Monetary Policy, Financial Regulation, and Industry Growth[1]

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[1] The views expressed here are the views of the authors and do not necessarily reflect the official views of the BIS.

Motivation

- Debate on financial regulation
  - Financial (banking) regulation is becoming tighter and some claim this will be costly for growth
  - Past regulations played a role in amplifying fluctuations
- Debate on monetary policy
  - narrow mandate (e.g. focused on price stability) vs. wider approach (e.g. aggressive policy response in downturns)
- Connections
  - Financial sector intermediates IR policy decisions$\Rightarrow$ financial regulation affects how much traction IR decisions have on the economy
  - IR decisions react to fluctuations $\Rightarrow$ why have components in financial regulation which would react to the cycle?

Road Map

- An analytical framework
  - investment decisions are affected by credit supply (scarcity and cyclicality) and CB interest rates decisions (cyclicality)
  - look at these effects for different levels of financial frictions.
- An empirical exercise
  - testing the framework's predictions using data on manufacturing sectors in a sample of advanced economies

Key Results

- Monetary policy stabilization through counter-cyclical interest rates is positive for growth and the more so for projects whose output is less tangible
    - But this holds only when bank leverage is large

$\Rightarrow$ Higher capital requirements reduce the benefits of counter-cyclical interest rates.

- Counter-cyclical credit is positive for growth and the more so for projects which are more liquidity dependent

$\Rightarrow$ Introducing CCBs insofar as it reduces credit pro-cyclicality provides a useful alternative source of stabilization.

- Single good economy, three periods: 0; 1 and 2; , unit mass of risk neutral entrepreneurs and risk averse financiers. Agents value date-2 consumption.

- At date 0, entrepreneurs invest in a LT project and borrow from financiers. At date 1, a state of nature $s \in \{h, l\}$ realizes. LT project may suffer downsizing. At date 2, output is reaped, financiers paid back and agents consume.

- Financiers have access to a ST technology with unit returns r_0 at date 1 and r_s at date 2 in state s. ST returns r_0 and r_s are set by the CB (perfect commitment).

The Theoretical Framework

Long-Term projects

- Entrepreneurs have access to a LT project:
  - Investing one at date 0 yields y_s at date 2 in state s ($y_h > y_l$).
  - Liquidating λ units of date-0 investment yields one unit at date 1.
- LT projects' final pledgeable return in state s is ρ_s.
- Parameter restrictions: LT project are illiquid, have positive NPV but are financially constrained, i.e.

$$\lambda r_0 > 1 \text{ and } y_s > r_0 r_s \text{ and } \lambda \rho_s < r_s$$

- An entrepreneur with initial wealth w invests I at date 0 and repays L_s at date 1 and D_s at date 2 in state s. She reaps a profit:

$$\pi_s = (I - \lambda L_s) y_s - D_s$$

- Incentive Compatibility: date-2 repayment cannot exceed final pledgeable output:

$$D_s \leq (I - \lambda L_s) \rho_s$$

- Individual Rationality: NPV of total repayments cannot be lower than financiers' outside option:

$$(I - w) r_0 r_l \leq L_s r_s + D_s$$

- Lending Constraint: Financiers cannot lend at date 0 more than $(i - 1) w$ to an entrepreneur with initial wealth w:

$$I \leq iw$$

- Entrepreneurs maximize expected profits conditional on IC, IR and LC:

$$\max_{I;\{L_s;D_s\}_s} \pi = E_s\left(I - \lambda L_s\right) y_s - E_s D_s$$
$$\text{s.t.} \begin{cases} D_s \leq \left(I - \lambda L_s\right)\rho_s \\ \left(I - w\right) r_0 r_I \leq L_s r_s + D_s \\ I \leq iw \end{cases}$$

- Optimum is such that: (i) LC is binding, (ii) downsizing takes place only in the bad state I:

$$I^* = iw \text{ and } L_h^* = 0 \text{ and } L_I^* = \frac{\left[\left(I^* - w\right) r_0 r_I - \rho_I I^*\right]^+}{r_I - \lambda\rho_I}$$

