Bank leverage and the tax advantage of debt

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Research question

How does the preferential tax treatment of debt affect bank leverage?

Most countries allow firms to deduct interest expenses from taxable income

Tax codes thereby incentivize debt financing over equity financing

Financial stability concerns, especially owing to bank leverage

A senseless subsidy

Most Western economies sweeten the cost of borrowing. That is a bad idea

Financial Times Global Economy + Add to myFT

Developed nations urged to end bias towards debt-based finance

OECD report shows harmful effects of borrowing contrasts with boost provided by equity finance

Banks are predominantly debt-financed

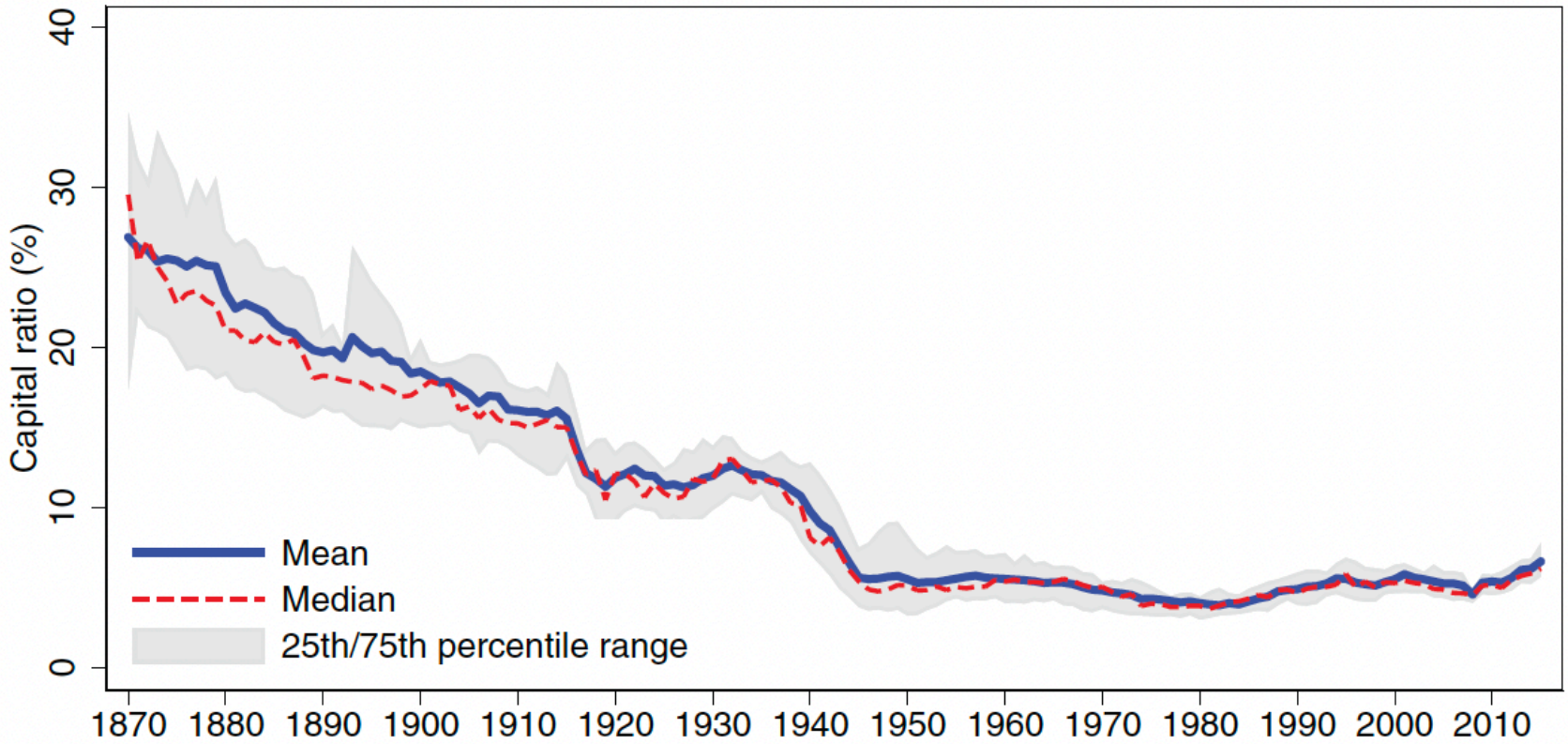


FIGURE 1

Capital ratio, averages by year for 17 countries, full sample.

Richter et al. 2021. Bank capital redux: solvency, liquidity, and crisis. RESTUD, 88(1).

What we do and *preview of findings*

1. We derive a comprehensive measure of the tax advantage of debt based on a banking-model with various tax shield determinants (corporate tax rate, limits to interest expense deductibility, allowances for corporate equity, and bank levies)

2. We compile a novel dataset that allows us to empirically measure the tax advantage of debt for advanced economies from 1870 to 2017

3. We estimate that a 1 percentage point (ppt) increase in the debt tax shield elicits a bank capital ratio response in the −0.5 to −0.25 ppt range

4. A historical accounting analysis indicates that the debt tax shield can account for 19% to 38% of the C20th decline in bank capital ratios

Outline

Model framework

One-period banking model with debt tax shield (Boot and de Vries, 2024)

- Debt tax shield originates from corporate tax rate, limits to interest expense deductibility, allowances for corporate equity, and bank levies

Shareholder value maximizing bank with balance sheet normalized to 1

- At time zero, bank decides how much equity, k, and debt, $1 - k$, to use to finance an investment project that returns s
- Debt financing incurs an interest expense, $i(1 - k)$
- At time one the bank liquidates, with all proceeds distributed to its financiers – equity holders and depositors
- Equity-debt tradeoff rendered pertinent by quadratic intermediation cost, which reflects costs associated with high leverage, such as regulatory penalties, creative accounting costs, market-enforced risk premiums (Huizinga et al. 2008; Gerali et al., 2010; Goldback et al., 2021)

Banking model

Bank's objective function:

$$\max_k \left\{ \left[(1-\tau)[s-\Gamma(k)] - \underbrace{(\mathsf{i}+\lambda)(1-k)}_{\substack{\textit{interest expense} \\ \textit{incl. bank levy}}} + \underbrace{\tau\beta\mathsf{i}(1-k)}_{\substack{\textit{interest expense} \\ \textit{deduction}}} + \underbrace{\tau\eta k}_{\substack{\textit{allowance for} \\ \textit{corp. equity}}} + k \right] \frac{1}{1+\mathsf{i}} - k \right\}$$

- τ corporate tax rate
- s investment project return
- $\Gamma = \frac{1}{2}\gamma(k^* - k)^2$ leverage cost
- k capital ratio (equity/total assets)
- k^* optimal capital ratio wo/ taxation
- i interest rate
- λ bank levy
- $(1-k)$ debt (BS normalized to 1)
- β deductible interest fraction
- η notional equity return

First order condition:

$$\underbrace{(1-\tau)\gamma(k^*-k)}_{\text{MC of leverage}} = \underbrace{\tau(\beta\mathsf{i}-\eta)-\lambda}_{\text{MB of leverage}}$$

Optimal bank capital ratio w/ taxation

$$k = k^* - \frac{1}{\gamma} S \tag{1}$$

- $S \equiv \frac{\tau(\beta i - \eta) - \lambda}{1 - \tau}$ effective debt tax shield

Claim 1

$$\frac{dk}{dS} = -\frac{1}{\gamma} < 0$$

Bank leverage increases in the debt tax shield for $\gamma > 0$.

