Productivity, Capital Reallocation and the Financial Crisis: Evidence from Europe and the US

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Motivation

- It is widely alleged that, since the financial crisis, the financial system has been impaired so that it functions less well in allocating capital thus restraining productivity growth.
- Whilst this suspicion is widespread, it has proved difficult to gather evidence to examine it
- This is perhaps not surprising since it is a hard question for some reasons:
  - It is necessary to define a counter-factual against a well-functioning system: compare productivity for a system where capital is allocated to "right" sectors with productivity under the current, allegedly, misallocated situation.
  - A sense of scale has to be identified. Much of the extant (business) capital stock is buildings, any such reallocation might be too small scale to make much material difference.
  - Once the extent of capital misallocation has been quantified, we want to know what is causing it.

Background

- Restuccia and Rogerson (2013) survey work on misallocation and productivity under two headings:
  - The **direct** method is to study the link between some likely source of capital misallocation (regulation, taxes, imperfect markets e.g. for credit) and TFP level or growth.
  - The **indirect** method starts from the view that total TFP might be lowered via a somehow suboptimal mix of sectoral/company TFP; that is, misallocation comes from a "mix" effect rather than effects on each sector.
- One stream of work, exemplified by Hsieh and Klenow, (2009) and implemented on cross-country data before and after the financial crisis by, for example:
  - Gopinath et al., (2015), Dias, Robalo Marques, and Richmond (2016); Gamberoni, Giordano, and Lopez-Garcia (2016); García-Santana et al. (2016)

Background

- In this paper we implement the method, due to Jorgenson and co-authors (see e.g. Jorgenson et al., (2007), (1987)) that is complementary to the mentioned literature.
- Their approach measures directly the effect that capital allocation would have on productivity growth if capital were allocated in an undistorted fashion.
- The benchmark "undistorted" allocation is intuitive: where the rate of return on capital is equalized between industries in the economy.

Our paper

- We explore the characteristics of capital reallocation before and after the financial crisis over countries.
- Then we look at the influence of intangible capital on reallocation and examine whether capital reallocation differs between intangible and tangible assets:
  - a number of papers have argued that growing intangible-intensity has changed the relation between allocation and interest rates (Caggese and Perez-Orive 2017).
- Finally, we study the correlation between capital reallocation and various indicators to check if it is correlated positively or negatively with low interest rates, or banking regulation and/or competition.

Measuring capital contribution to productivity growth

- The Jorgenson-Griliches (1967) contribution of capital services to productivity growth is, for one capital good, the share of capital rental payments times capital stock growth. That is:

$$Con\Delta lnK = (P_K K / P_Y Y)\Delta lnK \tag{1}$$

- with $P_K = P_I(\rho + d)$ where ρ is a rate of return, d is depreciation and P_I investment prices. Therefore eq(1) can be written in terms of rates of return as (Hall and Jorgenson, 1967):

$$Con\Delta lnK = (P_I K / P_Y Y)(\rho + d)\Delta lnK \tag{2}$$

Measuring capital reallocation (Jorgenson and Schreyer, (2013))

- Assume the benchmark productivity growth is calculated in the case characterized by a competitive market where the rates of return are equalized across industries.
- Then define $Con\Delta lnK^*$ as the capital contribution corresponding to the benchmark productivity growth case and $Con\Delta lnK$ the contribution for the current situation where rates of return differ between industries.
- Capital reallocation can then be defined as:

$$REALL = \Sigma(Con\Delta lnK) - \Sigma(Con\Delta lnK^*) \tag{3}$$

Measuring capital reallocation (Jorgenson and Schreyer, (2013))

- **REALL>0** if the economy is "working well" i.e. capital is flowing to the high ρ sectors, so there is a positive covariance between $\Delta lnKi$ and ρ_i, other things equal.
- By contrast, suppose the financial sector is working "badly". Then there is a negative covariance between ρ_i and $\Delta lnKi$ generating **REALL<0** because capital industry contributions become lower relative to economy-wide ρ.
- Thus we can calculate capital reallocation as:

