

MINISTRY OF FINANCE
OF THE SLOVAK REPUBLIC

institute for financial policy

Five years in a Balloon: Evaluating euro adoption in Slovakia using synthetic control method

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CERGE-EI

Joint workplace of Charles University and the Czech Academy of Sciences, founded in 1991

Western-style education: **PhD in Economics**, US-style PhD program, two years of course work followed by several years of supervised PhD dissertation research. More at www.cerge-ei.cz/phd

Frontier economic research: strong record of professional careers and publications in top economics and policy-oriented journals

Faculty and researchers: hired on international market, with PhDs from e.g. Princeton University, Chicago University and others

Center of Excellence by USAID and EU, 'National Centers of Excellence in basic research' awards by the Czech Science Foundation till 2018

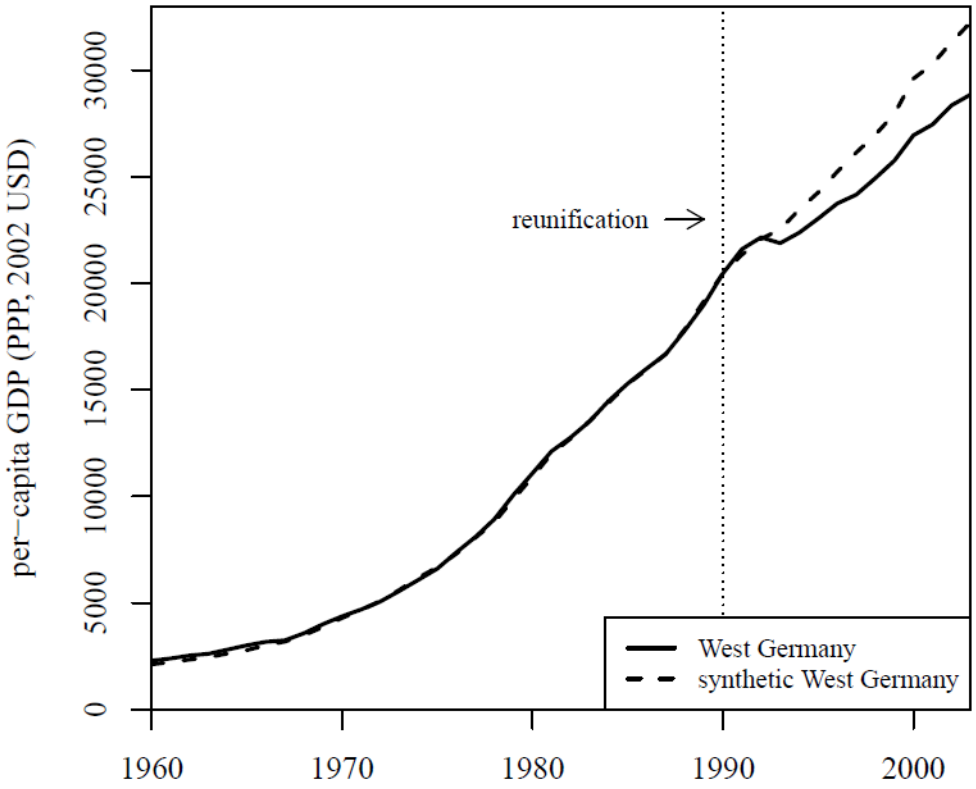
Governed and visited by economic luminaries: Nobel Laureates and prominent economists on the Executive and Supervisory Committee; Nobel Prize Lecture series every year; premier seminar series (50+ speakers coming annually)

What is Synthetic Control Method?

- SCM evaluates causal effects of interventions in comparative studies with aggregate data

Example: What are the costs of German reunification for the West Germany?

SCM constructs the output of a synthetic West Germany using the **weighted combination of outputs of other control countries** (e.g. AT, US, JP, CH, NL)



Why to use Synthetic Control Method?

