Analyzing the Relationship between Personal Income Tax Progressivity and Income Inequality

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Advisor: Professor Yuriy Gorodnichenko

Research Question

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- Do flat taxes statistically significantly affect inequality?
- How do all these effects persist over time?
  - Impulse response functions

Motivation

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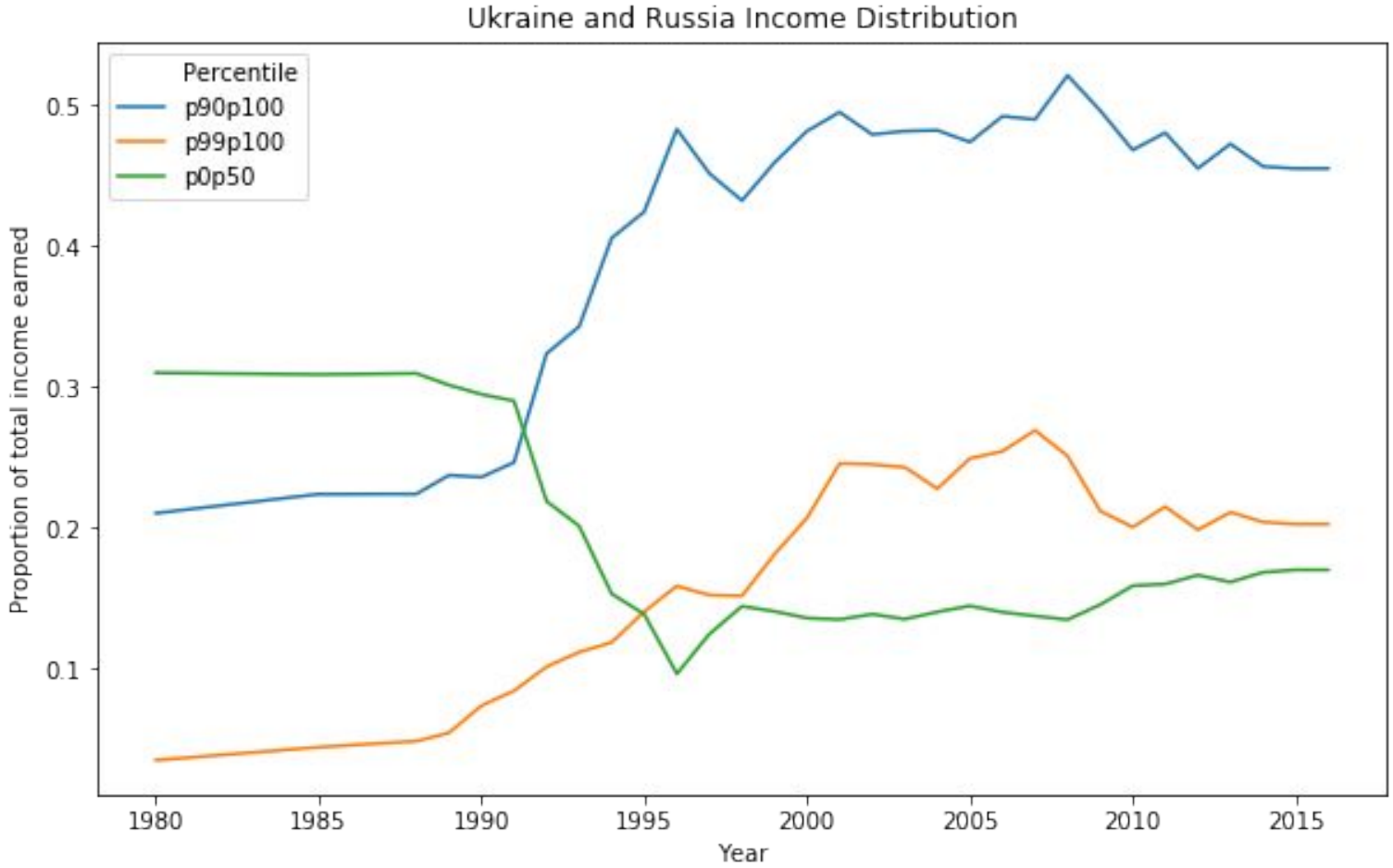
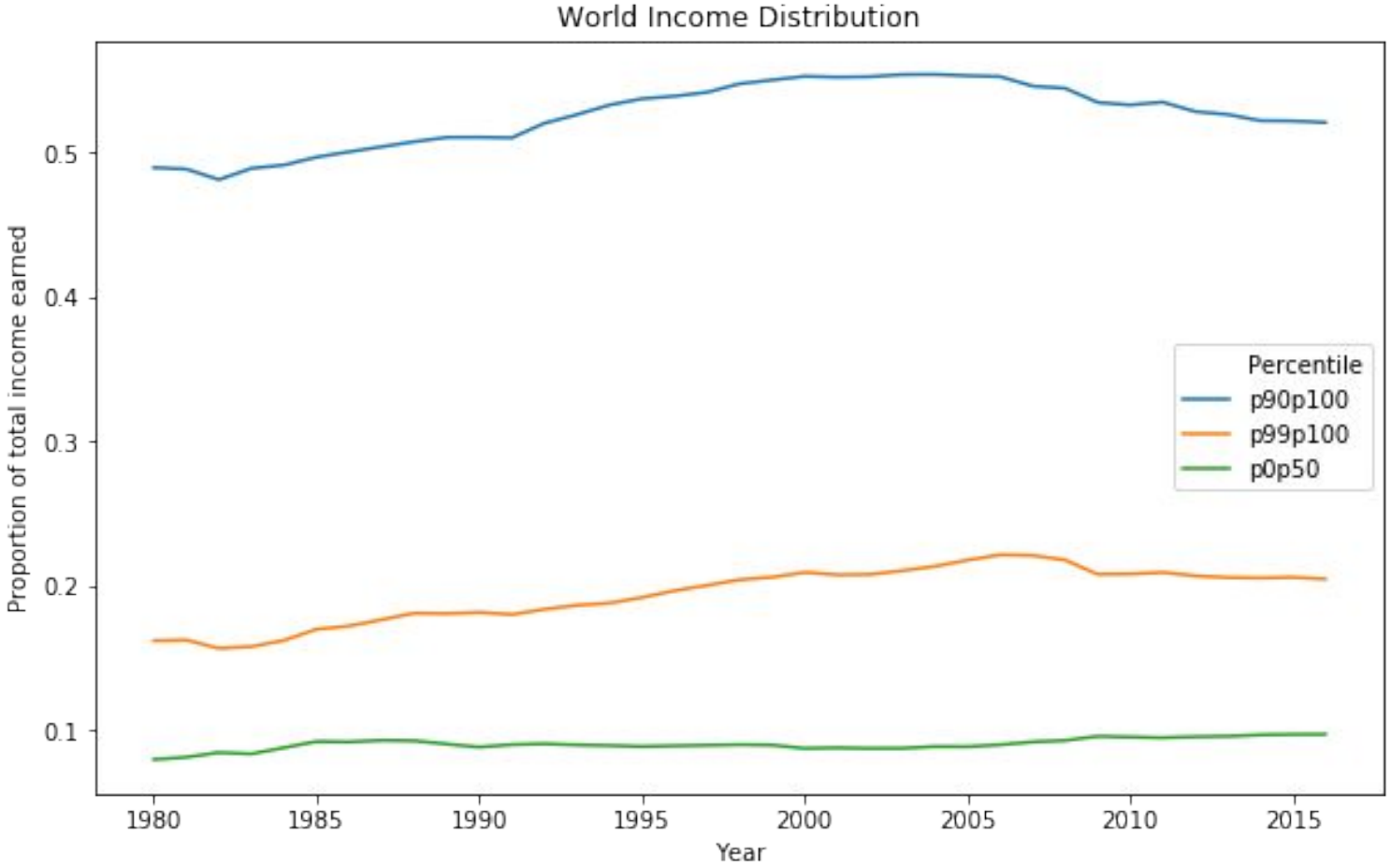
- The net income received by top 1 percent earners has skyrocketed, whereas the proportional income for bottom 50 percent has shrunk to historically low levels.

