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

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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:

    $\Delta T_t \to \Delta Y_t$ and $\Delta Y_t \to \Delta T_{t+1}$ in SVAR and using quarterly data

  - Key advantage:

    Ease of implementation. By far, the workhorse of the profession.

  - Key limitations:

  1 - Biases due to "anticipation" effects. E.g., Ramey and Shapiro (*QJE*, 1998), Leeper, Walker, and Yang (*AEJ: EP*, 2012).

  2 - Not obvious that $\Delta Y_t \to$ No ΔT_t

    Example: 2016 Ecuador earthquake - 26 days to tax policy change
        Earthquake occurred on April 16 (est. fall in GDP 1% to 2%)$\to$
        Pres. Correa announces 2% increase in VAT on April 20 $\to$
        Congress approves VAT increase on May 12 $\to$
        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)**

- <u>Key strategy:</u>
   - Use of narrative records (e.g., speeches and congressional reports) to assess the nature of legislated ΔT in the U.S.
   - Differentiate ΔT 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

- <u>Key advantage:</u>
   Clear identification of exogenous tax changes

- <u>Key limitation:</u>
   - 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

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

  - Several recent studies have used this approach for the industrial world:
    - Guajardo, Leigh, and Pescatori (2014), Alesina, Favero, and Giavazzi, (2015), Riera-Crichton, Vegh, and Vuletin (2016) for about 20 industrial countries during fiscal consolidation episodes
    - Cloyne (2013) for U.K., Hayo and Uhl (2013) for Germany, Gil, Marti, Morris, Perez, and Ramos (2017) for Spain, and Pereira and Wemans (2013) for Portugal

  - 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.
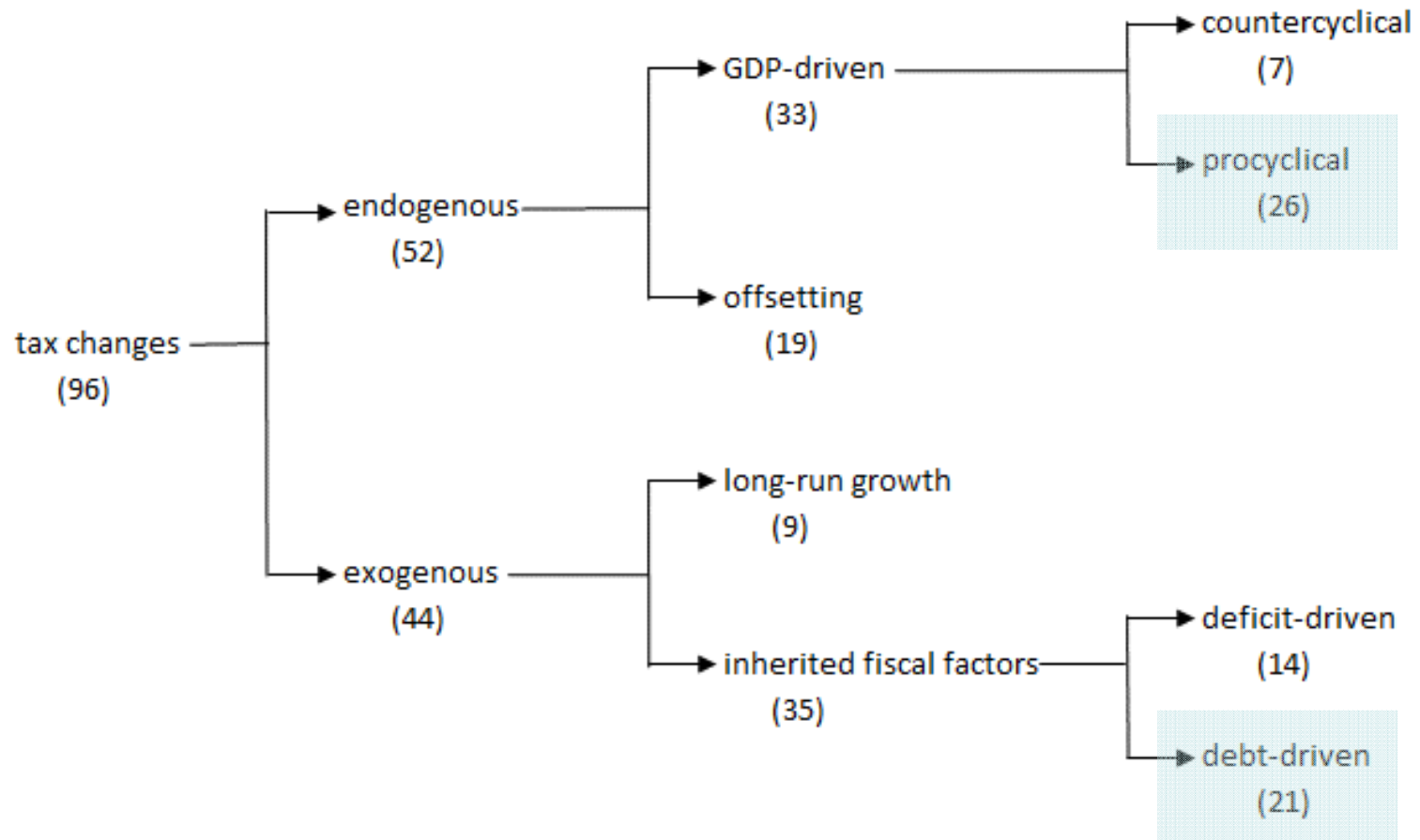
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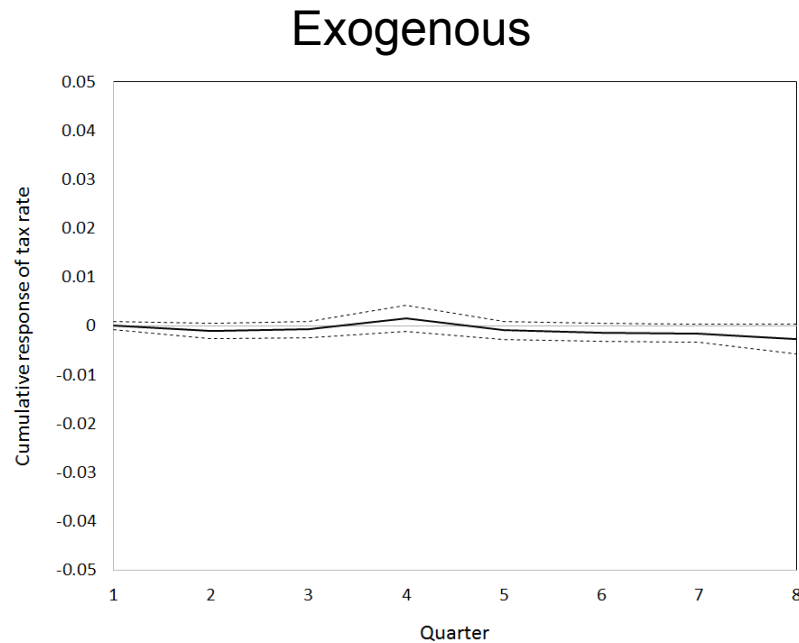6. Final thoughts

Tax changes: Identifying motivation
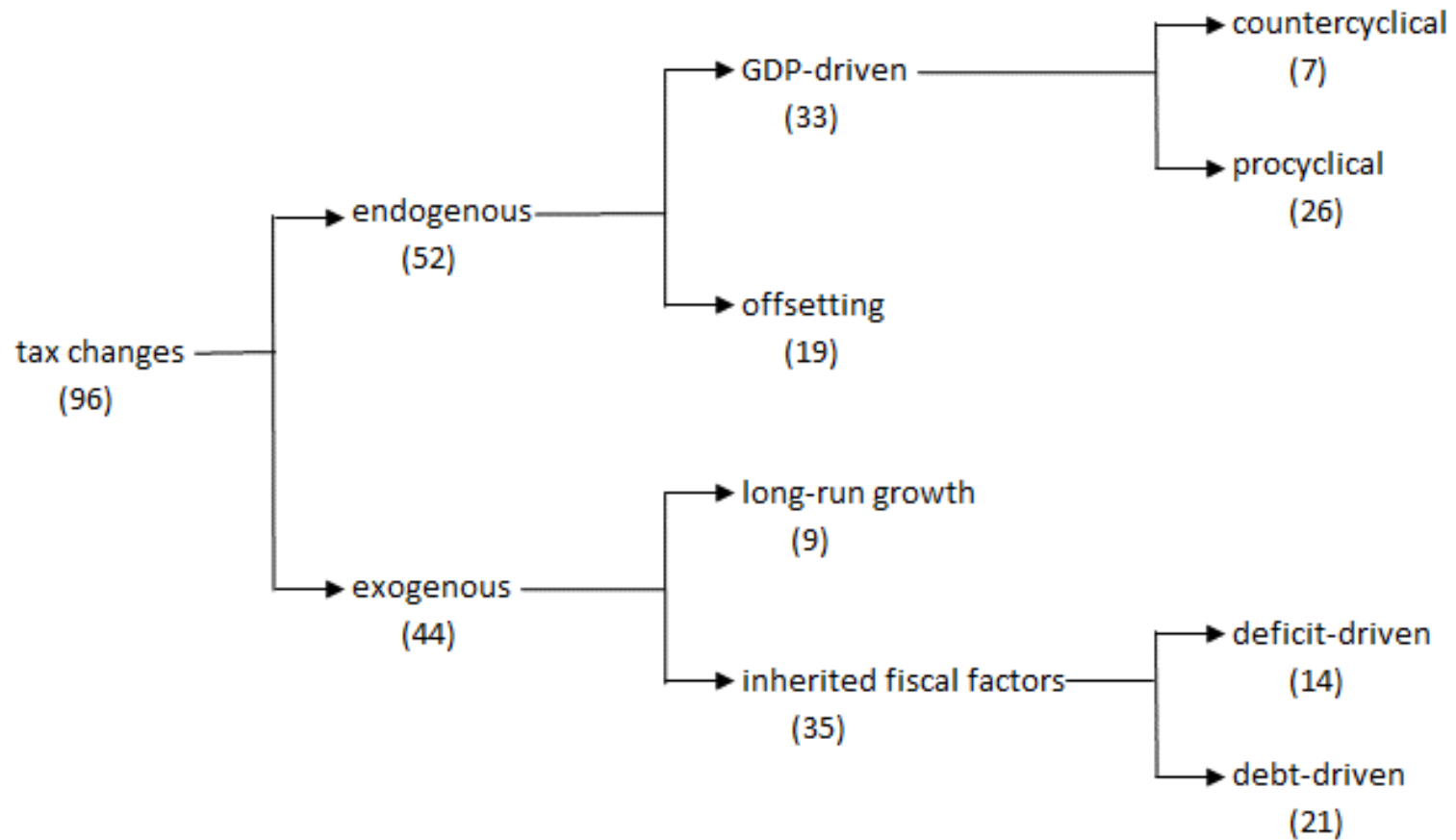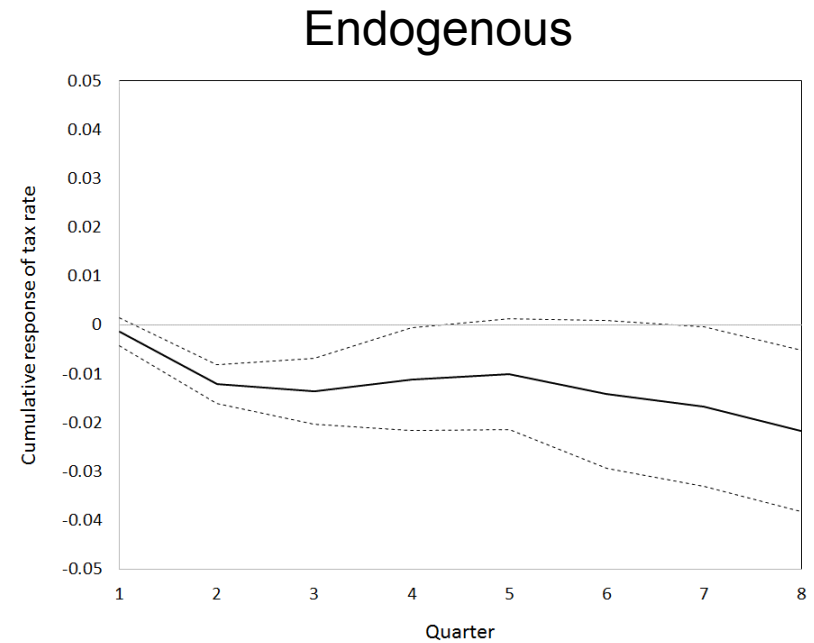
Tax changes: Identifying motivation

