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

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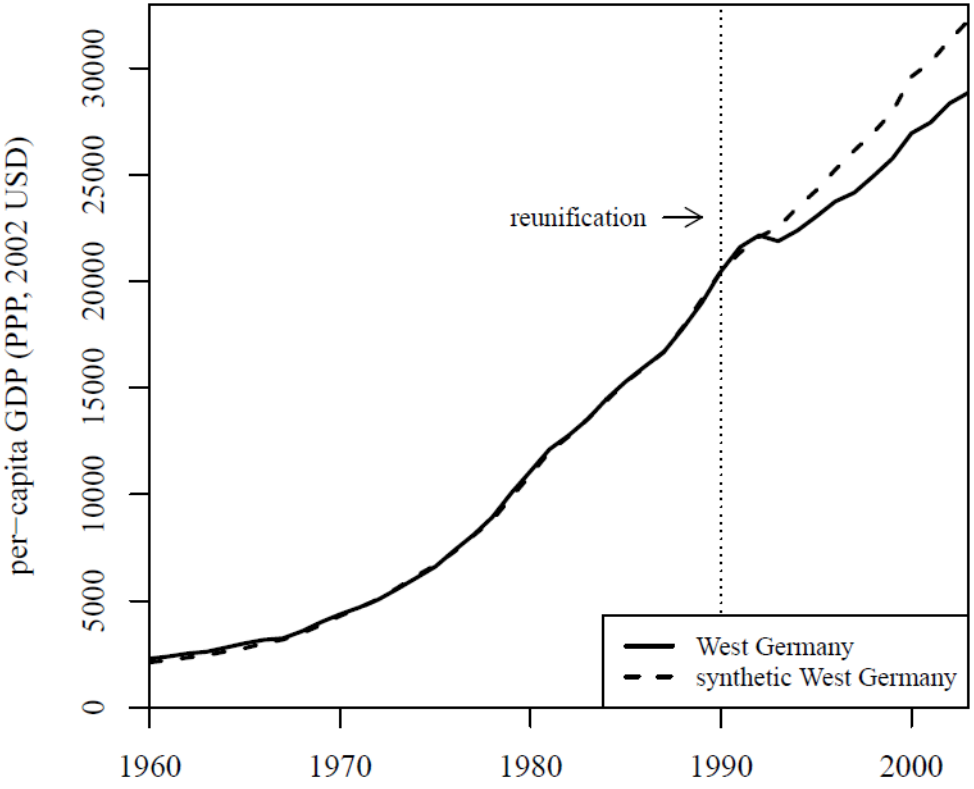
What is Synthetic Control Method?

- 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 SCM?

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

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

- In such case the Diff-in-Diff estimate would be biased (b/c 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 μ_i as well.

How to use SCM?

- 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 $\mathbf{(X_1 - X_0W)V(X_1 - X_0W)}$ 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, the **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 method?

- 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: 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)