- What if the true model of the no-intervention counterfactual output contains unobserved FE interacting with time-varying coefficient?

$$Y^N_{it} = \delta_t + Z_i \theta_t + \boldsymbol{\lambda_t \mu_i} + \varepsilon_{it}$$

- In such case the Diff-in-Diff estimate would be biased (because it assumes constant FE in time)

- Yet, if you weight the control group s.t. SC matches Z_i and pre-intervention Y_{it} , then you match $\boldsymbol{\mu_i}$ as well.

How to use Synthetic Control Method?

- Let X_1 be a vector of pre-intervention characteristics for the **treated country** (it includes Z_1 and several linear combinations of pre-intervention outcomes)
- Let X_0 be a matrix of the same variables for the **non-treated** countries
- Then the vector of country-weights W* is chosen to minimize **$(X_1 - X_0W)V(X_1 - X_0W)$** s.t. **weights (from 0 to 1) of the control countries sum up to 1.**
- Matrix V reflects the relative importance of the different outcome predictors and it is chosen subjectively: minimize MSPE, cross-validation, etc.

What is the difference anyway?

- Standard regression estimator is also a weighted estimator with weights summing to 1, **albeit only implicitly**
- Yet, **weights in regression may be negative or greater than 1** and thus the estimates may extrapolate beyond the support of the data
- SCM is explicit and transparent in weights, thus enables the qualitative analysis

Does anybody publish with that?

- Abadie, A. and J. Gardeazabal. 2003. **"The Economic Costs of Conflict: A Case Study of the Basque Country."** AER.
- Abadie, A., Diamond, A., and Hainmueller, J. 2010. **"Synthetic control methods for comparative case studies: Estimating the effect of California's tobacco control program."** Journal of the American Statistical Association.
- Abadie, A., Diamond, A., and Hainmueller, J. 2014. **"Comparative politics and the synthetic control method."** American Journal of Political Science.
- Acemoglu et al. 2013. **"The Value of Connections in Turbulent Times: Evidence from the United States."** NBER
- Saia, A. 2015. **"Choosing the open sea: The cost to the UK of staying out of the Euro."** mimeo

Why adoption of euro in Slovakia?

- Slovakia has its close match without euro currency: Czech Republic
- **Slovakia is a "middle" country** (mid-income, mid-human capital, mid-industry share, etc.), hence it would fit within the convex hull (i.e. support of the data from other countries)
- Slovakia adopted the euro just before the financial crisis in 2009

Which countries and which covariates?

- **Which countries** to pick as the control group?
  - Those who joined EU recently
  - Those whose exchange rate was floating
- Candidates: CZ, PL, HU, RO
- **Which covariates?** Following ADH (2014):
  - REER (Eurostat)
  - Openness of the economy
  - Human capital index
  - Investment-to-GDP ratio
  - Share of industry on the economy (World Bank)

(rest of the data is from Penn World Tables)