Tax changes: Identifying motivation

- **Validation of our narrative approach**

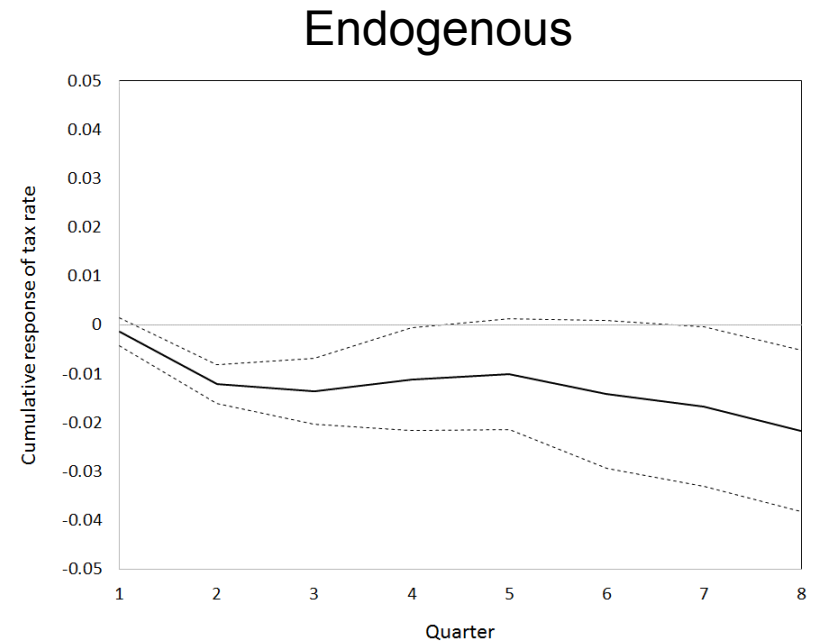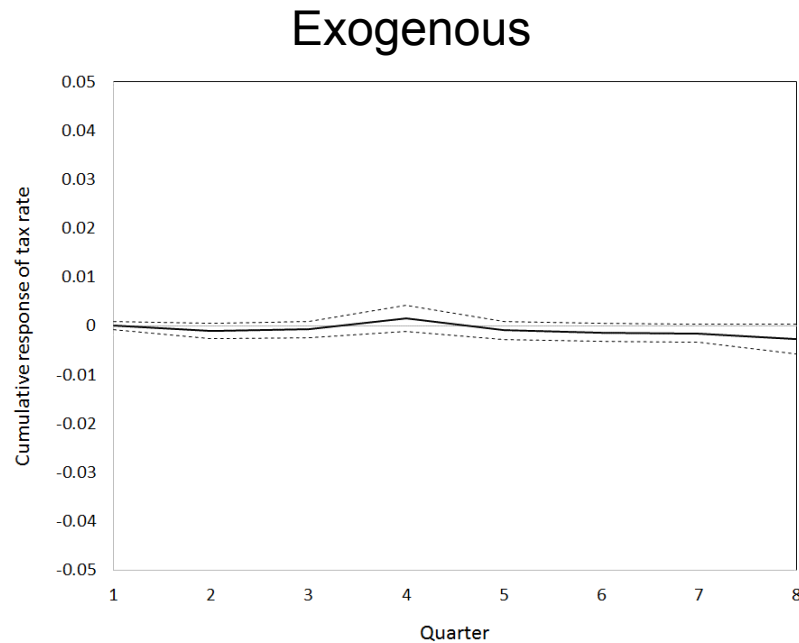 What is the response of tax changes to a GDP shock?

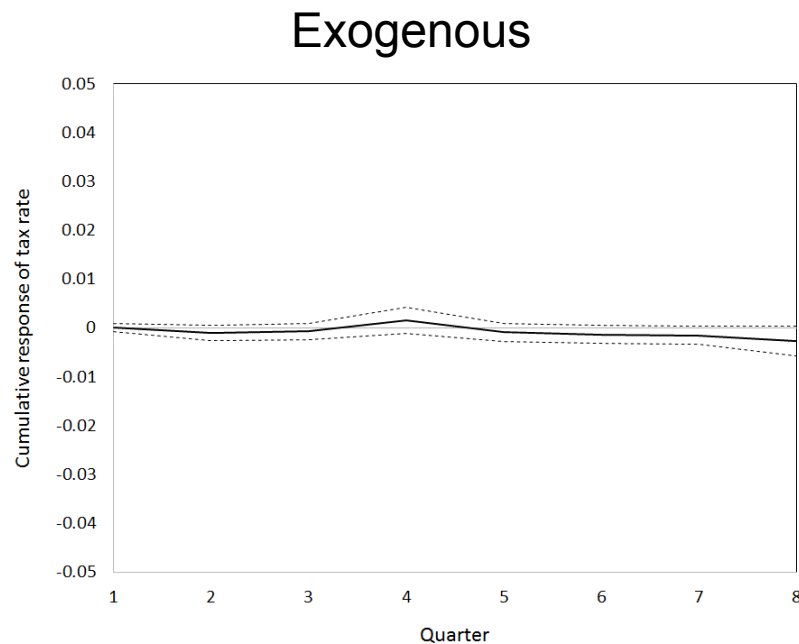| Exogenous	Endogenous

does not respond

Tax changes: Identifying motivation

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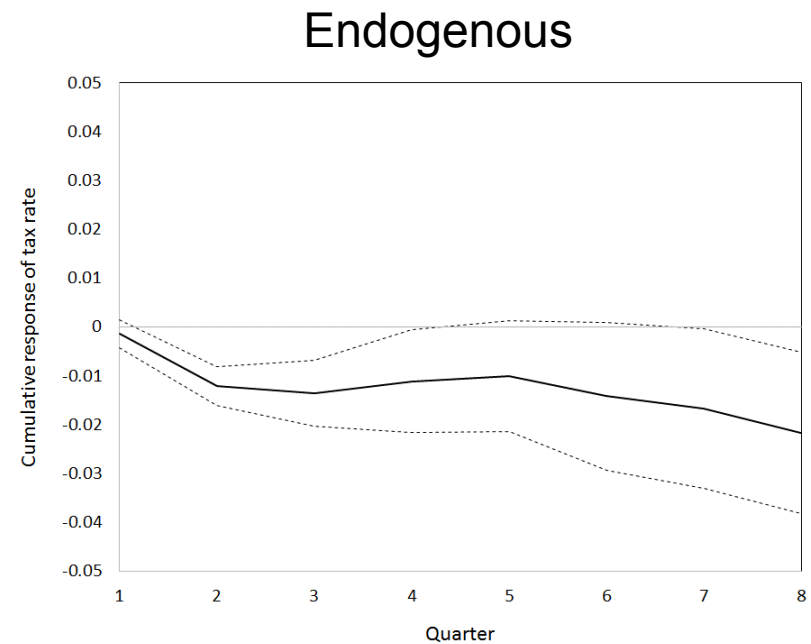Exogenous | Endogenous

does not respond 🙂

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 😊

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:**

$$\Delta y_{i,t+h} = \alpha_{i,h} + \beta_h \Delta t_{i,t}^{exog} + \lambda_h(L) \Delta y_{i,t-1} + \psi_h(L) \Delta t_{i,t-1}^{all} + \phi_h(L) \Delta g_{i,t-1} +$$
$$+ \varrho_h T_h + \upsilon_h T_h^2 + \mu_{i,t,h},$$