Motivation


Ukraine and Russia Income Distribution
Percentile
p90p100
p99p100
p0p50
Proportion of total income earned
0.5
0.4
0.3
0.2
0.1
1980
1985
1990
1995
2000
2005
2010
2015
Year

Motivation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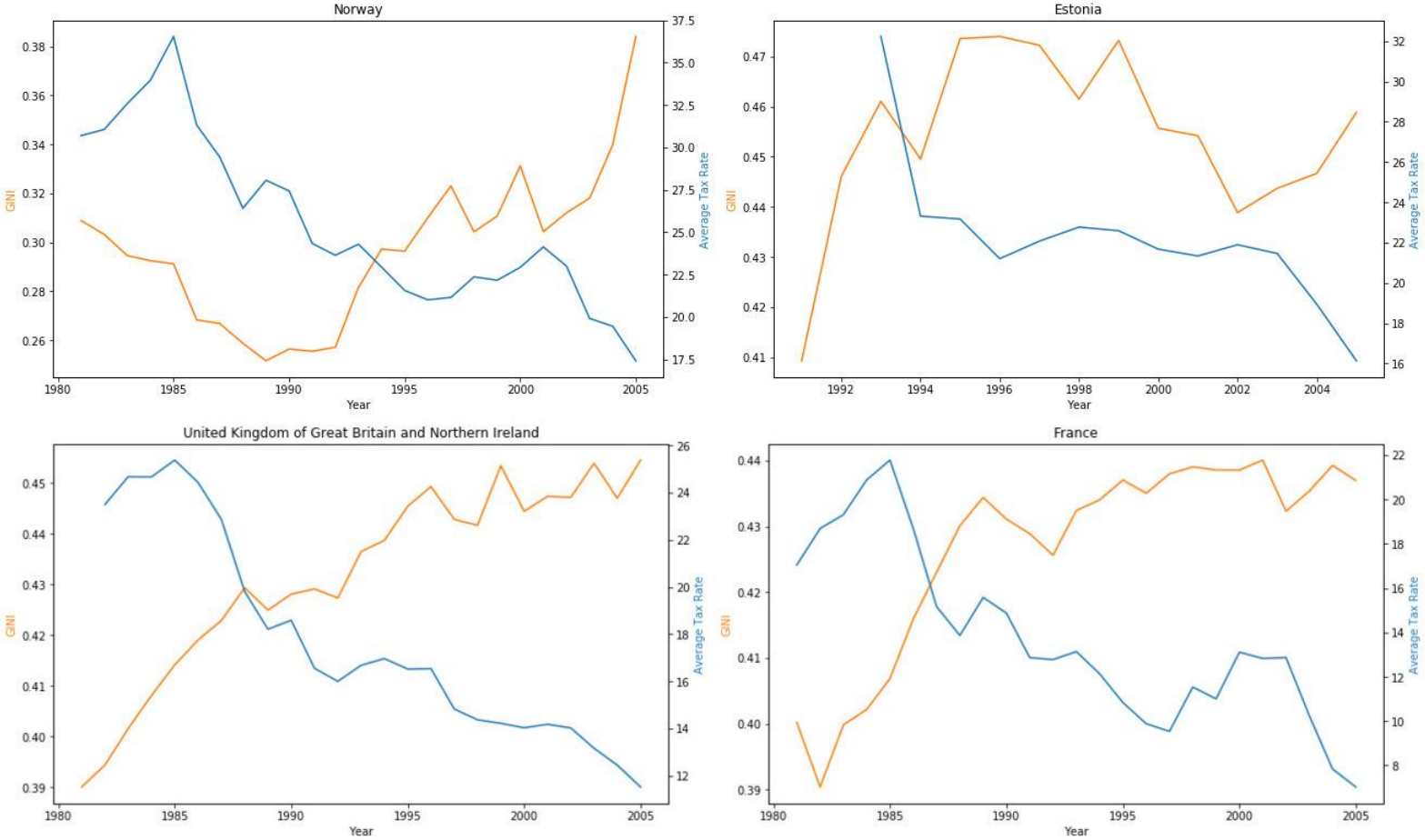
Motivation


Norway
Estonia
United Kingdom of Great Britain and Northern Ireland
France
GNI
Average Tax Rate
Year

Motivation

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  - cities that are far behind these trends and are failing to incorporate technology into manufacturing or other industries (such as Flint, Merced)
  - cities that are somewhere in between.

