International Risk Sharing in the EMU

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Question

Has adoption of Euro had impact on risk sharing across Euro Area?

- Unclear if/how a common currency alters shock absorption capacity
- Potential trade-off:
  - higher capital and credit market integration (at least pre-crisis)
  - loss of shock-absorption mechanism

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This paper

1. Build **counterfactual dataset** of macro variables for the Eurozone countries for the scenario of no adoption of the Euro
   - Synthetic control method: Abadie & Gardeazabal (2003)
2. Estimate **risk sharing channels** pre and post Euro with actual and synthetic data to evaluate effect of Euro adoption on risk sharing
   - Risk sharing channels: Asdrubali et al. (1996)
   - Difference in difference estimation

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Results Preview

We find that Euro adoption:

1. Has **decreased** shock absorption capacity of member states
2. **Heterogeneous** effect between core and periphery countries
   - No significant change in risk sharing ability for core
   - Decrease in risk sharing through credit markets for periphery

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Data and SCM

Data

- OECD National Account Statistics
- 22 countries of which 11 are Eurozone member states
- Time span 1990-2014: we match from 1990 to 1998

Synthetic control method

- Generate synthetic counterpart of GDP, NI, DNI, C, G
- Use a pool of potential controls

SCM

Risk Sharing Channels Decomposition

Asdrubali et al. (1996)

1. Start from the identity:

$$\text{GDP} \equiv \frac{\text{GDP}}{\text{NI}} \frac{\text{NI}}{\text{DNI}} \frac{\text{DNI}}{\text{DNI+G}} \frac{\text{DNI+G}}{\text{C+G}} (\text{C+G})$$

2. Take logs and first differences
3. Multiply by $\Delta \log GDP_{i,t}$ and take expectations

$$\begin{aligned} \text{Var}[\Delta \log GDP_{i,t}] \equiv\ & \text{Cov}[\Delta \log \text{GDP}_{i,t}, \Delta \log \text{GDP}_{i,t} - \Delta \log \text{NI}_{i,t}] \\ & + \text{Cov}[\Delta \log \text{GDP}_{i,t}, \Delta \log \text{NI}_{i,t} - \Delta \log \text{DNI}_{i,t}] \\ & + \text{Cov}[\Delta \log \text{GDP}_{i,t}, \Delta \log \text{DNI}_{i,t} - \Delta \log(\text{DNI}_{i,t} + \text{G}_{i,t})] \\ & + \text{Cov}[\Delta \log \text{GDP}_{i,t}, \Delta \log(\text{DNI}_{i,t} + \text{G}_{i,t}) - \Delta \log(\text{C}_{i,t} + \text{G}_{i,t})] \\ & + \text{Cov}[\Delta \log \text{GDP}_{i,t}, \Delta \log(\text{C}_{i,t} + \text{G}_{i,t})] \end{aligned}$$

4. Divide by $\text{Var}(\Delta \log \text{GDP}_{i,t})$ to get the **identity**

$$1 \equiv \beta^m + \beta^g + \beta^p + \beta^s + \beta^u$$

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Risk Sharing Channels Decomposition

- The identity can be estimated via OLS as

$$
\begin{aligned}
\Delta \log GDP_{i,t} - \Delta \log NI_{i,t} &= \beta^{m} \Delta \log GDP_{i,t} + \epsilon^{m}_{i,t} \\
\Delta \log NI_{i,t} - \Delta \log DNI_{i,t} &= \beta^{g} \Delta \log GDP_{i,t} + \epsilon^{g}_{i,t} \\
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\end{aligned}
$$