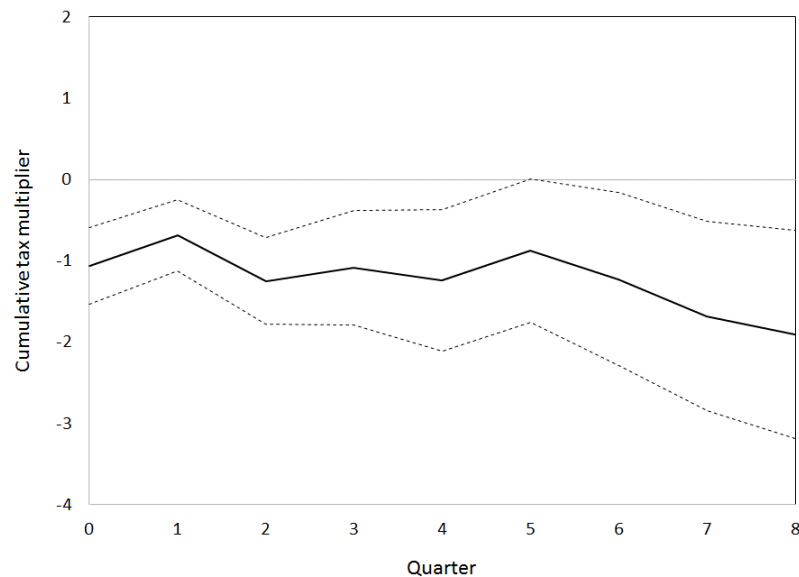- Second, we use β_h to compute standard tax multiplier at time horizon h:

$$Tax\ multiplier\ (h) = \frac{\beta_h}{e + \beta_h \cdot \overline{I}} \qquad Tax\ multiplier_{SE}\ (h) = \frac{e}{(e + \beta_h \cdot \overline{I})^2} \beta_h^{SE}$$

where I=R/Y and e=I/t.

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

■ **Main findings:**
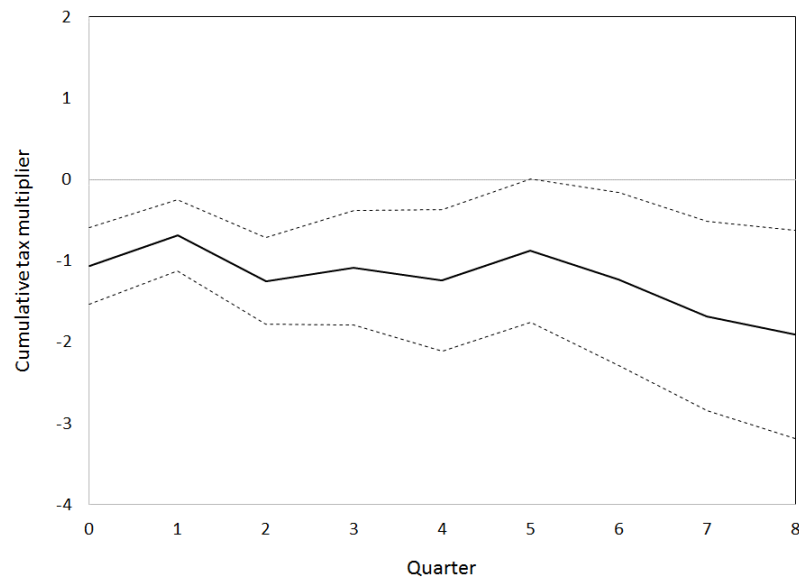
Using _exogenous_ tax rate changes

LR multiplier (exog.) = -1.7

Linear effect of tax changes on output: Estimations and biases due to misidentifications
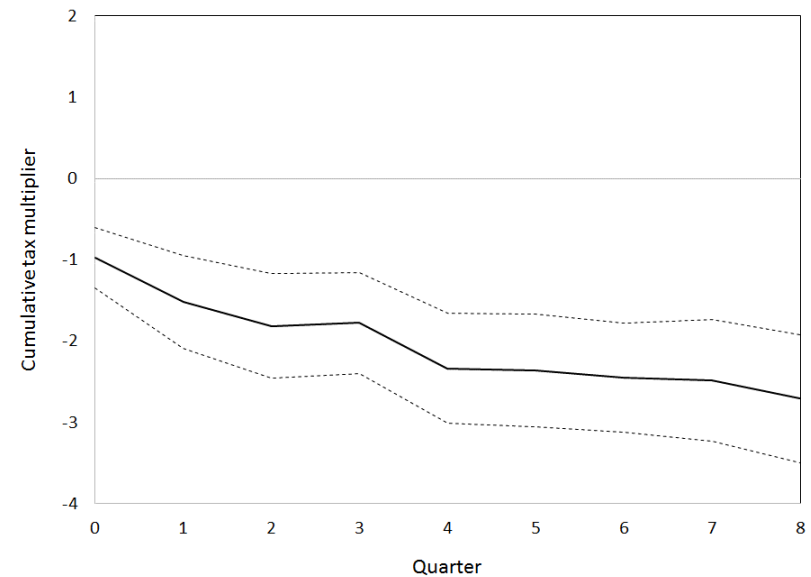
- **Main findings:**

Using _exogenous_ tax rate changes

Using _all_ tax rate changes
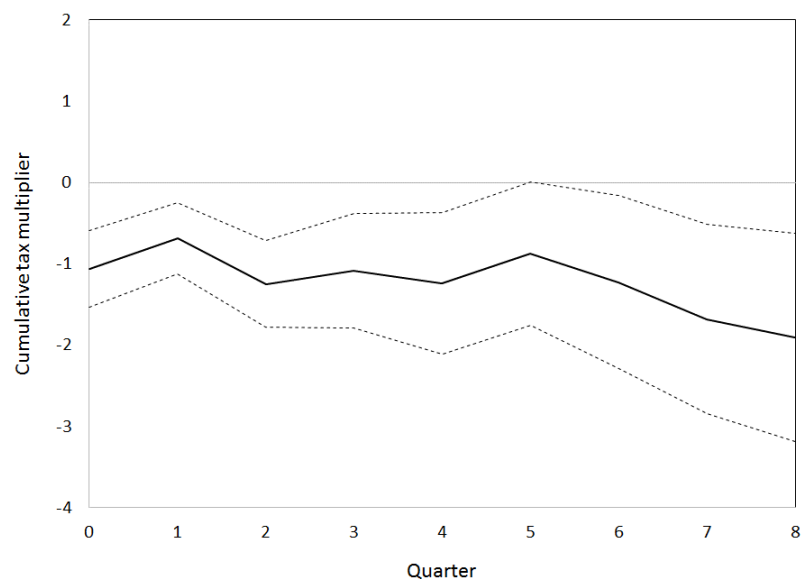

LR multiplier (exog.) = -1.7

LR multiplier (all) = -2.5

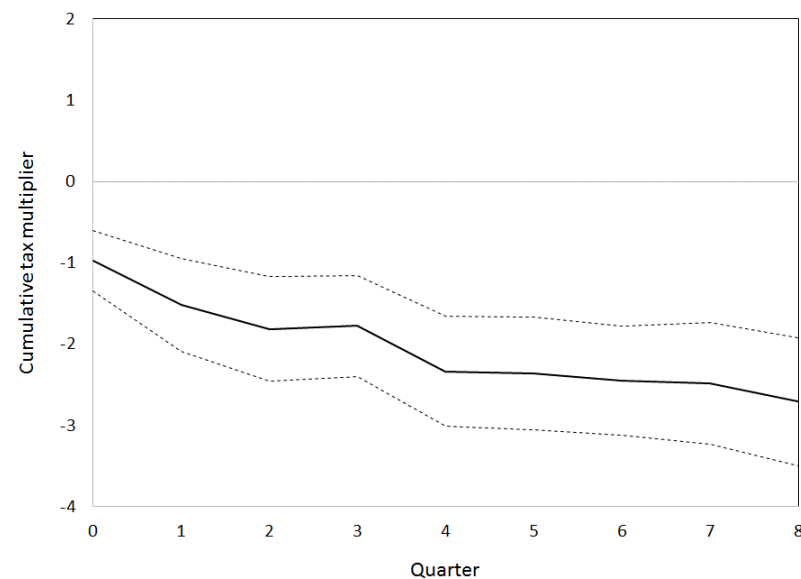# Linear effect of tax changes on output: Estimations and biases due to misidentifications

- **Main findings:**

Using _exogenous_ tax rate changes

Using _all_ tax rate changes

LR multiplier (exog.) = -1.7

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About 50% difference

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

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Using _exogenous_ tax rate changes

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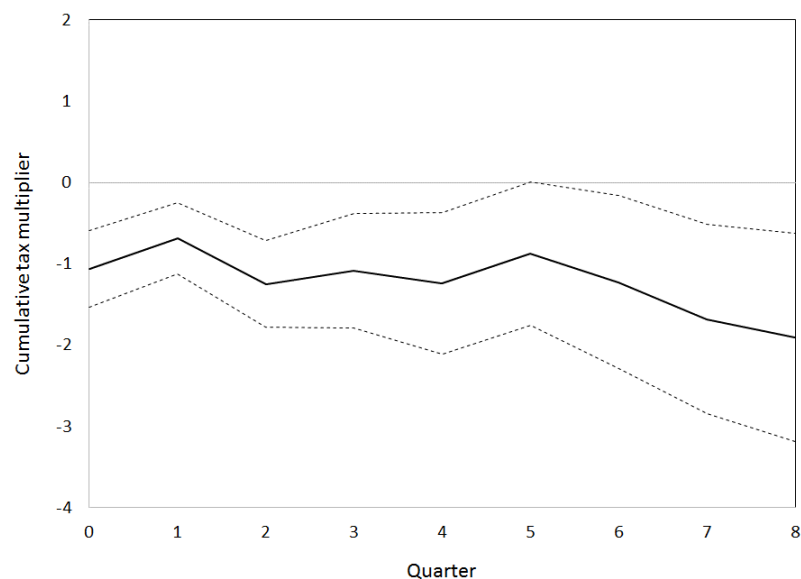
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Why?

