Estimating General Equilibrium Spillovers of Large-Scale Shocks

Summary Slides

Kilian Huber

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  - evaluate GE channels in models
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- Alternative: directly estimate spillovers using multi-layered variation

Related Literature

- Few studies in macro and finance directly estimate spillovers
  Dupor and McCrory 2018; Huber 2018; Bernstein et al. 2019; Auerbach et al. 2020; Gathmann et al. 2020; Helm 2020; Verner and Gyöngyösi 2020; Conley et al. 2021; Berg et al. 2021; Mian et al. 2022
- Methods tailored to labor and RCTs ("closed economies", Egger et al.)
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- This paper: framework and advice tailored to macro and finance
  - multiple spillover types
  - nonlinearities
  - mismeasurement (Ammermueller and Pischke 2009; Angrist 2014)
  - policy multipliers

This Paper

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5. Practical advice

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- Assume shock is exogenous to both individual firms'/households' and groups' outcomes.
- Application: effect of credit cut on firms, both directly affected firms and unaffected firms in same region and product market.

Framework

- Linear model:

$$y_i = \beta\, x_i + \sum_{j \neq i,\, reg.} \gamma^j\, x_j + \sum_{k \neq i,\, ind.} \lambda^k\, x_k + \alpha + \epsilon_i$$

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- β = direct effect = change in y_i if i alone got treated
- γ^j = spillover = change in y_i due to treatment of firm j (same region)
- λ^k = spillover = change in y_i due to treatment of firm k (same industry)

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- Spillover coefficient multiplies the "leave-out mean" (or size-weighted mean):

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- Assume exogeneity, so biases not driven by endogeneity or "reflection problem": $E\left(x_i \epsilon_i\right) = 0$
- Assume systematic variation across groups:

$$x_i = u_{r(i)} + u_{s(i)} + \nu_i$$

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- More on how to calculate dollar multipliers etc. in paper.