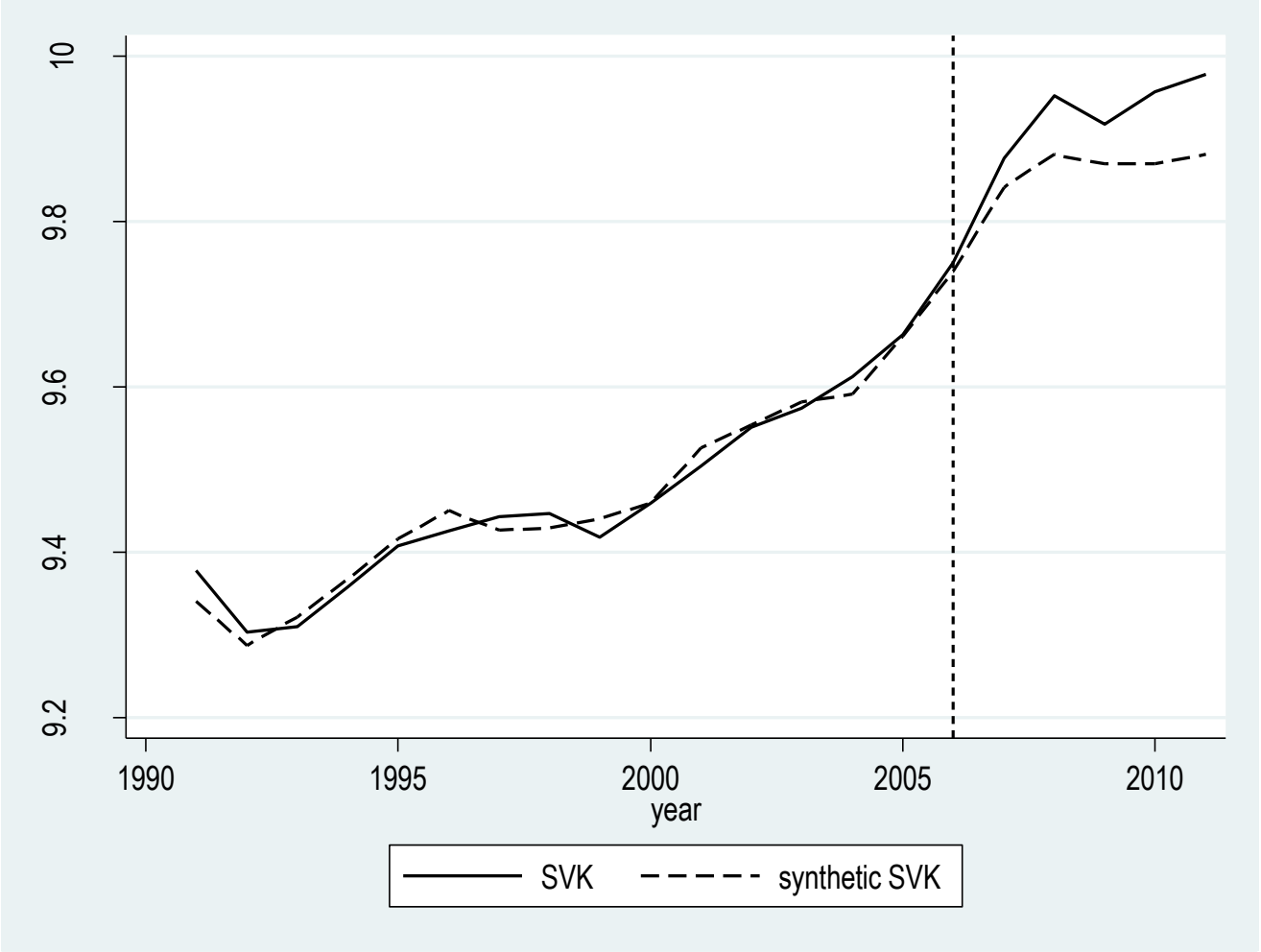
Pre and post intervention period

- 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

Co_No	Unit_Weight
CZE	.667
HUN	0
POL	0
ROU	.333

