The Network Origins of Bank Influence: Evidence from Bank–to–firm and Firm–to–Firm Linkages[1]

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Outline

Motivation (i)

(Old) empirical banking literature

Loan characteristics (costs, loan–to–value,...)

Idiosyncratic bank shocks to credit supply affect firm behaviour

- Bank–level restructuring
- Bank–level shift lending policies
- Bank–level shift risk appetite
- etc.

- firm–level sales
- firm–level investment
- firm–level tfp
- etc.

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Bank–level restructuring
Bank–level shift lending policies
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etc.

firm–level sales
firm–level investment
firm–level tfp
etc.

(Recent) empirical banking literature

Idiosyncratic bank shocks to credit supply affect macroeconomic outcomes

Economywide sales
Economywide investment
Economywide tfp

Motivation (ii)

Empirical banking literature

Idiosyncratic variation in lending affects aggregate real economy

- *Amiti & Weinstein (2018):* Investment
- *Manaresi & Pierri (2018):* TFP
- *Niepman & Eisenlohr (2017):* Trade patterns
- *Bremus et al. (2018):* GDP
- etc.

Macroeconomic literature

Idiosyncratic variation does not affect aggregate real economy

- Atomistic/representative bank(s)
- Lucas argument: things average out

Motivation (ii)

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This paper

What we do

1. Consensus between both literatures
2. Application to Belgium
3. Some financial sector policy implications

Literature

Crossroads of multiple literatures

1. **Empirical Banking Literature**

   Amiti & Weinstein (JPE,2018); Buch et al. (JMCB, 2014); Niepman & Eisenlohr (JIE, 2017); Greenstone et al. (AEJ, 2019), etc.

2. **Macro literature**

   Gerali et al. (JMCB, 2010); Andrés et al. (JMCB, 2013); Andrés & Arce. (EJ, 2012); Iacoviello (AER, 2005); etc.

3. **Propagation mechanisms**

   Acemoglu et al. (EM, 2012); Di Giovanni et al. (EM, 2014); Fahri & Baqaee (EM, 2018); Ozdagli & Weber (EM, 2018); Atalay (AEJ, 2017); Acemoglu et al. (AER, 2017) etc.

4. **I–O in DSGE**

   Smets et al. (2019); Long & Plosser (JPE, 1983; AER, 1987); Bouakez et al. (EER, 2014; IER, 2009); Dixon et al. (BoE, 2007); Pasten et al. (2018, 2017) etc.

5. **Macroprudential LTV requirements**

   Jensen et al. (EER, 2018); Walentin (tSJE, 2014); etc.

Plan

The model: Ingredients

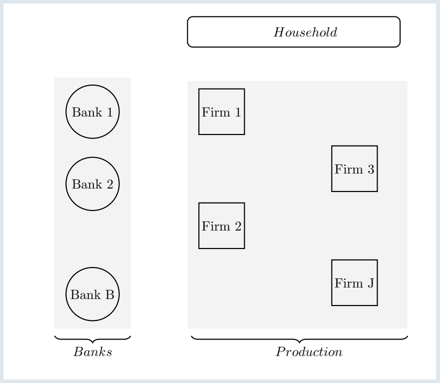
Two ingriedients

Iacoviello (2006, AER)

+ → Collateral constraint

Pasten et al (2018, JME)

→ Production network



The model: Households

Consumption Land Labour

Utility

$$\mathbb{E}_0\Big[\sum_{t=0}^{\infty}\beta^t\Big(\log(c_t)+\iota h_t-\sum_{j=1}^{J} g_j \frac{l_{jt}^{1+\varphi}}{1+\varphi}\Big)\Big]$$

s.t.

$$c_t + q_t(h_t - h_{t-1}) + \frac{R_{t-1}d_{t-1}}{\pi_t}$$

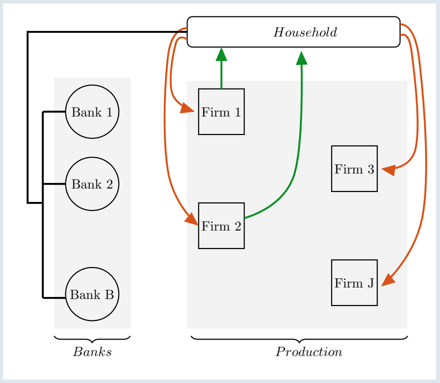
$$=$$

$$d_t + \sum_{j=1}^{J} w_{jt} l_{jt} + \sum_{j=1}^{J} \Delta_{jt} + \sum_{b=1}^{B} \Delta_{bt}$$

and

$$c_t = \Big(\sum_{j=1}^{J} \theta_j^{\frac{1}{\eta}} c_{jt}^{1-\frac{1}{\eta}}\Big)^{\frac{\eta}{\eta-1}}$$

Consumption weight



The model: Firms

Production Function

$$y_{jt} = A_j \left(n_{jt}^{\phi_j} m_{jt}^{1-\phi_j}\right)^{\delta_j} k_{jt}^{1-\delta_j} - \Phi_j$$

