. (2013)

- **Bunching methodology**: Saez (2010), Chetty et al. (2011)
Outline

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  Estimating Evasion

Policy Implications
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

\[
    c'(y) = 1 - \omega \\
    g'(\hat{c} - c(y)) = \tau \mu
\]

- 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 enforcement**, the optimal tax base is pure profits \( (\mu = 1) \)

With **imperfect enforcement**, the optimal tax base is in between pure profits and turnover \( (0 < \mu < 1) \) and depends on the evasion-output elasticity ratio

\[
\frac{\tau}{1 - \tau} \times \frac{\partial \omega}{\partial \tau} (\mu) = G(\mu) \times \frac{\varepsilon \hat{c} - c}{\varepsilon_y}
\]

- \( \frac{\tau}{1 - \tau} \) \( \frac{\partial \omega}{\partial \tau} (\mu) \): effective MTR down in \( \mu \)
- \( G(\mu) \): tax gap up in \( \mu \)
- \( \frac{\varepsilon \hat{c} - c}{\varepsilon_y} \): elasticity ratio
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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

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

Density

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

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

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

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

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

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

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

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

bunching at minimum tax kink

\[ y \downarrow, (\hat{c} - c) \downarrow \]
\[ \tau_y / \tau \]

Profit Rate \( (y - \hat{c}) / y \)
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 small 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 $B$ identifies (mostly) evasion:**

\[
B \propto \frac{\tau_y^2}{\tau \pi} \varepsilon_y - \frac{\Delta (\hat{c} - c)}{y}
\]
Robustness

- **Distortionary profit tax**
  - If $\omega > 0$ under profit tax, then turnover tax may improve real incentives
    - $\Rightarrow$ firms move away from the kink and **create a hole**

- **Distortionary turnover tax**
  - Small $\tau_y$ may create big distortions via cascading and extensive margin
    - $\Rightarrow$ GE effects and extensive responses **do not affect bunching**

- **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 **differential evasion from output and costs**
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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 tax payers
Variation in Minimum Tax Kink

- **Variation in profit tax rate** $\tau_\pi$ across firms:
  - High rate of 35%, low rate of 20%  
    [depends on incorporation date, turnover, assets, #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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**Empirical Results**
- Bunching Evidence
- Estimating Evasion

Policy Implications
Bunching Evidence

High rate firms

2006/07/09

0.5% turnover tax 35% profit tax

High rate kink

Binsize 0.214.
Bunching Evidence

High vs low rate firms

2006/07/09

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

Binsize 0.214.

Density

Reported Profit as Percentage of Turnover

High rate kink

Low rate kink

High rate firms
Low rate firms

Binsize 0.214.
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

-5 0 1.43 5 10

Reported Profit as Percentage of Turnover

Binsize 0.214.

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Bunching Evidence

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.

Heterogeneity

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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: 0.02, 0.04, 0.06, 0.08

Density

Low rate firms: 1.42, 2.5, 5, 10

High rate firms: 2006/07/09

Counterfactual

Polynomial degree 5. Binsize .214

Counterfactual
Estimating Evasion

High rate firms – 2006/07/09

Bunching = 4.44 (.1)
Without evasion: Output elasticity $[\varepsilon] = 133.3 \ (4)$
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) \([e=0]\)
\[66.2\% \text{ (2.0)} \quad [e=1]\]
\[64.2\% \text{ (2.0)} \quad [e=5]\]

Reported Profit as Percentage of Turnover

Low rate firms High rate firms  Counterfactual
Polynomial degree 5. Binsize .214
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% \((1.6)\) \([e=5]\)

Reported Profit as Percentage of Turnover

High rate firms
Low rate firms
Counterfactual

Polynomial degree 5. Binsize .214

Counterfactual
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Policy Implications
Optimal Tax Base (Given $\tau$ and $\varepsilon_y$)

$$\frac{\tau}{1 - \tau} \times \frac{\partial \omega}{\partial \tau} (\mu) \simeq -\frac{\Delta (\hat{c} - c)}{\hat{\Pi}} (\mu) \times \frac{1}{\varepsilon_y}$$
Optimal Tax Base (Varying $\tau$ and $\varepsilon_y$)

$e_y = 0.2$
$e_y = 0.5$
$e_y = 1$
$t_y = 0.005$
$tp = 0.35$

Tax Base Parameter ($m$)
0.1, 0.2, 0.3, 0.4, 0.5

Tax Rate ($t$)
0.2, 0.4, 0.6, 0.8, 1

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Conclusion

- Production inefficient policies like turnover taxes may be optimal under imperfect enforcement.

- Novel quasi-experimental approach using minimum tax schemes for estimating evasion responses to switches between profit taxes and turnover taxes.

- Large evasion responses to such switches in Pakistan, which justify deviations from a production efficient profit tax.

- Returns to improved tax enforcement are high: up to 2/3 of profit tax revenues are lost due to underreporting by corporations.
Counterfactual Estimation

- 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.
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”
Bunching Heterogeneity

Heterogeneity – by salary over turnover

High rate firms, 2006/07/09

Reported Profit as Percentage of Turnover

Binsize 0.214.

Density

Below median  Above median

Back
Bunching Heterogeneity

Heterogeneity – by turnover

High rate firms, 2006/07/09

Density

Reported Profit as Percentage of Turnover

Below median  Above median

Binsize 0.214.

Back
Bunching Heterogeneity

Heterogeneity – by interest payments over turnover

High rate firms, 2006/07/09

Reported Profit as Percentage of Turnover

Binsize 0.214.

Below median
Above median

Back
Bunching 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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