Challenges

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  - Structural measure: evaluating the capability of the system to redistribute income via tax brackets.
  - Effective measure: looking pre- and post- tax implementation and looking at the actual data to understand to what extent the redistribution was achieved

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- Erroneous data because of shadow economy, tax evasion and income misreporting

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    - Uses marginal and average tax rates' regression coefficients on log-income

Data

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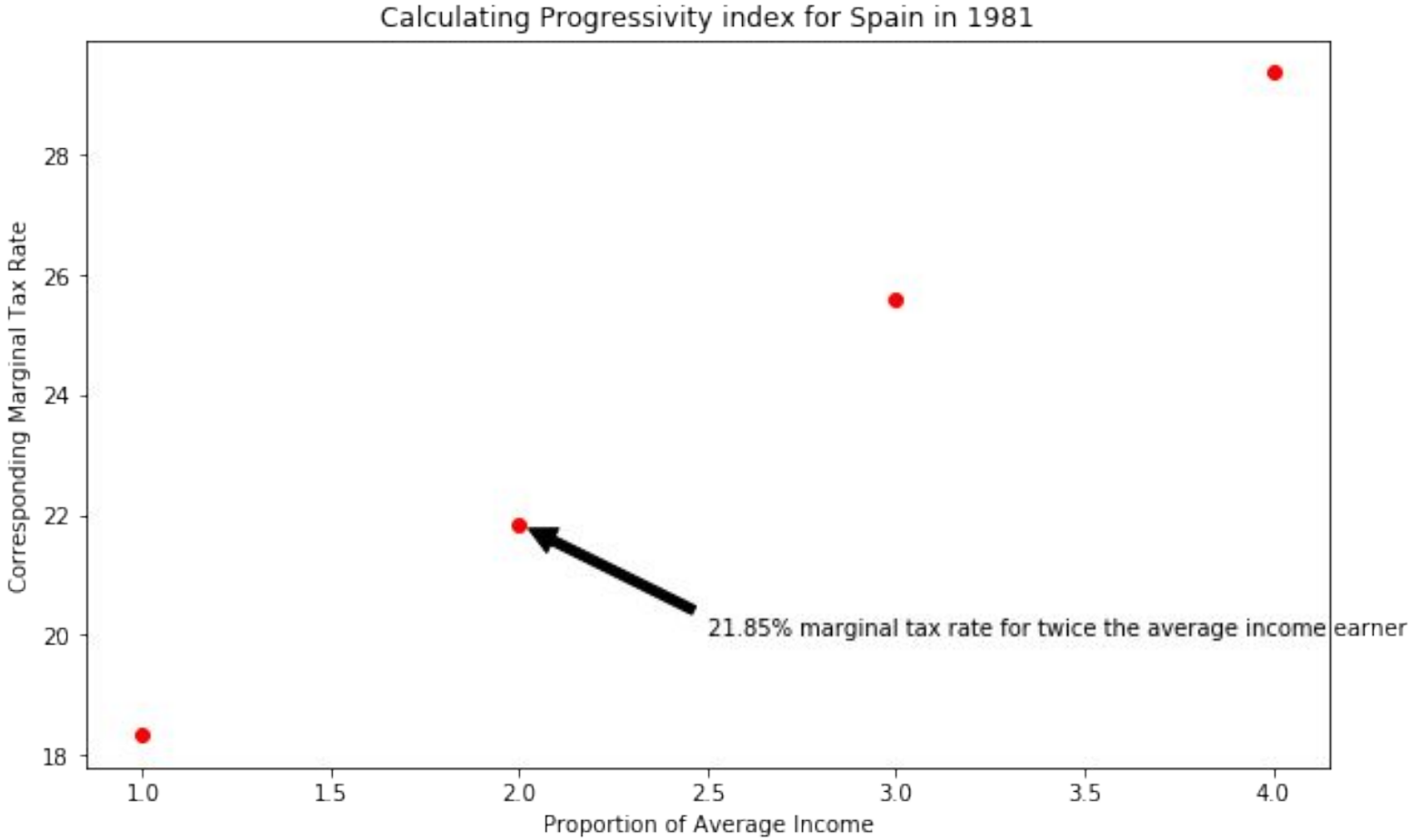
Issue with that: income tax brackets highly vary between countries.

Solution: use marginal tax rates from that dataset to construct a new structural progressivity measure with a standardized approach.

Data


Calculating Progressivity index for Spain in 1981
Corresponding Marginal Tax Rate
Proportion of Average Income
21.85% marginal tax rate for twice the average income earner
18
20
22
24
26
28
1.0
1.5
2.0
2.5
3.0
3.5
4.0

$$MarginalTaxRate_{\alpha,r,t} = \beta_0 + \beta_{1r,t} * StandardizedIncome_{\alpha,r,t} \quad (1)$$

where r is the index for country, t for year, α is the proportion/multiple of average income, $MarginalTaxRate$ is the marginal tax rate equivalent to α multiples of the average income earner. α takes values of 1, 2, 3 and 4 for years 1981-2005 and values 0.67, 1, 1.33 and 1.67 for years 2000-2018.

- Challenge with that?
  - Data available from 1981-2005 from source 1
  - Data available from 2000-2018 from source 2

Data

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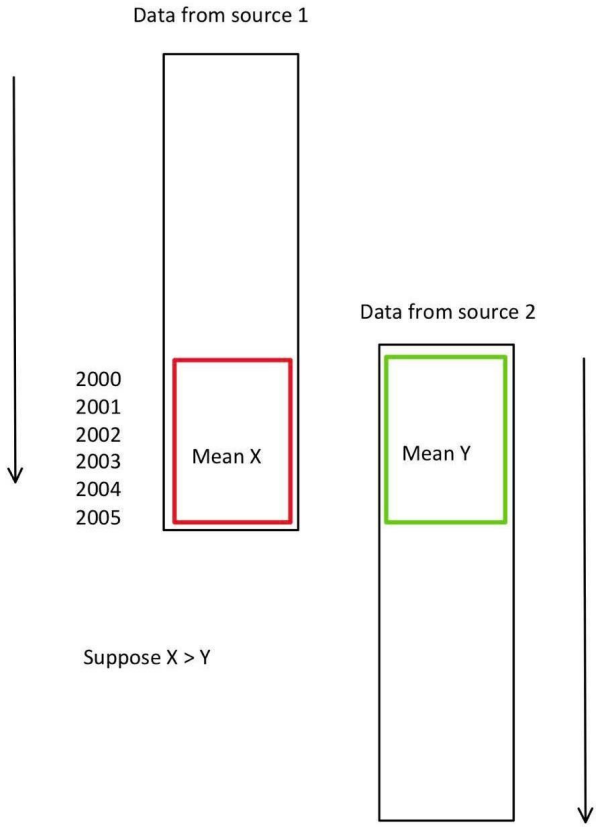
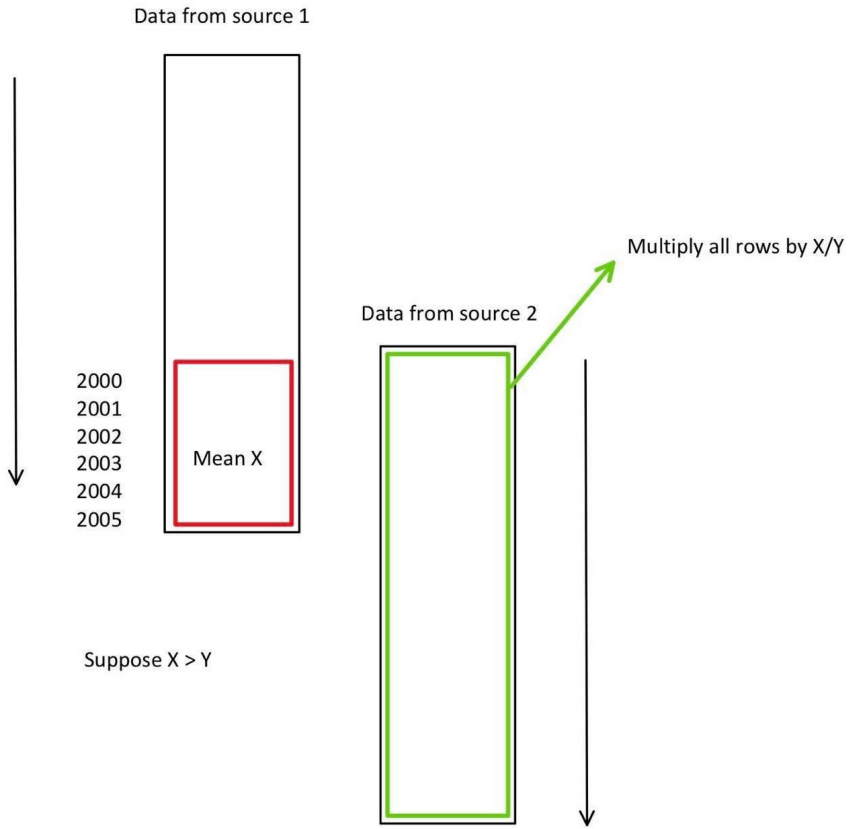
- Solution:
  - Mixed splicing technique

