Non-linear effects of tax changes on output: The role of the initial level of taxation

Samara Gunter  
*Colby College*

Daniel Riera-Crichton  
*World Bank*

Carlos Vegh  
*World Bank*

Guillermo Vuletin  
*World Bank*
OUTLINE

1. Big picture on tax multipliers
2. Identifying motivation of tax changes
3. Linear effect of tax changes on output
4. Non-linear effects of tax changes on output
5. Non-linearities in action
6. Final thoughts
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Big picture on tax multipliers: Goal and main source of contention

- Massive literature on government spending multipliers
- Much less work on tax multipliers because of measurement problems
  Romer and Romer (AER, 2010), Riera-Crichton, Vegh, Vuletin (JME, 2016)

- Main objective:
  \[ \Delta T \rightarrow \Delta Y \]

- Main source of contention:
  - How to address endogeneity concerns (i.e., identify exogenous tax shocks)
  - Why?
    Because \[ \Delta Y \rightarrow \Delta T \] (i.e., cyclicality of tax policy)

Vegh and Vuletin (AEJ:EP, 2015) show that tax policy is a-cyclical in industrial countries and pro-cyclical in developing countries.
Big picture on tax multipliers:
How to identify exogenous tax shocks

- **Identification I: Blanchard and Perotti (QJE, 2002)**
  - Key identifying assumption: 
    \[ \Delta T_t \rightarrow \Delta Y_t \text{ and } \Delta Y_t \rightarrow \Delta T_{t+1} \] 
    in SVAR and using quarterly data
  - Key advantage: 
    Ease of implementation. By far, the workhorse of the profession.
  - Key limitations:
    2. Not obvious that \( \Delta Y_t \rightarrow \text{No } \Delta T_t \)
      - Example: 2016 Ecuador earthquake - 26 days to tax policy change
        Earthquake occurred on April 16 (est. fall in GDP 1% to 2%)
        Pres. Correa announces 2% increase in VAT on April 20
        Congress approves VAT increase on May 12
        VAT effectively increased on June 1
Big picture on tax multipliers: How to identify exogenous tax shocks

- Identification II: Romer and Romer for the U.S. (AER, 2010)

  - Key strategy:
    - Use of narrative records (e.g., speeches and congressional reports) to assess the nature of legislated $\Delta T$ in the U.S.
    - Differentiate $\Delta T$ into:
      (i) endogenous (to output fluctuations)
      (ii) exogenous (e.g., inherited deficit-driven and long-run growth)
    - Estimate tax multiplier using only exogenous tax changes

  - Key advantage:
    Clear identification of exogenous tax changes

  - Key limitation:
    - Lack of data of legislated tax changes for a global sample
    - Classification of each tax change is extremely time-consuming
Big picture on tax multipliers: How to identify exogenous tax shocks


  - Several recent studies have used this approach for the industrial world:

  - Main findings of these industrial-country-based studies:
    - Large (in absolute value) multipliers: ranging from -2 to -5

- Surprisingly (or maybe not) there is no study analyzing tax multipliers in a more global sample of countries (i.e., developing countries).
Contributions of this paper

- **We take this challenge**
  - Build a narrative approach for a global sample focusing on VAT rate changes
  - 51 countries (21 ind. and 30 dev.) for the period 1970-2014, quarterly data
  - Total of 96 tax changes in 35 countries (18 ind. and 17 dev.)
  - Sources of narratives: IMF, OECD, domestic records, and news articles
  - Build upon Romer and Romer (2010) strategy and incorporate some new elements based on our global sample and tax measure

- **Preview of our empirical findings:**
  1. $\Delta Y/\Delta T < 0$
  2. Non-linear effects of tax changes on output based on distortionary and disincentive-based arguments (i.e., not macroeconomic-based)
  3. Bias due to misidentification depends on pro- or counter-cyclical nature of endogenous changes
  4. The policy implications of these non-linear arguments are very critical.
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Tax changes: Identifying motivation

- Tax changes (96)
  - Endogenous (52)
    - GDP-driven (33)
      - Countercyclical (7)
      - Pro cyclical (26)
    - Offsetting (19)
  - Exogenous (44)
    - Long-run growth (9)
    - Inherited fiscal factors (35)
      - Deficit-driven (14)
      - Debt-driven (21)
Tax changes: Identifying motivation

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Tax changes: Identifying motivation

- Validation of our narrative approach
  What is the response of tax changes to a GDP shock?

Exogenous

Endogenous
does not respond
Tax changes: Identifying motivation

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What is the response of tax changes to a GDP shock?

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What is the response of tax changes to a GDP shock?