- OLG model: Entrepreneurs live for two periods, each period brings a new generation whose initial wealth is current net investment.
- Entrepreneurs are either high or low pledgeability: $\rho_I = \overline{\rho}$ or $\rho_I = \underline{\rho}$
- Denoting s_t the state at date t, expected growth rate between date t and date $t+1$ as

$$g(\rho_I) = i - p\lambda E_{s_t} \frac{\left[(i-1) r_{s_t} r_I - \rho_I i\right]^+}{r_I - \lambda \rho_I}$$

The Theoretical Framework

Comparative Statics: How does interest rate cyclicality affect growth?

- Consider the CB introduces a mean-preserving spread in IR $\{r_s\}_s$.
- A: only low pledgeability entrepreneurs have to delever
- Expected growth rate then writes as

$$g(\rho_l) = i - p\lambda E_s \frac{[(i-1) r_s r_l - \rho_l i]^+}{r_l - \lambda \rho_l}$$

- Cutting r_l raises growth g, but only for low pledgeability firms:

$$\left.\frac{\partial g}{\partial r_l}\right|_{\rho_l = \overline{\rho}} = 0 \qquad \text{but} \qquad \left.\frac{\partial g}{\partial r_l}\right|_{\rho_l = \underline{\rho}} < 0$$

The Theoretical Framework

Comparative Statics: How does lending ability modify the growth effect of IR?

- Consider financiers' ability to lend is either i_h or i_l ($i_h > i_l$).
- A: when $i = i_l$, firms do not need to delever but when $i = i_h$, low pledgeability firms have to delever.
- Expected growth rate then writes as

$$g(\rho_l; i_j) = i_j - p\lambda E_s \frac{\left[(i_j - 1) r_s r_l - \rho_l i_j\right]^+}{r_l - \lambda \rho_l}$$

- Tight LC mutes the effect of interest rate cyclicality on growth:

$$i = i_l: \frac{\partial g}{\partial r_l} = 0 \quad \text{but} \quad i = i_h: \left.\frac{\partial g}{\partial r_l}\right|_{\rho_l = \overline{\rho}} = 0 \text{ and } \left.\frac{\partial g}{\partial r_l}\right|_{\rho_l = \underline{\rho}} < 0$$

The Theoretical Framework

Comparative Statics: How does the cyclicality in lending capacity affect growth?

- Consider financiers' ability to lend depends on the state of nature s; $i_s \in \{i_h; i_l\}$ with $i_h > i_l$.
- A: when $i = i_l$, entrepreneurs do not have to delever but when $i = i_h$, low pledgeability entrepreneurs have to delever.
- Denoting $i = E_s i_s$, the expected growth rate writes as

$$g\left(\rho_l; \{i_s\}_s\right) = i - E_s p\lambda \frac{\left[\left(i_s - 1\right) r_s r_l - \rho_l i_s\right]^+}{r_l - \lambda\rho_l}$$

- Pro-cyclical credit cuts more growth in lower pledgeability firms.

$$\left.\frac{\partial g}{\partial i_h}\right|_{\rho_l=\bar{\rho}} = 0 \qquad \text{and} \qquad \left.\frac{\partial g}{\partial i_h}\right|_{\rho_l=\underline{\rho}} < 0$$

The Theoretical Framework

Main conclusions

1. Counter-cyclical interest rates benefit disproportionately to low tangibility firms.
2. Benefits of counter-cyclical interest rates materialize when bank capital to asset ratio is relatively low.
3. Counter-cyclical credit benefits disproportionately low tangibility firms.

The empirical exercise

General Methodology

- We rely on RZ methodology in looking at the aforementioned effects on industry productivity growth.
  - Causality: macro policies more likely affect individual industries than individual industries affect macro policy.
  - Identification: which parts of the economy, macro policies affect most/least.