Data


Data from source 1
2000
2001
2002
2003
2004
2005
Mean X
Data from source 2
Mean Y
Suppose X > Y

Data


Data from source 1
2000
2001
2002
2003
2004
2005
Mean X
Suppose X > Y
Data from source 2
Multiply all rows by X/Y

Data

- Sources:

Data

- Sources:
  - OECD Tax Database
  - Michigan World Tax Database
  - Penn World Tables
  - World Inequality Database
  - KPMG

Model

- Independent variable selection

Model

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- Lag of those variables

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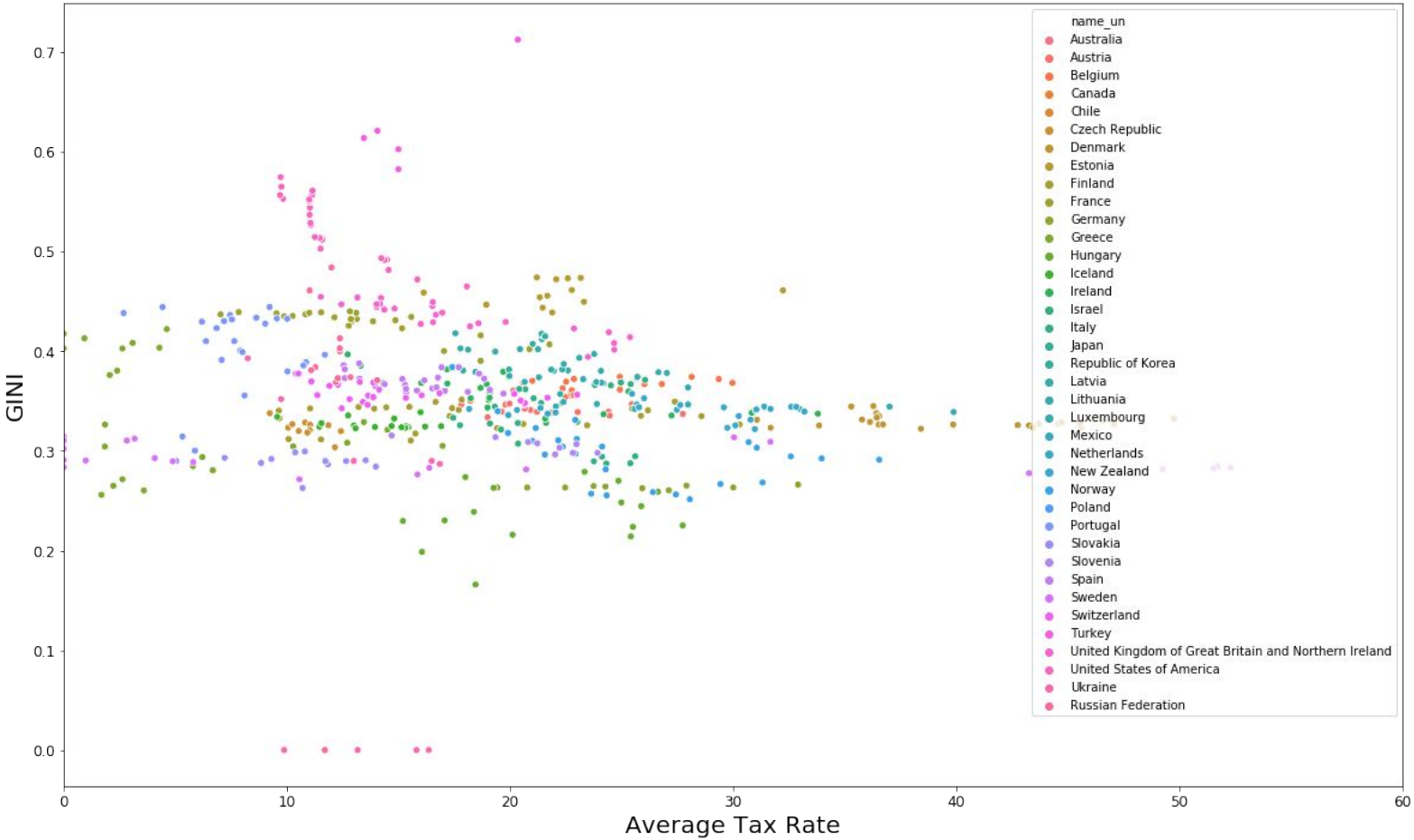
Model