**Exogenous**

- does not respond

**Endogenous**

- on average, pro-cyclical
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Linear effect of tax changes on output:

- Using Jorda (AER, 2005)'s local projections method we, first, estimate:

\[ \Delta y_{i,t+h} = \alpha_{i,h} + \beta_h \Delta t_{i,t}^{exog} + \lambda_h(L) \Delta y_{i,t-1} + \psi_h(L) \Delta t_{i,t-1}^{all} + \phi_h(L) \Delta g_{i,t-1} + \right. \\
\left. + \zeta_h T_h + \nu_h T_h^2 + \mu_{i,t,h}, \]

- Second, we use \( \beta_h \) to compute standard tax multiplier at time horizon \( h \):

\[
\text{Tax multiplier} (h) = \frac{\beta_h}{e + \beta_h \cdot I} \quad \text{Tax multiplier}_{SE} (h) = \frac{e}{(e + \beta_h \cdot I)^2} \beta_h^{SE}
\]

where \( I = R/Y \) and \( e = I/t \).
Linear effect of tax changes on output: Estimations and biases due to misidentifications

- **Main findings:**

  Using *exogenous* tax rate changes

  \[
  \text{LR multiplier (exog.)} = -1.7
  \]
Linear effect of tax changes on output: Estimations and biases due to misidentifications

- **Main findings:**

  - Using *exogenous* tax rate changes:
    - LR multiplier (exog.) = -1.7
  
  - Using *all* tax rate changes:
    - LR multiplier (all) = -2.5
Linear effect of tax changes on output: Estimations and biases due to misidentifications

- **Main findings:**

  - Using *exogenous* tax rate changes
  - Using *all* tax rate changes

  ![Graphs showing LR multipliers for exogenous and all tax rate changes](image)

  - LR multiplier (exog.) = -1.7
  - LR multiplier (all) = -2.5

  About 50% difference
Main findings:

Using *exogenous* tax rate changes

- LR multiplier (exog.) = -1.7

Using *all* tax rate changes

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About 50% difference

Why?
Linear effect of tax changes on output: Estimations and biases due to misidentifications

- **Main findings:**

  - Using *exogenous* tax rate changes
    - LR multiplier (exog.) = -1.7
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  About 50% difference

  Why? Because of average *pro-cyclical* nature of endogenous tax changes
Linear effect of tax changes on output: Estimations and biases due to misidentifications

- Bias in action: Explaining RR results for the United States

[Diagram showing the linear effect of tax changes on output with different lines representing 'Using all legislated tax changes' and 'Using exogenous tax changes'. The diagram highlights the opposite direction in bias compared to the findings.]
Linear effect of tax changes on output: Estimations and biases due to misidentifications

- Bias in action: Explaining RR results for the United States

Why?

Opposite direction in bias (compared to our findings)
Bias in action: Explaining RR results for the United States

Why? Because of average \textit{counter-cyclical} nature of endogenous tax changes
Linear effect of tax changes on output: Transmission mechanism

- Transmission mechanism behind our main findings:

On macroeconomic aggregates

On employment growth and labor force participation rate change

In sum, increases (decreases) in the VAT rate reduces (increases) the incentives to consume, invest, and work.
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The non-linear effect of tax changes on output: Theoretical arguments

- **Theoretical arguments**

  - *Jaimovich and Rebelo (JPE, 2017)* show theoretically that the long-run output effect of tax changes is small at low initial levels of taxation but exponentially larger when initial tax levels are high.

  - This is also related to a well-established public finance literature (e.g., Harberger, 1964; Browning, 1975; Feldstein, 1995; Hines, 2007) showing that the distortion imposed by taxation on economic activity is directly, and non-linearly, related to the level of tax rates.

  - By the same token, for a given level of initial tax rate, larger changes in a taxes have a larger effect on output.
The non-linear effect of tax changes on output: Evidence

- 1. Tax multipliers for different levels of initial tax rates

\[
\Delta y_{i,t+h} = \alpha_{i,h} + \beta_{i,h} \Delta t_{i,t}^{exog} + \delta_{i,h} \left[ \Delta t_{i,t}^{exog} \cdot t_{i,t-1}^{all} \right] + \gamma_{i,t-1}^{all} + \psi_{i,h}(L) \Delta t_{i,t-1}^{all} + \\
+ \lambda_{i,h}(L) \Delta y_{i,t-1} + \phi_{i,h}(L) \Delta g_{i,t-1} + \varrho_{i,h} T_h + \psi_{i,h} T_h^2 + \mu_{i,t,h},
\]
The non-linear effect of tax changes on output: Evidence

1. Tax multipliers for different levels of initial tax rates

\[ \Delta y_{i,t+h} = \alpha_{i,h} + \beta_h \Delta t_{i,t}^{\text{exog}} + \delta_h \left[ \Delta t_{i,t}^{\text{exog}} \cdot t_{i,t-1}^{\text{all}} \right] + \gamma_h t_{i,t-1}^{\text{all}} + \psi_h(L) \Delta t_{i,t-1}^{\text{all}} + \lambda_h(L) \Delta y_{i,t-1} + \phi_h(L) \Delta g_{i,t-1} + \varrho_h T_h + \psi_h T_h^2 + \mu_{i,t,h}, \]
The non-linear effect of tax changes on output: Evidence

1. Long-run (after 2 years) tax multipliers for different levels of initial tax rates
The non-linear effect of tax changes on output: Evidence