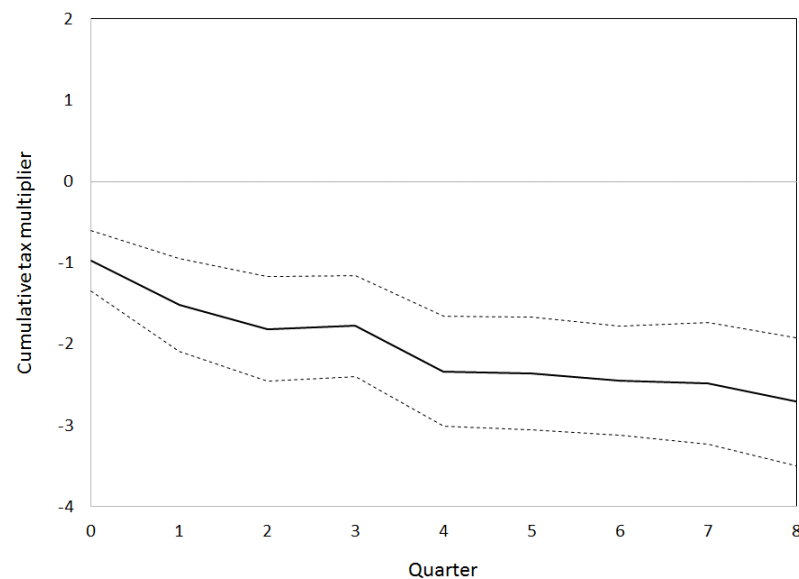# Linear effect of tax changes on output: Estimations and biases due to misidentifications

- **Main findings:**

Using _exogenous_ tax rate changes

Using _all_ tax rate changes

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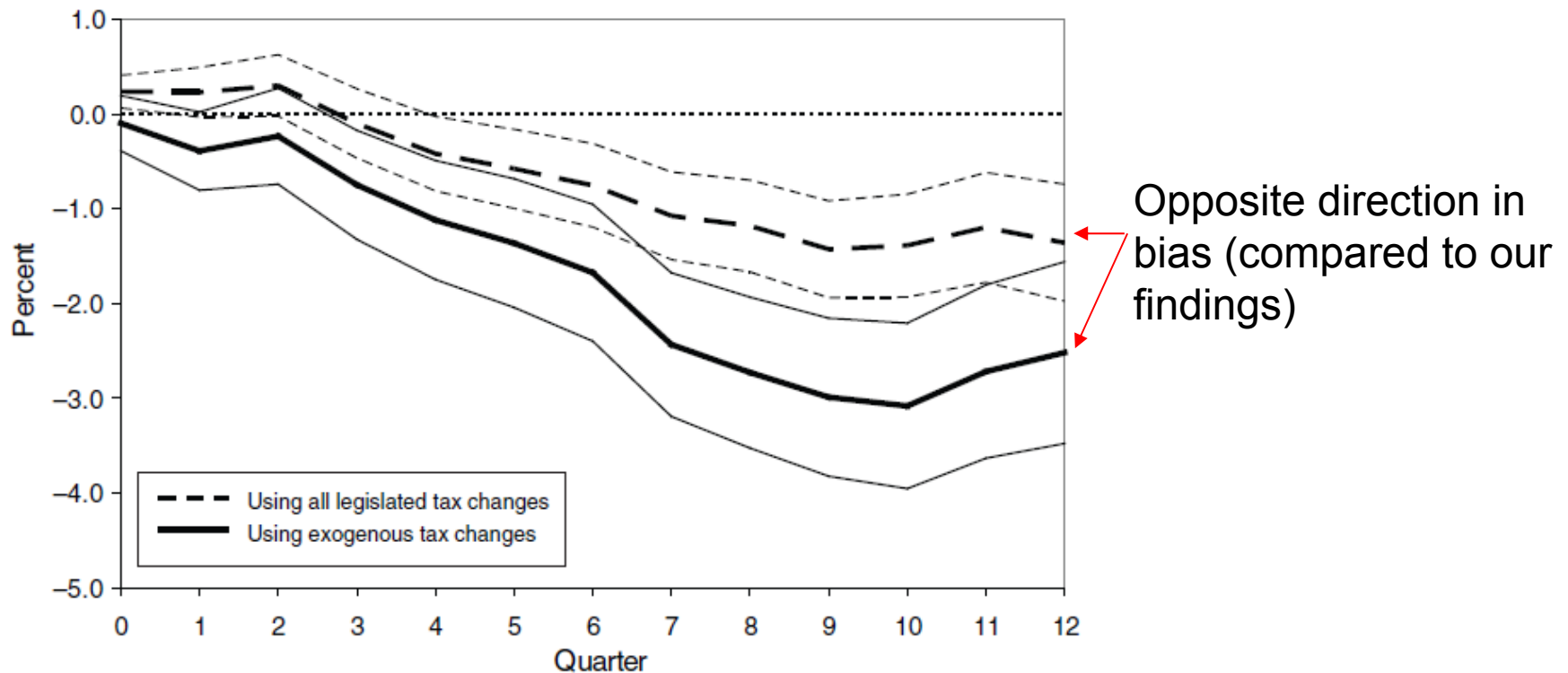LR multiplier (all) = -2.5

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**

Opposite direction in bias (compared to our findings)

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

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

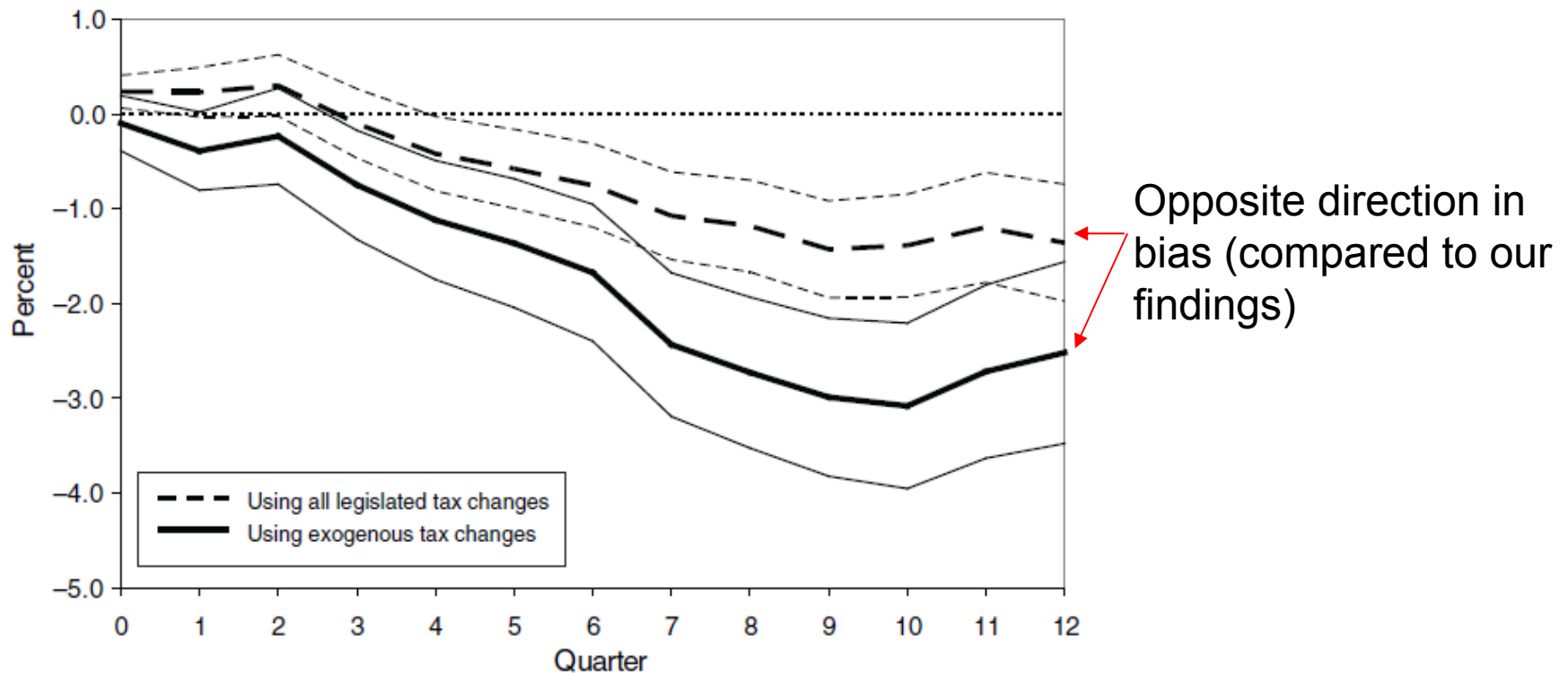Opposite direction in bias (compared to our findings)

Why?

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

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

Opposite direction in bias (compared to our findings)