Claim 2

The full tax advantage of debt is determined by the following interaction:

$$S \equiv \frac{\tau(\beta i - \eta) - \lambda}{1 - \tau}$$

Component derivatives

Outline

Data

Time series for the five **components of the tax shield** variable $S \equiv \frac{\tau(\beta i - \eta) - \lambda}{1-\tau}$:

corporate tax rate (τ), interest rate (i), taxes on bank debt (λ), limitations on interest expense deductibility (β), extension of tax-deductibility to dividend payments (η)

Data sources

law texts, government publications, national tax histories

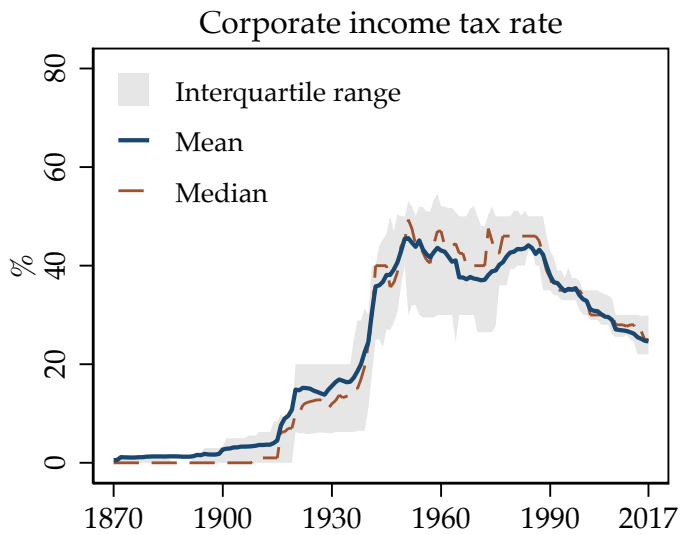
after 1950: OECD Tax Database, University of Michigan's World Tax Database, PWC Worldwide Tax Summaries

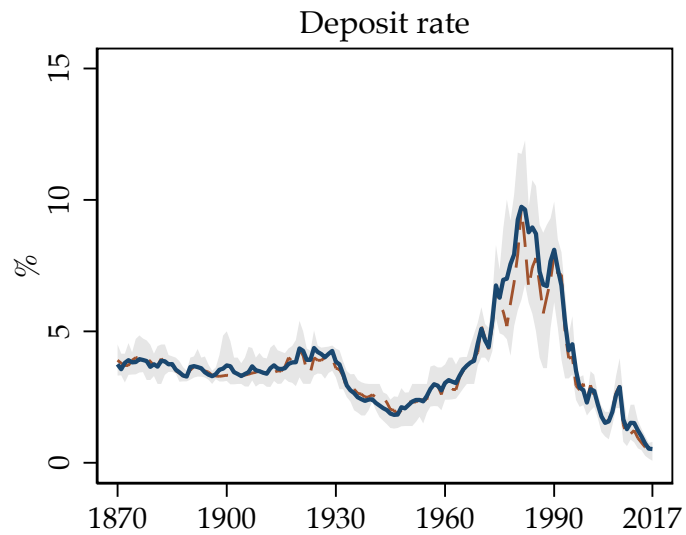
Final dataset: 1870 to 2017, annual, 17 advanced economies

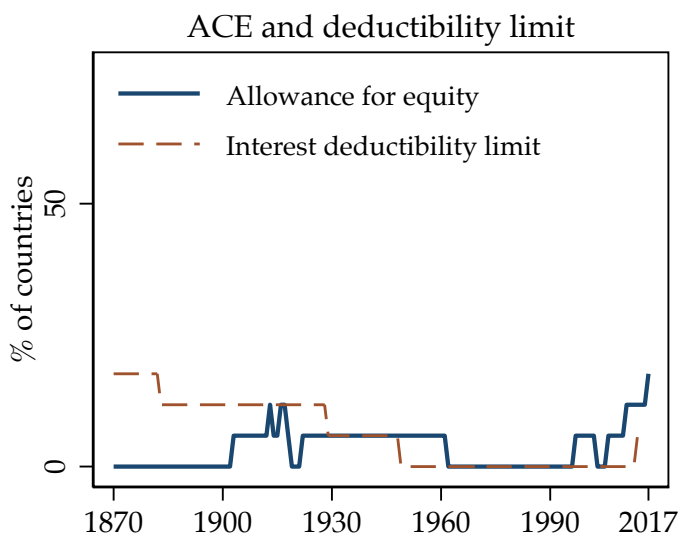
Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK, USA

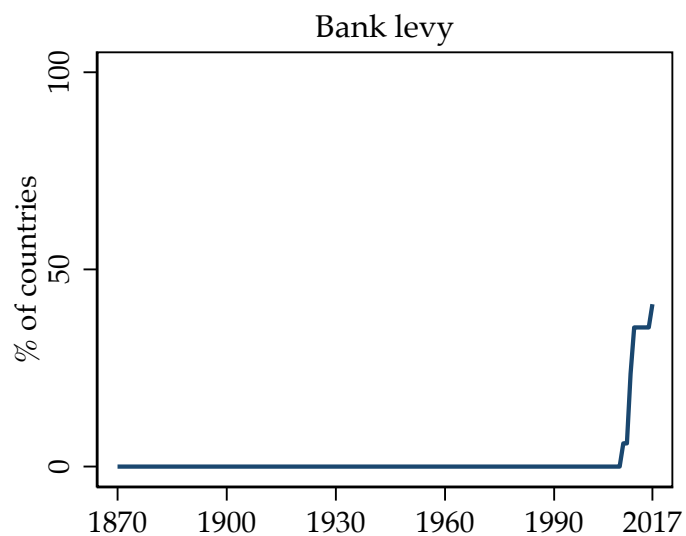
Bank adjustments

Components of banks' debt tax shield



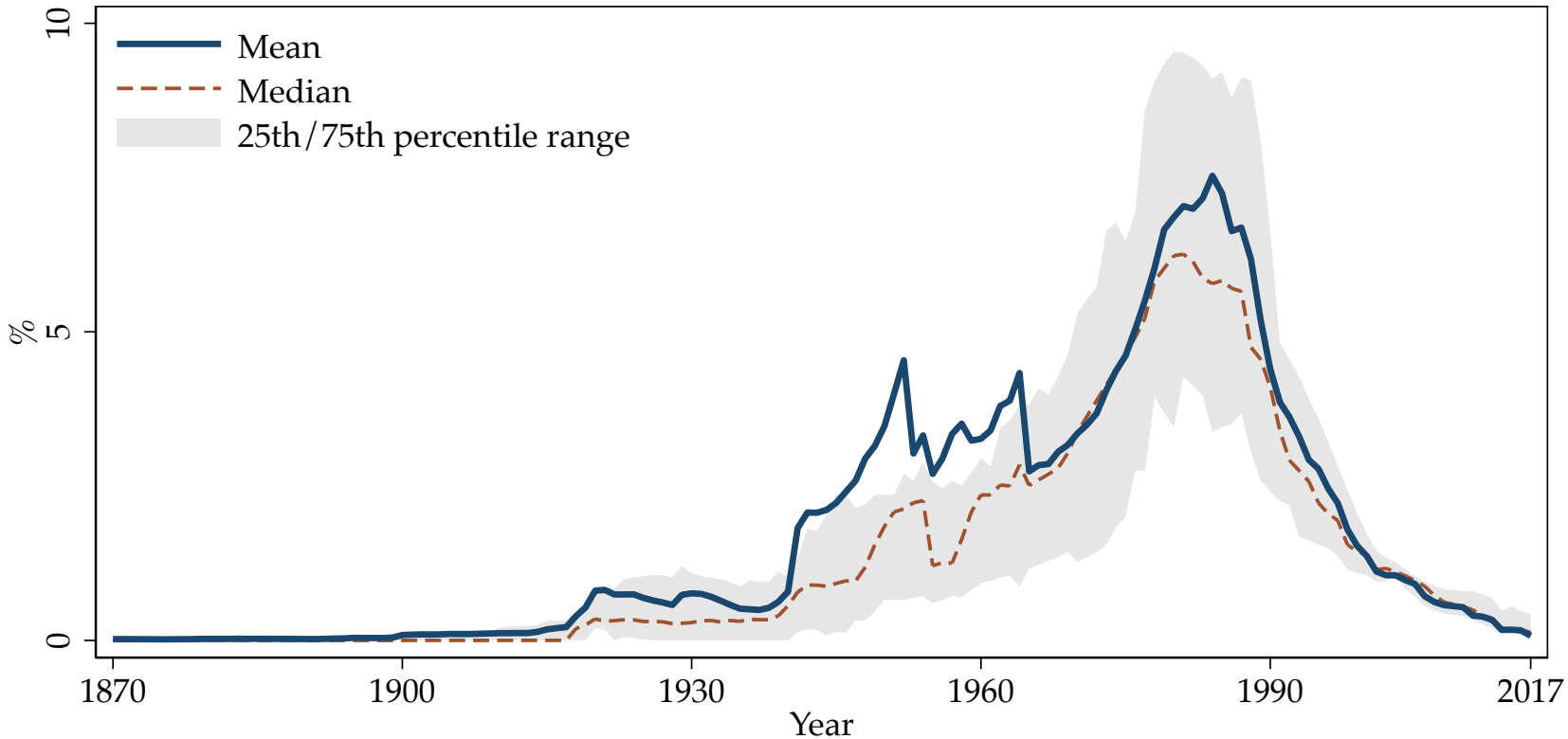






Banks' debt tax shield

Figure: Banking sector debt tax shield in advanced economies



Outline

Local projections

We estimate cumulative impulse response functions ($h = 0, ..., 5$)