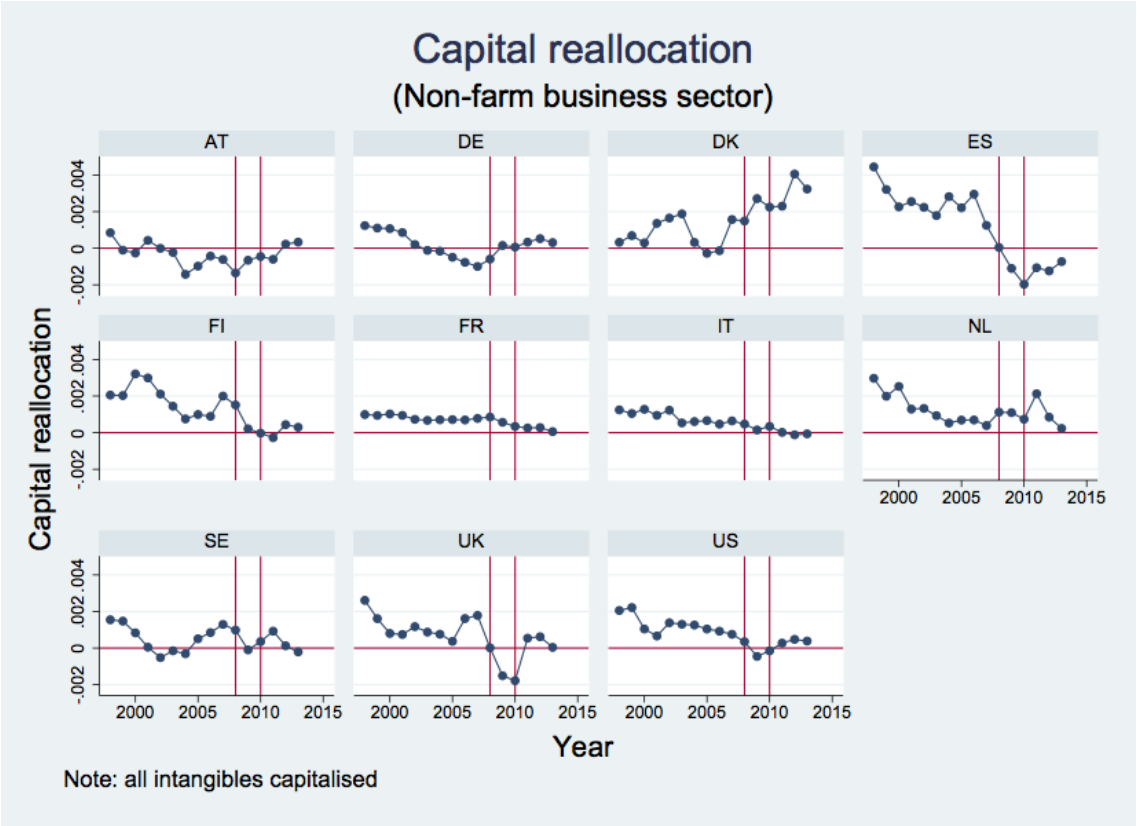
$$
\begin{aligned}
REALL_K &\equiv \sum_{i=1}^{I} (s_i^K \Delta \ln K)^{\rho=\rho_i} - \sum_{i=1}^{I} (s_i^K \Delta \ln K)^{\rho=\rho} \\
&= \sum_{i=1}^{I} \sum_{a=1}^{A} \left(\frac{\tau_{a,i} P_{Ia,i} (\rho_i + d_a) K_{a,i}}{P_{Q,i} Q_i} \right) \Delta lnK_{ai} - \sum_{i=1}^{I} \sum_{a=1}^{A} \left(\frac{\tau_{a,i} P_{Ia,i} (\rho + d_a) K_{a,i}}{P_{Q,i} Q_i} \right) \Delta lnK_{ai} \\
&= \sum_{i=1}^{I} \sum_{a=1}^{A} \left(\frac{\tau_{a,i} P_{Ia,i} K_{a,i}}{P_{Q,i} Q_i} \right) \Delta lnK_{ai} (\rho_i - \rho)
\end{aligned}
$$

Data

- Database with multiple dimensions:
  country, industry, institutional sector, time
- Harmonized measures of intangible assets (INTAN Invest and SPINTAN), other vars (EUKLEMS and NA)
- 20 industries (A-U Nace Rev 2), 1995-2013, so far 11 countries:
  - US
  - Big Northern Europe: DE, FR, UK
  - Scandinavian: DK FI, SE
  - Small Europe: AT, NL
  - Mediterranean: ES, IT
- Other sources are Eurostat and OECD for: long term interest rates, ESI, Business climate indicator.