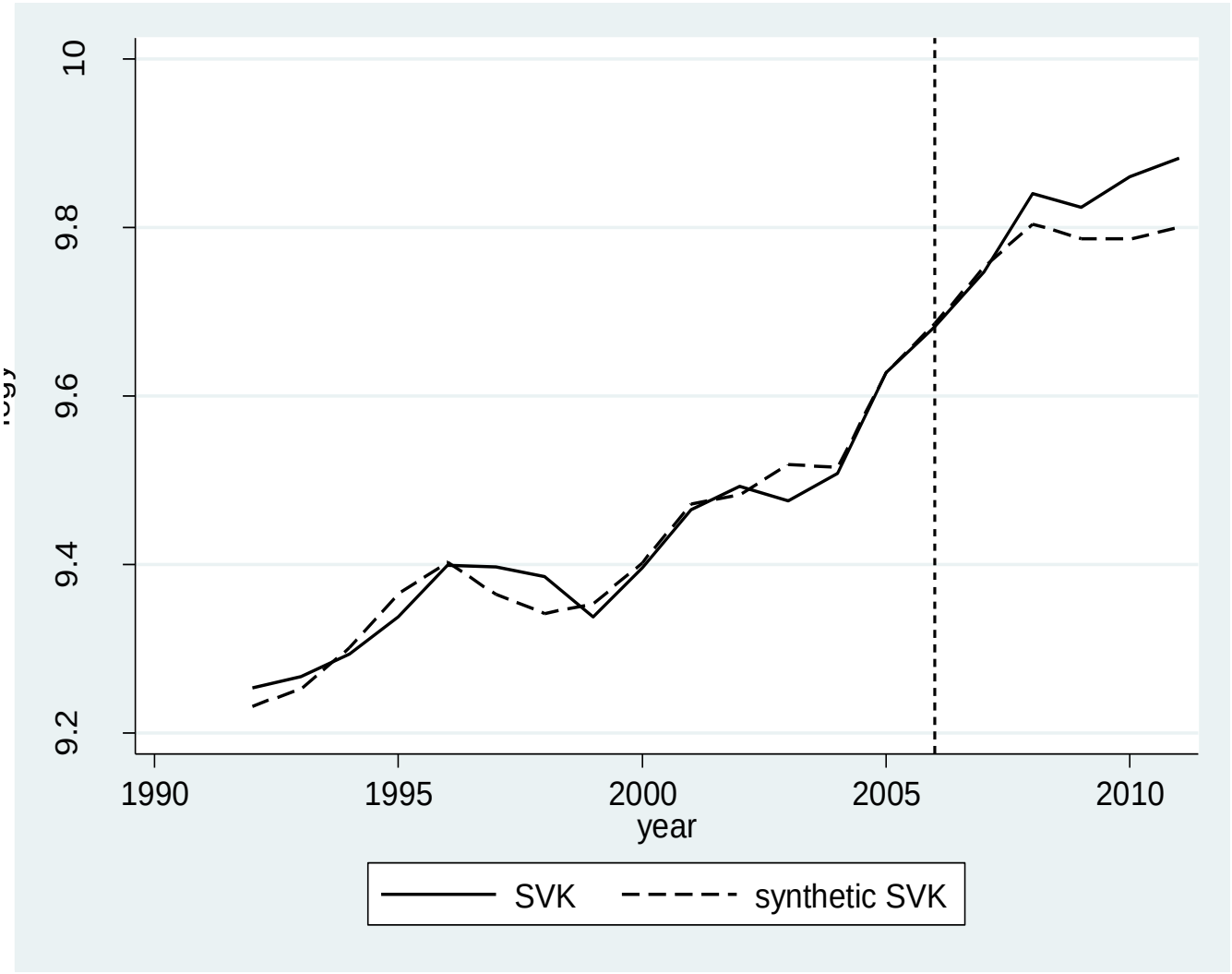
	Treated	Synthetic
ky	2.039591	2.662951
reer	4.944444	4.680156
open	.6216829	.4781823
indu	35.4906	38.33036
csh_i	.2131424	.2112437
hc	3.124868	3.161881
lngdp	9.456758	9.456873