$$\Delta^h k_{t+h,i} = \beta_0^{h,i} + \sum_{l=0}^{L} \beta_1^{h,l} \, \Delta S_{t-l,i} + \sum_{l} \beta_2^{h,l} X_{t-l,i} + u_{t+h,i} \tag{2}$$

- $k_{t,i}$: outcome of interest (bank capital ratio, bank capital, total assets)
- $\Delta S_{t,i}$: change in the debt tax shield
- $X_{t,i}$: a vector of control variables
- $\beta_0^{h,i}$: country-specific constants
- $u_{t+h,i}$: error term

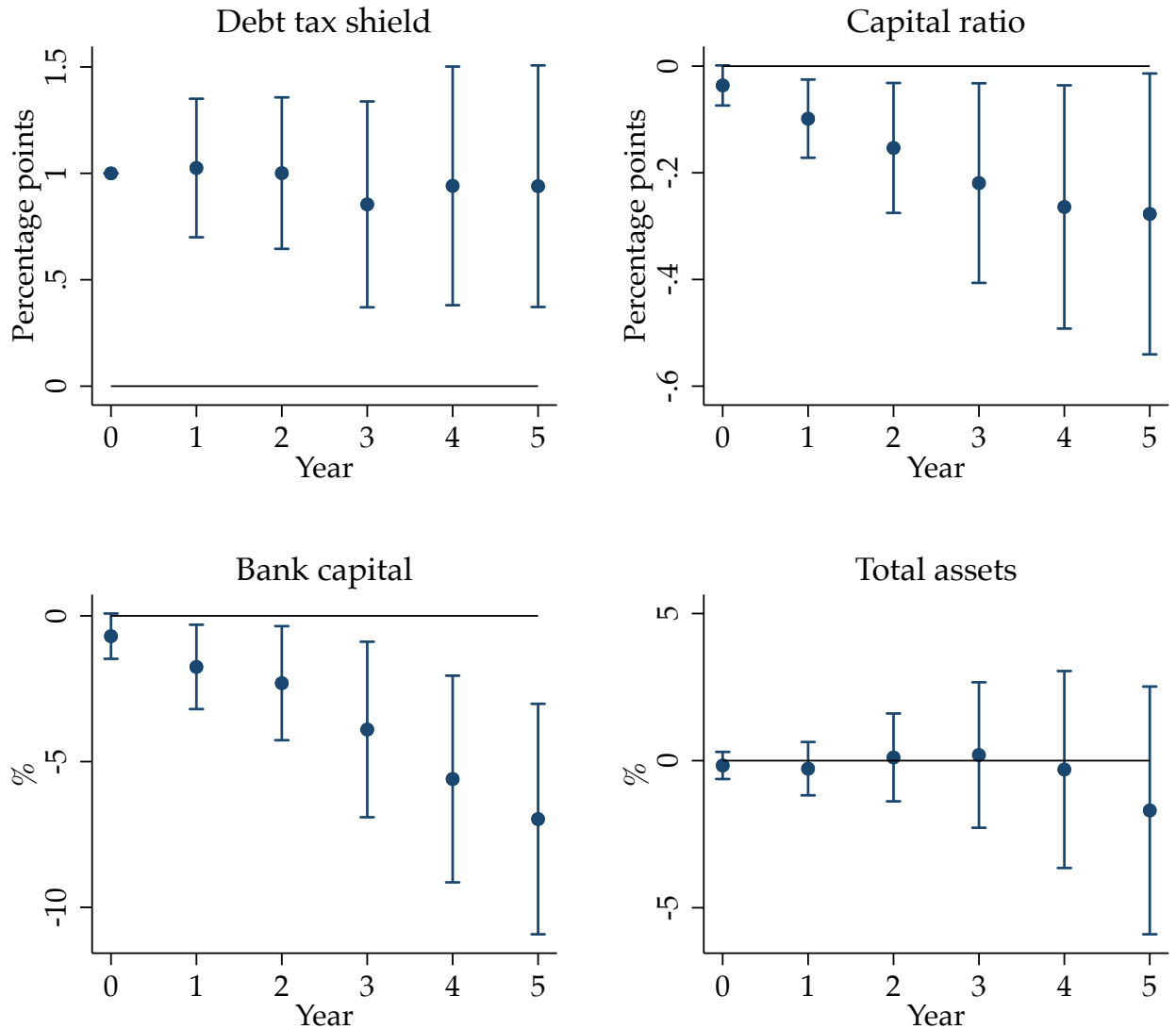
Interpretation of results:

$\{\beta_1^{h,0}\}_{h=0}^{5}$ cumulative response to a 1 ppt increase in S.

$\beta_1^{5,0}$ can be interpreted as an estimate of $\frac{dk}{dS} = -\frac{1}{\gamma}$ (Claim 1), because by year five ($h = 5$) the transition dynamics have usually played themselves out

Controls

Capital ratio response to 1 ppt debt tax shield increase



Subsample results | Individual components | Identification challenges

State-dependencies and asymmetries

- **Asymmetrically binding capital constraints**: ✓

  Hypothesis: in weakly capitalized banking systems, capital ratios are less responsive to shield hikes because banks' capital constraints are binding

- **Leverage ratchet effect**: ↯

  Hypothesis: bank leverage increases with shield hikes but does not decrease with shield cuts, because in a limited liability environment benefits of deleveraging accrue primarily to debt-holders, whereas the increase in retained earnings that accompanies deleveraging implies lower shareholder dividends

- **Capital account openness and debt shifting**: ✓

  Hypothesis: a tax shield increase causes a larger bank leverage increase in economies with an open capital account because local shield increases incentivize multinational banks to borrow locally on behalf of foreign affiliates

Capitalization | Ratchet effect | Openness

Outline

For how much leverage can the debt tax shield account for?

Estimate range: $\frac{dk}{dS} \in [-0.5; -0.25]$

Table: Contribution of the tax advantage of debt to bank capital ratios

	Tax shield increase		*Tax shield decrease*
	1870–1980s	1913–1980s	1980s–2010s
Actual Δk (ppts)	-20	-10	2.5
Predicted Δk (ppts)	-1.875 to -3.75	-1.875 to -3.75	1.875 to 3.75
	9% to 19%	19% to 38%	75% to 150%

Conclusion

Novel debt tax shield measure for banks reveals an inverse U-shaped pattern over the past one and a half centuries

New effect size estimates for the long run at the macro level suggest that policies that lower the debt tax shield (ACE, TCR, bank levies) are effective at lowering bank leverage

Historical accounting exercise suggests the debt tax shield was an important contributor to the C20th decline in bank capital ratios

Thank you for your attention

Appendix

Banking sector-specific corporate income tax rate series

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Steuersätze

(1) Die Körperschaftsteuer beträgt vorbehaltlich der Absätze 2 und 3

1. 60 vom Hundert des Einkommens bei
   a) Kapitalgesellschaften (Aktiengesellschaften, Kommanditgesellschaften auf Aktien, Gesellschaften mit beschränkter Haftung, Kolonialgesellschaften, bergrechtliche Gewerkschaften),

⋮

(3) Die Körperschaftsteuer beträgt 30 vom Hundert des Einkommens

1. bei Kreditanstalten des öffentlichen Rechts für Einkünfte aus dem langfristigen Kommunalkredit-, Realkredit- und Meliorationskreditgeschäft;
2. bei privaten Bausparkassen für Einkünfte aus dem langfristigen Realkreditgeschäft;
3. bei reinen Hypothekenbanken;
4. bei gemischten Hypothekenbanken für die Einkünfte aus den im § 5 des Hypothekenbankgesetzes genannten Geschäften;
5. bei Schiffspfandbriefbanken.