- Independent variable selection

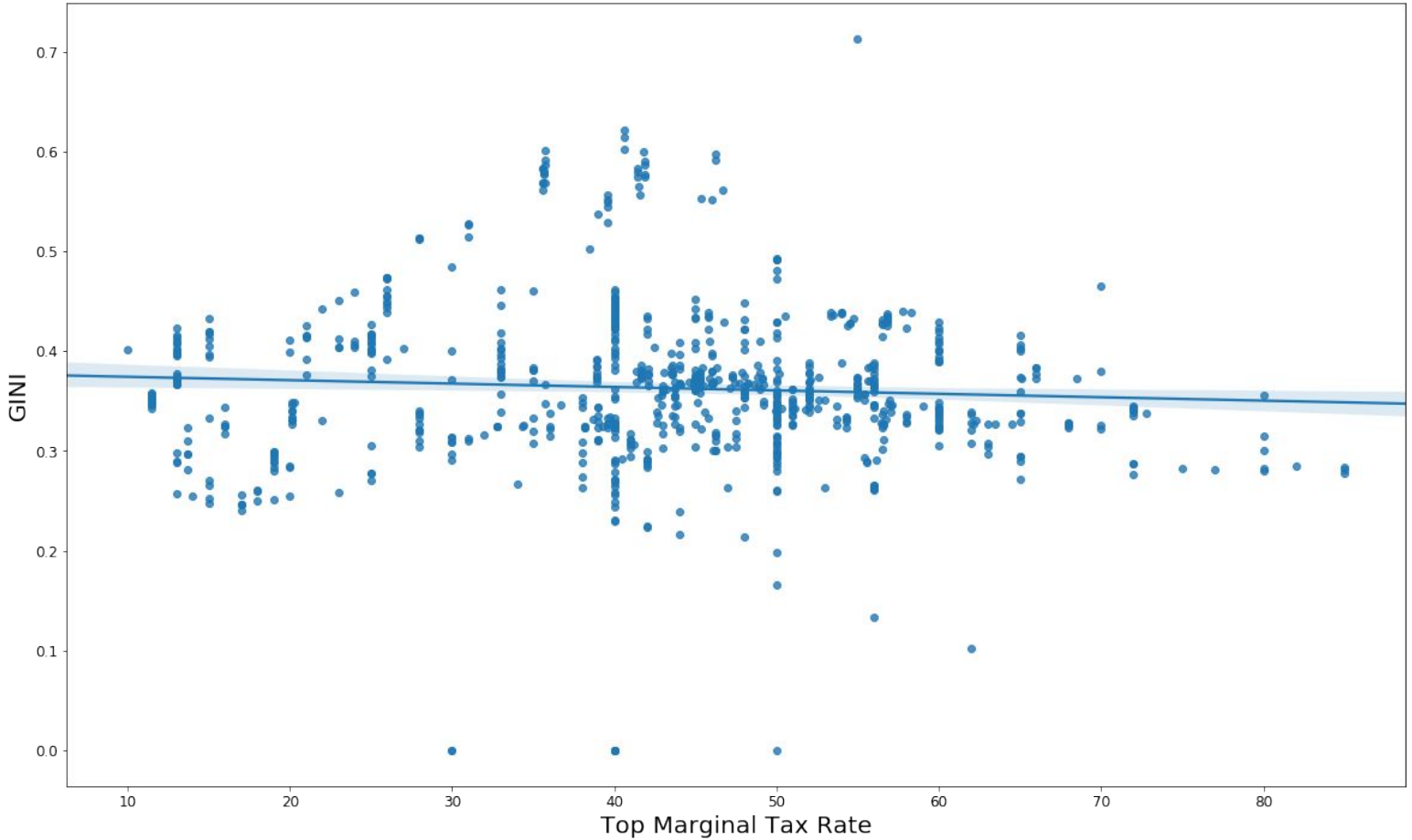
- Lag of those variables
  - To modify for implementation/institutional/time lags of the tax system

- Lag of the dependent variable
  - The current level of GINI almost surely determines the level of GINI tomorrow (the trend is set today)
  - Capture the fluctuations around the trend