Capital reallocation: all intangibles capitalised

- In the run up to the financial crisis, experience across countries varied: Spain, US and UK experienced a downward trend.
- In 2008-2009, REALL became negative in many, although not all countries with the fall in the UK and Spain particularly sharp.



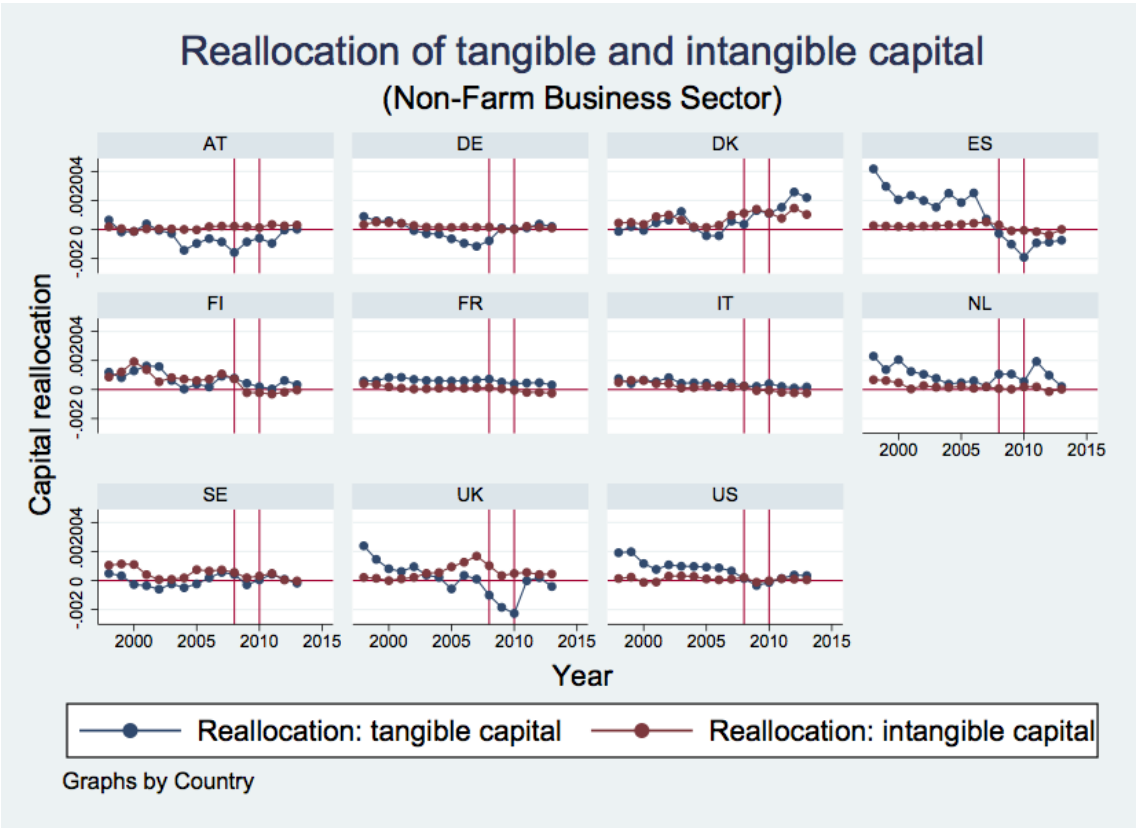
Capital reallocation and TFP

- The pre-great recession period, 1998-07 saw positive contributions of REALL to $\Delta lnTFP$ (except Austria)
- During the crisis REALL has been negative in 5 out of 11 economies.
- Since 2011 REALL increased but remaining below pre-crisis years.

Capital Reallocation					***DlnTFP***			
	1998-07	**2008-10**	**2011-13**	**Total**	***1998-07***	***2008-10***	***2011-13***	***Total***
Country								
AT	-0.02	-0.1	-0.01	-0.03	*1.28*	*-1.01*	*0.32*	*0.67*
DE	0.01	-0.01	0.05	0.01	*1.07*	*-1.93*	*0.57*	*0.41*
DK	0.09	0.21	0.37	0.17				
ES	0.27	-0.12	-0.12	0.12	*-1.23*	*-0.7*	*0.05*	*-0.89*
FI	0.23	0.08	0.04	0.16	*2.98*	*-2.32*	*-0.71*	*1.3*
FR	0.11	0.07	0.03	0.09	*0.92*	*-1.57*	*0.01*	*0.28*
IT	0.09	0.03	0.00	0.06	*-0.19*	*-1.52*	*-0.24*	*-0.45*
NL	0.15	0.11	0.13	0.14	*0.7*	*-0.92*	*-0.72*	*0.13*
SE	0.11	0.07	0.03	0.09	*2.48*	*-1.12*	*0.37*	*1.41*
UK	0.11	-0.2	0.03	0.04	*1.58*	*-0.91*	*0.25*	*0.86*
US	0.16	-0.01	0.04	0.11	*1.26*	*0.05*	*-0.14*	*0.77*
Total	**0.12**	**0.01**	**0.05**	**0.09**	***0.99***	***-1.09***	***-0.02***	***0.41***