Capital services

Intermediates

Labour

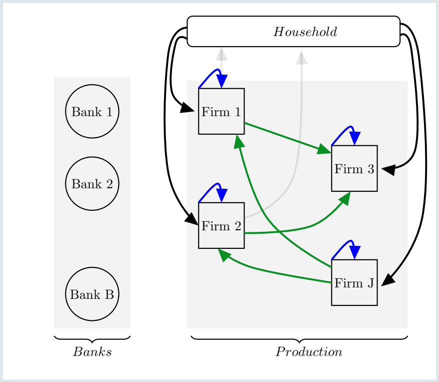
$$m_{jt} = \left(\sum_{j'=1}^{J} \omega_{jj'}^{\frac{1}{\eta}} m_{jj't}^{1-\frac{1}{\eta}}\right)^{\frac{\eta}{\eta-1}}$$

IO interactions, $\boldsymbol{\Omega}$

Subject to

Calvo

Demand



The model: Banks

Profit

$\mathbb{E}_0 \sum_{s=0}^{\infty} \Lambda_{t,t+s} P_{t+s} \Delta_{bt+s}$

Flow of funds constraint

$$\Delta_{bt} + \frac{R_{t-1} d_{bt-1}}{\pi_t} + \sum_{j=1}^{J} s_{jbt} = \sum_{j=1}^{J} \frac{R_{jbt-1} s_{jbt-1}}{\pi_t} + d_{bt}$$

Credit demand

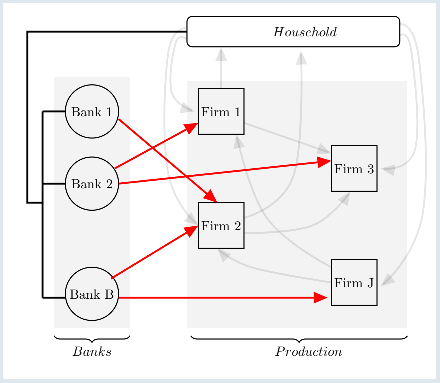
$$s_{jt} = \left(\sum_{b=1}^{B} \psi_{jb}^{\frac{1}{\mu_{jt}}} s_{jbt}^{1-\frac{1}{\mu_{jt}}} \right)^{\frac{\mu_{jt}}{\mu_{jt}-1}}$$

ψ_{jb} → Bank–firm credit network

Shocks
- Loan–to–value shocks: $(\epsilon_t^{(\ell)}, \epsilon_{bt}^{(\ell)})$
- Interest rate shocks: $(\epsilon_t^{(r)}, \epsilon_{bt}^{(r)})$

ϵ_{bt} → Idiosyncratic bank shock

ϵ_t → Aggregate bank shock



The model: Entrepreneurs

Produce capital services

$k_{jt} = \widetilde{n}_{jt}^{1-\nu_j} h_{jt-1}^{\nu_j}$

Utility function

$\mathbb{E}_0 \sum_{t=0}^{\infty} \gamma^t \widetilde{c}_{jt} \quad (\gamma < \beta)$

Flow of funds

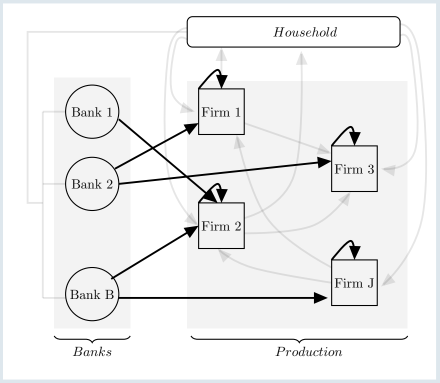
$f_{jt} k_{jt} + s_{jt}$

$=$

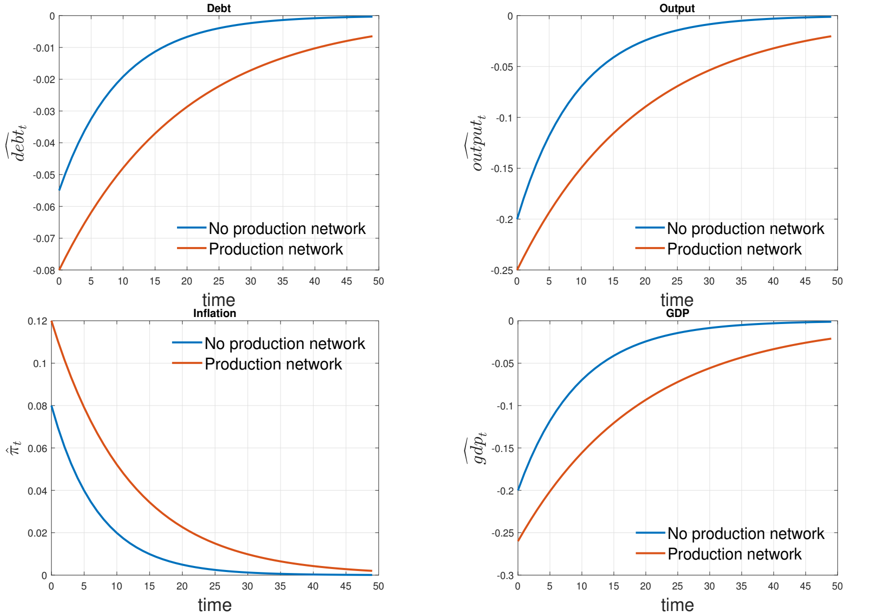
$\widetilde{c}_{jt} + q_t(h_{jt} - h_{jt-1}) + \frac{R_{jt-1} s_{jt-1}}{\pi_t} + w_{jt} \widetilde{n}_{jt}$