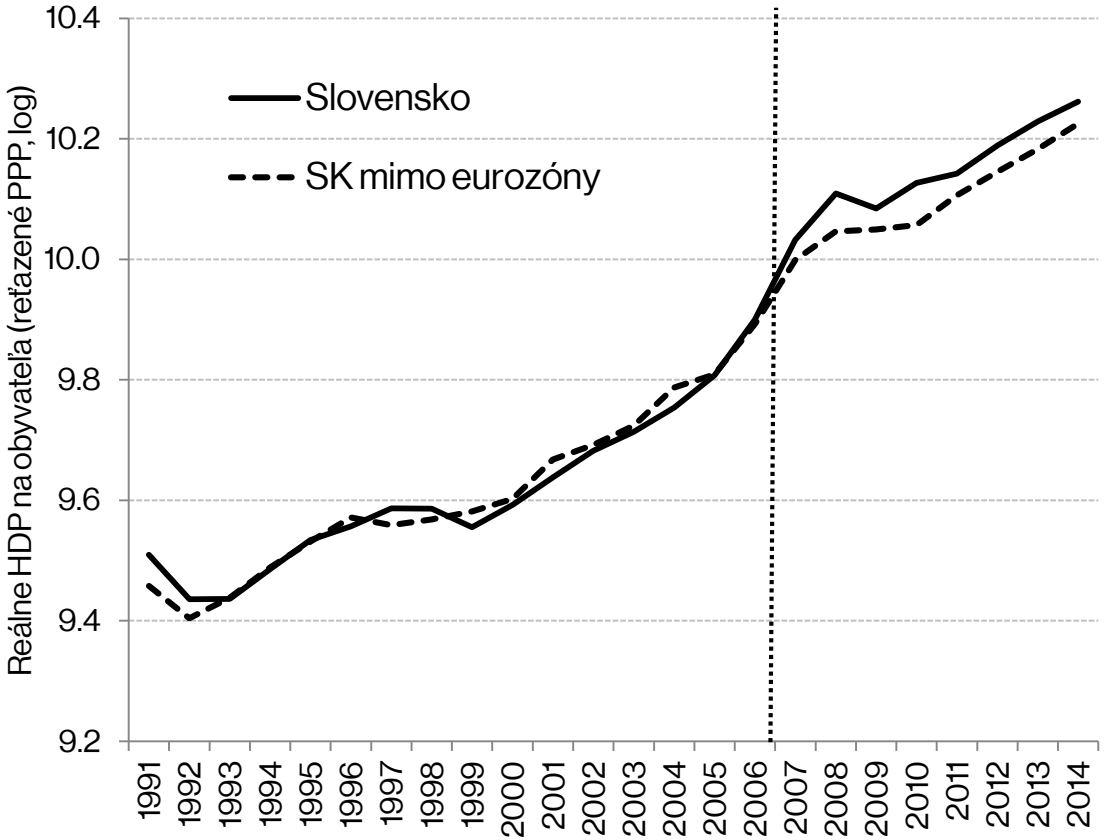
Pre and post intervention period

- Which year to pick as the onset of the intervention knowing that there may be an **anticipation effect** from the euro adoption?
  - SK joined ERM II in November 2005
  - Newly elected government in 2006 after hesitations confirmed the path of euro adoption
  - Fixed exchange rate from the 2H 2008
- We chose 2006 as in the 2H a massive appreciation of the Slovak currency began