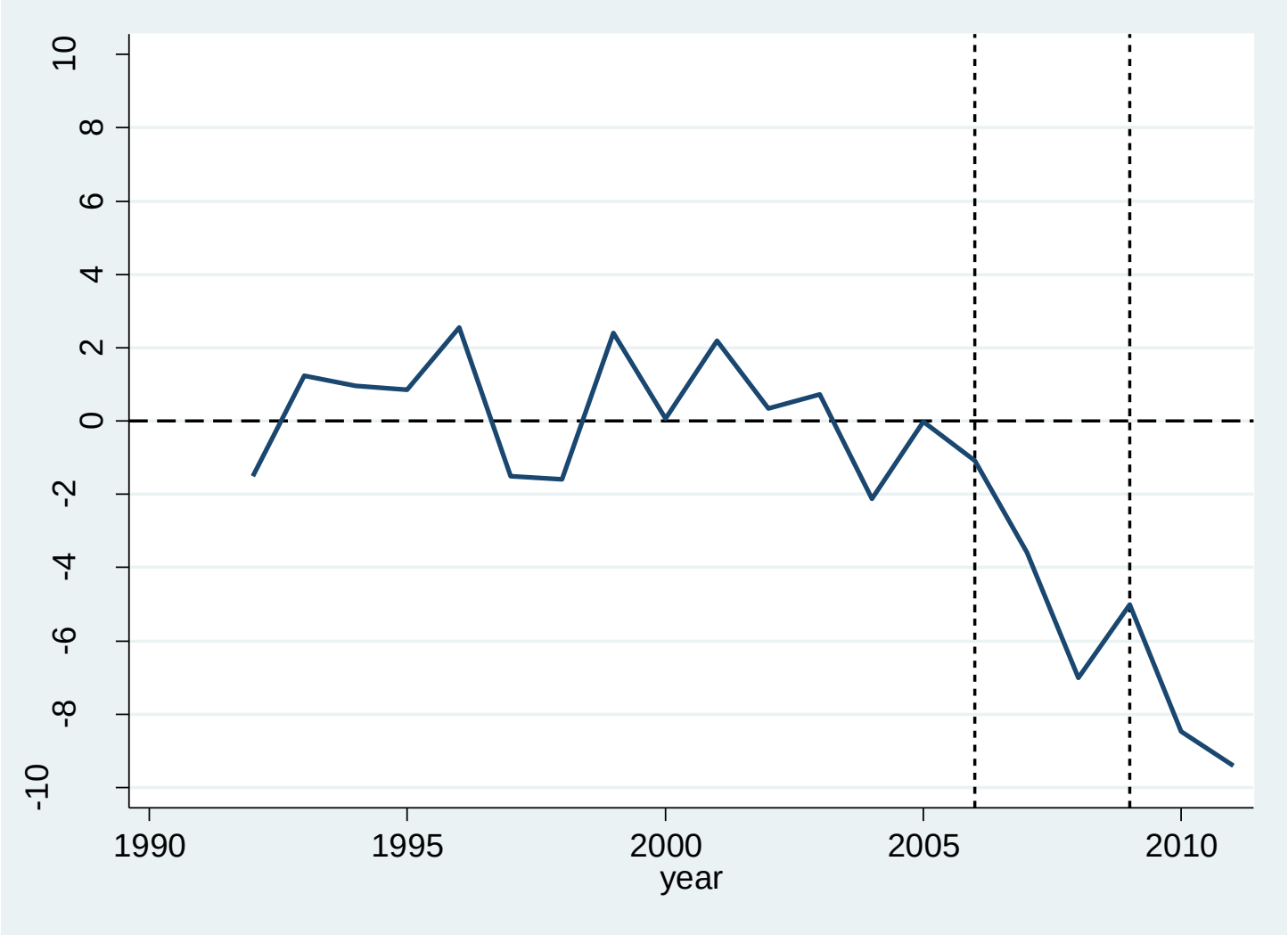
Results: GDP as a measure of productive capacity

Co_No	Unit_Weight
CZE	.63
HUN	0
POL	0
ROU	.37

	Treated	Synthetic
open	.6533413	.489313
reer	4.944444	4.827333
csh_i	.2109845	.2109164
hc	3.129547	3.156436
indu	35.4906	38.19266
logy	9.402391	9.402077