- 2. Long-run (after 2 years) tax multipliers for different levels of initial tax rates and size of tax change (including quadratic and cube terms and their interactions)
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Non-linearities in action I: Explaining differential effect of tax changes

- Differential effect of exogenous tax rate changes
Non-linearities in action I: Explaining differential effect of tax changes

Median test comparisons of initial tax rate and size of tax change

Panel A. Long-run growth versus inherited fiscal factor tax changes

<table>
<thead>
<tr>
<th></th>
<th>Long-run growth</th>
<th>Inherited fiscal factors</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(1) - (2)</td>
<td></td>
</tr>
<tr>
<td>Initial tax rate</td>
<td>21</td>
<td>19</td>
<td>2**</td>
</tr>
<tr>
<td>Size of tax change</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Long-run changes have higher initial tax rates than inherited fiscal factors.

Panel B. Inherited deficit- versus debt-driven tax changes

<table>
<thead>
<tr>
<th></th>
<th>Debt-driven</th>
<th>Deficit-driven</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(1) - (2)</td>
<td></td>
</tr>
<tr>
<td>Initial tax rate</td>
<td>19</td>
<td>18.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Size of tax change</td>
<td>2</td>
<td>1</td>
<td>1**</td>
</tr>
</tbody>
</table>

Debt-driven changes have larger size of tax changes than deficit-driven changes.
Non-linearities in action I: Explaining differential effect of tax changes

- Are these (i) non-linear arguments and (ii) differences in initial tax rate and/or size of tax change powerful in explaining the long-run differential effect of tax changes?
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Non-linearities in action II: How do taxes on *perceptions* on incentives to work and invest?

- Using Global Competitiveness Index data

VAT rate and incentives to work

VAT rate and incentives to invest
Non-linearities in action II: How do taxes on perceptions on incentives to work and invest?

- Using Global Competitiveness Index data

Evidence regarding the perceived effect of taxes on incentives to work and invest are, indeed, highly non-linear.
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6. Final thoughts
Non-linearities in action III: Contextualizing our findings

- Official agencies, central banks, and other non-official institutions have conducted individual country’s studies regarding the size of the VAT or indirect tax multipliers:

  - Peru changed its VAT rate from 18% to 19% in 2013.
  - Peru changed its VAT rate from 19% to 18% in 2011.
  - Colombia changed its VAT rate from 16% to 19% in 2017.
  - Portugal changed its VAT rate 5 times during the 1996-2012 period.
  - Spain changed its VAT rate 5 times during the 1986-2015 period.
Non-linearities in action III: Contextualizing our findings

- Are our (i) non-linear arguments and (ii) differences in initial tax rate and/or size of tax change powerful in explaining these findings?
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Non-linearities in action IV:
It works in empirics, but does it work in policy?

- Relation between current VAT rate and the expected change in cyclically adjusted revenues (CAR) as percent of GDP for 2018
Non-linearities in action IV:
It works in empirics, but does it work in policy?

- Relation between current VAT rate and the expected change in cyclically adjusted revenues (CAR) as percent of GDP for 2018

\[
\Delta \text{CAR} = \begin{cases} 
0.40 & \text{for VAT rate 6-13} \\
-0.15 & \text{for VAT rate 14-18} \\
-0.52 & \text{for VAT rate 19-27}
\end{cases}
\]

\[\Delta \text{CAR} = 1.1*** - 0.08*** \text{ VAT rate} \]
\[R^2 = 0.23\]
Non-linearities in action IV:
It works in empirics, but does it work in policy?

- Relation between current VAT rate and the expected change in cyclically adjusted revenues (CAR) as percent of GDP for 2018

Countries with large (small) VAT rates are expected to increase (decrease) their revenue pressure. Countries with moderate levels of VAT do not plan major changes.
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Final thoughts

- The impact of tax changes on output is highly non-linear. The effect is larger (in absolute terms) (i) the higher is the initial level of tax rate and (ii) the larger is the size of the tax rate change.

- Estimating tax multipliers involve much more than “academic debates” and have critical practical implications.
Final thoughts

- The impact of tax changes on output is highly non-linear. The effect is larger (in absolute terms) (i) the higher is the initial level of tax rate and (ii) the larger is the size of the tax rate change.

- Estimating tax multipliers involve much more than “academic debates” and have critical practical implications
Final thoughts

- In a related paper titled “Policy implications of Non-linear effects of tax changes on output” we analyze the policy effects on:

- **On the size of the government and economic development**
  Countries with low provision of public goods for its degree of development (e.g., Guatemala) which also tend to have low levels of tax rates, may be able to “catch up” to a more typical (i.e., larger) provision of public goods by increasing the VAT rate without harming economic activity.

- **On revenue mobilization in commodity dependent countries**
  Countries whose fiscal revenue structure “excessively” depends upon commodity revenues (e.g., Nigeria) could quickly mobilize non-commodity revenues by increasing the VAT rate without harming economic activity.

- **Implications for Laffer Curve**
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Thank you