Körperschaftsteuergesetz, 1954

Germany, 1949-1980 reduced rate of 30% applies to public credit- and mortgage-banks

Art. 90.

Aliquote

L'imposta si applica con le aliquote seguenti:

Categoria *A*	22%
Categoria *B*	18%
Categorie *C/1* e *C/2*	8%

Le aliquote sono ridotte alla metà per le prime 720.000 lire annue dei redditi imponibili delle categorie *B*, *C/1* e *C/2* delle persone fisiche e dei soggetti indicati nel terzo comma dell'articolo precedente. Per i redditi di lavoro subordinato classificati in categoria *C/2* la riduzione si applica in ciascun periodo di paga in ragione di lire 720.000 ragguagliate ad anno.

Ove concorrano redditi mobiliari di categorie diverse, la riduzione non può applicarsi su un ammontare complessivo eccedente lire 720.000 annue da imputarsi nell'ordine ai redditi delle categorie *C/2*, *C/1* e *B*.

L'aliquota è ridotta alla metà sulle quote di reddito delle aziende ed istituti di credito che vengano destinate a riserva legale o statutaria in eccedenza al ventesimo dell'utile di bilancio.

Teso Unico delle leggi sulle imposte dirette, 1958

Italy, 1958-1973: halving of 18% rate applies to most credit institutions

Back

Control variables

Variables commonly included in empirical analyses of capital structure (e.g. Hemmelgarn and Teichmann, 2014; Gu et al., 2015; de Mooij and Keen, 2016)

Macroeconomic:

- real GDP growth
- CPI inflation

Financial:

- bank profitability
- financial crisis dummy
- total loan growth
- equity return premium
- capital ratio (lags)

Institutional:

- deposit insurance
- lender of last resort
- deviation from regulatory capital requirement x ΔS
- excess profit- and war-taxes

International:

- global GDP growth and inflation
- S^{diff} x capital account openness (international debt shifting spillovers)

Sources: JST Macrohistory Database, World Bank's Banking Regulation and Supervision Survey, Bordo et al. 2001, Quinn et al., 2011

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Subsample results

Table: Temporal and regional subsamples

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Post-Bretton Woods	-0.01	-0.08	-0.20*	-0.35*	-0.44*	-0.50*
	(0.05)	(0.08)	(0.12)	(0.17)	(0.21)	(0.26)
Bretton Woods	-0.02	-0.08	-0.18*	-0.31*	-0.38*	-0.42*
	(0.04)	(0.06)	(0.10)	(0.14)	(0.18)	(0.22)
Pre-WW2	0.01	-0.23	-0.34	-0.55	0.09	0.08
	(0.16)	(0.29)	(0.39)	(0.48)	(0.50)	(0.49)
Northwestern Europe	-0.04*	-0.10*	-0.15*	-0.21*	-0.26*	-0.27*
	(0.02)	(0.04)	(0.07)	(0.10)	(0.12)	(0.14)
Scandinavia	-0.03	-0.08	-0.18*	-0.30*	-0.41*	-0.44*
	(0.05)	(0.07)	(0.09)	(0.13)	(0.16)	(0.20)
Southern Europe	0.01	-0.06	-0.19	-0.36*	-0.47*	-0.49*
	(0.06)	(0.09)	(0.13)	(0.17)	(0.19)	(0.21)
Asia-Pacific	-0.13	-0.22	-0.36	-0.72*	-0.87	-0.91
	(0.09)	(0.16)	(0.27)	(0.41)	(0.54)	(0.63)

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Model with added regulatory detail: policy predictions

Claim 3

$$\frac{dk}{d\tau} = -\frac{(\beta i - \eta - \lambda) + \rho}{\gamma(1-\tau)^2} < 0 \quad \text{for} \quad (\beta i - \eta - \lambda) > -\rho$$

$$\frac{dk}{di} = -\frac{\tau\beta}{\gamma(1-\tau)} \leq 0$$

$$\frac{dk}{d\eta} = \frac{\tau}{\gamma(1-\tau)} > 0$$

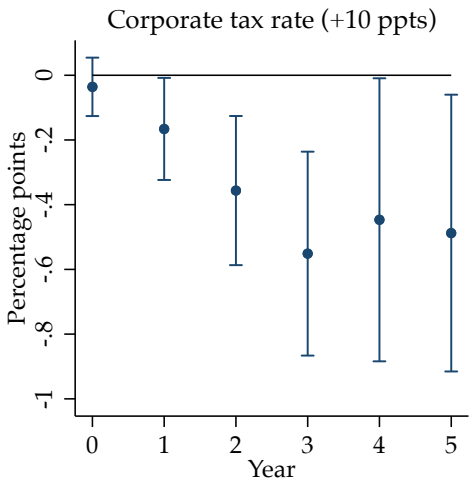
$$\frac{dk}{d\beta} = -\frac{\tau i}{\gamma(1-\tau)} < 0$$

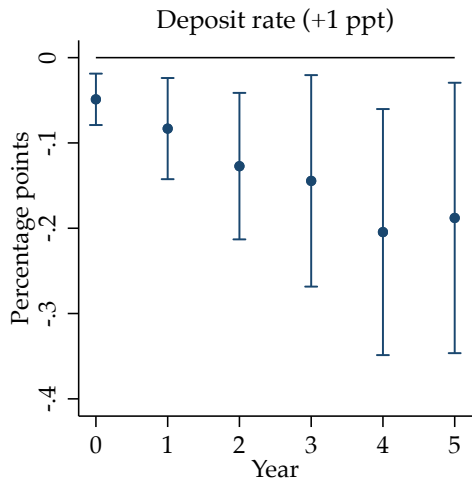
$$\frac{dk}{d\lambda} = \frac{1}{\gamma(1-\tau)} > 0$$

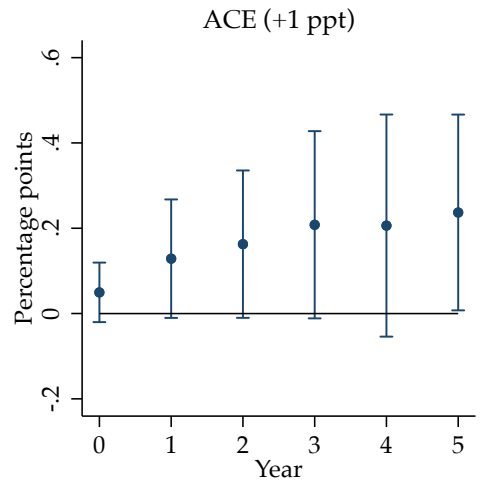
An increase in bank capital ratio can be elicited by a decrease in the corporate tax rate, a decrease in the interest rate, an increase in the deductible equity return, a decrease in the interest expense deductibility limit, and an increase in the bank levy.