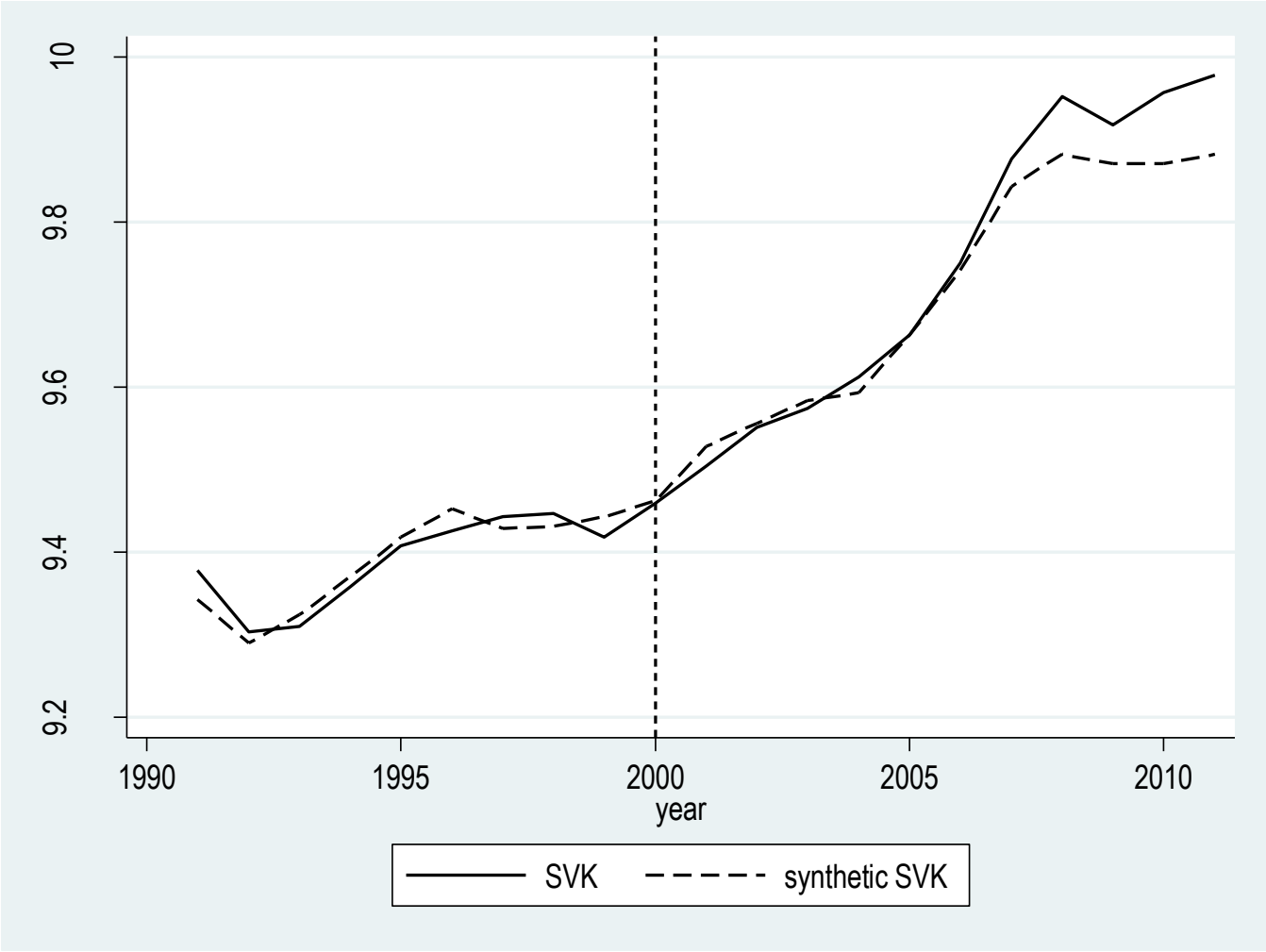
Slovakia gained 10% of GDP until 2011



Robustness: in-sample placebo

Co_No	Unit_Weight
CZE	.669
HUN	0
POL	0
ROU	.331

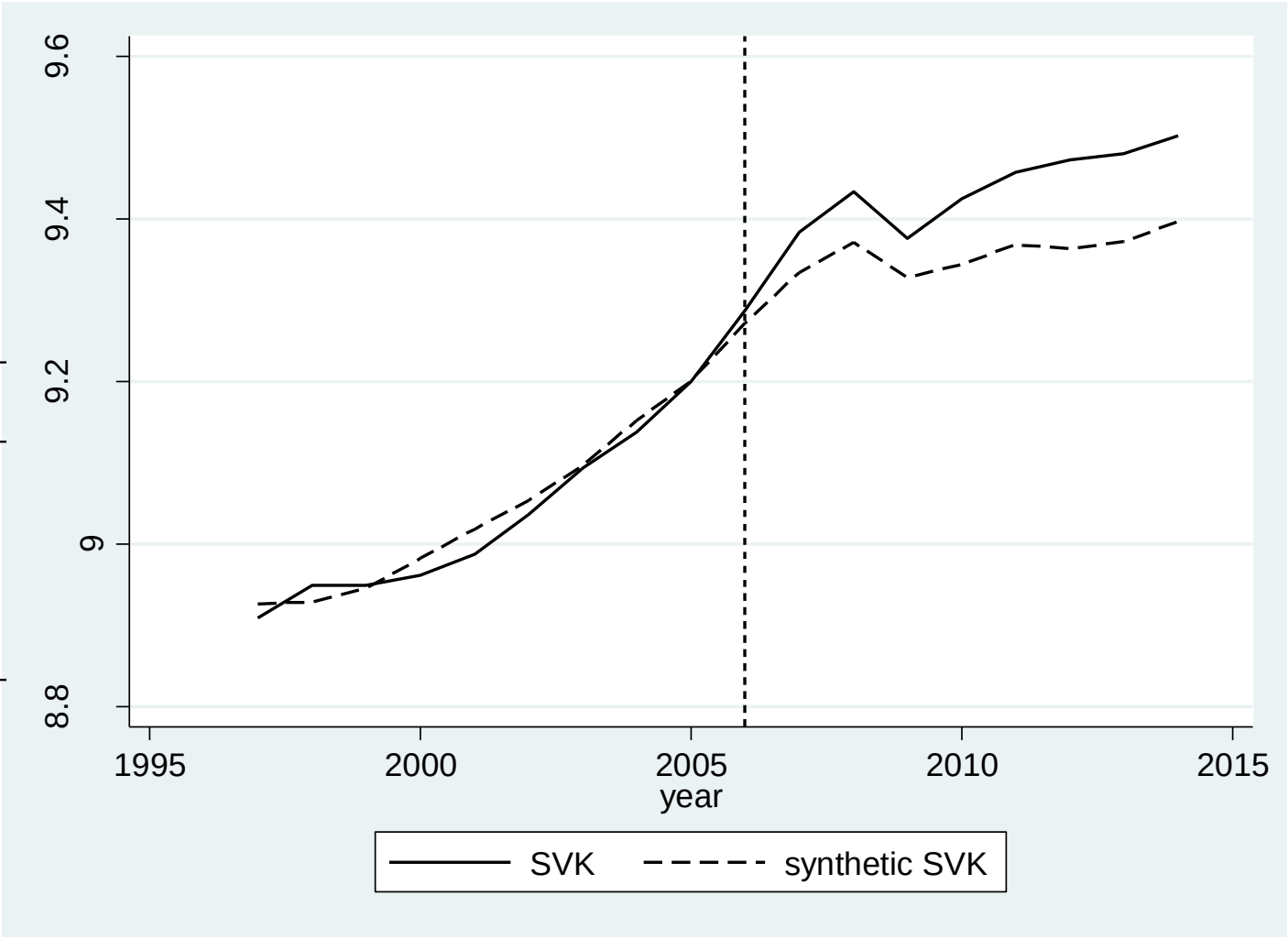
	Treated	Synthetic
ky	2.04192	2.724126
open	.4483305	.3455008
reer	3.8	5.653125
csh_i	.2155955	.2090016
hc	3.115736	3.106531
indu	35.6889	39.32522
lngdp	9.394745	9.395951



Robustness: using Eurostat data

Co_No	Unit_Weight
CZE	.608
HUN	0
POL	.164
ROU	.229

	Treated	Synthetic
openness	111.124	67.89234
inv	27.53173	23.955
hc	3.136204	3.18388
indu	35.10018	36.35848
logeugdp	9.024902	9.033843



