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# Tax Effort Revisited

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# Introduction

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**Tax effort revisited: new estimates from the Government Revenue Dataset**

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# Motivation: “Tax Effort”

- Motivation: Concern over estimation methods employed in existing tax effort studies
- **We don’t re-invent the wheel** but revisit existing findings.
- Employ new data and improved methods, attempt to better estimate tax effort for a larger sample of countries than before
- We find (think) that prior approaches have substantially under-estimated tax effort and been subject to biases from outlying observations in the input data
- Potentially important implications for the take-aways and interpretation of results.

# Background: "Tax Effort"

- **What is Tax Effort?**
  - Ratio of actual tax collected to "potential" tax collected

$$\frac{\text{Tax Collected}}{\text{Tax Potential}}$$

- Challenge at hand: how to best estimate **tax potential**
  - Tax Effort figures are often
    - cited in donor /advisory reports;
    - used as evidence to encourage LIC govt's to enhance tax collection
  - Thus, important that they are estimated as 'accurately' as possible and thus advice is grounded in realistic expectations regarding revenue mobilization
- Tax Effort estimates come with several important limitations - more later

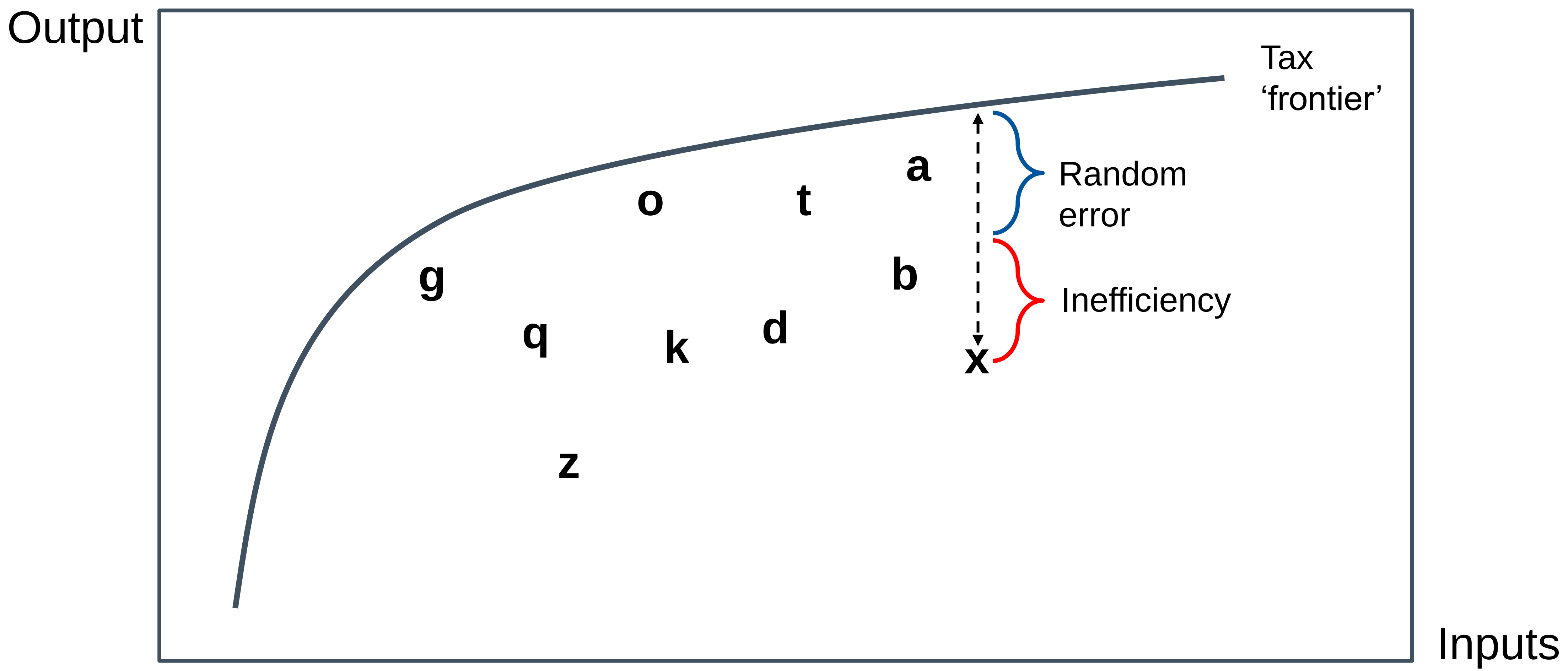
# Literature I

- Rich literature estimating determinants of tax ratio cross-country since (at least…) Oshima (1957)
- Traditionally/Initial studies, OLS / FE regression of Tax Ratio on
  - GDP per capita, Openness, Share of agriculture / manufacturing in GDP, Resource wealth
- Studies increasingly attempt to understand the role of demography and governance
  - Urbanization rates, human capital indices etc.
  - Control for corruption, democracy, etc. (WGI)
- More recent studies have moved to estimating tax effort according to Stochastic Frontier Analysis (SFA).