Tangible and intangible capital reallocation

- Tangible and intangible capital reallocation are quite correlated with the exceptions of AT, DE and ES where much of the variance in REALL is due to tangible reallocation and the UK, where the recession REALL fall seems very much due to tangible.



Investigating the drivers of capital reallocation

We investigate possible drivers of capital reallocation estimating the following specification:

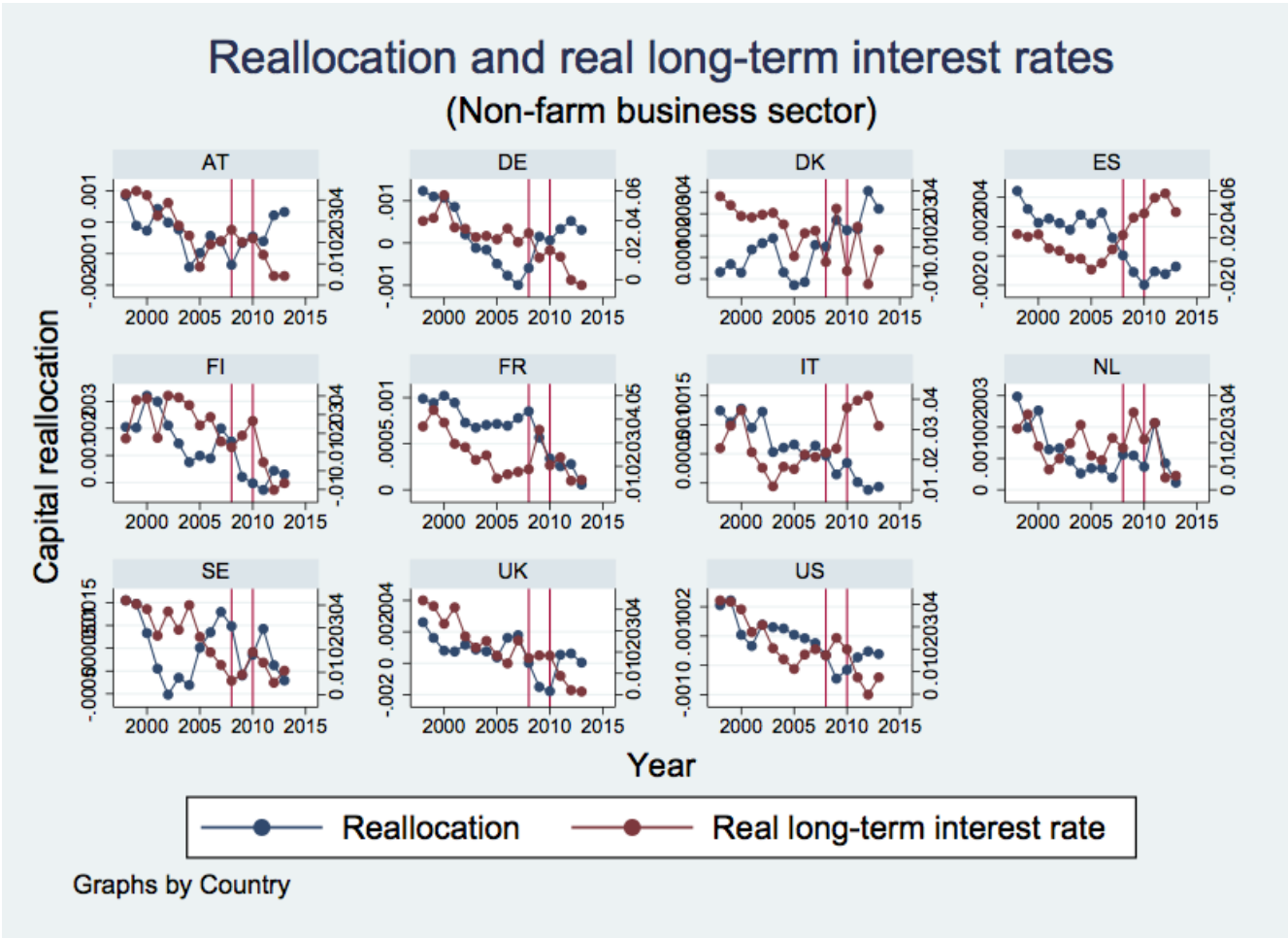
$$REALLK_{c,t} = \alpha_1 R_{c,t} + \alpha_2 Crisis + \alpha_3 Exp^j_{c,t} + \alpha_4 Z^i_{c,t} + \lambda_c + \lambda_t + \epsilon_{c,t}$$