- Coefficients interpreted as fraction of income variations smoothed by:

$$
1 \equiv \underbrace{\beta^{m}}_{\text{int. capital markets}} + \underbrace{\beta^{g}}_{\text{international transfers}} + \underbrace{\beta^{p}}_{\text{public savings}} + \underbrace{\beta^{s}}_{\text{private savings}} + \underbrace{\beta^{u}}_{\text{unsmoothed}}
$$

$$
\begin{aligned}
\Delta \log \mathrm{GDP}_{i,t} - \Delta \log \mathrm{NI}_{i,t} &\rightarrow \text{net income from abroad} \\
\Delta \log \mathrm{NI}_{i,t} - \Delta \log \mathrm{DNI}_{i,t} &\rightarrow \text{international transfers} \\
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\Delta \log(\mathrm{C}_{i,t} + \mathrm{G}_{i,t}) &\rightarrow \text{unsmoothed share}
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Risk sharing channels

$$y_{i,t} = (\gamma_1 + \gamma_2 \mathbb{1}_{i=tr} + \gamma_3 \mathbb{1}_{year \geq 1999} + \gamma_4 \mathbb{1}_{i=tr} * \mathbb{1}_{year \geq 1999}) \Delta \log GDP_{i,t} + \nu_t + u_{i,t}$$

Table: OLS with clustered SE and time FE - sample period 1990-2014

$\mathbb{1}_{y \geq 1999}$	$\mathbb{1}_{i=tr}$	Capital Markets	Int Transfers	Public Savings	Private Savings	Unsmoothed
0	0	-0.05	0.07***	0.13***	0.29***	0.55***
		(-0.46)	(3.21)	(4.57)	(5.92)	(9.22)
1	1	**-0.07**	**0.02**	**0.01**	**-0.20***	**0.24*****
		(-0.46)	(0.47)	(0.11)	(-1.81)	(3.30)
N		528	528	528	528	528
R^2		0.18	0.14	0.62	0.46	0.95

▸ DD ▸ Robustness

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DD Robustness

Core vs Periphery Countries

Table: **Core** (Austria, Belgium, Finland, France, Germany, Netherlands)

$\mathbb{1}_{y\geq 1999}$	$\mathbb{1}_{i=tr}$	**Capital Markets**	**Int Transfers**	**Public Savings**	**Private Savings**	**Unsmoothed**
0	0	-0.20^{**}	0.08	0.21^{***}	0.40^{***}	0.50^{***}
		(-2.67)	(1.50)	(4.45)	(2.95)	(4.45)
1	1	-0.17	0.00	0.03	0.03	0.11
		(-1.32)	(0.02)	(0.61)	(0.16)	(0.95)
N		288	288	288	288	288
R^2		0.32	0.18	0.73	0.58	0.97

Table: **Periphery** (Greece, Ireland, Italy, Portugal, Spain)

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0	0	0.02	0.07^{**}	0.11^{***}	0.28^{***}	0.52^{***}
		(0.19)	(2.34)	(3.80)	(4.79)	(8.24)
1	1	0.02	0.03	0.01	$-$ **0.38*****	**0.32*****
		(0.13)	(0.65)	(0.28)	(-4.11)	(3.39)
N		240	240	240	240	240
R^2		0.22	0.19	0.59	0.51	0.95

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Conclusion

Question

+ Effect of the Euro on ability to share risk across member states?

Method

+ Build a counterfactual dataset through SCM
+ Decompose risk sharing channels
+ Assess the effect of Euro adoption through DD

Results

+ Ability of shock absorption has decreased with adoption of Euro
+ Heterogeneous effects between Core and Periphery
    - No change in risk sharing for Core
    - Decrease in risk sharing through private savings for Periphery

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Risk Sharing: Definition

- **Perfect Risk Sharing**
  1. Income shocks do not get transmitted to consumption
  2. Consumption and income growth are not correlated
- **International**: income shock smoothed across countries
- **National**: income shock smoothed within a country

Bootstrapped Standard Errors

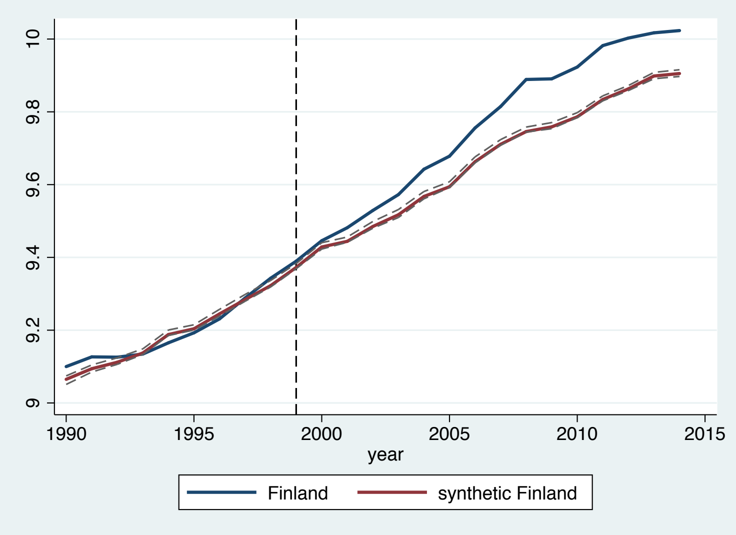

Figure: Consumption (Euro per capita)