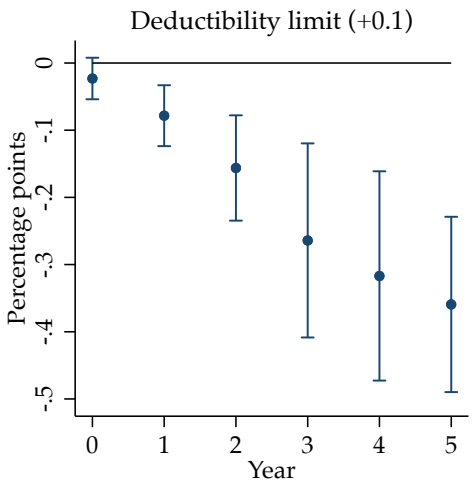
Back (model) Back (results)

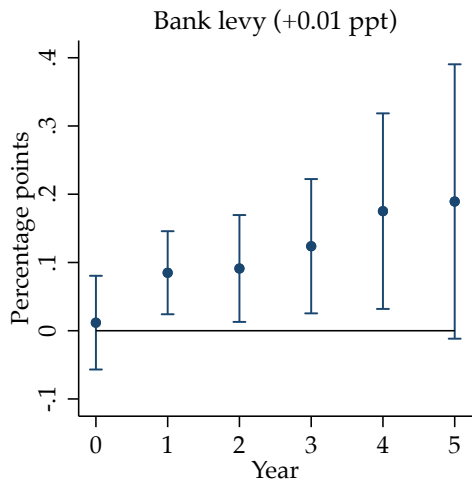
Capital ratio response to individual policies accords with theory











Model sign predictions: $\frac{dk}{d\tau} < 0$, $\frac{dk}{di} \leq 0$, $\frac{dk}{d\eta} > 0$, $\frac{dk}{d\beta} < 0$, $\frac{dk}{d\lambda} > 0$

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Identification challenges

1. **Anticipation effect**: w/ capital adjustment cost it is optimal to adjust capital ratios gradually in anticipation of shield change (Boryachenko & Müller, 2019)

   Pre-event analysis
   IPW estimator

2. **Correlated impulses**: fiscal reforms that affect debt tax shield could be correlated with other economic developments; main safeguard: saturated control vector

   IV estimator

3. **Simultaneity**: bank levies (λ), ACE (η), and limits on interest deductibility (β) targeted at levelling playing field between debt and equity financing; no serious reverse causality concern for interest rate (i) and corporate income tax rate (τ)

   wo/ η, β, or λ
   IPW estimator

4. **Functional form**: linear projection setup (2) grounded in linear optimality condition (1); optimality condition nonlinear for other leverage cost functions.

   Nonlinear spec.

5. **Measurement error**: countries with important regional corporate income tax component pose measurement concern (CAN, CHE, DEU, JPN, USA)

   IV estimator
   Subsample analysis

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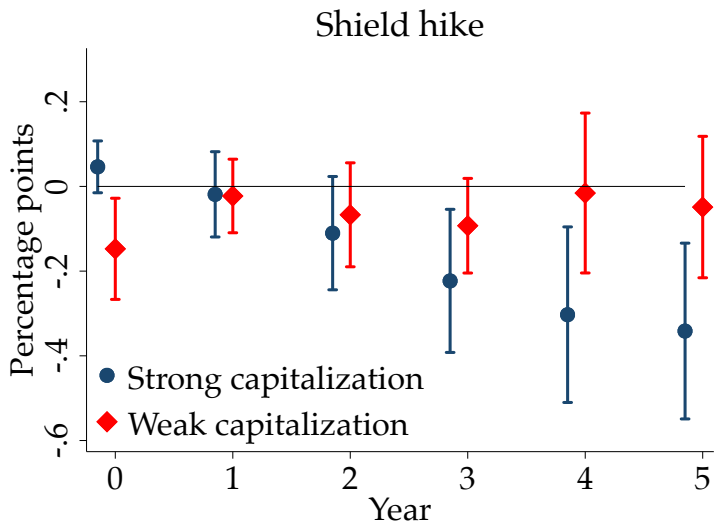
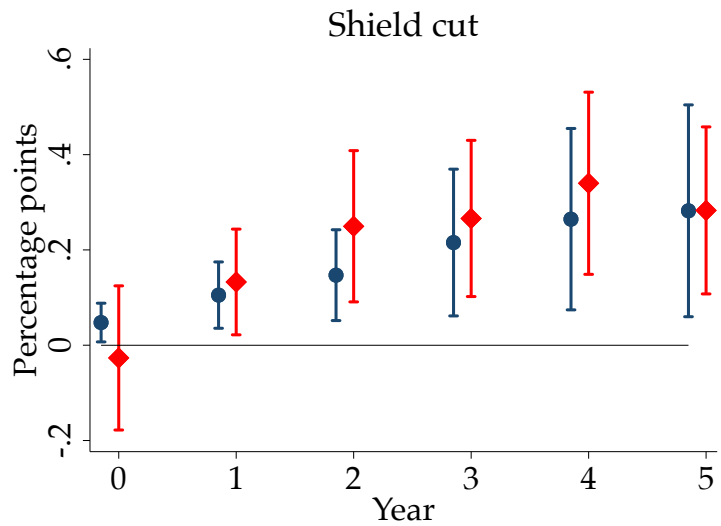
Asymmetrically binding capital constraints





	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Shield hike difference	0.19	0.00	-0.04	-0.13	-0.29	-0.29
Strong=weak (p-value)	0.01	0.95	0.63	0.23	0.09	0.06
Shield cut difference	-0.07	0.03	0.10	0.05	0.08	0.00
Strong=weak (p-value)	0.39	0.68	0.28	0.66	0.58	1.00

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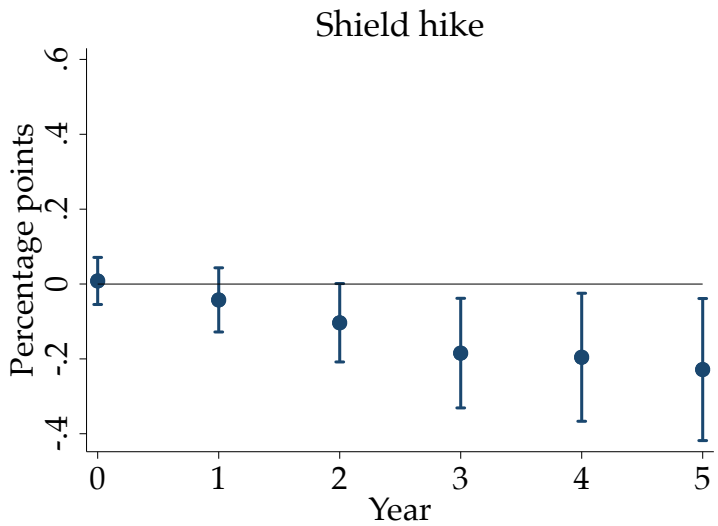
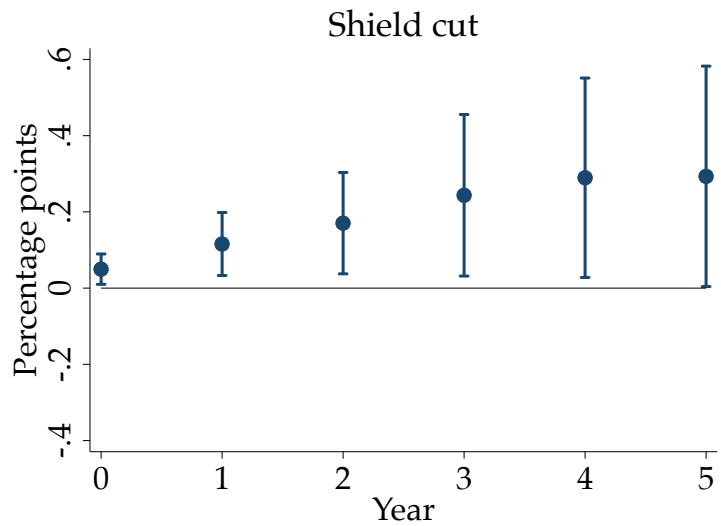
Leverage ratchet effect





	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Difference	0.06	0.07	0.07	0.06	0.09	0.06
Hike=cut (p-value)	0.06	0.06	0.25	0.50	0.42	0.62