Legend:
- - - Using all legislated tax changes
— Using exogenous tax changes
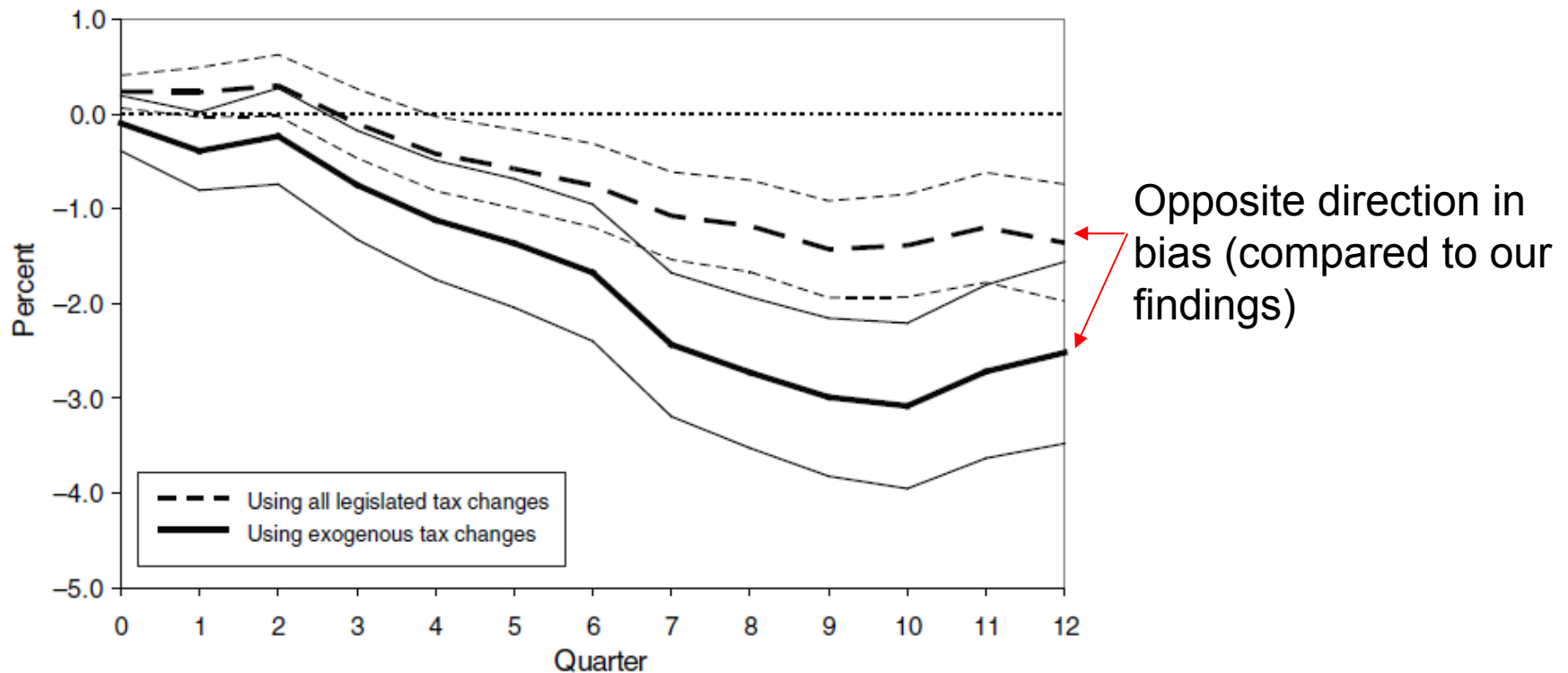
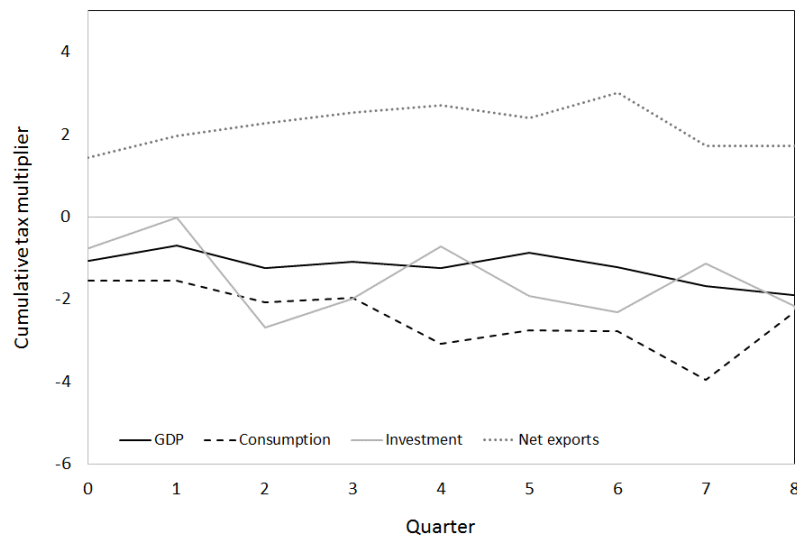Why? Because of average *counter-cyclical* nature of endogenous tax changes
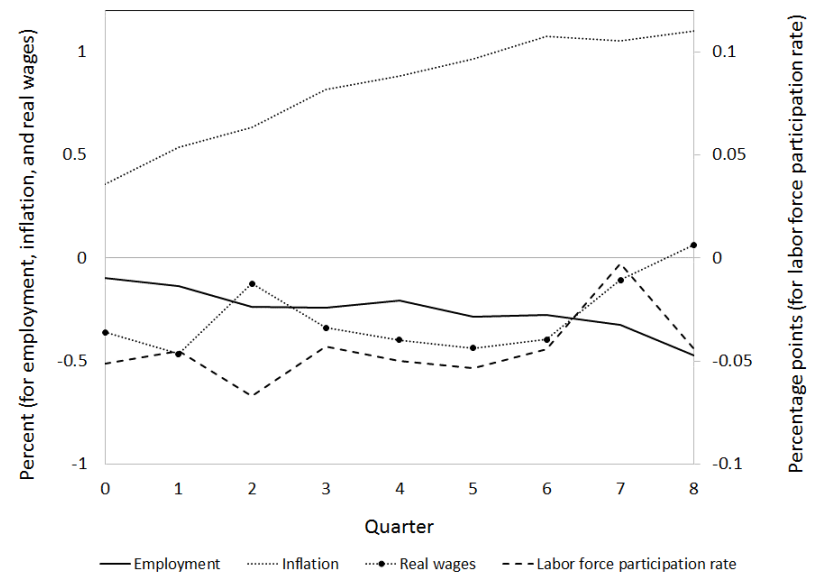
Linear effect of tax changes on output: Transmission mechanism

- **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

OUTLINE

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-stablished 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**

$$
\begin{aligned}
\Delta y_{i,t+h} =\ & \alpha_{i,h} + \beta_h \Delta t_{i,t}^{exog} + \delta_h \left[\Delta t_{i,t}^{exog} \cdot t_{i,t-1}^{all} \right] + \gamma_h t_{i,t-1}^{all} + \psi_h(L)\Delta t_{i,t-1}^{all} + \\
& + \lambda_h(L)\Delta y_{i,t-1} + \phi_h(L)\Delta g_{i,t-1} + \varrho_h T_h + \upsilon_h T_h^2 + \mu_{i,t,h},
\end{aligned}
$$

The non-linear effect of tax changes on output: Evidence

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$$\Delta y_{i,t+h} = \alpha_{i,h} + \beta_h \Delta t_{i,t}^{exog} + \delta_h \left[\Delta t_{i,t}^{exog} \cdot t_{i,t-1}^{all} \right] + \gamma_h t_{i,t-1}^{all} + \psi_h(L)\Delta t_{i,t-1}^{all} +$$
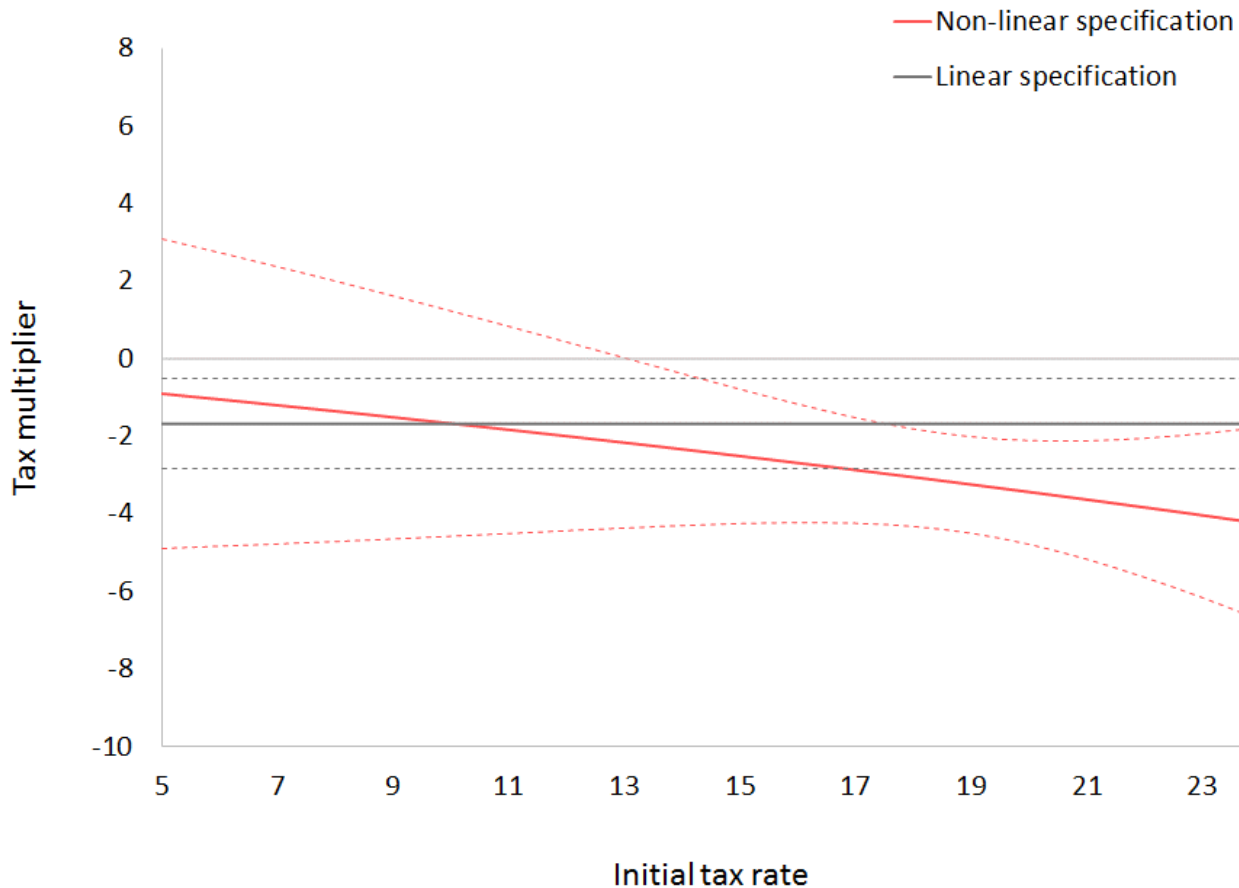$$+\lambda_h(L)\Delta y_{i,t-1} + \phi_h(L)\Delta g_{i,t-1} + \varrho_h T_h + \upsilon_h T_h^2 + \mu_{i,t,h},$$