Collateral constraint

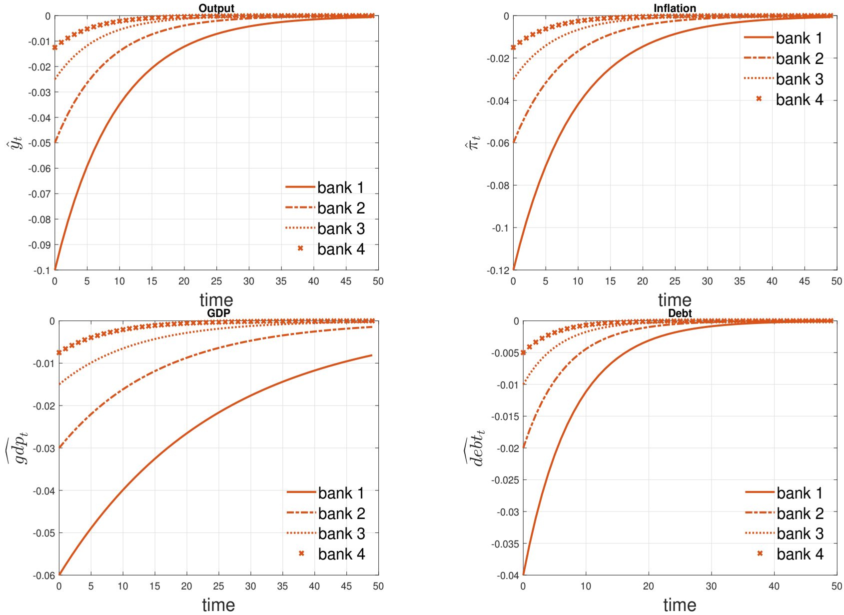
$s_{jt} \leq \ell_{jt} \mathbb{E}_t \frac{q_{t+1} h_{jt} \pi_{t+1}}{R_{jt}}$



Model mechanics (i): Aggregate LTV shock



Model mechanics (ii): Bank–level LTV shocks



Plan

Model analysis (i): Simplifying assumptions

1. Households have linear disutility of labor ($\varphi = 0$).
2. Monetary policy targets steady state nominal gross domestic product ($P_t c_t = Pc$)
3. All firms are equally capital intensive ($\{\delta_j = \delta\}_{j=1}^{J}$).
4. Entrepreneurs have zero consumption mass, $\{\widetilde{c}_{jt} = 0\}_{j=1}^{J}$ and the collateral constraint does not bind.
5. We replace the Calvo framework of staggerd price setting

$$P_{jt} = \begin{cases} \mathbb{E}_{t-1}[P^*_{jt}] & \text{with probability } \alpha \\ P^*_{jt} & \text{with probability } 1-\alpha \end{cases}$$

Model analysis (iii)

$$\widehat{gdp}_{t|B} = \nu\epsilon_t^{(r)} + \boldsymbol{\nu}'_B\boldsymbol{\varepsilon}_{t|B}^{(r)}$$

Model analysis (iii)

Aggregate shock

$$\widehat{gdp}_{t|B} = \nu \epsilon_t^{(r)} + \boldsymbol{\nu}'_B \boldsymbol{\varepsilon}_{t|B}^{(r)}$$

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Aggregate shock — Vector of idiosyncratic shocks

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$$\widehat{gdp}_{t|B} = \nu \epsilon_t^{(r)} + \boldsymbol{\nu}'_B \boldsymbol{\varepsilon}_{t|B}^{(r)}$$

$$\boldsymbol{\nu}_B \equiv -\kappa \boldsymbol{\Psi}' [\mathbb{I} - \widetilde{\boldsymbol{\Omega}}']^{-1} \boldsymbol{\theta}$$

Model analysis (iii)

Aggregate shock

Vector of idiosyncratic shocks

$$\widehat{gdp}_{t|B} = \nu\epsilon_t^{(r)} + \boldsymbol{\nu}'_B \boldsymbol{\varepsilon}_{t|B}^{(r)}$$

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Model analysis (iii)

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Bank-firm credit network

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Influence of individual firms

$$[\mathbb{I} - \widetilde{\boldsymbol{\Omega}}']^{-1} = \sum_{n=0}^{\infty} \widetilde{\boldsymbol{\Omega}}^n \qquad \text{(c.f. Waugh (1950))}$$

$$= \mathbb{I} + \widetilde{\boldsymbol{\Omega}} + \widetilde{\boldsymbol{\Omega}}\widetilde{\boldsymbol{\Omega}} + ...$$