Application: Credit Cut

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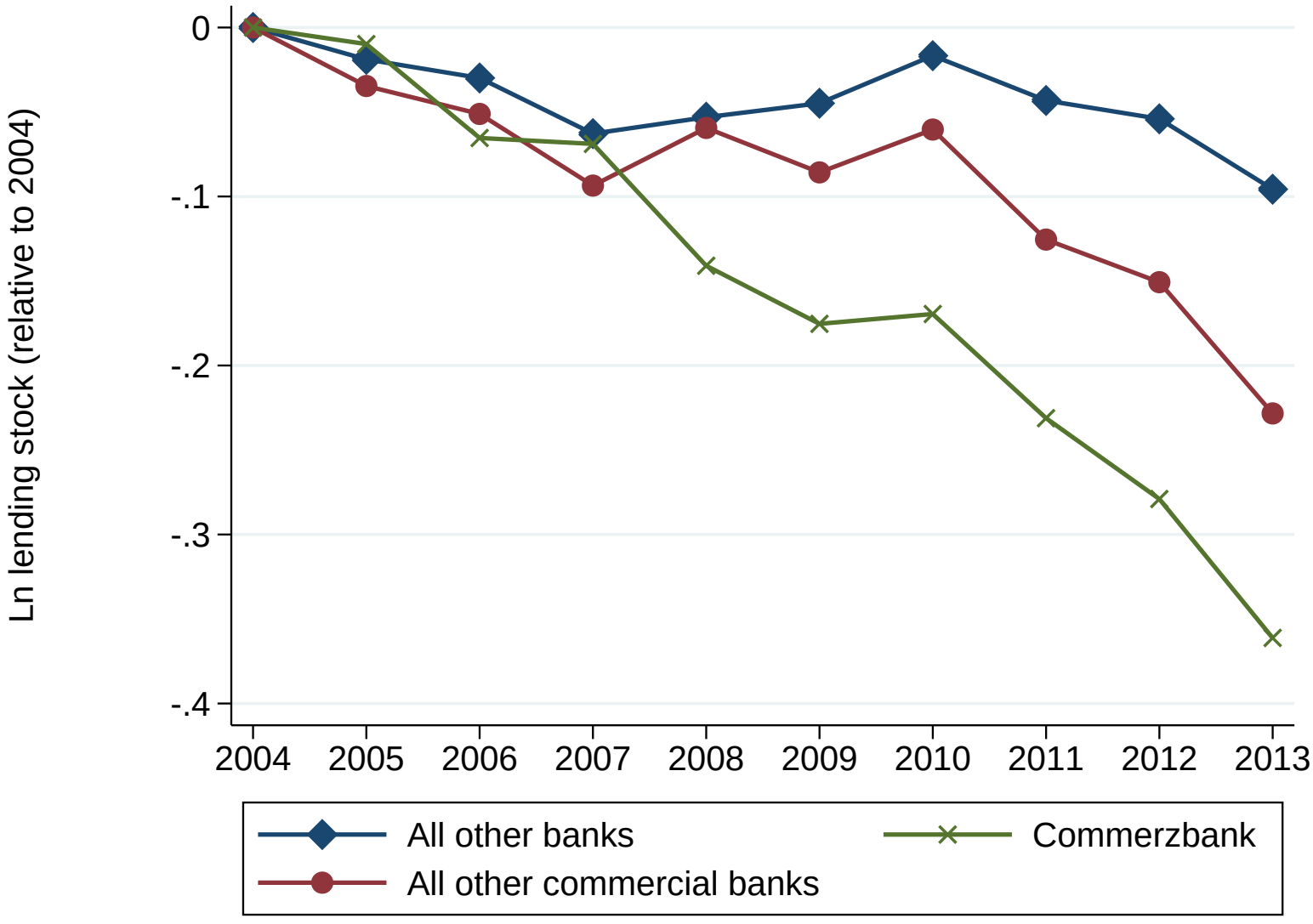
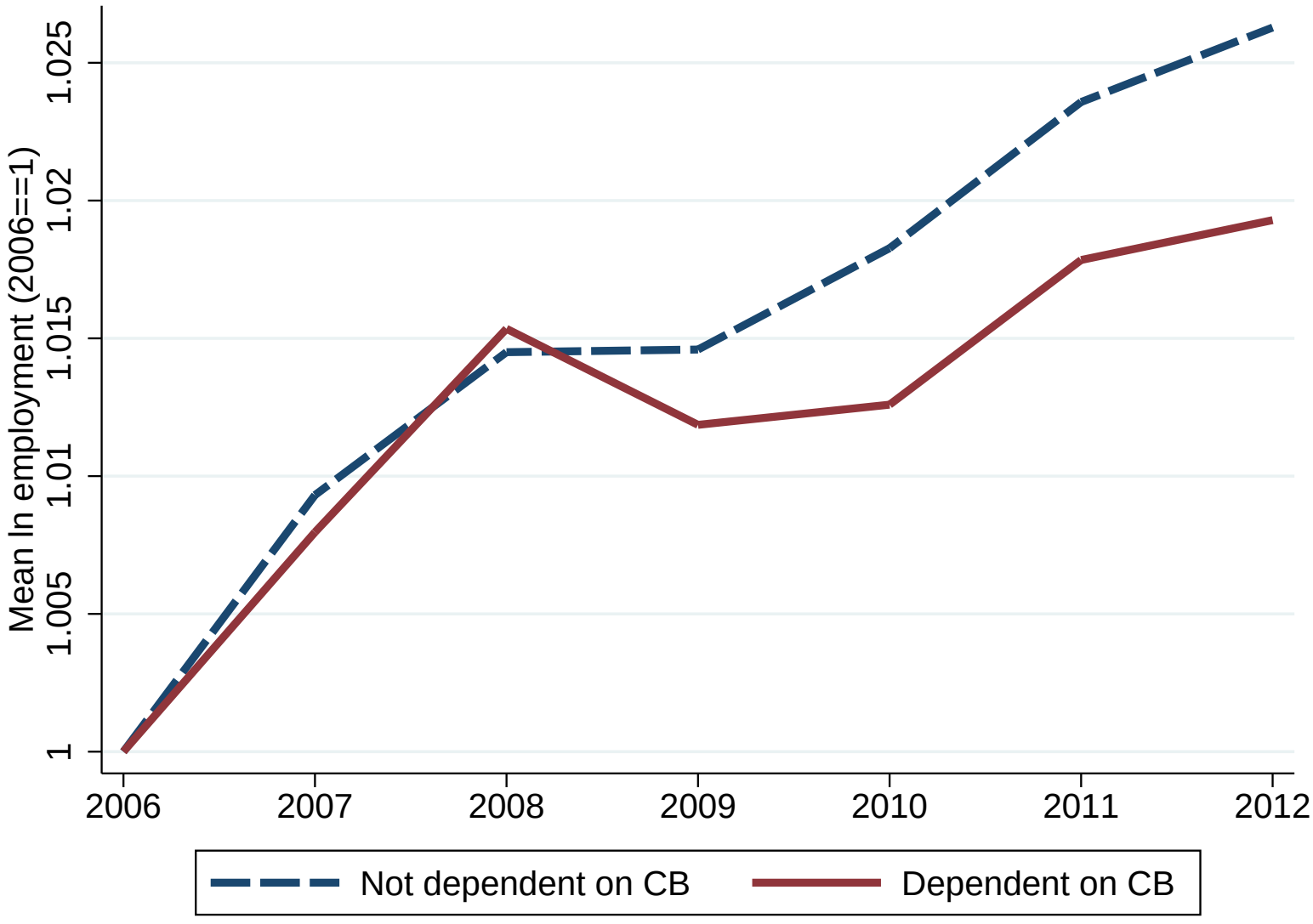
- Some firms depend on this bank for credit.
- Treatment: Indicator for direct dependence on the bank.
- Research question: amplification or dampening through spillovers?