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)**
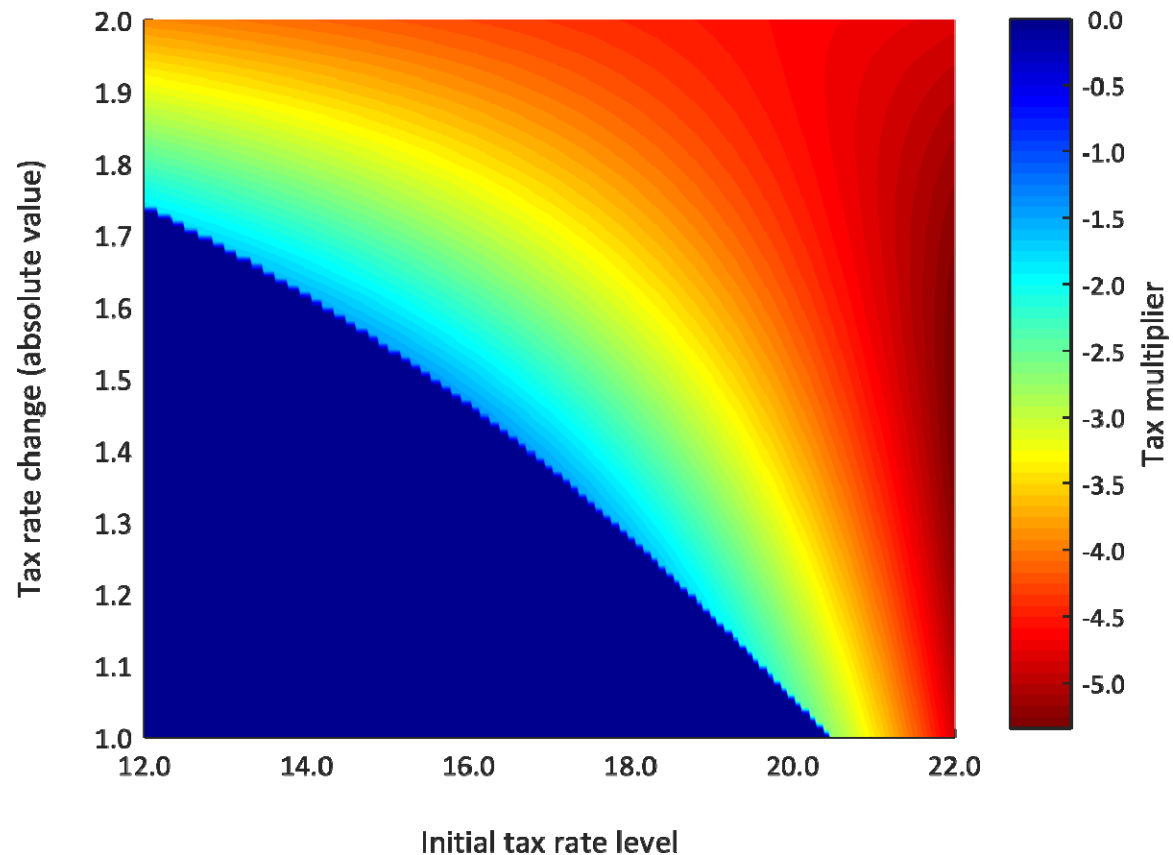
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Non-linearities in action I: Explaining differential effect of tax changes

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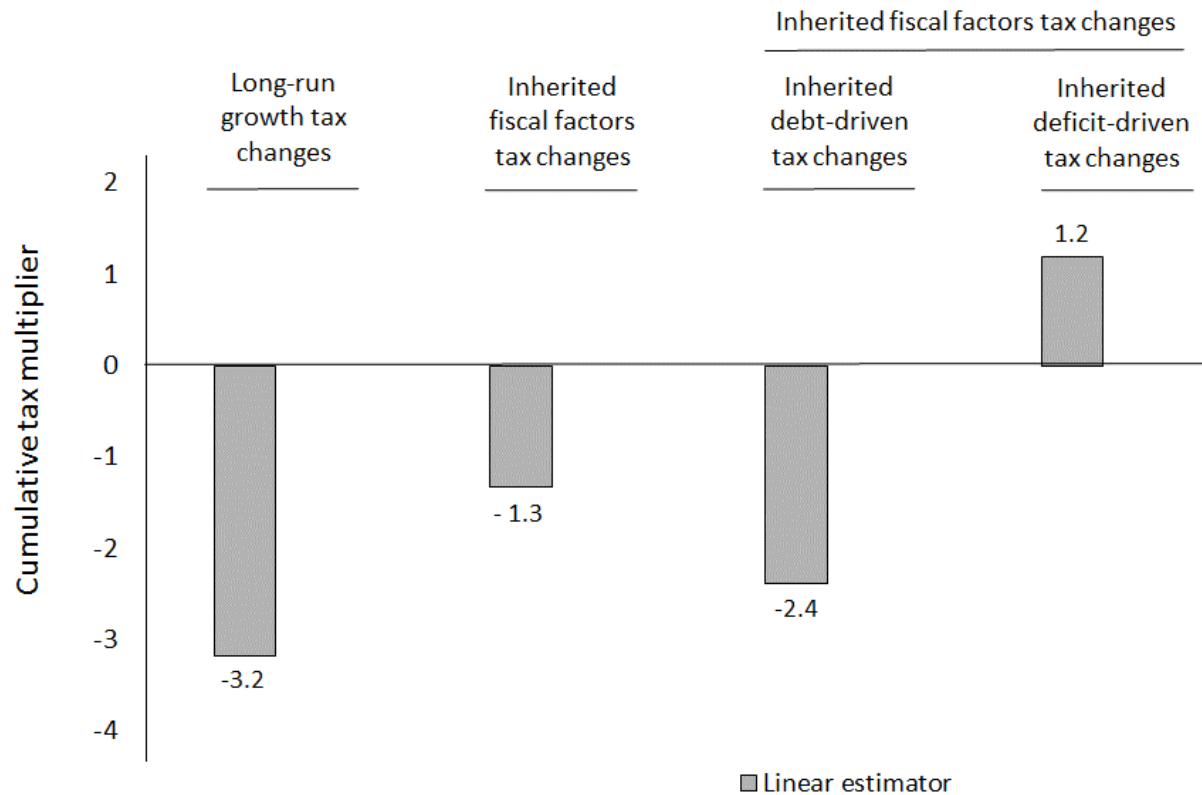
Non-linearities in action I: Explaining differential effect of tax changes

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

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

	Long-run growth	Inherited fiscal factors	Difference
	(1)	(2)	(1) - (2)
Initial tax rate	21	19	2**
Size of tax change	1	1	0

Long-run changes have <u>higher initial tax rates</u> than inherited fiscal factors

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

	Debt-driven	Deficit-driven	Difference
	(1)	(2)	(1) - (2)
Initial tax rate	19	18.5	0.5
Size of tax change	2	1	1**

Debt-driven changes have <u>larger size of tax changes</u> 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?
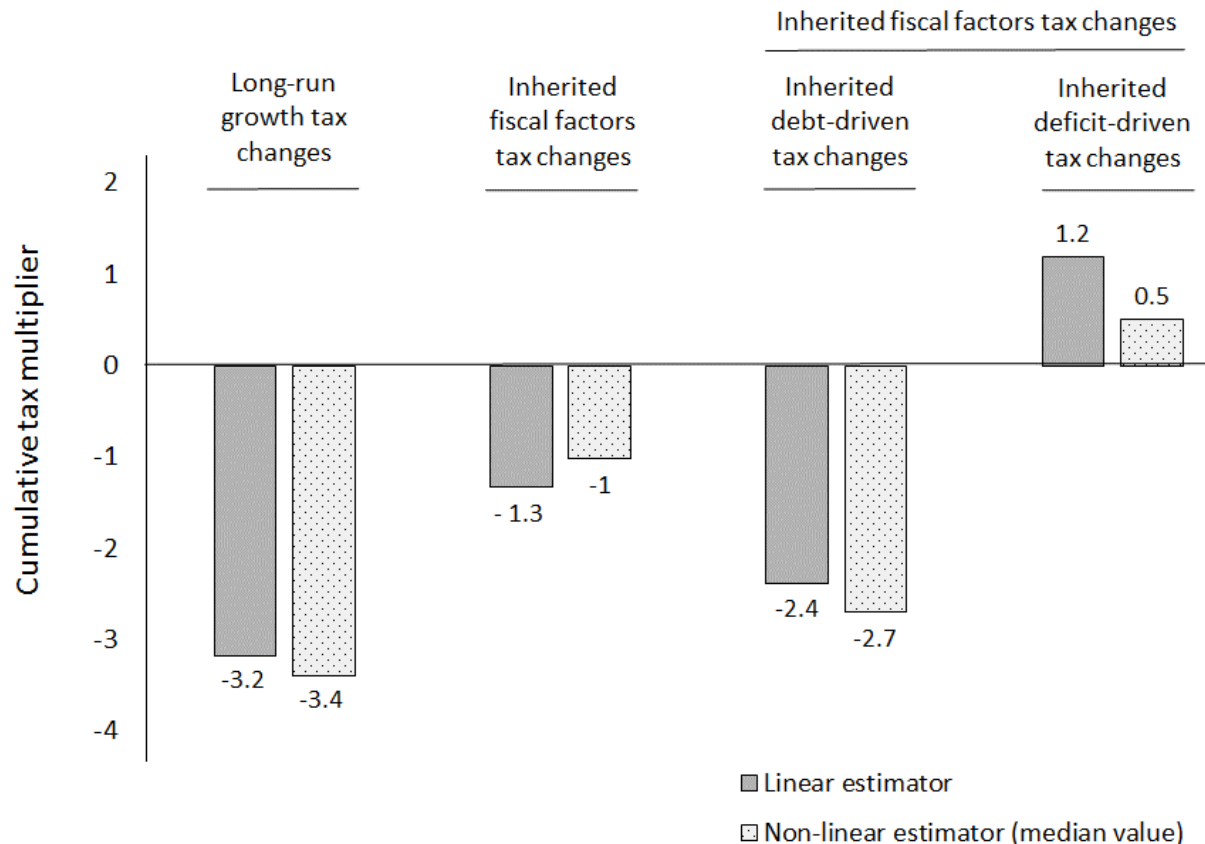
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Non-linearities in action II:
How do taxes on *perceptions* on incentives to work and invest?