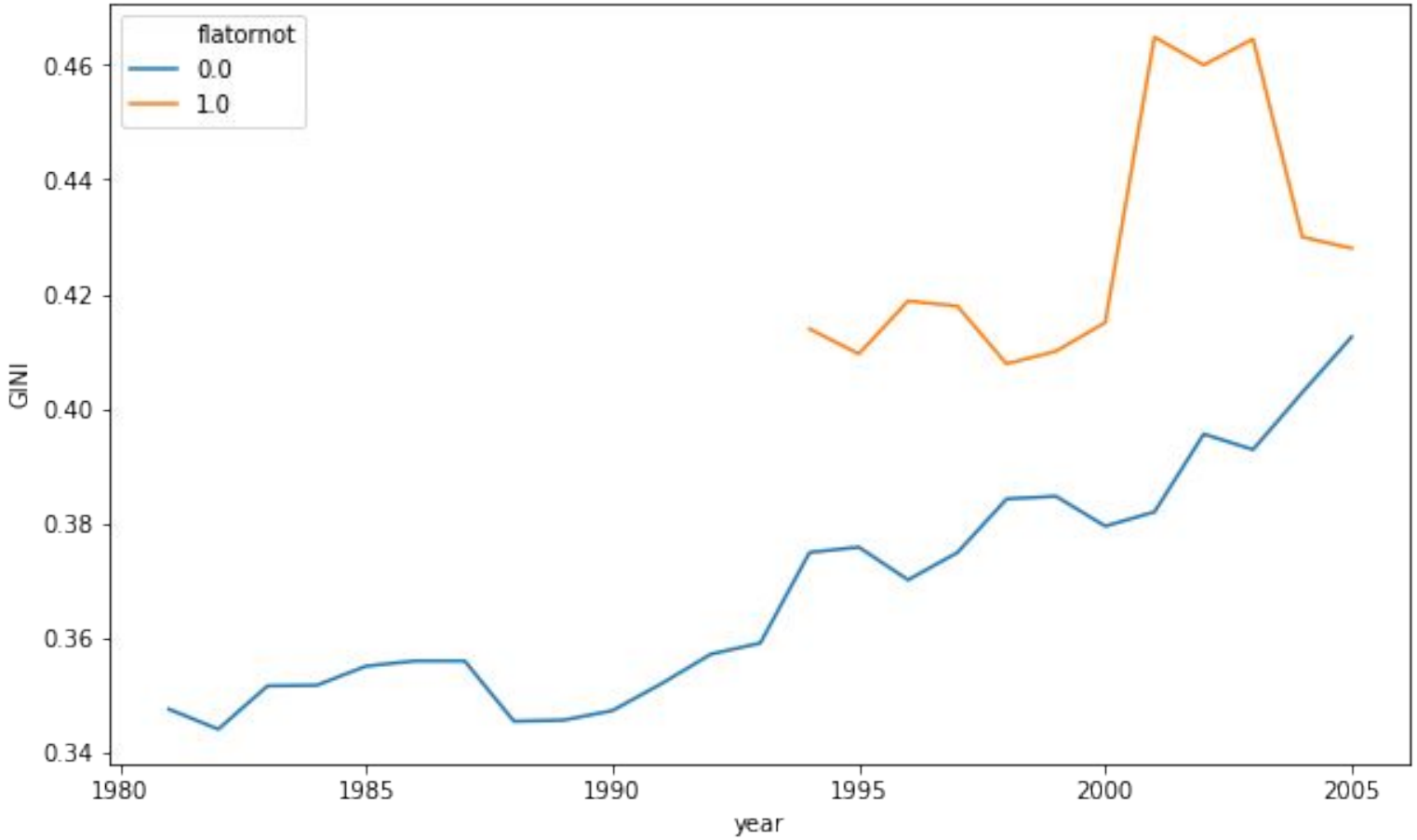
Model


GINI
Average Tax Rate
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
10
20
30
40
50
60
name_un
Australia
Austria
Belgium
Canada
Chile
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Iceland
Ireland
Israel
Italy
Japan
Republic of Korea
Latvia
Lithuania
Luxembourg
Mexico
Netherlands
New Zealand
Norway
Poland
Portugal
Slovakia
Slovenia
Spain
Sweden
Switzerland
Turkey
United Kingdom of Great Britain and Northern Ireland
United States of America
Ukraine
Russian Federation

Model


GINI
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
10
20
30
40
50
60
70
80
Top Marginal Tax Rate

Model


flatornot
0.0
1.0
0.46
0.44
0.42
0.40
0.38
0.36
0.34
GINI
1980
1985
1990
1995
2000
2005
year

$$GINI_{t+h,r} = \alpha + \gamma_h * Progressivity_{t,r} + \theta_h * Flatornot_{t,r} + \delta_h * TopRate_{t,r} + \sigma_h * AverageTaxRate_{t,r} + GINI_{t-1,r} + 1\text{-}Year\text{-}Lag\ of\ Covariates + \lambda_r + \eta_t + \epsilon_{t,r}$$

where h takes values greater than or equal to 0 and is the variable in index used to trace policy response functions, $Progressivity_{t,r}$ is the index of progressivity, $Flatornot_{t,r}$ is the dummy variable for country r in year t being 1 if the country has flat tax policy enacted in year t and 0 otherwise, $TopRate_{t,r}$ is the marginal tax rate of the highest income bracket, $AverageTaxRate_{t,r}$ is the avergae tax rate of average income earner in country r in year t, and the last terms are the 1-year-lags of the dependent variable and independent variables, country fixed effects, time fixed effects and an error term.

Model

- Country and time fixed effects:

Model

- Country and time fixed effects:
  - filtered out within country inherent differences, as well as extraneous shocks on yearly basis, such as 2008 Financial crisis or any important economic event.

Results

Variables						
Average Tax Rate (for avg. earner)	-0.0151 (0.0142)	-0.0124* (6.98e-03)	-0.0117* (6.98e-03)	-0.0111 (6.99e-03)	8.05e-03 (0.0146)	9.30e-03 (0.0149)
Top Marginal Tax Rate	-0.0103 (9.76e-03)	-3.67e-03 (4.80e-03)	-4.35e-03 (4.80e-03)	-0.0155* (9.15e-03)	-0.0155* (9.17e-03)	-0.0155* (9.18e-03)
Dummy for Flat tax	-0.322 (0.486)	0.252 (0.242)	0.773** (0.349)	0.696** (0.353)	0.897** (0.376)	0.905** (0.377)
Progressivity index 1	-1.59e-03 (3.06e-03)	9.70e-04 (1.48e-03)	1.04e-03 (1.47e-03)	9.97e-04 (1.47e-03)	1.07e-03 (1.47e-03)	1.86e-03 (2.27e-03)
1-year-lag GINI		81.0*** (1.82)	80.8*** (1.81)	81.0*** (1.82)	81.2*** (1.85)	81.2*** (1.85)
1-year-lag Dummy for Flat tax			-0.667** (0.323)	-0.553* (0.333)	-0.638* (0.366)	-0.642* (0.366)
1-year-lag Top Marginal Rate				0.0125 (9.01e-03)	0.0130 (9.04e-03)	0.0132 (9.06e-03)
1-year-lag Average Tax Rate (for avg. earner)					-0.0208 (0.0143)	-0.0221 (0.0146)
1-year-lag Progressivity index 1						-1.03e-03 (2.27e-03)
Constant	34.9*** (0.915)	6.78*** (0.751)	6.86*** (0.750)	6.67*** (0.762)	6.42*** (0.783)	6.42*** (0.784)
Observations	845	820	820	820	812	812
R-squared	0.313	0.827	0.828	0.828	0.826	0.826

Table 1: The following table includes 6 different regression model results with different sets of covariates. GINI is scaled up by 100. The main model results with all specified covariates included is in the last column. For this last column, Top Marginal Tax Rate, Dummy for Flat tax, 1-year-lag of Dummy for Flat tax, 1-year-lag of GINI are statistically significant. An interesting case is the sign change of flat tax dummy from current year to the lagged year. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$: Standard errors in parentheses.

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- h = 0 will characterize the statistical relationship between the same year covariates and inequality level
- Only Top Marginal Tax Rate and Flat Tax Dummy turn out to be significant 90 and 95% level.

Impulse Response Functions

DATA88 EconModels

Variable	h=0	h=1	h=2	h=3	h=4	h=5
Average Tax Rate	9.30e-03	-8.87e-03	-0.0132	-0.0169	-0.0359	-0.0403
	(0.0149)	(0.0192)	(0.0221)	(0.0241)	(0.0250)	(0.0255)
Flat Tax Dummy	0.905**	0.572	0.771	0.657	0.742	0.548
	(0.377)	(0.490)	(0.561)	(0.610)	(0.701)	(0.713)
Top Marginal Tax Rate	-0.0155*	-0.0114	-0.0115	-3.89e-03	-2.01e-03	9.10e-03
	(9.18e-03)	(0.0119)	(0.0137)	(0.0148)	(0.0156)	(0.0158)
Progressivity Index 1	1.86e-03	2.21e-03	3.37e-03	2.18e-03	-3.41e-04	1.20e-03
	(2.27e-03)	(2.94e-03)	(3.38e-03)	(3.67e-03)	(3.79e-03)	(3.87e-03)
1-year-lag GINI	81.2***	67.6***	55.4***	41.0***	31.4***	23.2***
	(1.85)	(2.52)	(2.91)	(3.23)	(3.41)	(3.51)
1-year-lag Average Tax Rate	-0.0221	-0.0186	-0.0240	-0.0291	-0.0184	-0.0190
	(0.0146)	(0.0189)	(0.0218)	(0.0238)	(0.0248)	(0.0253)
1-year-lag Progressivity index 1	-1.03e-03	-1.16e-03	-2.56e-03	-2.12e-03	1.73e-04	-1.38e-03
	(2.27e-03)	(2.93e-03)	(3.37e-03)	(3.66e-03)	(3.79e-03)	(3.87e-03)
1-year-lag Top Marginal Tax Rate	0.0132	9.67e-03	9.28e-03	1.98e-03	1.95e-03	-8.06e-03
	(9.06e-03)	(0.0117)	(0.0135)	(0.0147)	(0.0154)	(0.0157)
1-year-lag Flat Tax Dummy	-0.642*	-0.669	-1.14**	-0.957	-1.14	-1.37*
	(0.366)	(0.475)	(0.548)	(0.598)	(0.692)	(0.714)
Constant	6.42***	12.0***	16.6***	22.1***	25.4***	28.3***
	(0.784)	(1.05)	(1.22)	(1.35)	(1.42)	(1.46)
Observations	812	782	754	725	696	668
R-squared	0.826	0.691	0.585	0.493	0.441	0.405

