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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* 

- **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

Output

Inputs

Tax ‘frontier’

Random error

Inefficiency
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.
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
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 9th 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
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.

\[ T_{it} = f(X_{it}; \beta) \cdot \xi_{it} \cdot e^{\nu_{it}} \]

\( 0 < \xi_{it} < 1 \).

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

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

Tax collection is also subject to a series of random shocks, \( e^{v_{it}} \).
Estimation of the Stochastic Tax Frontier

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

\[ q_{it} = \ln \left( \frac{T_{it}}{y_{it}} \right) \]

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).