Robustness Checks - Match on Differences

Table: OLS estimated risk sharing channels - Matched on first differences

$\mathbb{1}_{y\geq 1999}$	$\mathbb{1}_{i=tr}$	**Capital Markets**	**Int Transfers**	**Public Savings**	**Private Savings**	**Unsmoothed**
0	0	-0.10^{*}	0.05^{**}	0.12^{***}	0.41^{***}	0.52^{***}
		(-1.89)	(2.18)	(4.28)	(7.06)	(9.87)
0	1	0.01	-0.00	-0.01	0.01	-0.01
		(0.39)	(-0.29)	(-0.66)	(0.30)	(-0.21)
1	0	0.12^{**}	-0.04	-0.08^{**}	-0.11^{*}	0.11^{*}
		(1.97)	(-1.39)	(-2.30)	(-1.66)	(1.78)
1	1	0.00	-0.00	0.01	-0.09^{*}	0.08^{*}
		(0.10)	(-0.25)	(0.42)	(-1.90)	(1.87)
N		484	484	484	484	484
R^2		0.20	0.06	0.47	0.53	0.95

Back

Robustness Checks - Placebo Studies

Table: Placebo OLS estimated risk sharing channels

$\mathbb{1}_{y\geq 1999}$	$\mathbb{1}_{i=tr}$	**Capital Markets**	**Int Transfers**	**Public Savings**	**Private Savings**	**Unsmoothed**
0	0	-0.12^{*}	0.07^{***}	0.06^{***}	-0.08	1.06^{***}
		(-1.94)	(4.15)	(2.74)	(-1.04)	(14.91)
0	1	-0.07	-0.03	0.02	0.10	-0.02
		(-0.99)	(-1.39)	(0.66)	(1.08)	(-0.17)
1	0	0.12	0.01	0.01	0.11	-0.25^{**}
		(1.45)	(0.41)	(0.29)	(1.05)	(-2.53)
1	1	0.03	-0.01	-0.02	-0.02	0.02
		(0.33)	(-0.53)	(-0.46)	(-0.14)	(0.14)
N		420	420	420	420	420
R^2		0.17	0.15	0.57	0.31	0.93

Robustness Checks - Anticipation Effect

Table: OLS estimated risk sharing channels - Treatment in 1997

$\mathbb{1}_{y \geq 1999}$	$\mathbb{1}_{i=tr}$	**Capital Markets**	**Int Transfers**	**Public Savings**	**Private Savings**	**Unsmoothed**
0	0	-0.13	0.03	0.13^{***}	0.41^{***}	0.56^{***}
		(-1.54)	(1.14)	(3.27)	(4.15)	(6.03)
0	1	0.03	0.03	0.02	-0.03	-0.05
		(0.33)	(0.87)	(0.51)	(-0.30)	(-0.47)
1	0	0.11	-0.01	-0.05	-0.05	-0.00
		(1.18)	(-0.20)	(-1.25)	(-0.45)	(-0.01)
1	1	-0.01	-0.05	-0.04	-0.10	0.20^{*}
		(-0.05)	(-1.43)	(-0.89)	(-0.84)	(1.77)
N		462	462	462	462	462
R^2		0.26	0.14	0.69	0.57	0.96

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Robustness - Exclusion financial crisis