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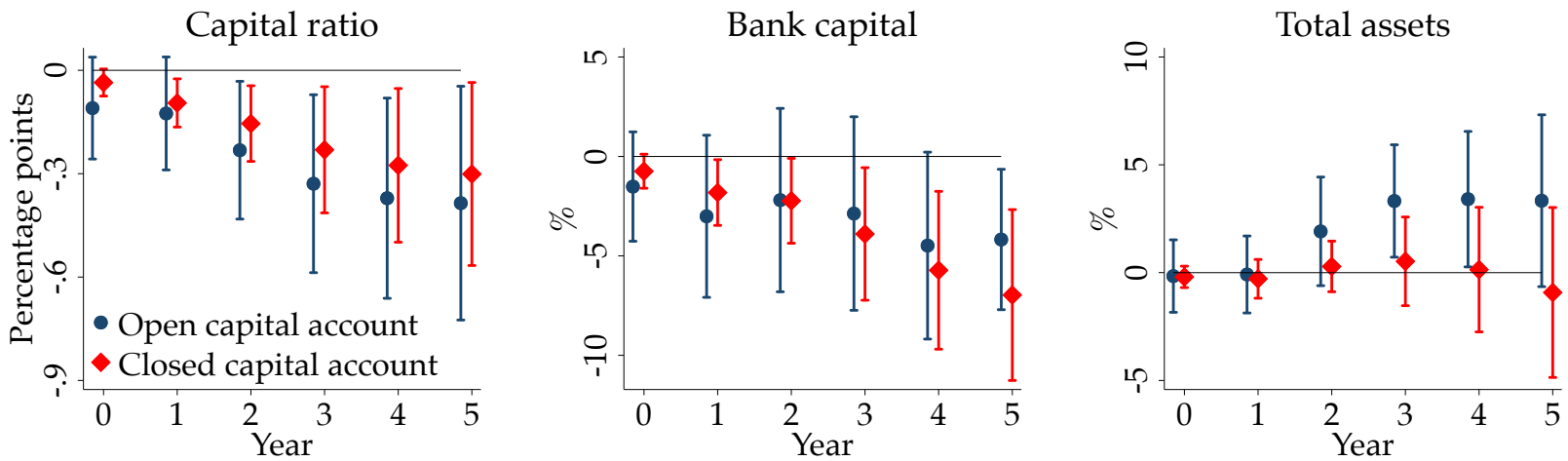
Capital account openness and debt shifting



	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital ratio difference	0.07	0.03	0.08	0.10	0.10	0.08
Open=closed (p-value)	0.35	0.72	0.42	0.38	0.43	0.51
Bank capital difference	0.77	1.19	-0.04	-1.03	-1.24	-2.79
Open=closed (p-value)	0.59	0.57	0.99	0.64	0.61	0.27
Total assets difference	-0.04	-0.20	-1.63	-2.80	-3.27	-4.26
Open=closed (p-value)	0.97	0.80	0.17	0.02	0.02	0.03

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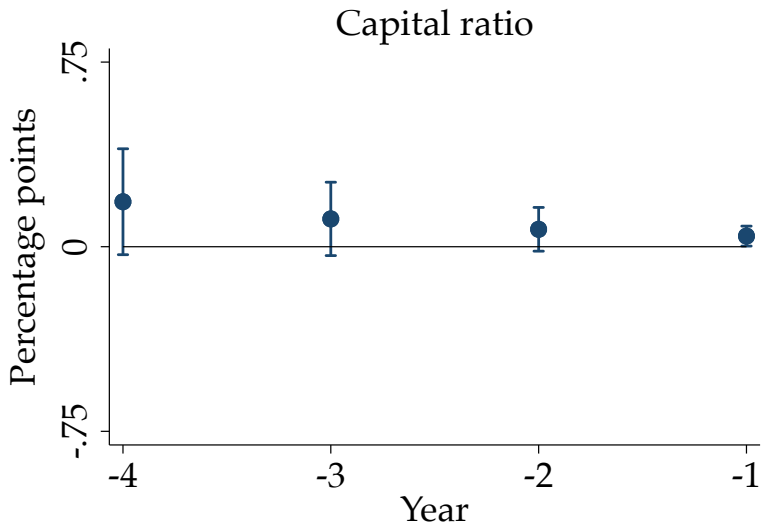
Pre-event analysis



Notes: Cumulative growth rate prior to a +1 ppt change in the tax advantage of debt.

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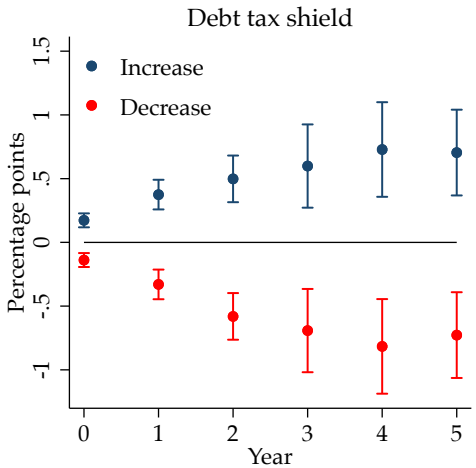
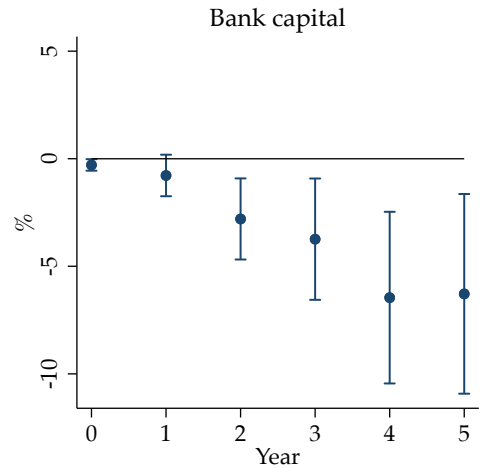
Inverse probability weighting à la Angrist et al., 2018

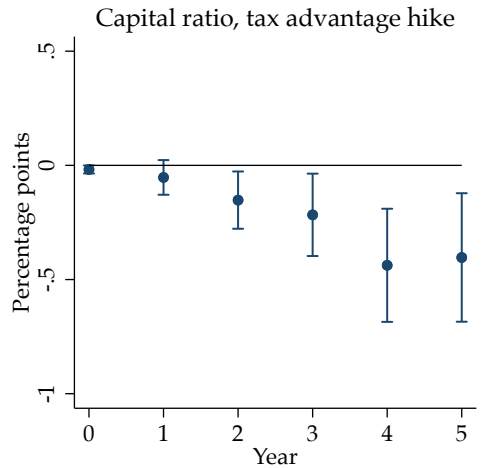
Shock and capital ratio:

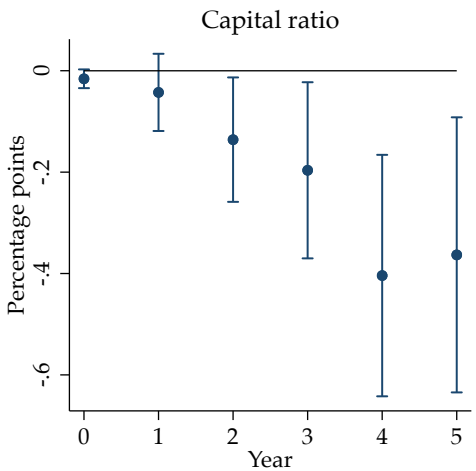


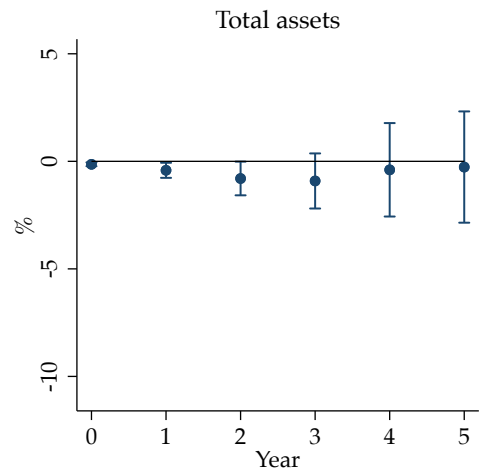
Capital versus assets:

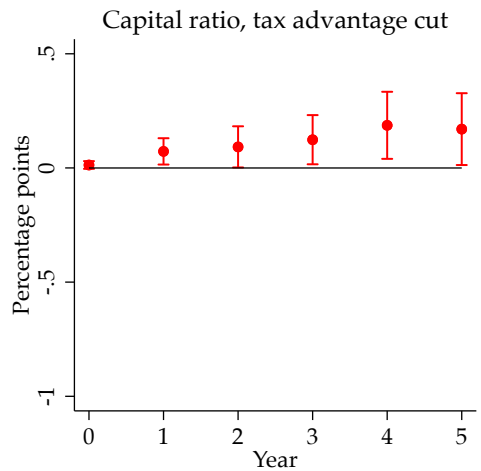


Hike versus cut:









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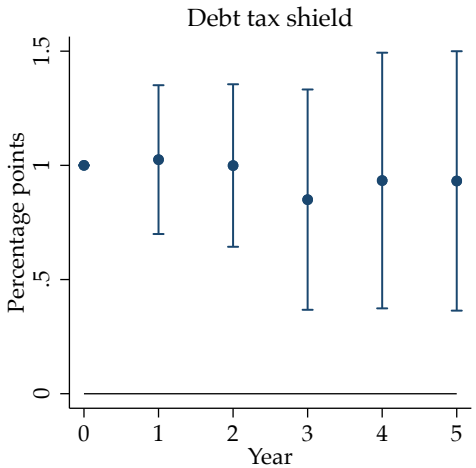
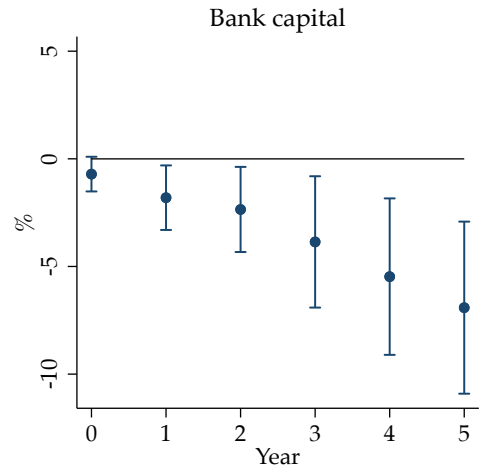
No ACE-, interest deductibility limit-, and bank levy-changes

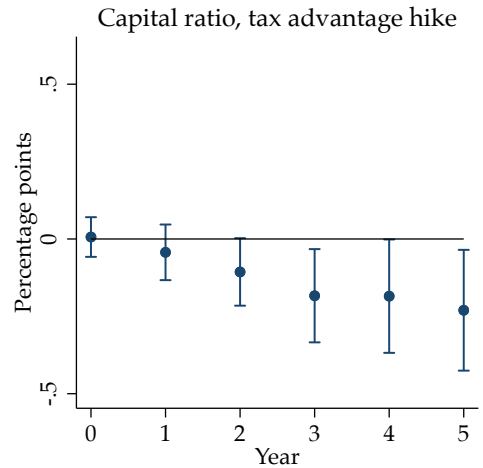
Shock and capital ratio:

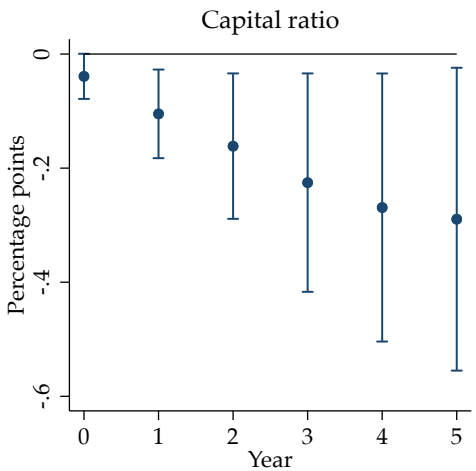


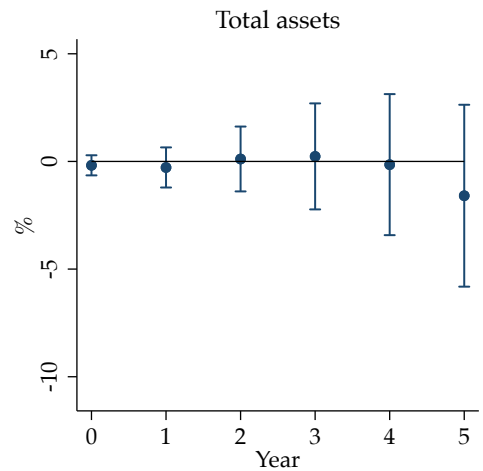
Capital versus assets:

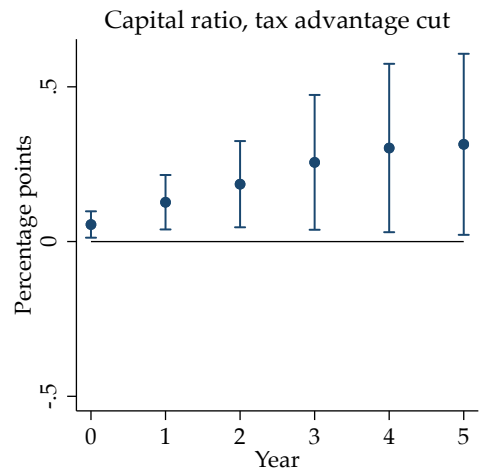


Hike versus cut:









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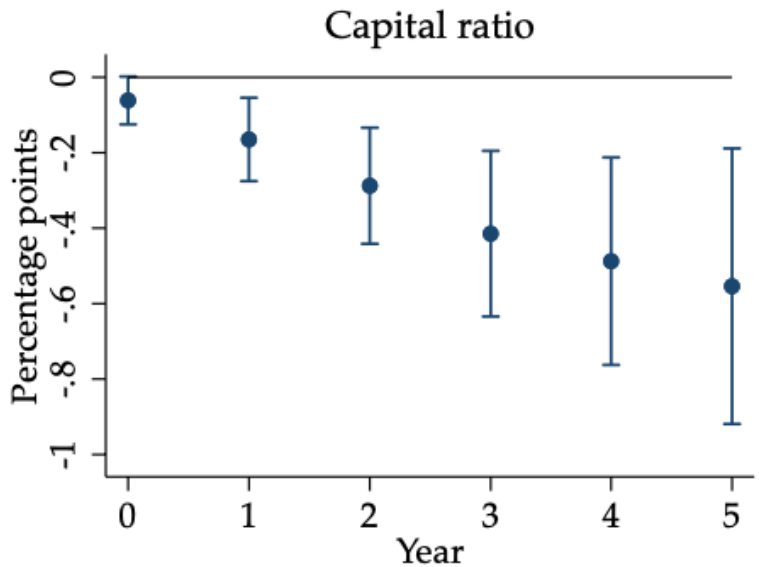
IV estimator

Instrumental variable: *peer pressure* for fiscal reform originating from other countries, $\frac{1}{N}\sum_{j\neq i}\Delta^c S_{j,t} KAOPEN_{j,t},\ c = 1, 2$

	First stage
$\Delta^1 S^{glo}$	0.63***
	(0.12)
$\Delta^2 S^{glo}$	-0.33***
	(0.10)
F-statistic	13.34
Observations	2468



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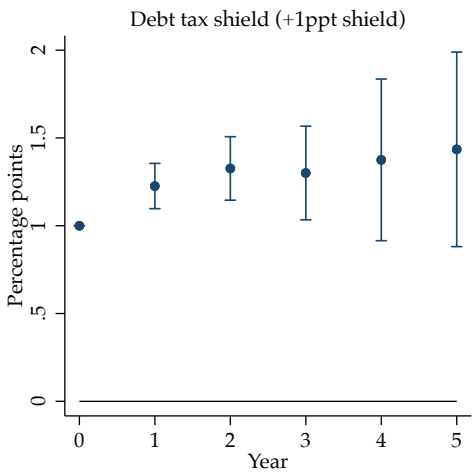
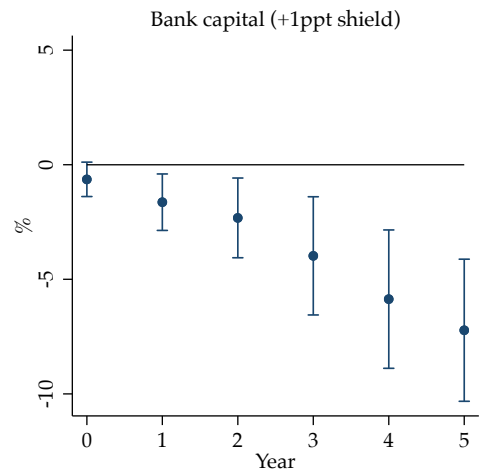
Nonlinear optimality condition