- **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?

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VAT rate and incentives to work
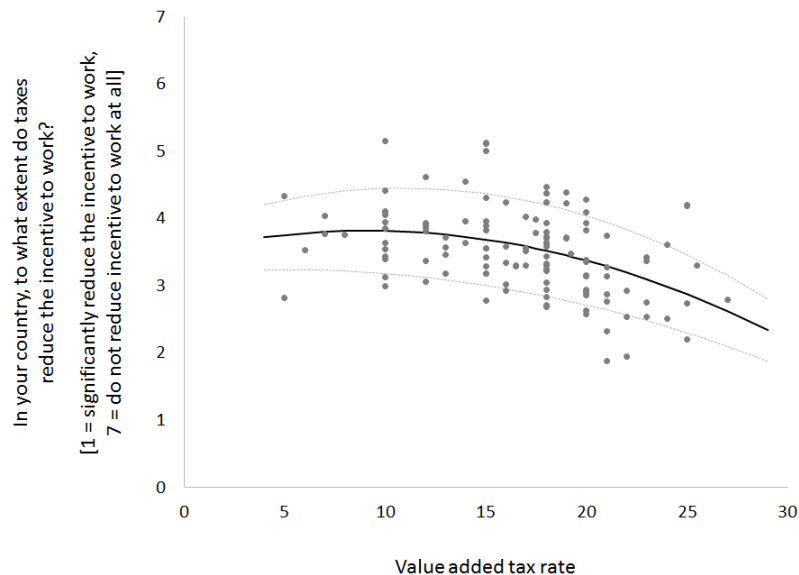
VAT rate and incentives to invest
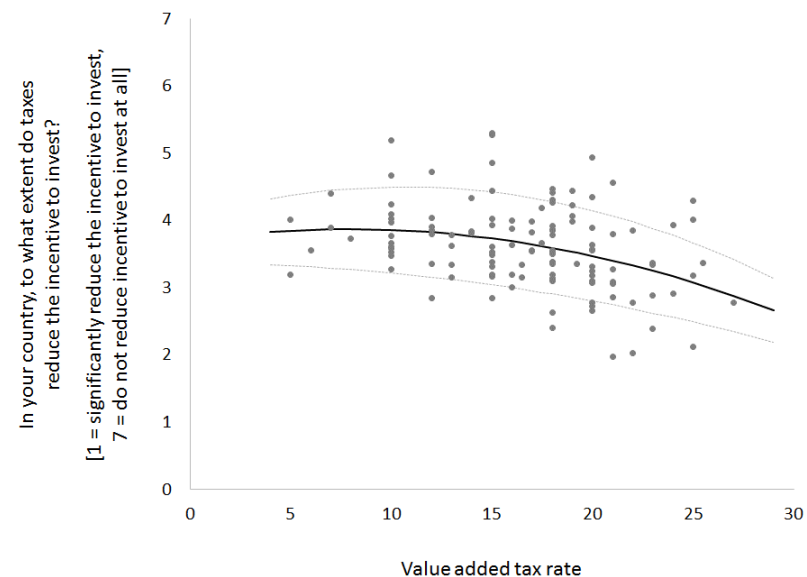
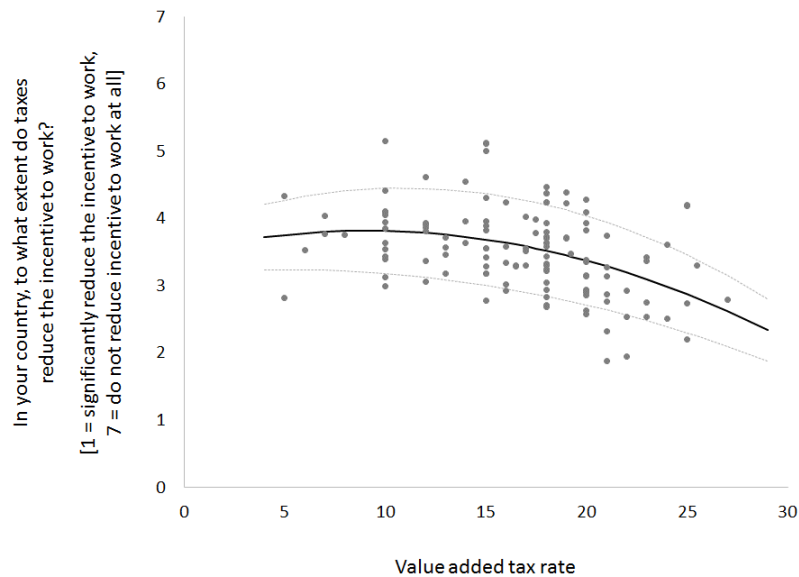Evidence regarding the perceived effect of taxes on incentives to work and invest are, indeed, highly non-linear

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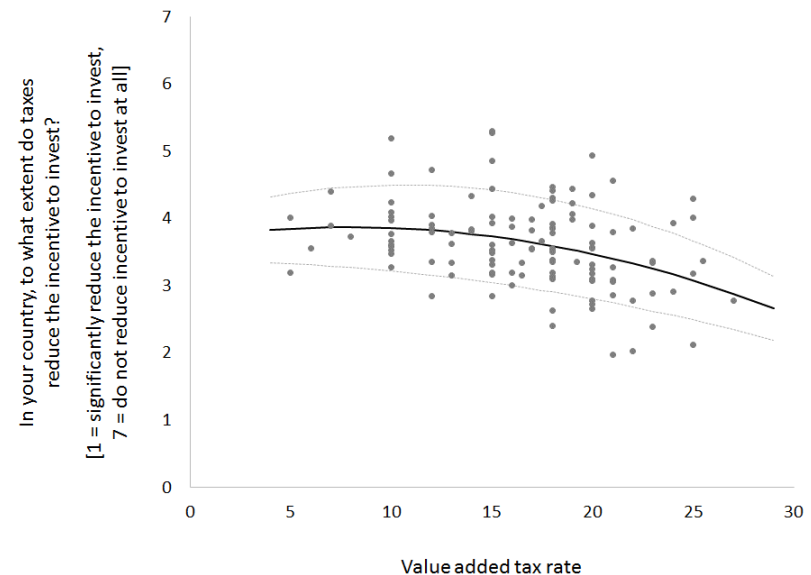
5. Non-linearities in action III

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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 2003.

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.

Peru's Fiscal Council, 2018 [x]

Peru's Fiscal Council, 2018 [x]

Bancolombia, 2016 [x]

Pereira and Wemans, 2013 [x]

Gil, et al., 2017 [xx]

Cumulative tax multiplier

0
-1
-2
-3
-4
-5
-6

□ Linear estimator from external source

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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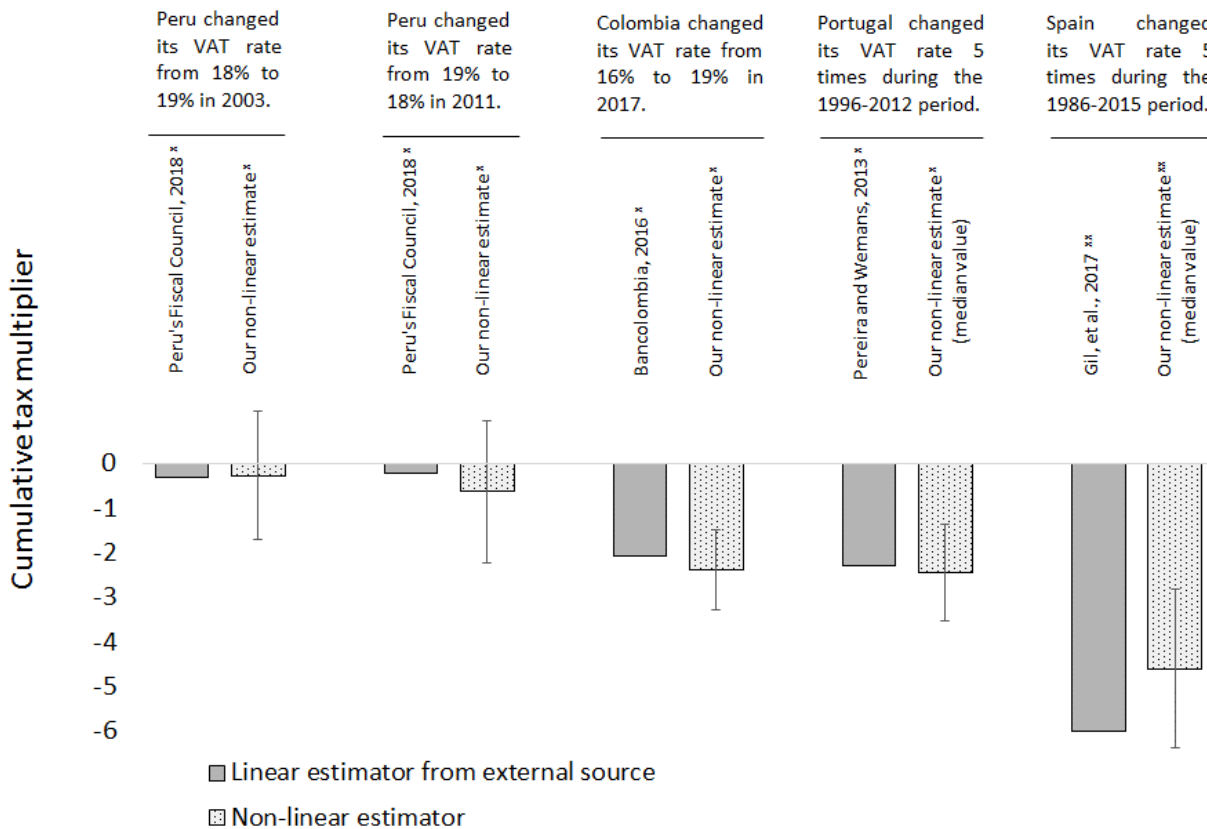
5. Non-linearities in action IV

6. Final thoughts

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

ΔCAR = 1.1*** - 0.08*** VAT rate

$R^2 = 0.23$

Expected change in cyclically adjusted revenues (as percent of GDP) between 2017 and 2018