Aggregate shock

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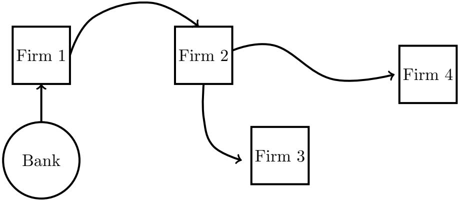

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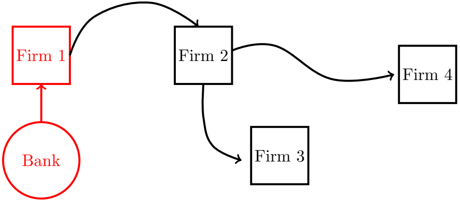

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$\boldsymbol{\Psi}'$ → Bank-firm credit network

$[\mathbb{I} - \widetilde{\boldsymbol{\Omega}}']^{-1} \boldsymbol{\theta}$ → Influence of individual firms

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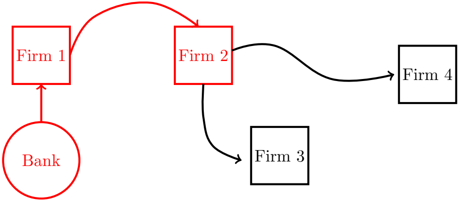

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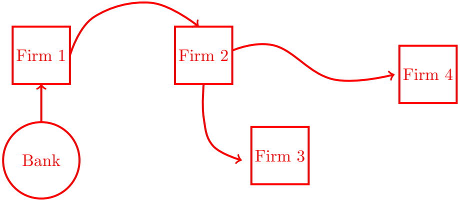

Model analysis (iii)

$$Var(\widehat{gdp}_{t|B}) = (\sum_{b=1}^{B} \boldsymbol{\nu}_b^2)\sigma_{idio}^2 + \nu^2\sigma_{agg}^2$$

Model analysis (iii)

Aggregate origin

Depends on structure of the economy

Does not depend on B

$$Var(\widehat{gdp}_{t|B}) = (\textstyle\sum_{b=1}^{B} \boldsymbol{\nu}_b^2)\sigma_{idio}^2 + \boxed{\nu^2}\sigma_{agg}^2$$

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Idiosyncratic bank-level origin

Depends on structure of the economy

Depends on B: Decays as B increases

Model analysis (iii)

$$Var(\widehat{gdp}_{t|B}) = \boxed{(\textstyle\sum_{b=1}^{B} \boldsymbol{\nu}_b^2)}\sigma_{idio}^2 + \boxed{\nu^2}\sigma_{agg}^2$$

Aggregate origin

- Depends on structure of the economy
- Does not depend on B

Idiosyncratic bank-level origin

- Depends on structure of the economy
- Depends on B: Decays as B increases

How fast does this decay?

Model analysis (iv): Step 1 - no production network

Definition

The first–order outdegree of firm j is defined as $d^{(1)}_{j|J} \equiv \theta_j$.

Definition

The first–order outdegree of bank b is defined as:
$d^{(1)}_{b|B} \equiv \sum_{j=1}^{J}(1-\delta)\psi_{jb|B}d^{(1)}_{j|J}$.

Definition

The (population) coefficient of variation of $d^{(1)}_B$ *is*

$$CV_{d^{(1)}_B} \equiv \frac{\sqrt{\mathbb{V}(d^{(1)}_B)}}{\bar{d}^{(1)}_B}$$

where $\bar{d}^{(1)}_B \equiv \frac{1}{B}\sum_{b=1}^{B} d^{(1)}_{b|B}$ *is the average bank outdegree and*
$\mathbb{V}(d^{(1)}_B) = \left(\frac{1}{B}\sum_{b=1}^{B}(d^{(1)}_{b|B} - \bar{d}^{(1)}_B)^2\right)^{\frac{1}{2}}$ *is the population variance of* $d^{(1)}_B$.

Model analysis (v): Step 1 - no production network

Proposition

Provided an economy with a first–order outdegree sequence of the financial sector $d_B^{(1)}$*, aggregate volatility satisfies*

$$\sqrt{Var\ (\widehat{gdp}_{t|B})} \geq \frac{\kappa}{\sqrt{B}}\sqrt{1 + CV^2_{d_B^{(1)}}}\sigma_{idio}$$

1. Representative bank: $B = 1$ and $CV^2_{d_B^{(1)}} = 0$
2. Atomistic banks: $B = \infty$
3. Empirical banking literature: $B \in (1, \infty)$ and $CV^2_{d_B^{(1)}} =?$

Model analysis (vi): Step 2 - one step propagation

Definition

The second–order outdegree of firm j is defined as $d^{(2)}_{j|J} \equiv \sum_{j'=1}^{J} \theta_{j'}[\widetilde{\Omega}]_{j'j}$.

Definition

The second–order outdegree of bank b is defined as: $d^{(2)}_{b|B} \equiv \sum_{j=1}^{J}(1-\delta)\psi_{jb|B}d^{(2)}_{j|J}$.