Results: GDP as a measure of living standard

weights	unit.names
0.656	Czech Republic
0.007	Hungary
0.005	Poland
0.332	Romania

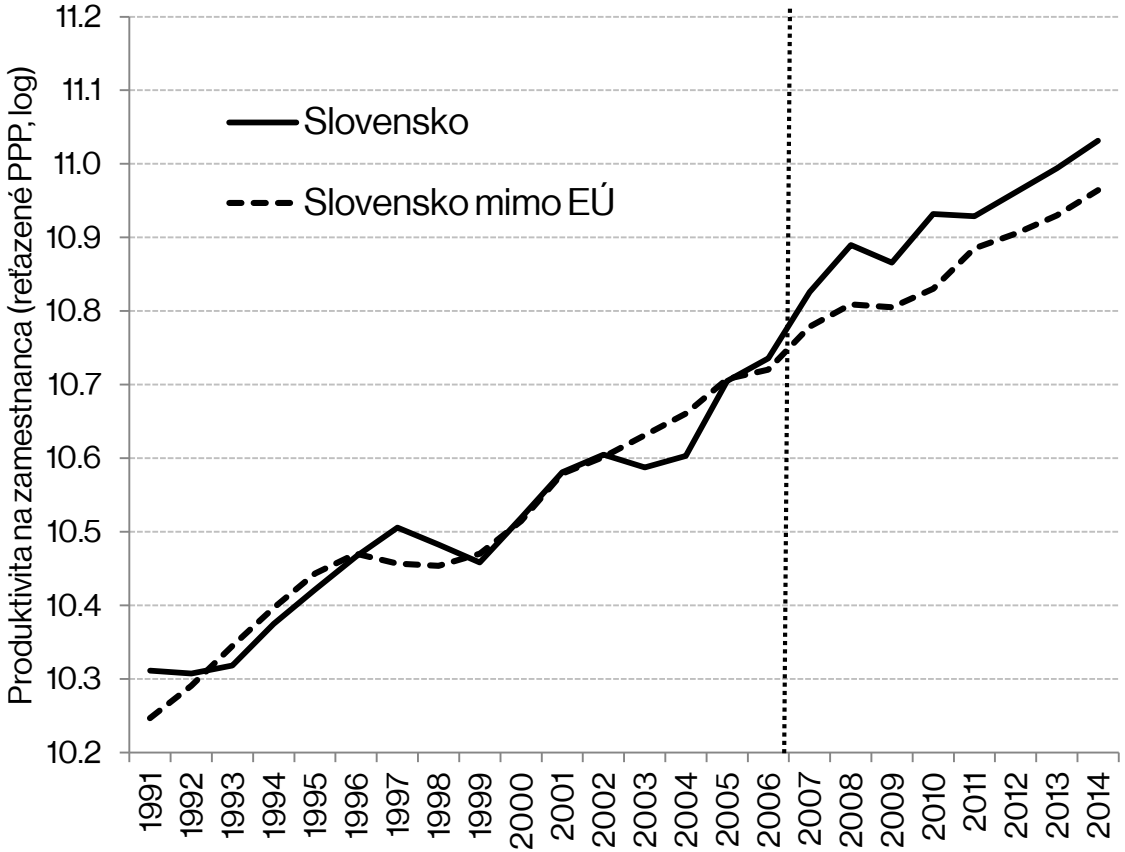
	Treated	Synthetic	Sample Mean
ky	2.040	2.651	2.184
open	0.624	0.479	0.474
indu	0.355	0.383	0.355
csh_i	0.221	0.219	0.195
reer	4.944	4.681	4.419
hc	3.269	3.264	3.064
special.lngdp.1991	9.510	9.458	9.221
special.lngdp.1992	9.436	9.404	9.211
special.lngdp.1993	9.436	9.438	9.263
special.lngdp.1994	9.486	9.489	9.326
special.lngdp.1995	9.534	9.532	9.385
special.lngdp.1996	9.557	9.572	9.412
special.lngdp.1997	9.587	9.559	9.430
special.lngdp.1998	9.586	9.568	9.458
special.lngdp.1999	9.555	9.582	9.489
special.lngdp.2000	9.593	9.602	9.516
special.lngdp.2001	9.638	9.668	9.581
special.lngdp.2002	9.682	9.692	9.618
special.lngdp.2003	9.713	9.724	9.634
special.lngdp.2004	9.754	9.787	9.687
special.lngdp.2005	9.807	9.809	9.705