# Literature II

- **SFA** studies
- Fenochietto and Pessino (2010; 2013), Langford and Ohlenburg (2016); Mawejje and Sebudde (2019).
- “Production Function” approach; estimated “tax frontier” represents theoretical maximum amount of tax a country could collect, *given the inputs in the model*.
- In SFA approach, the difference between tax collected and the tax frontier is broken into a random error and an inefficiency term.

# SFA: Concepts



# Estimation of the Stochastic Tax Frontier

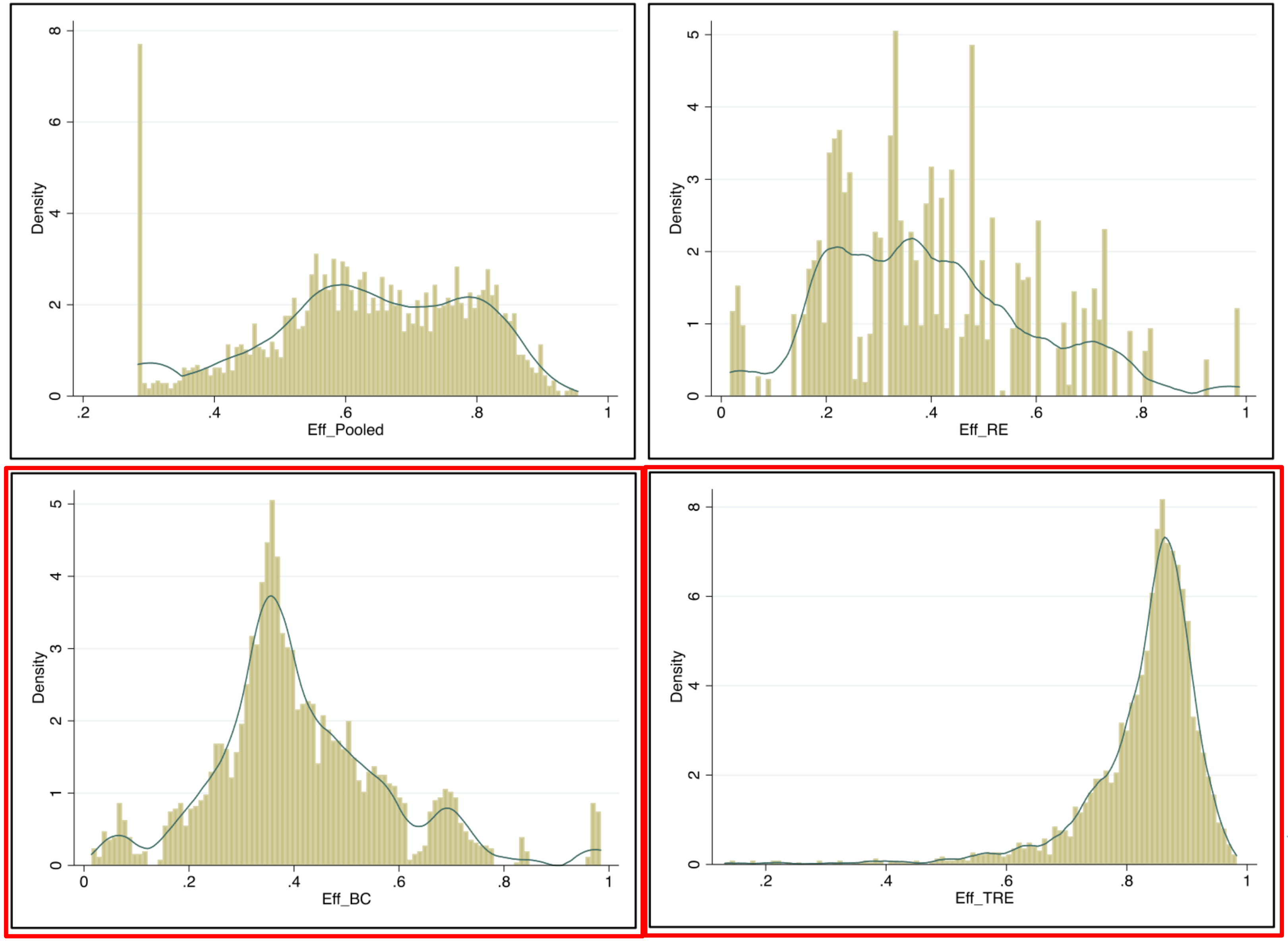
We first estimate the STF according to 4 different models by maximum simulated likelihood

(i) Pooled Model (**Pooled**)
(ii) Random effects (**RE**) (Pitt & Lee, 1981)
(iii) Battese and Coelli (**BC**) (Battese and Coelli, 1995)
(iv) True Random Effects (**TRE**) (Greene, 2005)

Then compute the tax effort scores

Key q is which specification / approach is ‘best’ ?