Definition

The (population) coefficient of variation of $d^{(2)}_B$ is

$$CV_{d^{(2)}_B} \equiv \frac{\sqrt{\mathbb{V}(d^{(2)}_B)}}{\bar{d}^{(2)}_B}$$

Model analysis (vii): Step 2 - one step propagation

Proposition

Provided an economy with a first and second–order outdegree sequence of the financial sector $d_B^{(1)}$, $d_B^{(2)}$, *aggregate volatility satisfies*

$$\sqrt{Var\ (\widehat{gdp}_{t|B})} \geq \left(\frac{1}{\sqrt{B}}\sqrt{1 + CV_{d^{(1)}_{b|B}}} + \frac{\boldsymbol{\theta}'\widetilde{\boldsymbol{\Omega}}\boldsymbol{\iota}}{\sqrt{B}}\sqrt{1 + CV_{d^{(2)}_{b|B}}}\right)\kappa\sigma_{idio}$$

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Model mechanics (v): Relaxing assumptions

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3. All firms are equally credit intensive ($\{\delta_j = \delta\}_{j=1}^{J}$).
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$$P_{jt} = \begin{cases} \mathbb{E}_{t-1}[P_{jt}^*] & \text{with probability } \alpha \\ P_{jt}^* & \text{with probability } 1-\alpha \end{cases}$$

Plan

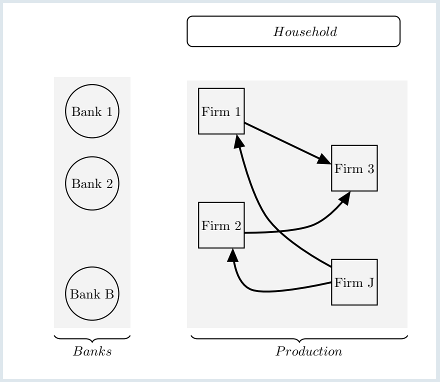
Calibration model parameters

1. Production Linkages

$B2B$ database

Annual, time span $2002 - 2014$

Reporting threshold



Calibration model parameters

1. Production Linkages

   B2B database

   Annual, time span 2002 – 2014

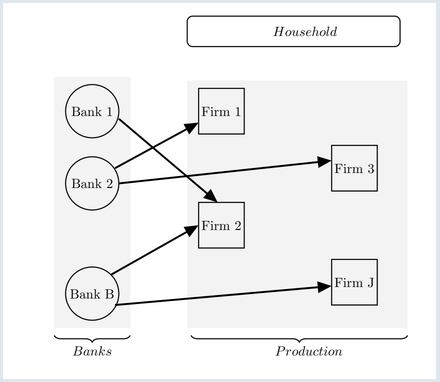
   Reporting threshold

2. Credit lines & LTVs

   Belgian Corporate Credit Register

   Annual, time span 2002 – 2014

   Reporting threshold



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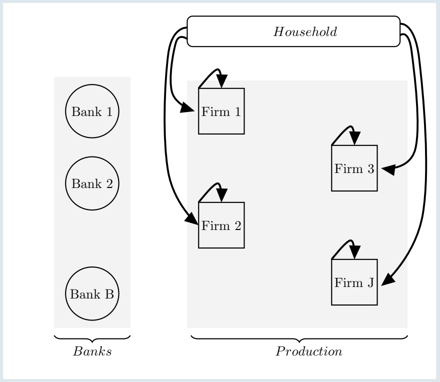
3. Production function parameters

   Annual accounts



Calibration model parameters

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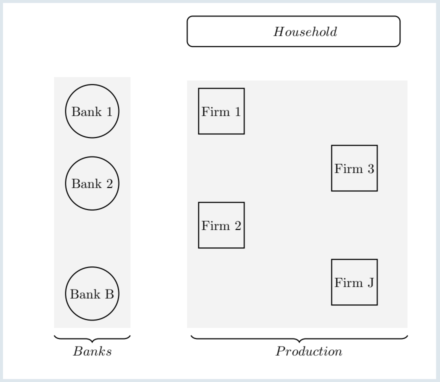
3. Production function parameters

   Annual accounts

4. Price stickiness

   Prices underlying PPI



Calibration model parameters

1. Production Linkages

   B2B database

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   Reporting threshold

2. Credit lines & LTVs

   Belgian Corporate Credit Register

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   Reporting threshold

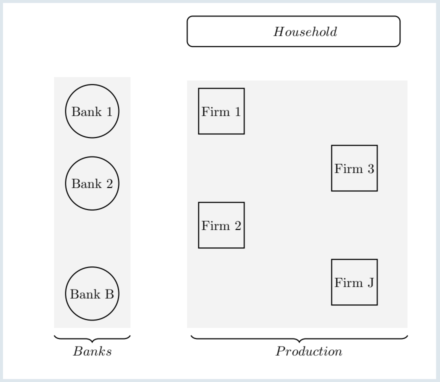
3. Production function parameters

   Annual accounts

4. Price stickiness

   Prices underlying PPI

5. Other parameters



Volatility: Simplified framework

$$Var(\widehat{gdp}_{t|B}) = (\sum_{b=1}^{B} \boldsymbol{\nu}_{b|B}^2)\sigma_{idio}^2 + \nu^2 \sigma_{agg}^2$$