Credit cut by Commerzbank



Direct Employment Effect



Product Market Spillovers

- IO economists write theories about product markets: demand versus technology spillovers.
- Test by constructing product market leave-out mean (industry for tradable and industry-region for non-tradables).
- Estimate:

$$y_i = \beta\, x_i + \lambda\, \overline{x_{s(i)}} + \alpha + u_i$$

Negative Industry Spillover

Coefficient on x_i	-0.030***	
	(0.007)	
Coefficient on $\overline{x_{s(i)}}$	-0.030*	
	(0.018)	
Coefficient on $\overline{x_{r(i)}}$		
Sectors in sample	All sectors	
Observations	45,252	45,252

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- No, cannot take spillover estimate at face value.
- There will be mechanical bias if a true spillover is excluded, even if uncorrelated to other spillover.
- Regional spillovers operate through demand versus agglomeration spillovers.

Add Regional Spillover

Coefficient on x_i	-0.030***	-0.027***
	(0.007)	(0.007)
Coefficient on $\overline{x_{s(i)}}$	-0.030*	-0.015
	(0.018)	(0.018)
Coefficient on $\overline{x_{r(i)}}$		-0.114**
		(0.051)
Sectors in sample	All sectors	
Observations	45,252	45,252

Understanding Mechanical Bias

- True model:

$$y_i = \beta\, x_i + \gamma\, \overline{x_{r(i)}} + \lambda\, \overline{x_{s(i)}} + \alpha + \epsilon_i$$

- Excluded regional term correlated with direct effect, so all coefficients biased.

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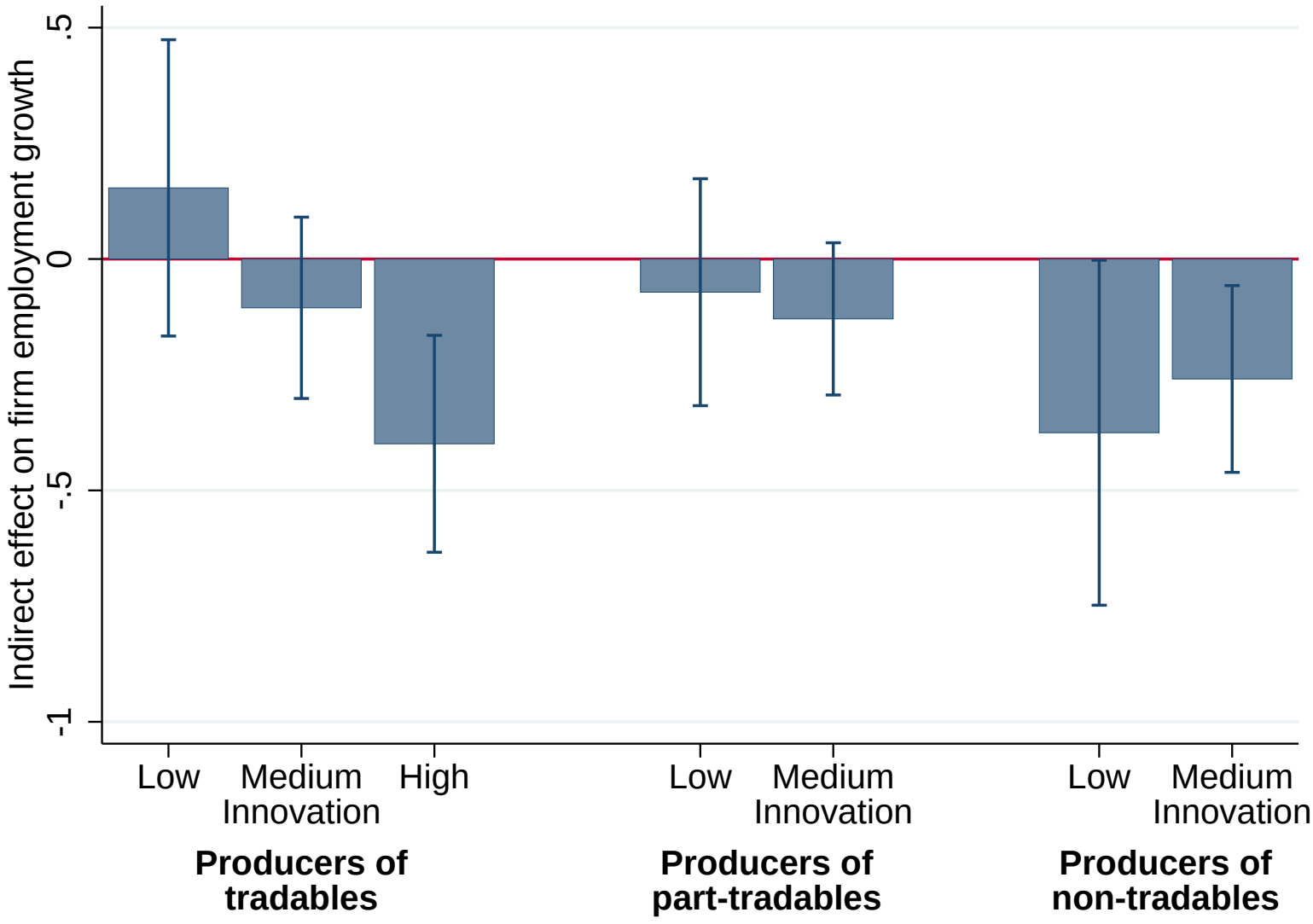
- Suggestions:
  - if observed, include other spillover types
  - IV
  - heterogeneity in spillovers using theory