# Distribution of results in Comparison




Distribution of Tax Effort scores shown, according to model employed

161 countries, 1980-2019

# Results: Preferred Specification

- **TRE** stands out; More right-skewed and tighter variance. **Why?**

- We find that the TRE model is better able to disentangle inefficiency from unobserved time-invariant heterogeneity.

- The RE, BC models are not able to do this to the same extent, and thus time-invariant unobserved heterogeneity ends up being attributed to inefficiency (and subsequently, a lower tax effort score).

- This is a substantive limitation of the BC and RE models, with implications for their interpretation and use!

# Results: Avg. Tax Effort scores

- The average (global) tax effort score according to TRE is **0.84**

- Langford and Ohlenburg (2016):
  **0.64** avg. tax effort
- USAID CTD
  **0.51** avg. tax effort

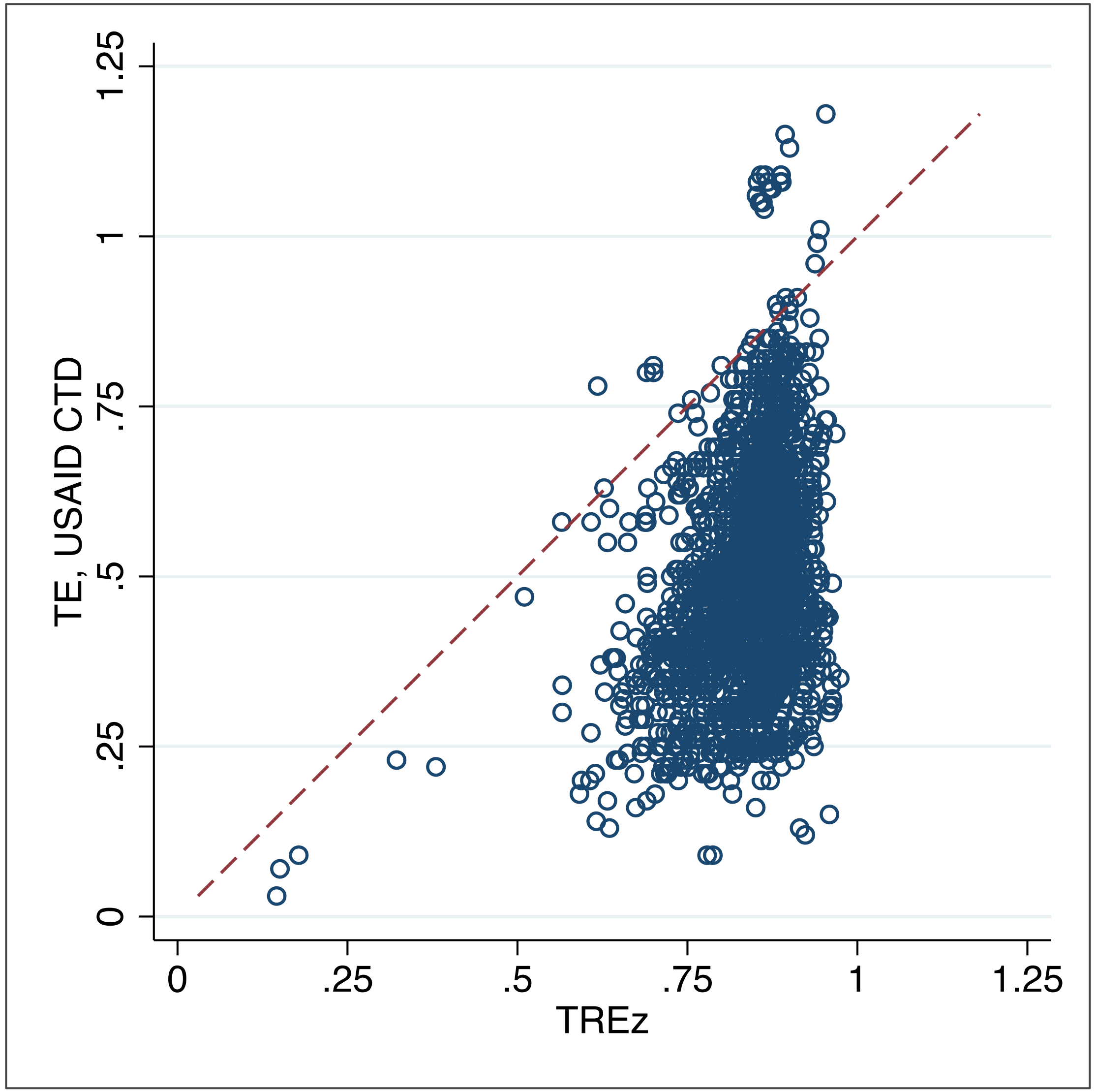
- Tax potential **(T/T.E.) via TRE** is 20.91% of GDP (2019).
- This represents an average increase of around 3.26% of GDP.