This table: $\frac{\sqrt{(\sum_{b=1}^{B} \boldsymbol{\nu}_{b|B}^2)}}{\nu}$

Household demand → $\boldsymbol{\theta}$; Production network → $\boldsymbol{\Omega}$; Credit network → $\boldsymbol{\Psi}$

				Hom $\boldsymbol{\alpha}$	Het $\boldsymbol{\alpha}$	Het $\boldsymbol{\alpha}$	Hom $\boldsymbol{\alpha}$	Hom $\boldsymbol{\alpha}$	→ Calvo parameter
				Het $\boldsymbol{\phi}$	Het $\boldsymbol{\phi}$	Hom $\boldsymbol{\phi}$	Hom $\boldsymbol{\phi}$	Hom $\boldsymbol{\phi}$	→ Labour intensity
				Hom $\boldsymbol{\delta}$	Het $\boldsymbol{\delta}$	Hom $\boldsymbol{\delta}$	Het $\boldsymbol{\delta}$	Hom $\boldsymbol{\delta}$	→ Capital intensity
	$\boldsymbol{\theta}$	$\boldsymbol{\Omega}$	$\boldsymbol{\Psi}$						
(1)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.447					
(2)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134					
(3)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.386					
(4)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134					
(5)	Hom, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.357					
(6)	Hom, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134					
(7)	Hom, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.318					
(8)	Hom, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134					

Volatility: Simplified framework

$$Var(\widehat{gdp}_{t|B}) = (\sum_{b=1}^{B} \boldsymbol{\nu}_{b|B}^2)\sigma_{idio}^2 + \nu^2\sigma_{agg}^2$$

This table: $\frac{\sqrt{(\sum_{b=1}^{B} \boldsymbol{\nu}_{b|B}^2)}}{\nu}$

Household demand → $\boldsymbol{\theta}$; Production network → $\boldsymbol{\Omega}$; Credit network → $\boldsymbol{\Psi}$

	$\boldsymbol{\theta}$	$\boldsymbol{\Omega}$	$\boldsymbol{\Psi}$	Hom $\boldsymbol{\alpha}$ / Het $\boldsymbol{\phi}$ / Hom $\boldsymbol{\delta}$	Het $\boldsymbol{\alpha}$ / Het $\boldsymbol{\phi}$ / Het $\boldsymbol{\delta}$	Het $\boldsymbol{\alpha}$ / Hom $\boldsymbol{\phi}$ / Hom $\boldsymbol{\delta}$	Hom $\boldsymbol{\alpha}$ / Hom $\boldsymbol{\phi}$ / Het $\boldsymbol{\delta}$	Hom $\boldsymbol{\alpha}$ / Hom $\boldsymbol{\phi}$ / Hom $\boldsymbol{\delta}$
(1)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.447				
(2)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134				
(3)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.386				
(4)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134				
(5)	Hom, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.357				
(6)	Hom, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134				
(7)	Hom, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.318				
(8)	Hom, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134				

$\boldsymbol{\alpha}$ → Calvo parameter

$\boldsymbol{\phi}$ → Labour intensity

$\boldsymbol{\delta}$ → Capital intensity

Volatility: Simplified framework

$$Var(\widehat{gdp}_{t|B}) = (\sum_{b=1}^{B} \boldsymbol{\nu}_{b|B}^2)\sigma_{idio}^2 + \nu^2 \sigma_{agg}^2$$

This table: $\frac{\sqrt{(\sum_{b=1}^{B} \boldsymbol{\nu}_{b|B}^2)}}{\nu}$

	Household demand	Production network	Credit network						
				Hom $\boldsymbol{\alpha}$	Het $\boldsymbol{\alpha}$	Het $\boldsymbol{\alpha}$	Hom $\boldsymbol{\alpha}$	Hom $\boldsymbol{\alpha}$	Calvo parameter
				Het $\boldsymbol{\phi}$	Het $\boldsymbol{\phi}$	Hom $\boldsymbol{\phi}$	Hom $\boldsymbol{\phi}$	Hom $\boldsymbol{\phi}$	Labour intensity
				Hom $\boldsymbol{\delta}$	Het $\boldsymbol{\delta}$	Hom $\boldsymbol{\delta}$	Het $\boldsymbol{\delta}$	Hom $\boldsymbol{\delta}$	Capital intensity
	$\boldsymbol{\theta}$	$\boldsymbol{\Omega}$	$\boldsymbol{\Psi}$						
(1)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.447					
(2)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134					
(3)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.386					
(4)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134					
(5)	Hom, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.357					
(6)	Hom, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134					
(7)	Hom, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.318					
(8)	Hom, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134					

Volatility: Simplified framework

$$Var(\widehat{gdp}_{t|B}) = (\sum_{b=1}^{B} \boldsymbol{\nu}_{b|B}^2)\sigma_{idio}^2 + \nu^2\sigma_{agg}^2$$