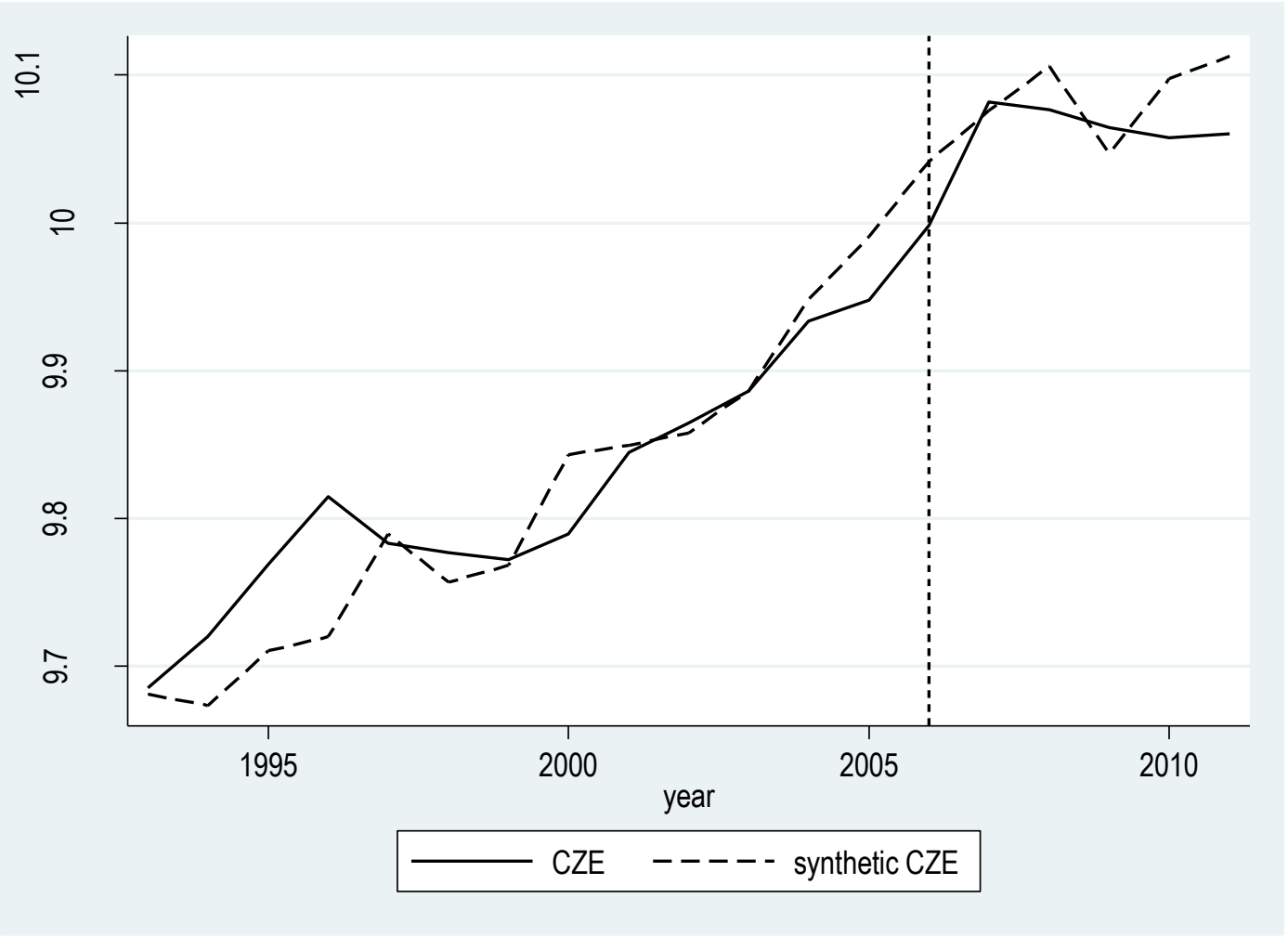
Robustness: Placebo euro in CZ?