Table: OLS estimated risk sharing channels - Sample period 1990-2007

$\mathbb{1}_{y\geq1999}$	$\mathbb{1}_{i=tr}$	**Capital Markets**	**Int Transfers**	**Public Savings**	**Private Savings**	**Unsmoothed**
0	0	-0.02	0.04^{***}	0.14^{***}	0.34^{***}	0.50^{***}
		(-0.19)	(3.56)	(4.44)	(3.08)	(6.56)
0	1	-0.06	-0.01	0.00	0.06	-0.00
		(-0.37)	(-0.22)	(0.04)	(0.38)	(-0.00)
1	0	0.32^{**}	0.03	-0.14^{***}	-0.19	-0.03
		(2.18)	(1.11)	(-3.14)	(-1.54)	(-0.28)
1	1	-0.16	-0.05	0.02	-0.08	0.27^{***}
		(-0.96)	(-1.55)	(0.33)	(-0.60)	(3.09)
N		374	374	374	374	374
R^2		0.15	0.13	0.40	0.37	0.96

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Robustness - Exclusion of financial crisis

Table: **Core** (Austria, Belgium, Finland, France, Germany, Netherlands)

$\mathbb{1}_{y\geq 1999}$	$\mathbb{1}_{i=tr}$	**Capital Markets**	**Int Transfers**	**Public Savings**	**Private Savings**	**Unsmoothed**
0	0	-0.20**	0.08	0.21***	0.40**	0.50***
		(-2.66)	(1.49)	(4.43)	(2.94)	(4.43)
1	1	-0.23*	-0.08	0.03	0.14	0.14
		(-1.84)	(-1.21)	(0.47)	(0.87)	(1.17)
N		204	204	204	204	204
R^2		0.31	0.28	0.57	0.46	0.97

Table: **Periphery** (Greece, Ireland, Italy, Portugal, Spain)

$\mathbb{1}_{y\geq 1999}$	$\mathbb{1}_{i=tr}$	**Capital Markets**	**Int Transfers**	**Public Savings**	**Private Savings**	**Unsmoothed**
0	0	0.02	0.07**	0.11***	0.28***	0.52***
		(0.21)	(2.30)	(3.80)	(4.74)	(8.30)
1	1	-0.01	-0.08*	0.02	-0.18*	0.25*
		(-0.05)	(-2.07)	(0.60)	(-2.20)	(2.11)
N		170	170	170	170	170
R^2		0.26	0.28	0.38	0.46	0.97

Matrix V

- Positive definite and diagonal
- Minimises mean squared prediction error (MSPE) of the outcome variable in pre-intervention period

$$\min_{V} \quad (Y_1 - Y_0 W^*(V))'(Y_1 - Y_0 W^*(V))$$

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Existing Empirical Evidence on Euro Area Risk Sharing

- **Balli, Kalemli-Ozcan and Sorensen (2012)**
  - Estimate risk sharing channels among EMU, EU, and OECD countries
- **Kalemli-Ozcan, Luttin and Sorensen (2014)**
  - Estimate risk sharing channels for EU with focus on sovereign crisis
- **Furceri and Zdzienicka (2015)**
  - Risk sharing in EMU significantly lower than in US and in Germany
- **Poncela et al. (2016)**
  - Risk sharing dynamically across OECD countries with panel VAR

- These papers **do not carry out a counterfactual experiment**
- **No causal assessment** of effect of Euro adoption on member states

Synthetic Control Method: Literature

- **Abadie & Gardeazabal (2003)**
  - Study the effect of terrorism on Basque Country on per capita GDP

  Useful when no natural counterfactual exists, as for macro policies

- **Abadie, Diamond & Hainmueller (2010)**
  - Effect of California Tobacco Control Program on cigarette consumption
- **Billmeier & Nannicini (2012)**
  - Effect of economic liberalization on per capita GDP
- **Campos, Coricelli & Moretti (2014)**
  - Effect of joining the EU on per capita GDP
- **Saia (2016)**
  - Effect of not joining the Euro on UK-EMU trade volume

Risk Sharing Measure

When country fully shares risk:

- Idiosyncratic shocks to income are NOT transmitted to consumption

$$\text{Corr}(\Delta \log(C_i), \Delta \log(Y_i)) = 0$$

When country does not fully share risk:

- Idiosyncratic shocks to income are (at least) partially transmitted to consumption

$$\text{Corr}(\Delta \log(C_i), \Delta \log(Y_i)) > 0$$

Risk Sharing Measure

$$\text{Corr}(\Delta \log(C_i), \Delta \log(Y_i)) = \gamma_1 + \gamma_2 \mathbb{1}_{i=tr} + \gamma_3 \mathbb{1}_{year \geq 1999} + \gamma_4 \mathbb{1}_{i=tr} * \mathbb{1}_{year \geq 1999} + \epsilon_i$$

Table: γ_4 for $\text{Corr}(\Delta \log(C_i), \Delta \log(Y_i))$

All countries	Core	Periphery
0.14***	0.08	0.21***
(2.75)	(1.51)	(2.24)

- Sample period: 1990-2014.
- Core countries: Austria, Belgium, Finland, France, Germany, Netherlands.
- Periphery countries: Greece, Ireland, Italy, Portugal, Spain.

Further robustness

1. Anticipation of treatment to 1997 ▸ anticipation
2. Exclusion of the crisis period ▸ no crisis
3. Match on first differences of series ▸ first diff

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Synthetic Control Method

Goal: Generate synthetic counterpart of GDP, NI, DNI, C, G as weighted average of a pool of potential controls

- Before adoption of Euro, define:
  - K x 1 vector X_1 of variables of interest for each EA country
  - K x N matrix X_0 of same K variables for N non EA countries in our counterfactual pool
- Find vector W that solves

$$\min_{W} \quad (X_1 - X_0 W)' V (X_1 - X_0 W)$$

$$s.t. \quad w_j \geq 0 \quad \forall j \qquad \sum_j w_j = 1$$

V positive-def diagonal matrix representing relative importance of the different variables for the outcome variable

- Y_1^* counterfactual of Y_1 for EA countries *after* adoption of Euro

$$Y_1^* = Y_0 W^*$$

Matrix V
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Matrix V
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Synthetic Control Method: Weights for G

Controls	AT	BE	FI	FR	DE	GR	IE	IT	NL	PT	ES
AUS									14.8		
CA		6.3		3.1	17.8			37.9	20.4		33
DK	55.9	23.1		70.7			59.2		57.6		
JP	44.1	30.2		16.6	30.7	20.7			7.1		
KO						19.4	39.3			36.8	32.9
MX				3.2			1.5			15.6	9.3
NZ			46.7			59.9		30.3		7.6	
SWE		30.2	53.3	6.3	30.9			6.6		40	24.8
CH					10.5			18.8			
UK					10.2						
US		10.2						6.5			

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Assumption 1

Pre-treatment covariates approximate path of treated unit

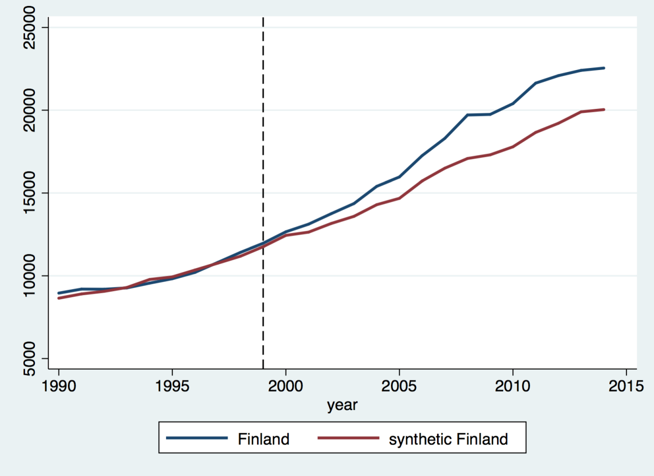

Figure: Consumption (Euro per capita)

Assumption 2

Control units are not affected by the treatment

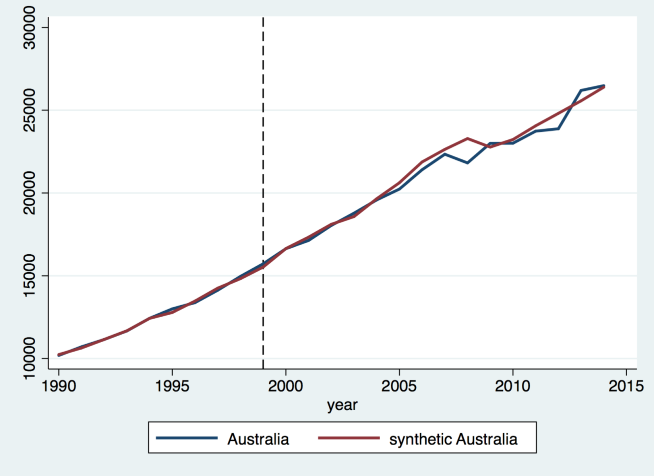

Figure: Consumption (Euro per capita)