This table: $\frac{\sqrt{(\sum_{b=1}^{B} \boldsymbol{\nu}_{b|B}^2)}}{\nu}$

	Household demand $\boldsymbol{\theta}$	Production network $\boldsymbol{\Omega}$	Credit network $\boldsymbol{\Psi}$	Hom $\boldsymbol{\alpha}$, Het $\boldsymbol{\phi}$, Hom $\boldsymbol{\delta}$	Het $\boldsymbol{\alpha}$, Het $\boldsymbol{\phi}$, Het $\boldsymbol{\delta}$	Het $\boldsymbol{\alpha}$, Hom $\boldsymbol{\phi}$, Hom $\boldsymbol{\delta}$	Hom $\boldsymbol{\alpha}$, Hom $\boldsymbol{\phi}$, Het $\boldsymbol{\delta}$	Hom $\boldsymbol{\alpha}$, Hom $\boldsymbol{\phi}$, Hom $\boldsymbol{\delta}$
(1)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.447	0.464	0.445	0.473	0.440
(2)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134	0.134	0.134	0.134	0.134
(3)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.386	0.400	0.384	0.408	0.380
(4)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134	0.134	0.134	0.134	0.134
(5)	Hom, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.357	0.370	0.355	0.378	0.352
(6)	Hom, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134	0.134	0.134	0.134	0.134
(7)	Hom, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.318	0.330	0.317	0.336	0.313
(8)	Hom, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}$	0.134	0.134	0.134	0.134	0.134

→ Calvo parameter ($\boldsymbol{\alpha}$)
→ Labour intensity ($\boldsymbol{\phi}$)
→ Capital intensity ($\boldsymbol{\delta}$)

Volatility (ii): full framework

	Household demand	Production network	Credit network	Homogeneous LTV rates (Economywide)	Homogeneous LTV rates (Bank level)	Heterogeneous LTV rates
(1)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.465	0.473	0.492
(2)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134
(3)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Het, $\widehat{\boldsymbol{\Psi}}$	0.386	0.392	0.408
(4)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134
(5)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.348	0.354	0.368
(6)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134
(7)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Het, $\widehat{\boldsymbol{\Psi}}$	0.277	0.282	0.293
(8)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134

Volatility (ii): full framework

	Household demand	Production network	Credit network	Homogeneous LTV rates (Economywide)	Homogeneous LTV rates (Bank level)	Heterogeneous LTV rates
(1)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.465	0.473	0.492
(2)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134
(3)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Het, $\widehat{\boldsymbol{\Psi}}$	0.386	0.392	0.408
(4)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134
(5)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.348	0.354	0.368
(6)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134
(7)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Het, $\widehat{\boldsymbol{\Psi}}$	0.277	0.282	0.293
(8)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134

Volatility (ii): full framework

	Household demand	Production network	Credit network	Homogeneous LTV rates (Economywide)	Homogeneous LTV rates (Bank level)	Heterogeneous LTV rates
(1)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.465	0.473	0.492
(2)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134
(3)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Het, $\widehat{\boldsymbol{\Psi}}$	0.386	0.392	0.408
(4)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134
(5)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.348	0.354	0.368
(6)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134
(7)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Het, $\widehat{\boldsymbol{\Psi}}$	0.277	0.282	0.293
(8)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134

Volatility (ii): full framework

	Household demand	Production network	Credit network	Homogeneous LTV rates (Economywide)	Homogeneous LTV rates (Bank level)	Heterogeneous LTV rates
(1)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.465	0.473	0.492
(2)	Het, $\widehat{\boldsymbol{\theta}}$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134
(3)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Het, $\widehat{\boldsymbol{\Psi}}$	0.386	0.392	0.408
(4)	Het, $\widehat{\boldsymbol{\theta}}$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134
(5)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Het, $\widehat{\boldsymbol{\Omega}}$	Het, $\widehat{\boldsymbol{\Psi}}$	0.348	0.354	0.368
(6)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Het, $\widehat{\boldsymbol{\Omega}}$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134
(7)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Het, $\widehat{\boldsymbol{\Psi}}$	0.277	0.282	0.293
(8)	Hom, $\widehat{\boldsymbol{\theta}}^S$	Hom, $\widehat{\boldsymbol{\Omega}}^S$	Hom, $\widehat{\boldsymbol{\Psi}}^S$	0.134	0.134	0.134