The empirical exercise

The specification

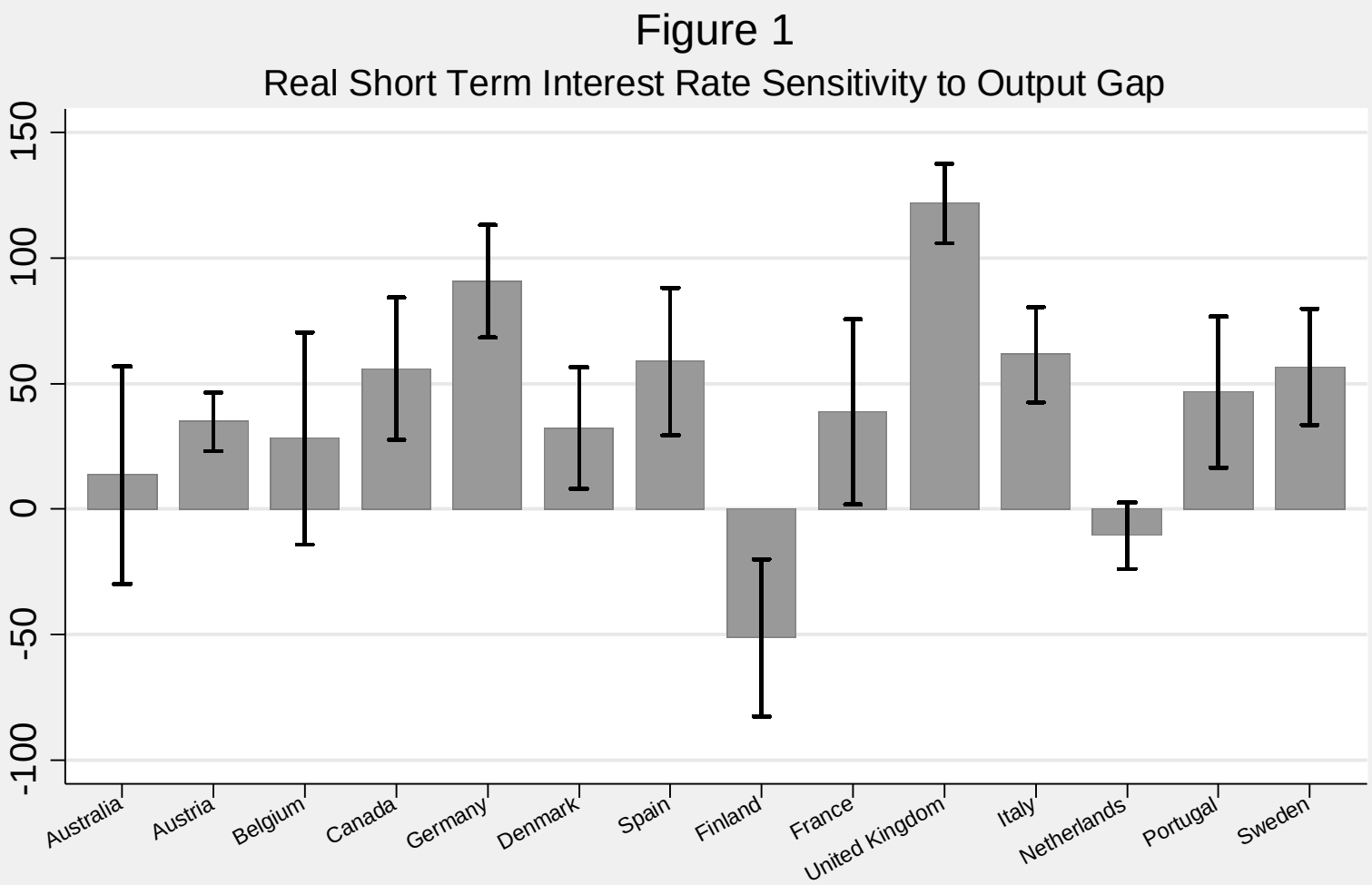
- We run the following estimation

$$g_{i,c} = \alpha_i + \beta_c + \gamma.var_c \times f_i + \varepsilon_{i,c}$$

- Dependent variable:
  - industry productivity growth over 1999-2005 (post ECB period).
- Macro variables:
  - Interest rate cyclicality: real ST interest rate sensitivity to output gap
  - Financiers' lending capacity: bank capital to asset ratio
  - Financiers' lending cyclicality: credit gap sensitivity to output gap
- Industry financial constraints:
  - credit constraint: asset tangibility for corresponding US sector
  - liquidity constraint: labor cost to sales ratio for corresponding US sector

The empirical exercise

Real interest rate cyclicality across countries



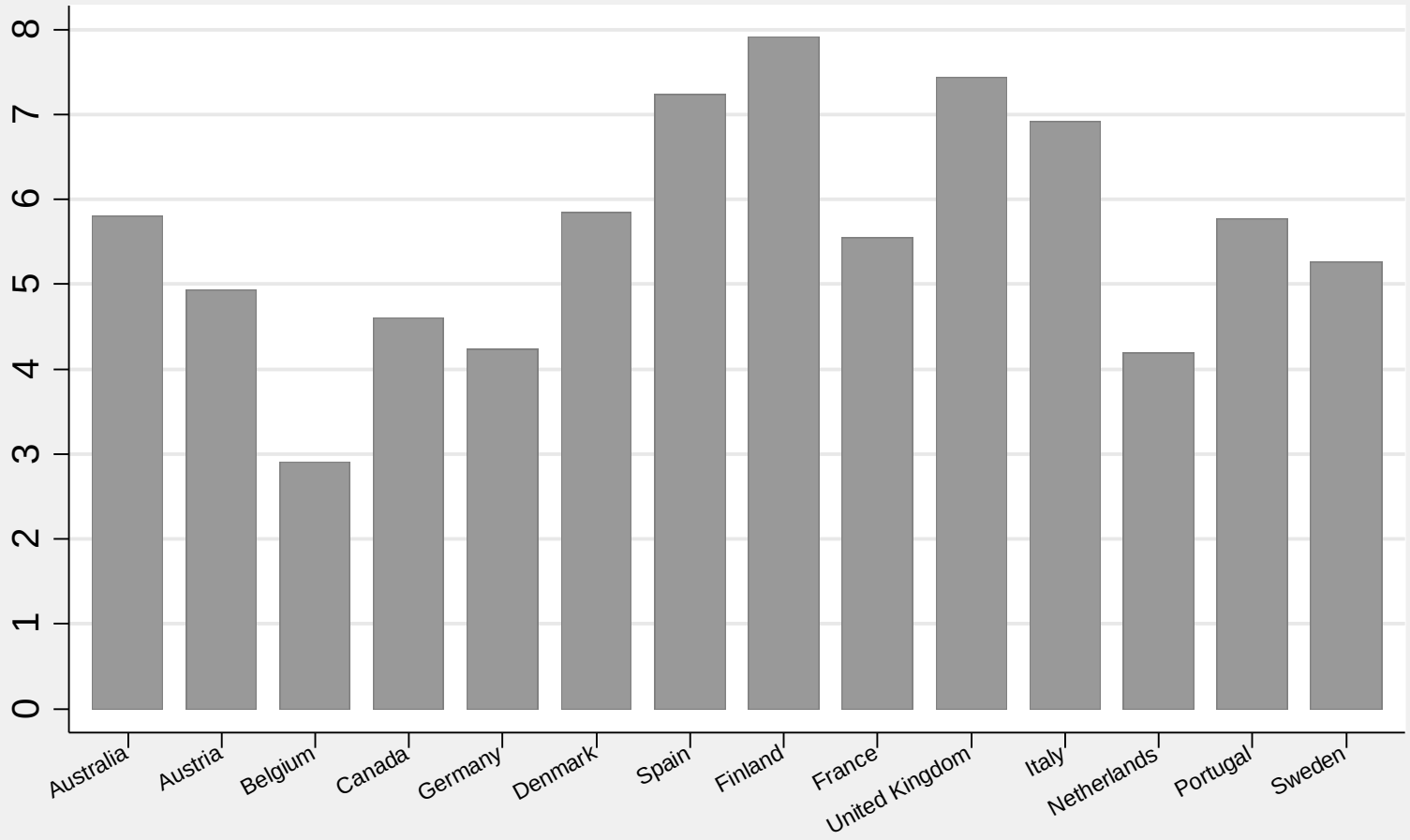
Note: Each bar represents the output gap sensitivity in percentage points of the real short term interest rate for the period 1995-2005 for each country, controlling for the one quarter lagged real short term interest rate. The black line indicates the confidence interval at the 10% level around the sensitivity estimate for each country.