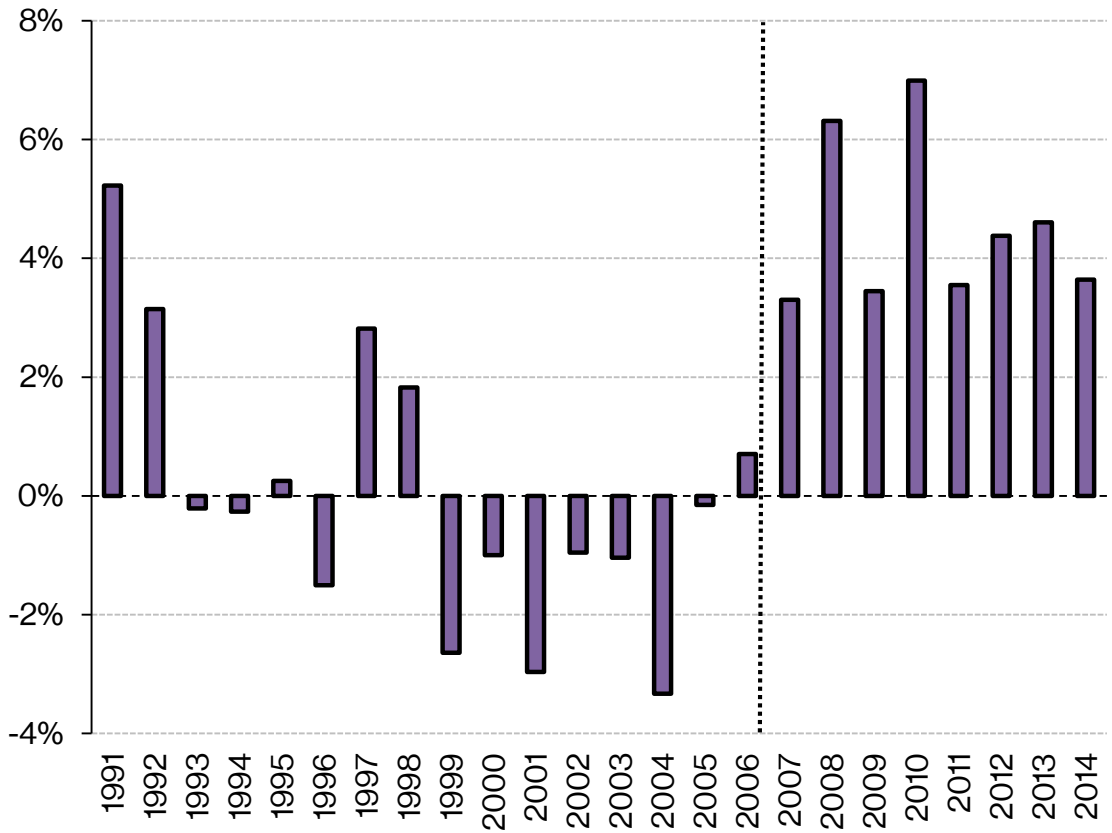
Results: Productivity

weights	unit.names
0.621	Czech Republic
0.288	Hungary