Value added tax rate
(as of November 2017)

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**

VAT rate 6-13: $\Delta CAR = 0.40^{***}$

VAT rate 14-18: $\Delta CAR = -0.15$

VAT rate 19-27: $\Delta CAR = -0.52^{***}$

$\Delta CAR = 1.1^{***} - 0.08^{***}$ VAT rate

$R^2 = 0.23$

(y-axis) Expected change in cyclically adjusted revenues (as percent of GDP) between 2017 and 2018

(x-axis) Value added tax rate (as of November 2017)
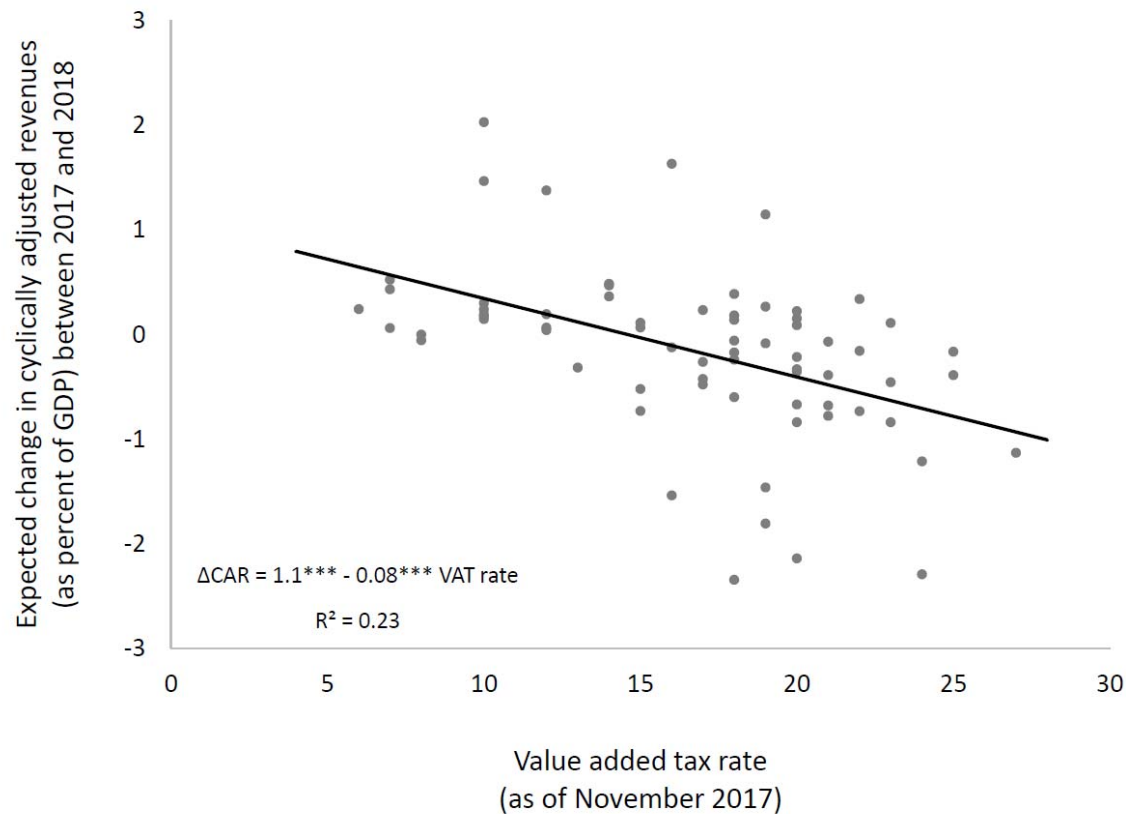
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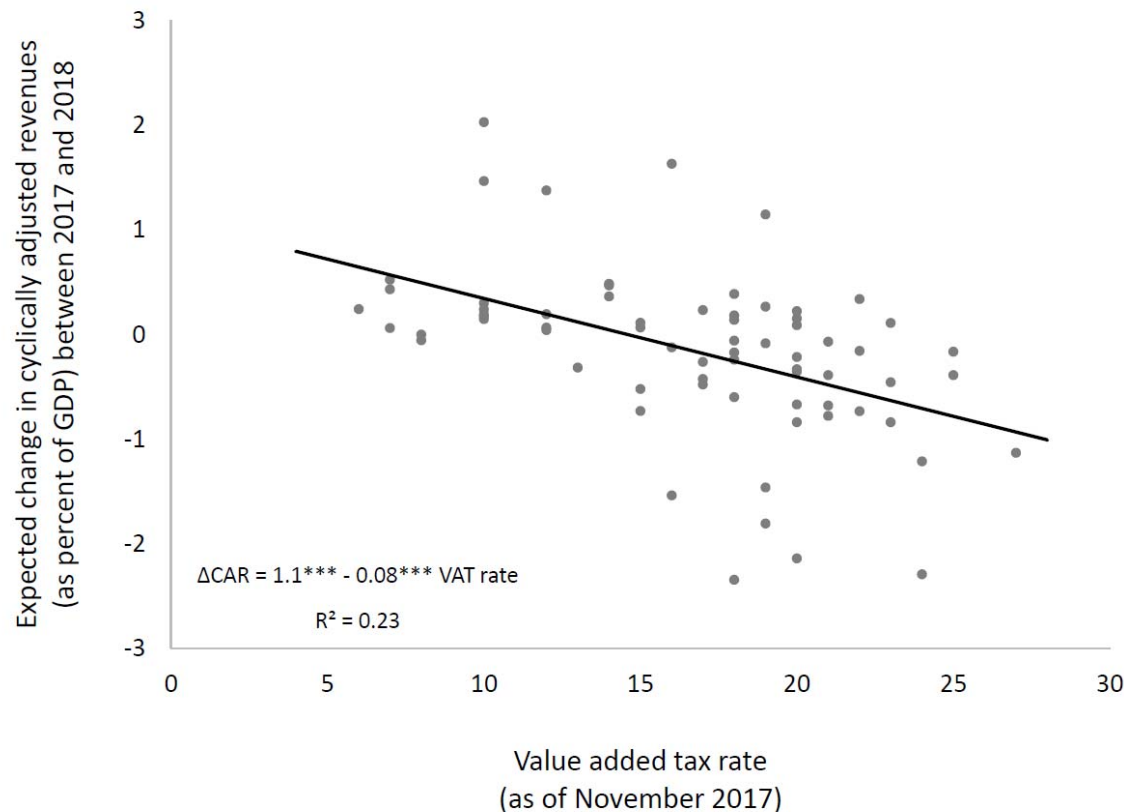

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$R^2 = 0.23$

Expected change in cyclically adjusted revenues (as percent of GDP) between 2017 and 2018

Value added tax rate
(as of November 2017)

Countries with large (small) VAT rates are expected to increase (decrease) their revenue pressure. Countries with moderate levels of VAT do not plan mayor 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**

Tax Multiplier

- 0
- From 0 to -3
- From -3 to -4
- Larger (in absolute value) than -4
- No data

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.

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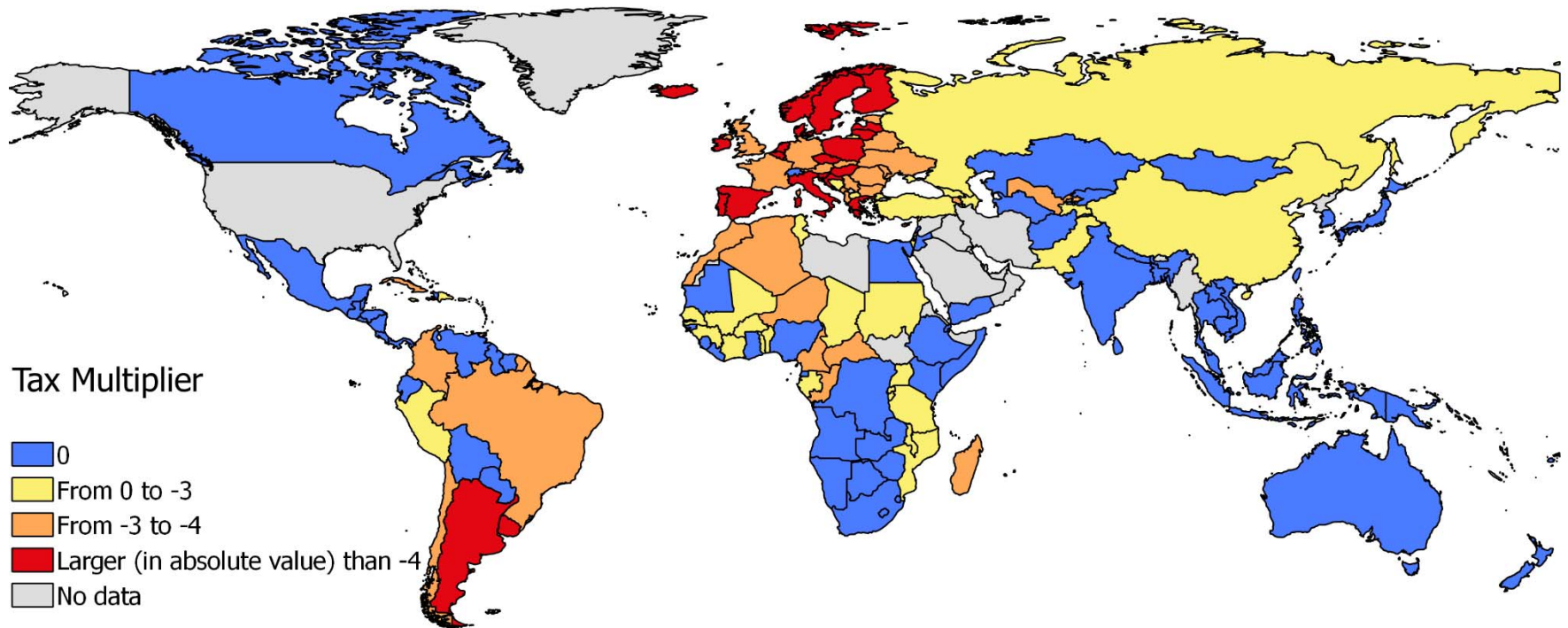
Final thoughts

- **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