where

- R is long term interest rate,
- Crisis is a dummy variable for 2008,
- Exp^j are indicators of economic sentiment, with j=ESI, OECD Business climate indicator (US)
- Z^i are other controls for financial market and credit conditions
- λ_c and λ_t are country and time dummies.

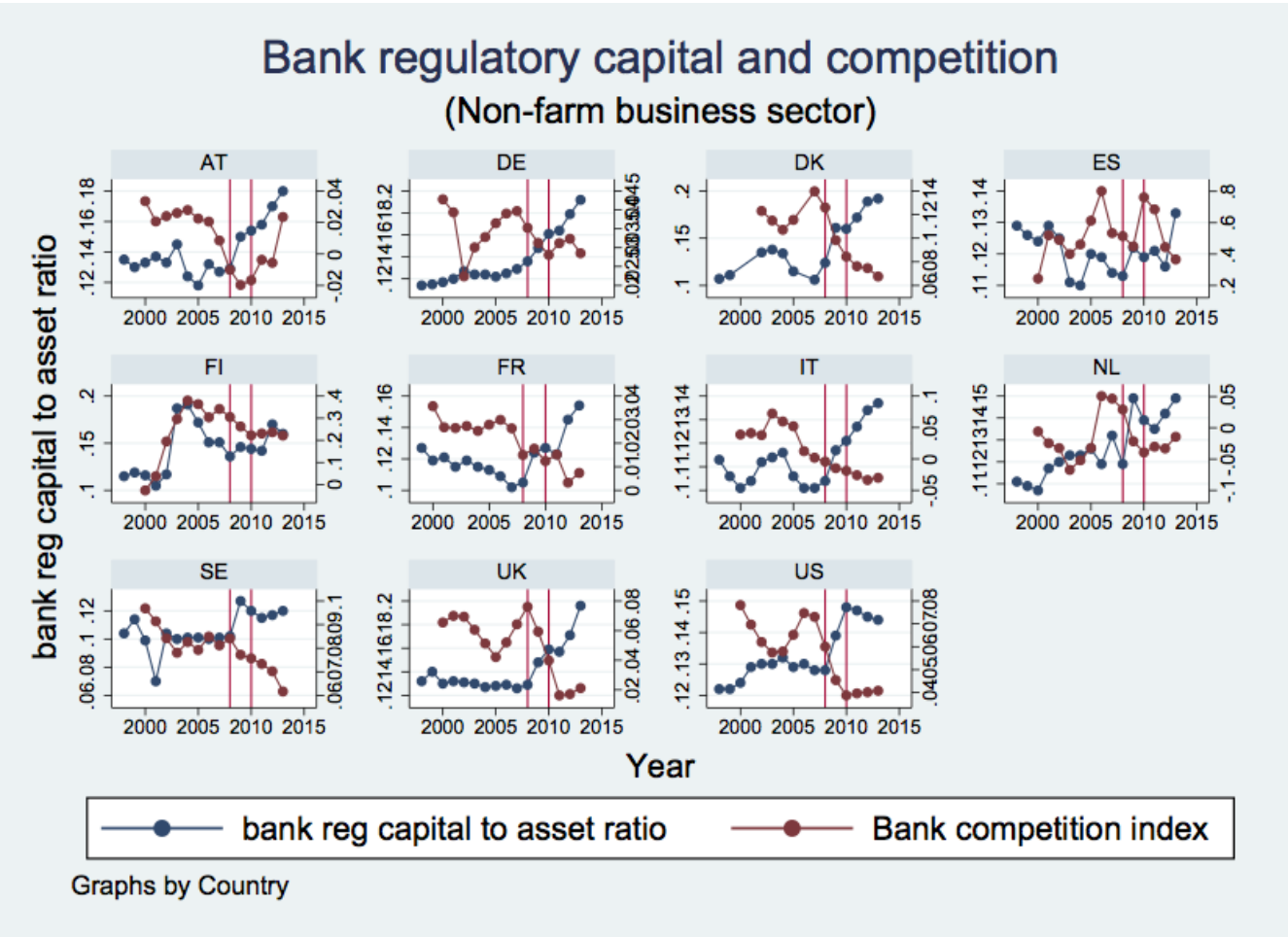
Reallocation and long-term real interest rates