Assumption 3 & 4

3. Pre treatment covariates do not include anticipation effects

- Matching up to 1997: results are robust
- Already conservative as use 1999 as adoption year (instead of 2001)
- If anticipation effects were present, SCM would deliver lower bound estimates as part of true treatment effect is not imputed to the treatment itself

4. Optimal weights do not change between pre and post treatment

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Difference in Difference

Each regression estimated as Difference in Difference:

$$y_{i,t} = (\gamma_1 + \gamma_2 \mathbb{1}_{i=tr} + \gamma_3 \mathbb{1}_{year \geq 1999} + \gamma_4 \mathbb{1}_{i=tr} * \mathbb{1}_{year \geq 1999}) x_{i,t} + \nu_t + u_{i,t}$$

- x_{it} independent variable: $\Delta \log GDP_{i,t}$
- y_{it} dependent variables
- $$\mathbb{1}_{i=tr} = \begin{cases} 1 & \text{if actual series} \\ 0 & \text{if synthetic series} \end{cases}$$
- $$\mathbb{1}_{year \geq 1999} = \begin{cases} 1 & \text{if year} \geq 1999 \\ 0 & \text{otherwise} \end{cases}$$
- ν_t: time fixed effects

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Parallel trends

Difference in Difference

Each regression estimated as Difference in Difference:

$$y_{i,t} = (\gamma_1 + \gamma_2 \mathbb{1}_{i=tr} + \gamma_3 \mathbb{1}_{year \geq 1999} + \gamma_4 \mathbb{1}_{i=tr} * \mathbb{1}_{year \geq 1999}) x_{i,t} + \nu_t + u_{i,t}$$

- x_{it} independent variable: $\Delta \log GDP_{i,t}$
- y_{it} dependent variables
- $$\mathbb{1}_{i=tr} = \begin{cases} 1 & \text{if actual series} \\ 0 & \text{if synthetic series} \end{cases}$$
- $$\mathbb{1}_{year \geq 1999} = \begin{cases} 1 & \text{if year} \geq 1999 \\ 0 & \text{otherwise} \end{cases}$$
- ν_t: time fixed effects

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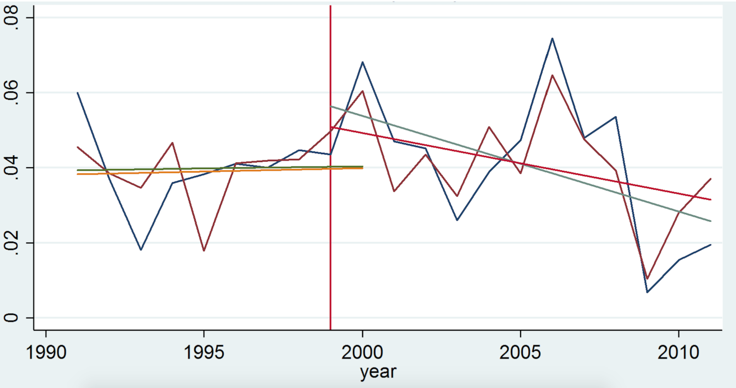
Parallel trends

Parallel Trend Assumption

Figure: $\Delta \log(C+G)$ for actual (blue) and synthetic (red) series



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Potential explanation

- With euro, periphery countries able to borrow at lower interest rate
- Private borrowing increases $\rightarrow$ C increases
- Less able to smooth income shocks

Bias Correction

- Synthetic variable $\tilde{x}$ with error u

$$\tilde{x} = x + u \quad \text{with } \mathrm{Cov}(\tilde{x}, u) = \lambda$$

- Estimate measurement error using
  - Placebo data
  - Pre-treatment period, under assumption of time invariance
- Correct point estimates