The empirical exercise

Bank capital across countries

Figure 3

Bank Capital to Asset Ratio (% Total Assets)



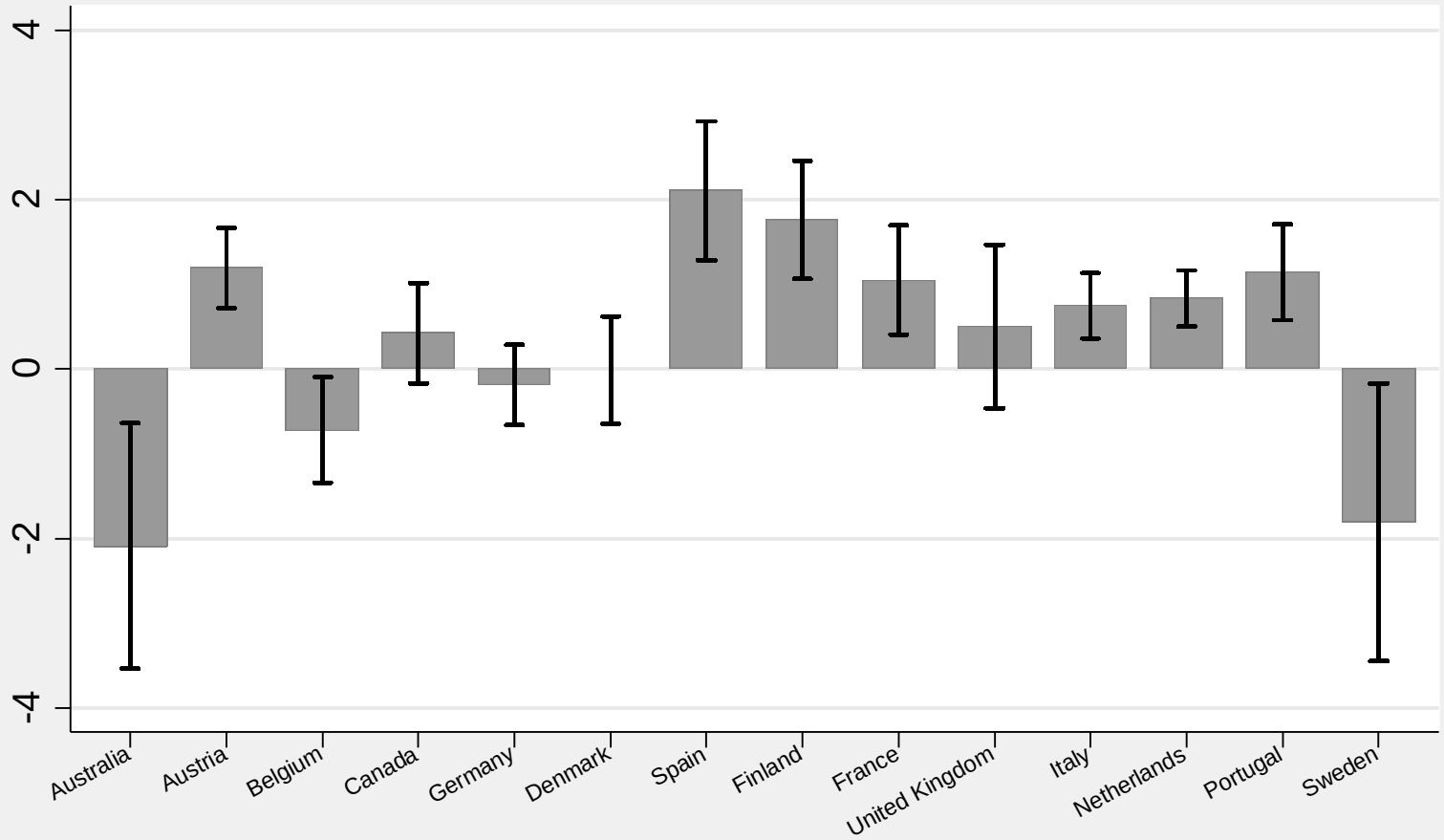
Source: World Development Indicators

The empirical exercise

Credit to non-financial firms cyclicality across countries

Figure 4

Credit to Non-Financial Corporations Sensitivity to Output Gap



Note: Each bar represents the output gap sensitivity of the credit gap to non-financial corporations for the period 1999-2005 for each country. The black line indicates the confidence interval at the 10% level around the sensitivity estimate for each country.

First prediction

Counter-cyclical interest rates

Counter-cyclical real short term interest rates benefit disproportionately to financially constrained/liquidity dependent sectors.

The empirical exercise

ST interest rates cyclicality and industry growth

Dependent variable: labour productivity growth — Table 2

	(i)	(ii)	(iii)	(iv)
Log of initial relative labour productivity	**–1.085**	**–1.122**	**–1.226**	**–1.158**
	(1.319)	*(1.294)*	*(1.273)*	*(1.243)*
Interaction (asset tangibility and real short-term interest rate countercyclicality I)	**–17.89***			
	(9.47)			
Interaction (asset tangibility and real short-term interest rate countercyclicality II)		**–15.65****		
		(6.93)		
Interaction (labour costs to sales and real short-term interest rate countercyclicality I)			**22.64****	
			(8.66)	
Interaction (labour costs to sales and real short-term interest rate countercyclicality II)				**16.82****
				(6.83)
Observations	550	550	550	550
R-squared	0.248	0.251	0.249	0.249

The dependent variable is the average annual growth rate in hour labour productivity over the period 1999–2005 for each industry in each country. Initial relative labour productivity is the ratio of industry hour labour productivity to total manufacturing hour labour productivity in 1999. Asset tangibility is the median fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980–89. Labour costs to sales is the median ratio of labour costs to shipments for US firms in the same industry for the period 1980–89. Real Short-term interest rate countercyclicality I is the coefficient of the output gap when the real short-term interest rate is regressed on a constant, the output gap and the one-quarter-lagged real short-term interest rate for each country. Real short-term interest rate countercyclicality II is the coefficient of the output gap in the regression which minimises the RMSE for each country. The interaction variable is the product of variables in parentheses. Standard errors – clustered by industry – are in parentheses. All estimations include country and industry dummies. Significance at the 1%, 5% and 10% level is indicated by ***, ** and * respectively.

Second prediction

Counter-cyclical interest rates and bank capital

Benefits of counter-cyclical real short term interest rates materialize when bank capital to asset ratio is relatively low.