Table 2: This table summarizes the regression results for the main model for different values of h. GINI is scaled up by 100. $h = 0$ case is same as the last column of Table 1, because it takes the current year GINI as the dependent variable. The rest of the values of h aim to investigate the effect of the covariates on GINI lead variables. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$: Standard errors in parentheses.

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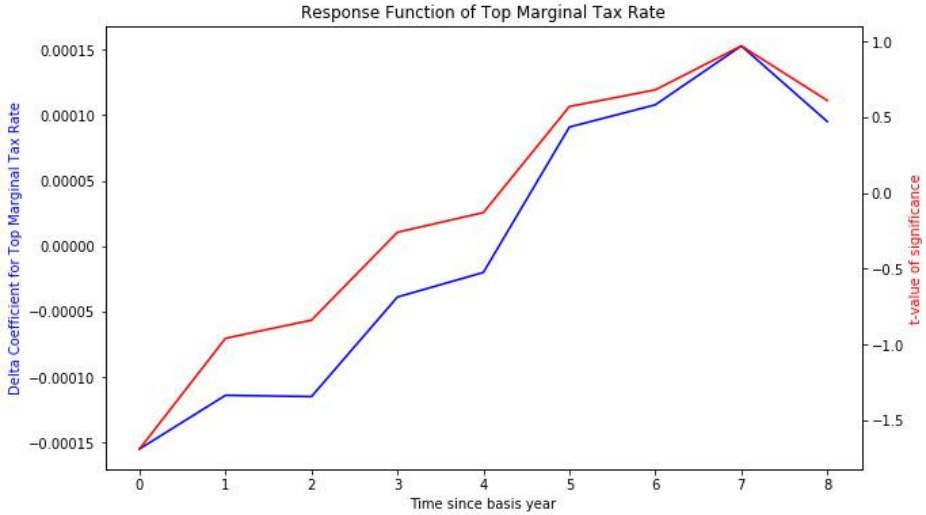
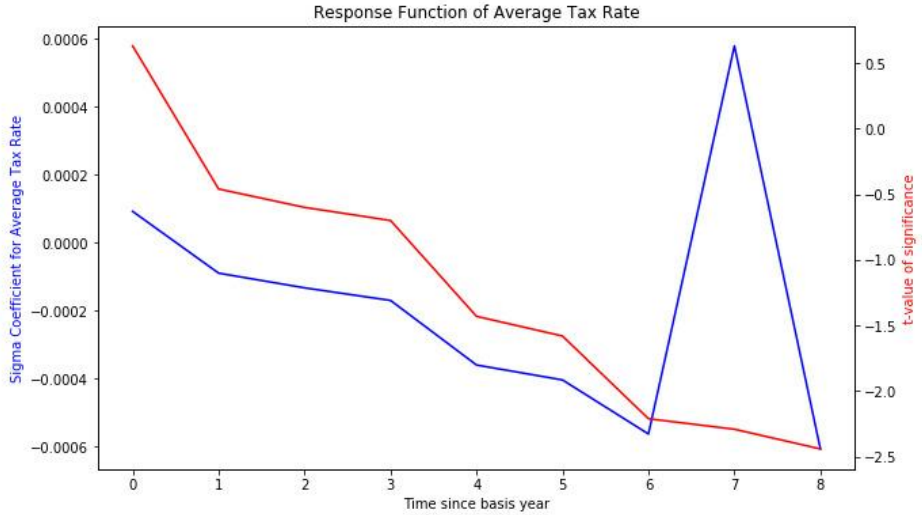
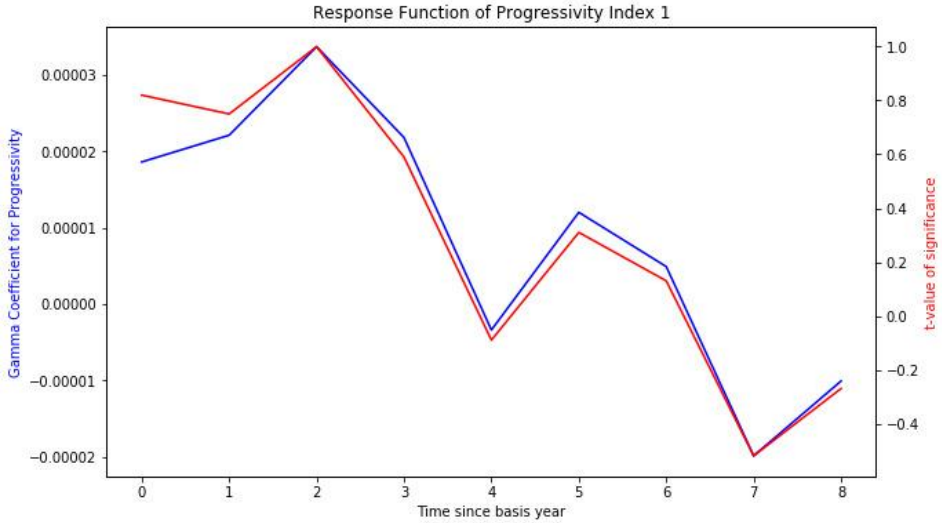
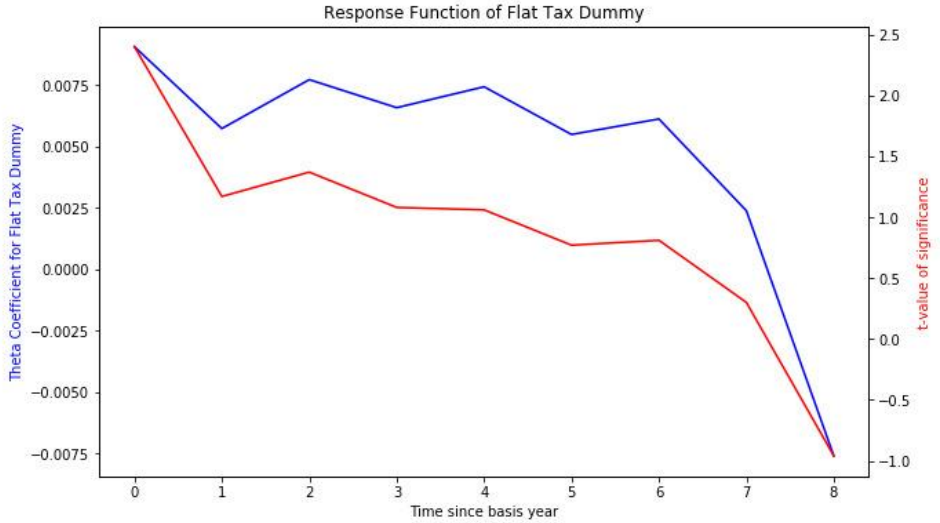
Impulse Response Functions