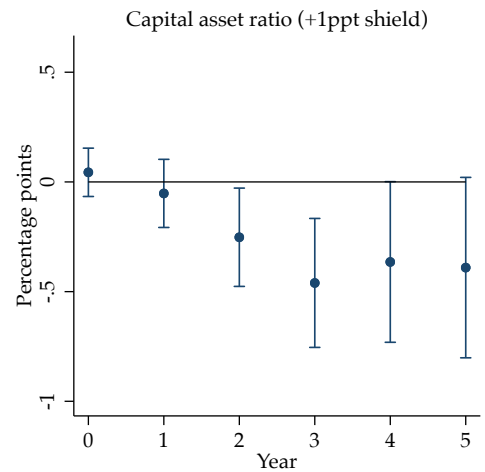
Shock and capital ratio:

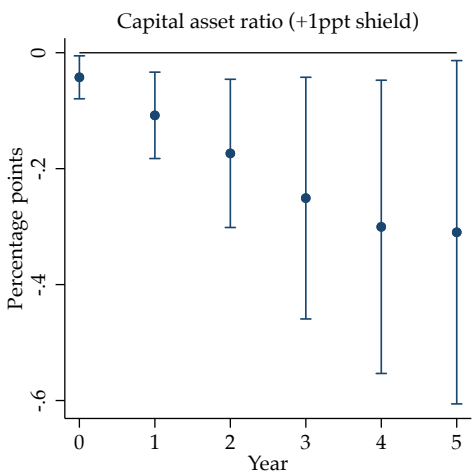


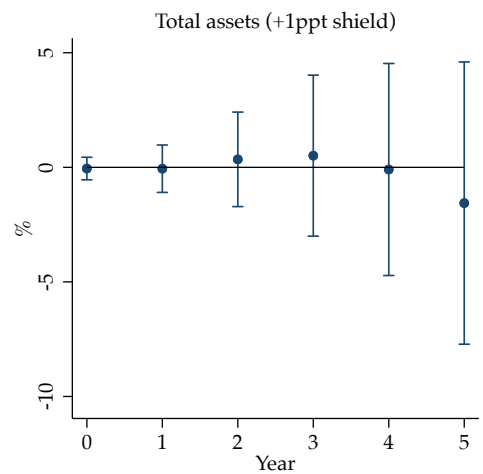
Capital versus assets:

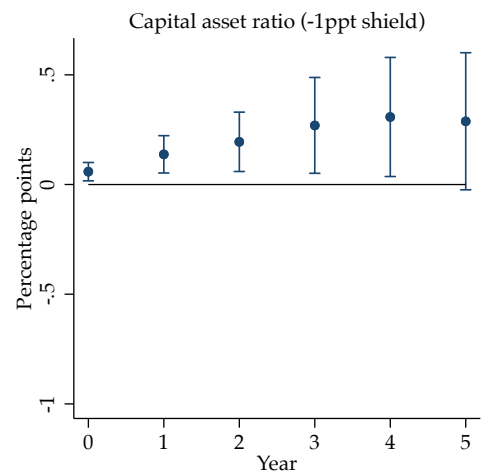


Hike versus cut:









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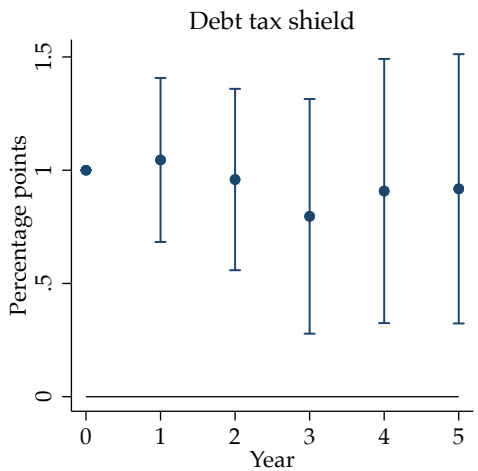
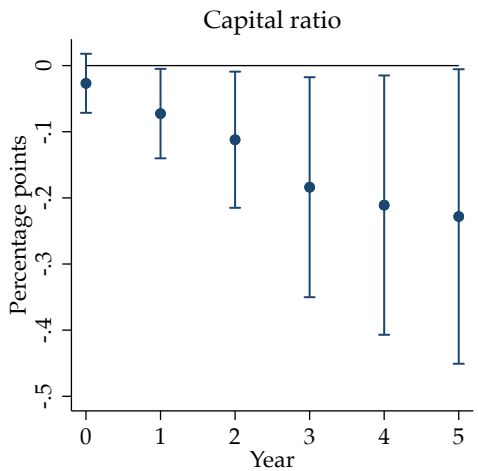
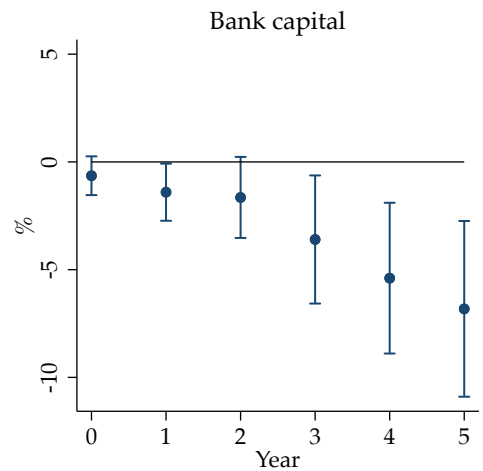
Excluding countries with regional tax rate heterogeneity

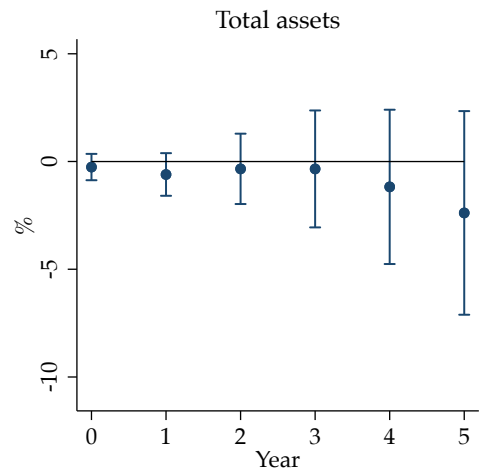
Shock and capital ratio:



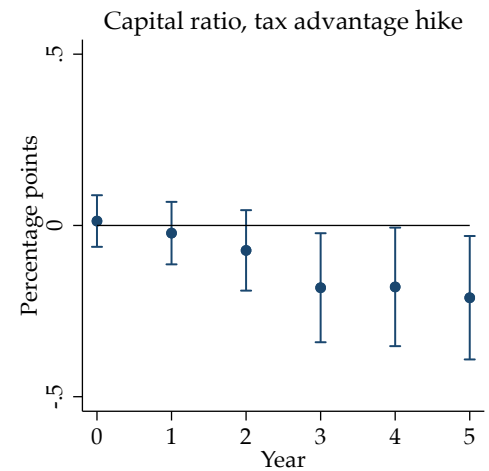


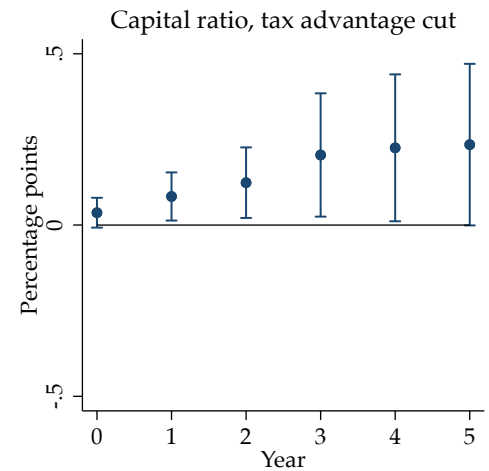
Capital versus assets:





Hike versus cut:





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