The empirical exercise

IR cyclicality, bank capital and industry growth

Dependent variable: labour productivity growth — Table 4

	Above median	(i)	(ii)	(iii)	(iv)
Log of initial relative labour productivity		**-1.124**	**-1.157**	**-1.400**	**-1.208**
		(1.456)	*(1.384)*	*(1.298)*	*(1.313)*
Interaction (asset tangibility and real short-term interest rate countercyclicality I)		**-45.97*** **			
		(7.096)			
Interaction (asset tangibility and real short-term interest rate countercyclicality II)			**-26.07*** **		
			(3.134)		
Interaction (asset tangibility and real short-term interest rate countercyclicality I)	Average bank capital to asset ratio	**37.19*** **			
		(8.703)			
Interaction (asset tangibility and real short-term interest rate countercyclicality II)			**21.15*** **		
			(6.383)		
Interaction (labour costs to sales and real short-term interest rate countercyclicality I)				**51.20*** **	
				(8.561)	
Interaction (labour costs to sales and real short-term interest rate countercyclicality II)					**29.26*** **
					(5.323)
Interaction (labour costs to sales and real short-term interest rate countercyclicality I)				**-37.30*** **	
				(8.769)	
Interaction (labour costs to sales and real short-term interest rate countercyclicality II)					**-25.25** **
					(8.699)
Observations		550	550	550	550
R-squared		0.261	0.256	0.258	0.255

Third prediction

Counter-cyclical interest rates vs. counter-cyclical interest rates

Counter-cyclical credit benefits disproportionately to liquidity dependent sectors, independently of the effect of counter-cyclical real short term interest rates.

The empirical exercise

IR cyclicality, lending cyclicality and industry growth

Dependent variable: growth in labour productivity per hour — Table 5

	(i)	(ii)	(iii)	(iv)
Log of initial relative labour productivity	**-1.087**	**-1.140**	**-1.152**	**-1.089**
	(1.382)	*(1.377)*	*(1.221)*	*(1.248)*
Interaction (asset tangibility and real short-term interest rate countercyclicality I)	**-17.94****			
	(7.233)			
Interaction (asset tangibility and real short-term interest rate countercyclicality II)		**-16.09*****		
		(4.850)		
Interaction (asset tangibility and credit to NFC pro-cyclicality)	**-0.124**	**-0.920**		
	(3.317)	*(2.942)*		
Interaction (labour costs to sales and real short-term interest rate countercyclicality I)			**21.02***	
			(11.27)	
Interaction (labour costs to sales and real short-term interest rate countercyclicality II)				**14.65***
				(7.243)
Interaction (labour costs to sales and credit to NFC pro-cyclicality)			**-6.125****	**-5.529****
			(2.244)	*(2.325)*
Observations	550	550	550	550
R-squared	0.249	0.252	0.251	0.251

The dependent variable is the average annual growth rate in labour productivity per hour for the period 1999–2005 for each industry in each country. Initial relative labour productivity is the ratio of industry labour productivity per hour to total manufacturing labour productivity per hour in 1999. Asset tangibility is the median fraction of assets represented by net property, plant and equipment for US firms in the same industry for the period 1980–89. Labour costs to sales is the median ratio of labour costs to shipments for US firms in the same industry for the period 1980–89. Real short-term interest rate countercyclicality I is the output gap sensitivity of the real short-

Conclusions

Main takeaways

- Stabilization through counter-cyclical IR benefits disproportionately to financially constrained/liquidity dependent sectors.
  - This holds in countries where bank capital to asset ratio is relatively low
  - Where bank capital to asset ratio is relatively high, counter-cyclical IR do not make any difference
- Counter-cyclical lending benefits disproportionately to liquidity dependent sectors.
  - This effect comes on top of that of counter-cyclical interest rates

Conclusions

Main policy implications

- Following the 2008-2009 financial crisis, Basel III is calling for higher bank regulatory capital to asset ratios:
  - This will reduce growth in financially constrained sectors, but only in countries where interest rates are significantly counter-cyclical.
- Following the 2008-2009 financial crisis, Basel III is calling for counter-cyclical capital buffers:
  - This will raise growth in liquidity dependent sectors, irrespective of other developments.