0.000	Poland
0.091	Romania

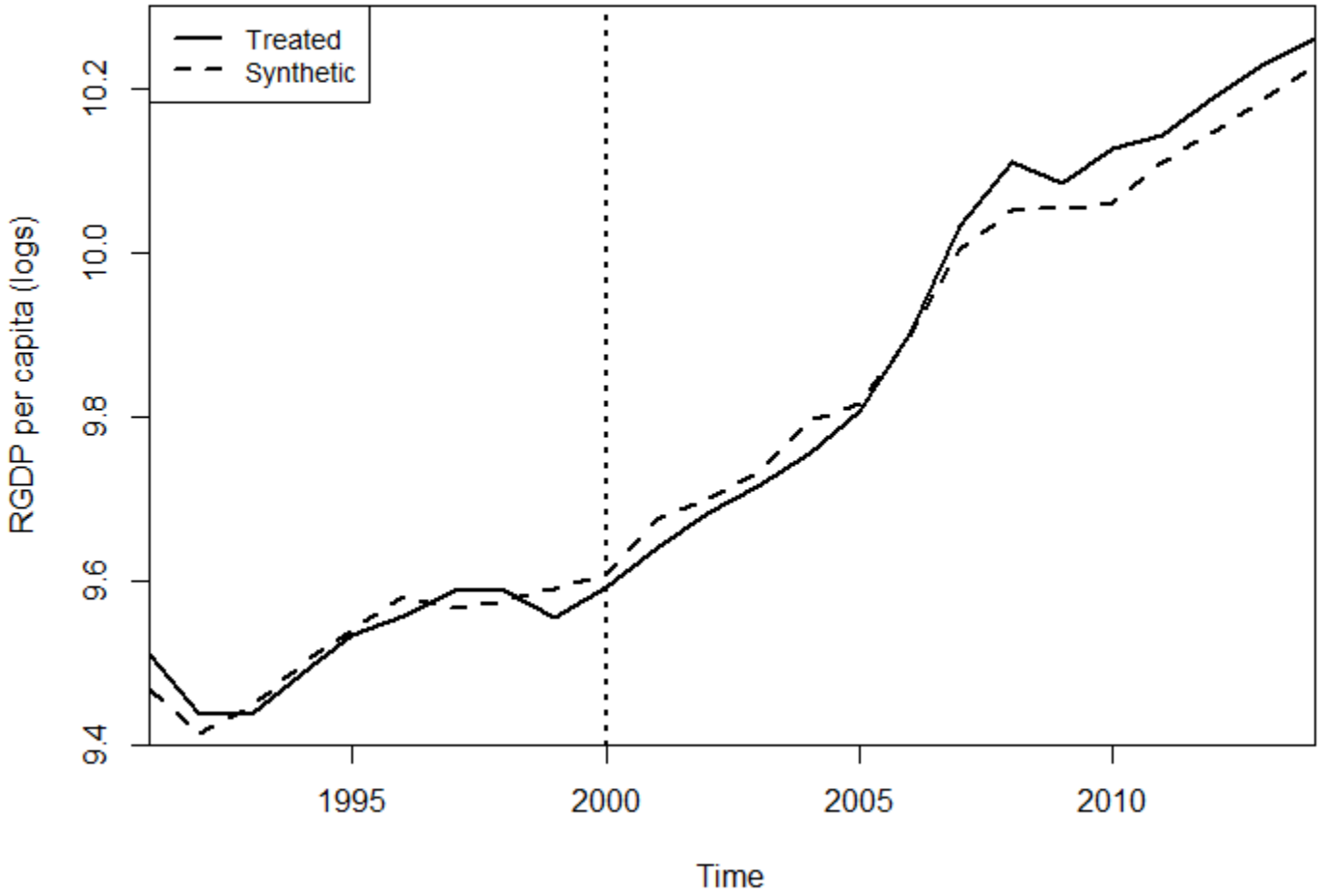
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