Impulse Response Functions





Conclusion

- *Top Marginal Tax* Rate at time *t* turns statistically significant in negatively affecting the GINI at time *t (GINI ↓)*

Conclusion

- *Top Marginal Tax* Rate at time *t* turns statistically significant in negatively affecting the GINI at time *t (GINI ↓)*

- *Flat tax dummy* at time *t* turns statistically significant in positively affecting the GINI at time *t (GINI ↑)*

Conclusion

- *Top Marginal Tax* Rate at time *t* turns statistically significant in negatively affecting the GINI at time *t (GINI ↓)*

- *Flat tax dummy* at time *t* turns statistically significant in positively affecting the GINI at time *t (GINI ↑)*

- *Lagged flat tax dummy* at time *t* (or *Flat tax dummy* at time *t-1*) turns statistically significant in negatively affecting the GINI at time *t (GINI ↓)*

Conclusion

- *Top Marginal Tax* Rate at time *t* turns statistically significant in negatively affecting the GINI at time *t (GINI ↓)*
- *Flat tax dummy* at time *t* turns statistically significant in positively affecting the GINI at time *t (GINI ↑)*
- *Lagged flat tax dummy* at time *t* (or *Flat tax dummy* at time *t-1*) turns statistically significant in negatively affecting the GINI at time *t (GINI ↓)*
- Our *Progressivity* measure turns insignificant. Previous papers and robustness checks in this paper also do not find any significance between GINI and any other pre-existing progressivity measure

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- *Flat tax dummy* at time *t* turns statistically significant in positively affecting the GINI at time *t (GINI ↑)*
- *Lagged flat tax dummy* at time *t* (or *Flat tax dummy* at time *t-1*) turns statistically significant in negatively affecting the GINI at time *t (GINI ↓)*
- Our *Progressivity* measure turns insignificant. Previous papers and robustness checks in this paper also do not find any significance between GINI and any other pre-existing progressivity measure
- *Impulse Response Functions* show a fading pattern as expected

Discussion

- The insignificance of progressivity index in the model signals that there is no statistically significant difference in inequality levels based on how ”progressive” the tax system is.

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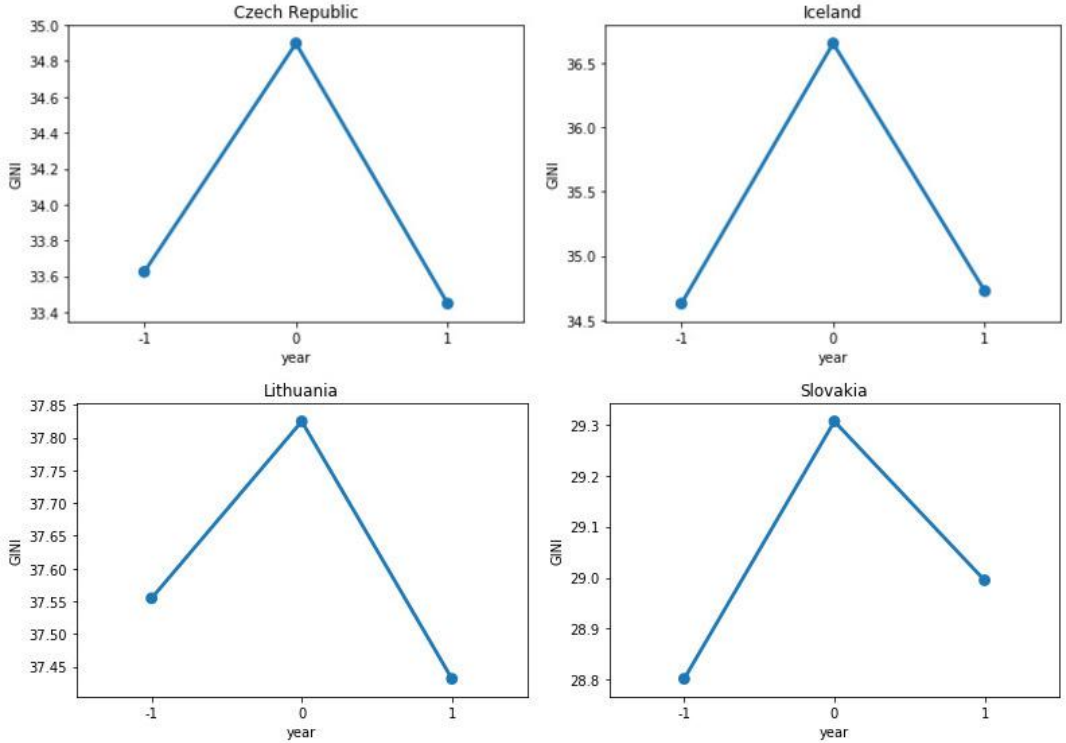
- The insignificance of progressivity index in the model signals that there is no statistically significant difference in inequality levels based on how ”progressive” the tax system is.
- Switching to flat system, the inequality level measured by GINI index is significantly increased, emphasizing that the main beneficiaries of the flat tax policy are the top earners. Yet, this effect is completely reversed in 4 of the 9 flat tax countries analyzed, with lagged dummy flat tax variable yielding negative significant coefficients.

Discussion

Particularly interesting is the case of flat tax countries:



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- This opens an interesting discussion of whether the equilibrium inequality level in the economy is ”self-adjusting” in time with the flat tax policy being the process through which it reaches certain level of inequality rather than the reason.

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- Possible explanations:
  - trickle-up economics (via generous social packages) argument by Jackson et al. (2019)

Q&A

- Questions
- Contacts:
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