- Do low interest rates foster capital misallocation?
- In almost all countries, bar Spain and Italy the interest rate has been falling with REALL showing heterogeneous dynamics.



Bank regulatory capital and competition

- Especially starting in the period just after the financial crisis competition fell and has fallen since, with some exceptions, the US and the UK.
- Regulatory capital rose over the crisis and has risen since, strongly so in some cases.



Raw data

- REALL has fallen and then risen, as has ESI.
- Real interest rates have fallen throughout, as has competition.
- Regulatory capital has risen, but the interaction between regulatory capital and competition has fallen in the most recent period i.e. the fall in competition has not been offset by a rise in regulatory capital.

Period	REALL*100	real int rate	ESI	Regcap/asset	compet	compet*regcap	time dummies	Sum
1999-07	0.092	0.025	1.038	0.122	0.101	0.013	-0.051	
2008-10	0.017	0.021	0.945	0.134	0.103	0.013	-0.118	
2011-13	0.045	0.014	0.973	0.151	0.083	0.012	-0.167	
Regression coeffs		-1.16	0.34	3.41	0.99	-9.66		
Change 98/07 to 08/10	**-7.52%**	-0.36%	-9.28%	1.19%	0.21%	0.03%	-6.75%	
predicted		0.42%	-3.18%	4.05%	0.21%	-0.31%	**-6.75%**	-5.57%
Change 08/10 to 11/13	2.81%	-0.75%	2.82%	1.78%	-1.99%	-0.16%	-4.92%	
predicted		0.87%	0.97%	6.08%	-1.97%	1.55%	**-4.92%**	2.58%

Empirical Results

Dependent variable is REALL as eq(3)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Intrate	**-2.65***	-1.65	-1.90	**-6.73****	-1.55	-1.16
	(-1.93)	(-0.95)	(-1.76)	**(-2.30)**	(-1.63)	(-1.53)
Intrate_postcrisis		-1.78				
		(-0.89)				
esi			**0.44***	**0.43***	**0.28***	**0.34***
			(2.17)	**(2.12)**	**(2.05)**	**(2.10)**
Intan_intensity				-0.46		
				(-1.01)		
Intrate_intan				10.69*		
				(1.89)		
Banking competition					-0.24**	0.99*
					(-2.37)	(2.08)
Regulatory capital					**1.80***	**3.41****
					(1.89)	**(2.97)**
Banking competition_regulatory capital						**-9.66****
						(-2.72)
Observations	176	176	176	176	165	165
R-squared	0.34	0.34	0.38	0.41	0.45	0.47

Main findings

- Low real interest rates raise REALL, contrary to the view they are positively correlated which one might guess from the oft-described co-incidence of low interest rates and what is supposed as low REALL
- There is no statistically significantly different marginal impact of real interest rates post-crisis.
- Low economic sentiment (ESI) also lowers REALL
- Interaction between intangible intensity and real interest rates is positive, but borderline significant: low interest rates in an intangible intensive economy lower REALL, in line with Caggese and Perez-Orive (2017), but the effect is not strongly significant.
- More REALL is correlated with more regulatory capital, but less banking competition.

Policy implications

- All in all, most of the REALL behavior is accounted for by time dummies, i.e. unknown shocks.
- But, if the remaining effects are causal, then our results suggest that adverse shocks to reallocation can be offset by more ESI, more regulatory capital and more banking competition.

Conclusions

- We have calculated the Jorgenson reallocation term, which gives a measure of the contribution to aggregate TFP growth due to the allocation of capital across sectors in a benchmark economy where rates of return are equalized and one where they are persistently different.
- The raw data indicates that reallocation got worse in many countries between 2008 and 2009 and has remained worse since then.
- The fall in REALL is associated with falls in economic sentiment and in competition between banks, but is offset by rises in bank regulatory capital and diminishing interest rates.