Heterogeneous Regional Spillover



Heterogeneous Regional Spillover

-0.031**	-0.026***
(0.013)	(0.009)
-0.045	-0.007
(0.031)	(0.024)
-0.213***	-0.067
(0.077)	(0.055)
Non-tradable and high R&D	Tradable and low R&D
14,810	30,442

Mechanical Bias due to Mismeasurement

- Incorrectly specified regressors generate mechanical bias:
  - direct effect is nonlinear, but direct treatment is measured using linear regressor
  - measurement error in direct treatment

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- For exposition, introduce measurement error in direct treatment
- Size of “high” error calibrated using Bound and Krueger (1991) error in earnings growth.

Measurement Error

Coefficient on x_i^*	-0.027***	-0.023***	-0.024***	-0.009
	(0.007)	(0.006)	(0.006)	(0.006)
Coefficient on $\overline{x_{r(i)}}^*$	-0.123**	-0.155***	-0.160***	-0.256***
	(0.050)	(0.054)	(0.058)	(0.086)
Measurement error	None	Low	Medium	High
Sectors in sample	All sectors			
Observations	45,252	45,252	45,252	45,252

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- Individual measurement error gets averaged away in leave-out mean.
- Less error in leave-out mean than in direct effect.
- True direct effect erroneously loads onto spillover coefficient.
- Analytical derivation for biases in paper.

Little Heterogeneity with ME

-0.021**	-0.004
(0.010)	(0.007)
-0.346***	-0.214**
(0.128)	(0.094)
High Non-tradable and high R&D	High Tradable and low R&D
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Mismeasurement Solutions

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- Same intuition for nonlinear effect, very relevant for finance, e.g., borrowing and liquidity constraints.

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- Employment: Total effect = 10 jobs.
- Undo direct effect at 0.47 mio per firm, get 10 jobs in region.
- Provide 100k USD in debt, get 1.4 jobs.
  - Know only direct effect: would estimate 0.4 jobs.
  - Know only region effect: don't know how to target direct firms.

Recommendations

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- 5. Identify theoretical mechanisms driving spillovers.
  - regional: demand and agglomeration effects
  - sectoral: competition and productivity
  - cross region: trade, migration, capital mobility, and aggregate policy

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- 6. Estimate heterogeneous spillovers as suggested by theory

Conclusion

- Macro shocks affect firms/households through many complex GE spillover channels.
- Need to know GE channels for modeling and policy –> estimating spillovers is potentially powerful .
- More potential applications sketched in paper, ranging from sectoral, labor market, and country-level spillovers.
- Most challenging: estimating country spillovers requires exogenous country variation.
  - fiscal spending due to wars (Ramey 2019)
  - foreign policy (Jiménez et al. 2012)
  - political upheavals (Fuchs-Schündeln 2008)
  - idiosyncratic policy (Romer and Romer 2004)