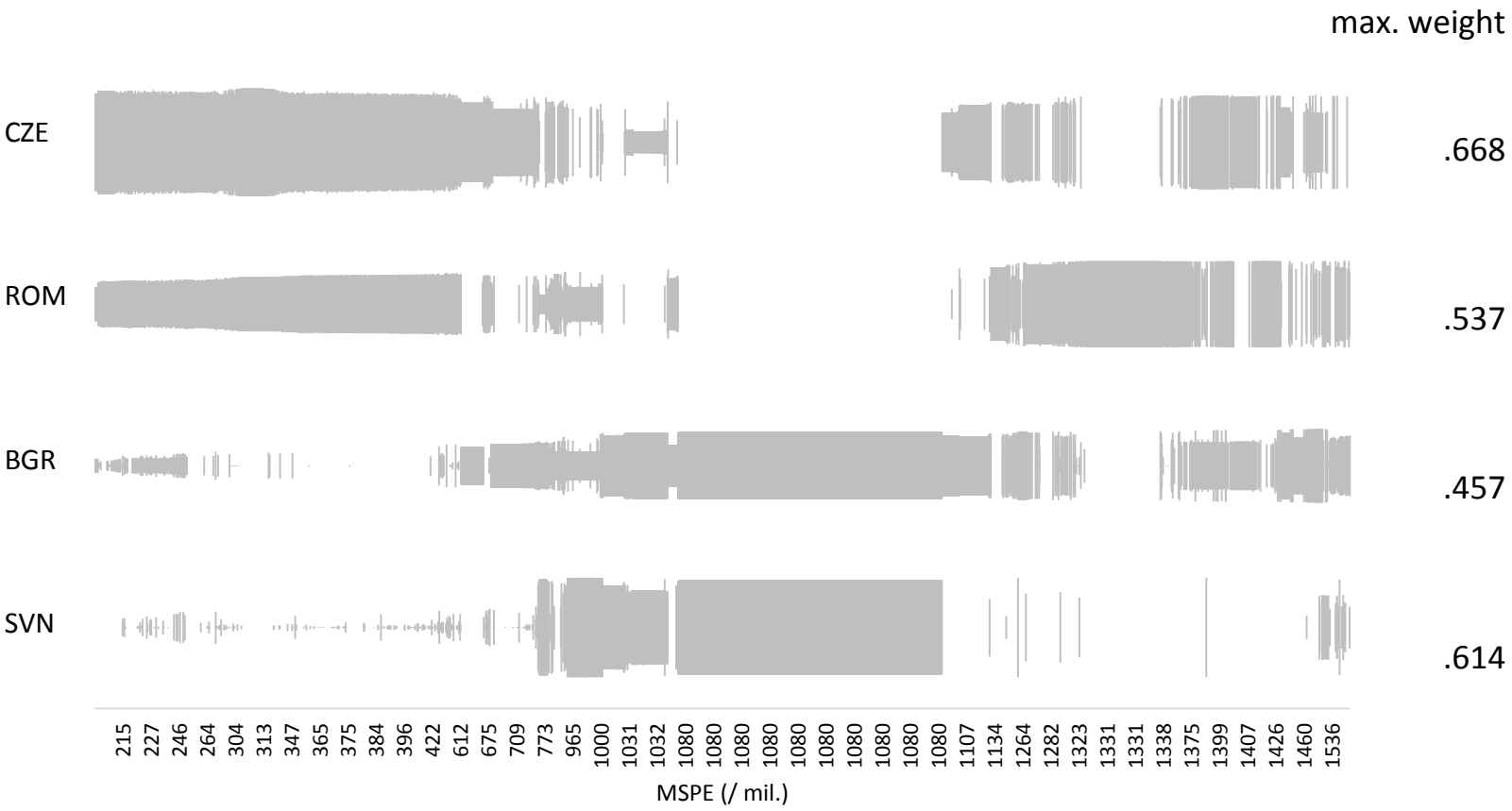
Gain <- Gap between actual GDP and synthetic Slovakia