- 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

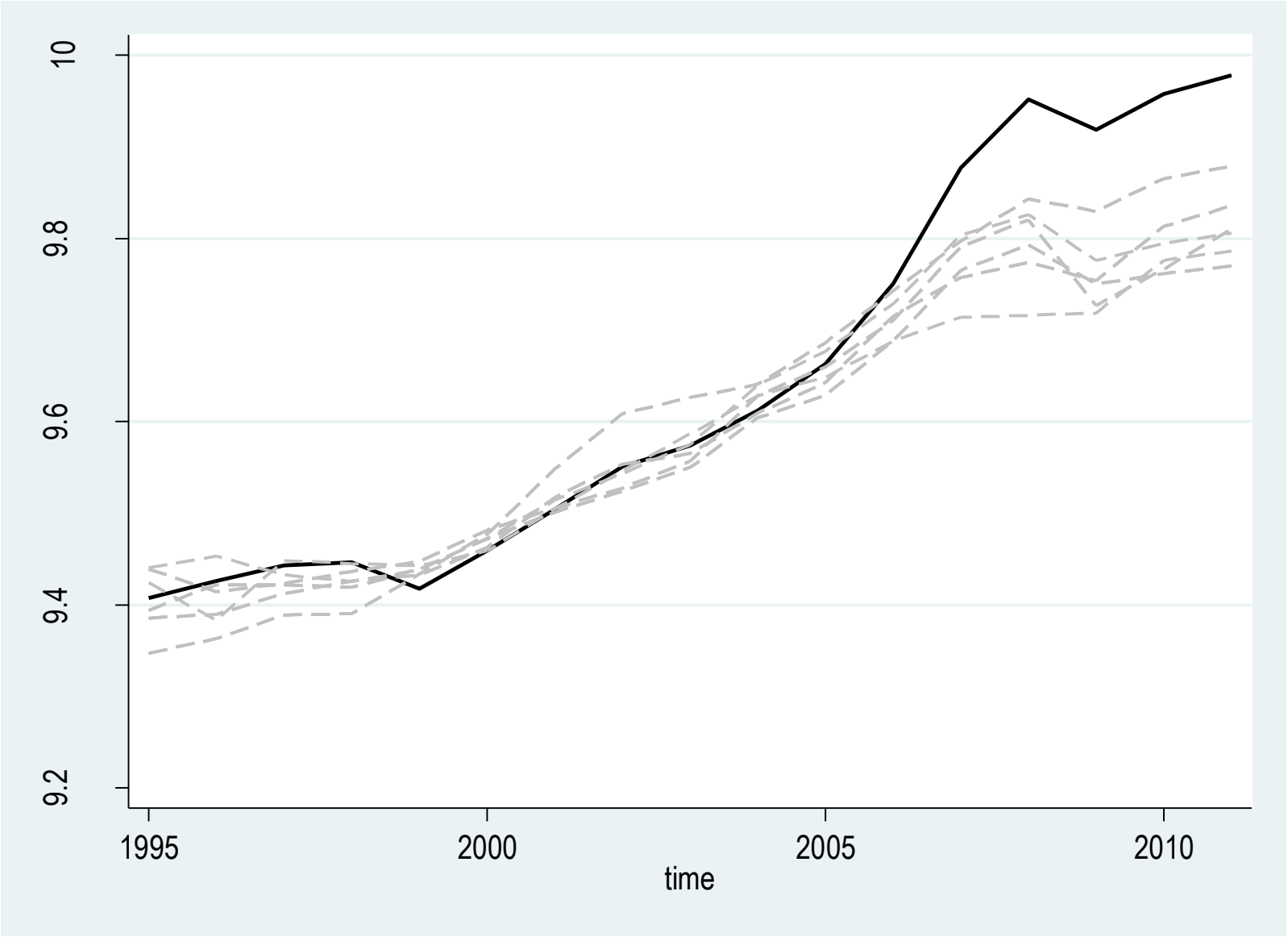
Robustness: Placebo in CZ

Co_No	Unit_Weight
JPN	.308
MYS	.13
NOR	.418
TJK	.143

	Treated	Synthetic
open	.6275041	.6268412
indu	38.08656	35.83458
csh_i	.2344716	.2342723
hc	3.325583	3.065933
lngdp	9.814233	9.805628



Robustness: SK vs more control groups



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: into the black box

- Fixed effect regression (12 New EU countries)
  - Real exchange rate cannot explain the whole variation in output
  - EURO has positive and sig. effect during the crisis, but out of the crisis as well
  - What exactly drives this effect?

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