| Region / Income group | TRE | Total tax (current) | Tax potential (TRE) |
|---|---|---|---|
| LIC | 0.84 | 12.31% | 14.52% |
| LMIC | 0.82 | 16.00% | 19.79% |
| UMIC | 0.84 | 18.06% | 21.51% |
| HIC | 0.87 | 21.80% | 24.73% |
| East Asia & Pacific | 0.81 | 16.70% | 19.91% |
| Europe & Central Asia | 0.87 | 23.55% | 27.15% |
| Latin America & Caribbean | 0.88 | 16.47% | 18.63% |
| Middle East & North Africa | 0.82 | 10.67% | 13.07% |
| North America | 0.87 | 23.36% | 26.90% |
| South Asia | 0.83 | 15.01% | 17.89% |
| Sub-Saharan Africa | 0.82 | 14.90% | 18.43% |
| World average | 0.84 | 17.65% | 20.83% |

# Results

**TRE** (horizontal) vs **BC** model from USAID Collecting Taxes Database:

Again, see that the scores have a tighter variance and are, on average, a lot higher

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# Examples of bias in existing estimation methods

**Importance of understanding the inputs of the model**

- E.g. Slovakia:
- Slovakia collects ~ 19.8% of GDP (excl. social security)
  - **BC** estimate of TE is **0.36**. Suggests Tax Potential is 55% of GDP.
  - **TRE** estimate of TE is **0.85**. Suggests Tax Potential at 22.3% of GDP.
- Look at input variables, none are particularly extreme, save for Trade (% GDP), where it is ranked 9$^{th}$ in the world (over 200% in 2022).

# Examples of bias in existing estimation methods

- Burundi (2019) collects ~ 13.7% tax : GDP (excl. social security)
- The BC estimate of tax effort is 0.97, suggesting tax potential is just 14.1% of GDP.
- None of underlying input variables show particularly extreme values, save for the **urbanization rate**, where **Burundi ranks bottom of every country in the sample at just 11.8 per cent.**
- Again, the estimate of TE appears skewed by extreme values of just one input variable.

# Limitations & Concluding Remarks

- Our results suggest that recent SFA estimates of TE have, in many cases, been substantial under-estimates.
    - Primarily, this is due to the methodology employed & sensitivity to outlying observations

- Where these scores have previously entered policy dialogues, this is potentially misleading.

# TE in the wider context

- TE scores represent a potentially useful piece of evidence, but shouldn't be solely relied upon. They are very high-level.
- Other pertinent evidence that can play complement to build a more complete picture / diagnostic:
  - Tax Expenditure analysis
  - VAT Gap analysis
  - Distributional analysis etc.
- **They likely mean something different in HICs to LICs**

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# Estimation of the Stochastic Tax Frontier

$$T_{it} = f(X_{it;}\beta)$$

$T_{it}$ is the (observed) tax-to-GDP ratio for country *i* at time *t*.

$f(X_{it;}\beta)$ is the production function; vector of inputs, **X**, is used to generate tax revenue **T**;

$\beta$ is the vector of parameters to be estimated.

$$T_{it} = f(X_{it;}\beta) \cdot \xi_{it} \cdot e^{v_{it}}$$

$0 < \xi_{it} < 1.$

$\xi_{it} = 1$ is where the tax authorities are collecting the maximum potential tax revenue, given the underlying factors captured in $\boldsymbol{X}$

$\xi_{it} < 1$ describes a situation where there is inefficiency in the process of tax collection, and $\boldsymbol{T}$ is less than potential.

Tax collection is also subject to a series of random shocks, $e^{v_{it}}$

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# Estimation of the Stochastic Tax Frontier

$$q_{it} = \alpha + \beta' x_{it} + v_{it} - u_{it}$$

$$q_{it} = \ln\left(\frac{T_{it}}{Y_{it}}\right)$$

$$q_{it} = \alpha + \beta' x_{it} + \boxed{\vartheta_c z_{it,c}} + v_{it} - u_{it}$$

$$u_{it} = \boxed{\vartheta_e z_{it,e}}$$

V-u is a composite error term, incorporating both a random error and the inefficiency in tax collection

Also want to account for heterogeneity in collection via observed factors (**z**).

Can influence ***q*** directly or be a driver of the inefficiency term (no consensus).