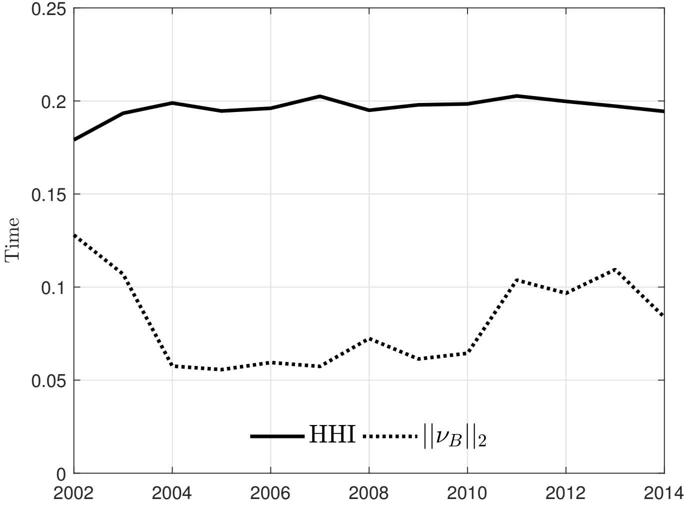
Plan

Financial sector policy (i): Usability Herfindahl index

$$\sqrt{Var(\widehat{gdp}_{t|B})} = HHI \times \sigma_{idio} \; (\textit{Gabaix 2011, Buch et al. (2018)})$$
$$= \|\boldsymbol{\nu}_B\|_2 \sigma_{idio} (\textit{This paper, simplified})$$
$$\neq \|\boldsymbol{\nu}_B\|_2 \sigma_{idio} (\textit{This paper})$$

- Buch et al. (2014, JMCB): $\Delta HHI \uparrow \sqrt{Var(\widehat{gdp}_{t|B})} \uparrow$
- This paper: $\Delta HHI \uparrow \overset{?}{\Rightarrow} \sqrt{Var(\widehat{gdp}_{t|B})} \uparrow\downarrow$

Financial sector policy (i): Usability Herfindahl index



Financial sector policy (ii): Sectoral Specialization

- Large evidence of sector specialization[2]

Pros

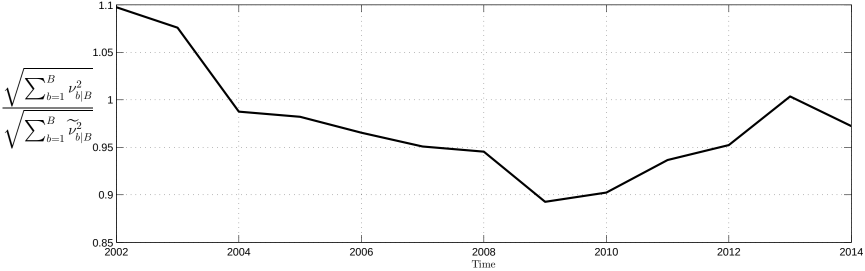
- Screening/monitoring
- Assessment collateral
- Below avg. default risk
- Above avg. recovery risk
- Macroeconomic volatility?

Cons

- Portfolio concentration
- Macroeconomic volatility?

[2] De Jonghe et al. (2018, Belgium), Niepman (2018, US), Paravisini (2018, Chile), Boeve (2017, Germany) etc.

Financial sector policy (ii): Sectoral Specialization



Financial sector policy (iii): Identifying significant banks

- Criteria for significance of banks
  1. Size
  2. Cross–border activities
  3. Direct public financial assistance
  4. Economic importance

Table: Kendall rank correlation coefficient

Year	All banks	Below median size	Above median size	Top 10
2002	0.701	0.594	0.390	0.672
2003	0.665	0.651	0.346	0.745
2004	0.673	0.597	0.304	0.600
2005	0.666	0.558	0.350	0.709
2006	0.668	0.493	0.517	0.709
2007	0.678	0.622	0.412	0.709
2008	0.651	0.552	0.371	0.672
2009	0.684	0.640	0.453	0.709
2010	0.650	0.443	0.446	0.672
2011	0.636	0.384	0.516	0.709
2012	0.664	0.407	0.484	0.709
2013	0.638	0.522	0.398	0.709
2014	0.622	0.608	0.431	0.636

Financial sector policy (iii): Identifying significant banks

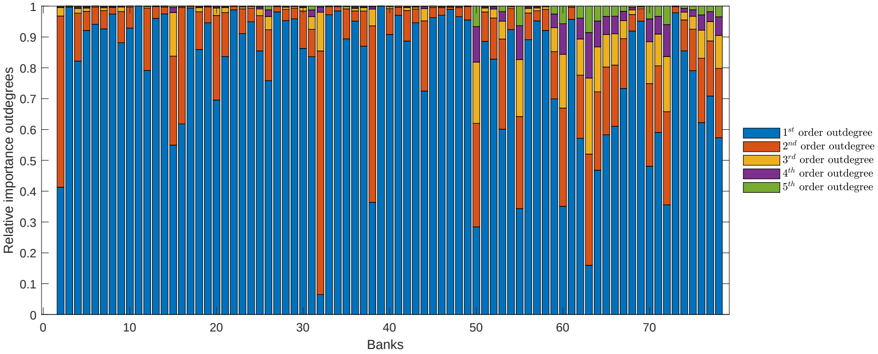


Figure: Decomposition of bank–specific influence (calibration for 2002, $B = 78$).

Plan

Conclusion

1. Consensus between both literatures
   - Empirical banking literature
   - Macroeconomic models
2. Application to Belgium
3. Some financial sector policy implications
   - Usability HHI
   - Bank specialization
   - Identifying important banks