Robustness: in-sample placebo



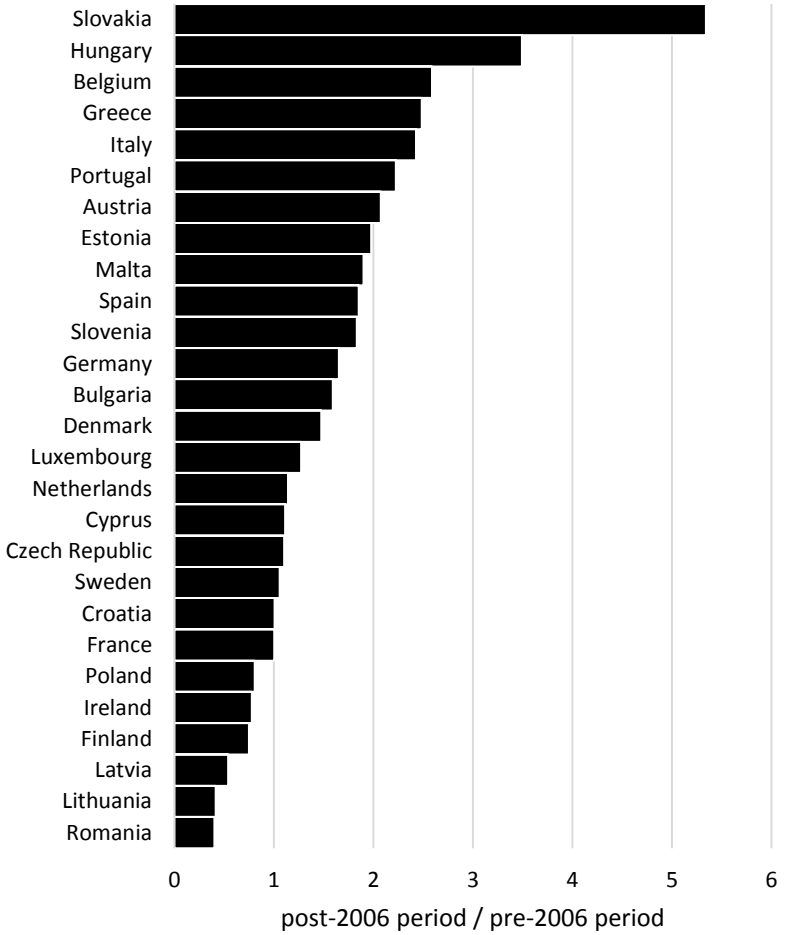
Robustness: marginally worse MSPE

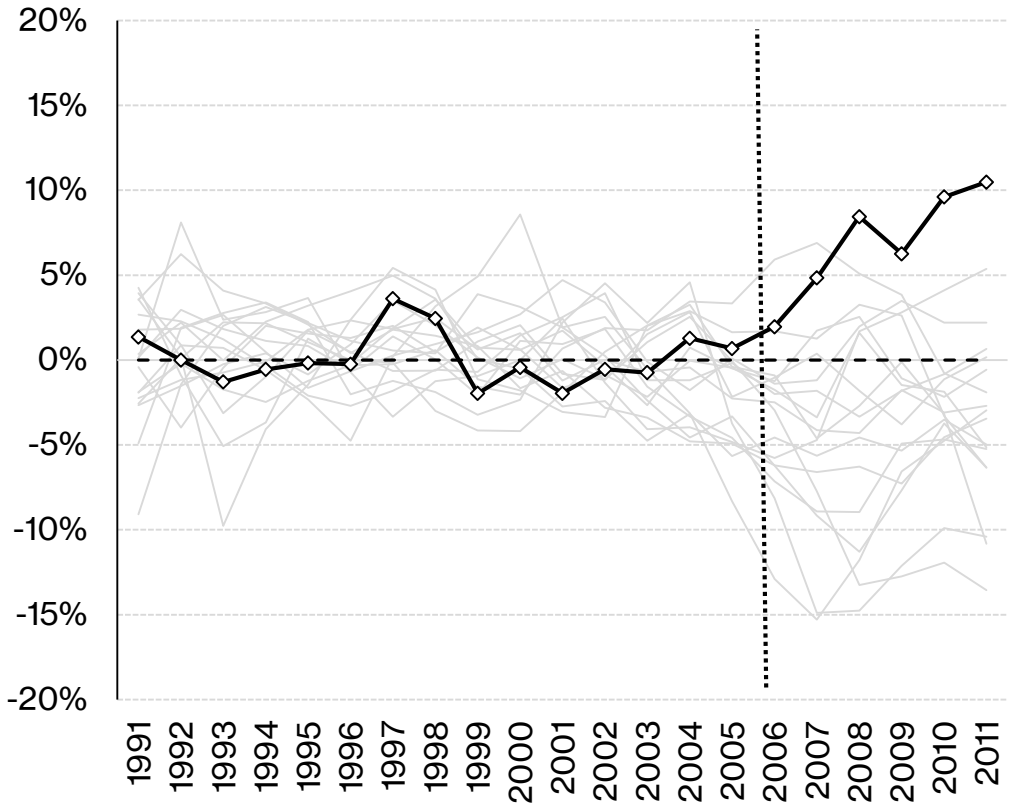


Robustness: Placebo euro in CZ?

- Not feasible, because CZ is the richest economy from the small control group => impossible to construct richest economy as a weighted average ($\Sigma w=1$) of poorer economies
- Similar problem with RO, which is the poorest economy
- SCM need to respect the support of the data (or not?)

I Robustness: broader look





Difficulties: spillovers

- What if euro adoption in Slovakia affected the output in control countries?
  - Limited number (CZ, RO) of control countries enables us to identify such bias
  - If euro in Slovakia helped CZ and RO, then the synthetic estimate is underestimated and vice versa
  - Channel of the bias can be examined: does CZ and RO competitiveness worsen b/c of euro in SK?

More work: finding the channel

- Into the Black Box: How exactly euro helped Slovakia?
  - Rajan & Zingales (1998) approach: industries depending on foreign markets (tradables) should grow faster in countries with euro
  - Yet, this channel turned out NOT to be significant
  - If EURO works, then it works through different channel