

Productivity Growth and Financial Constraints

Conference “**Productivity dynamics after the crisis**”

Banque de France – Collège de France

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Based on:

- Antonin Bergeaud, Gilbert Cette and Remy Lecat
« Productivity Trends in Advanced Countries Between 1980 and 2012 »
The Review of Income and Wealth, vol. 62(3), September 2016, pp. 420-444
- Antonin Bergeaud, Gilbert Cette and Remy Lecat
« Total Factor Productivity in Advanced Countries: A Long Term Perspective »
International Productivity Monitor, Number 32, Spring 2017, pp. 6-24.
- Gilbert Cette, Simon Corde and Rémy Lecat
« Stagnation of productivity in France: A legacy of the crisis or a structural slowdown? »
Economics and Statistics, n° 494-496, 2017, pp. 11-36
- Gilbert Cette, Simon Corde and Rémy Lecat
« Firm level Productivity dispersion and Convergence »
Banque de France, Working Paper n° 662, 2018, February
Economics Letters, Vol. 166, May, pp. 76-78
- **Philippe Aghion, Antonin Bergeaud, Gilbert Cette, Remy Lecat and Helene Maghin**
« The Conteracting Effects of Credit Constraints on Productivity: Theory and Evidence »
Mimeo, 9th May 2018
- Antonin Bergeaud, Gilbert Cette and Remy Lecat
« Interest rates and productivity: an empirical analysis on macro level data »
Ongoing research

Content

Main messages

1. Introduction: A general productivity slowdown
2. The story tested
3. Data
4. Financial constraints and productivity
5. Conclusion

Main messages

- **General productivity slowdown** in OECD countries and real long-term interest rates decrease since the 1980s
- **At the firm level, lower financial constraints** ⇒
 - Easier for innovators to finance innovation ⇒ **positive impact on productivity**
 - Less cleansing, less entry, damage resource allocation ⇒ **negative impact on productivity**
- **At the aggregate level, concave relationship between financial constraints and productivity**
 - Low FC ⇒ Impact of lower cleansing dominates
 - High FC ⇒ Impact of lower innovation financing dominates
- **At the country level, productivity and interest rates: a circular relationship**
 - Slowdown in productivity ⇒ lower interest rates as long-term capital return decreases
 - Lower interest rates ⇒ slowdown in productivity as survival of less productive firms (lower cleansing) and investment in less profitable project

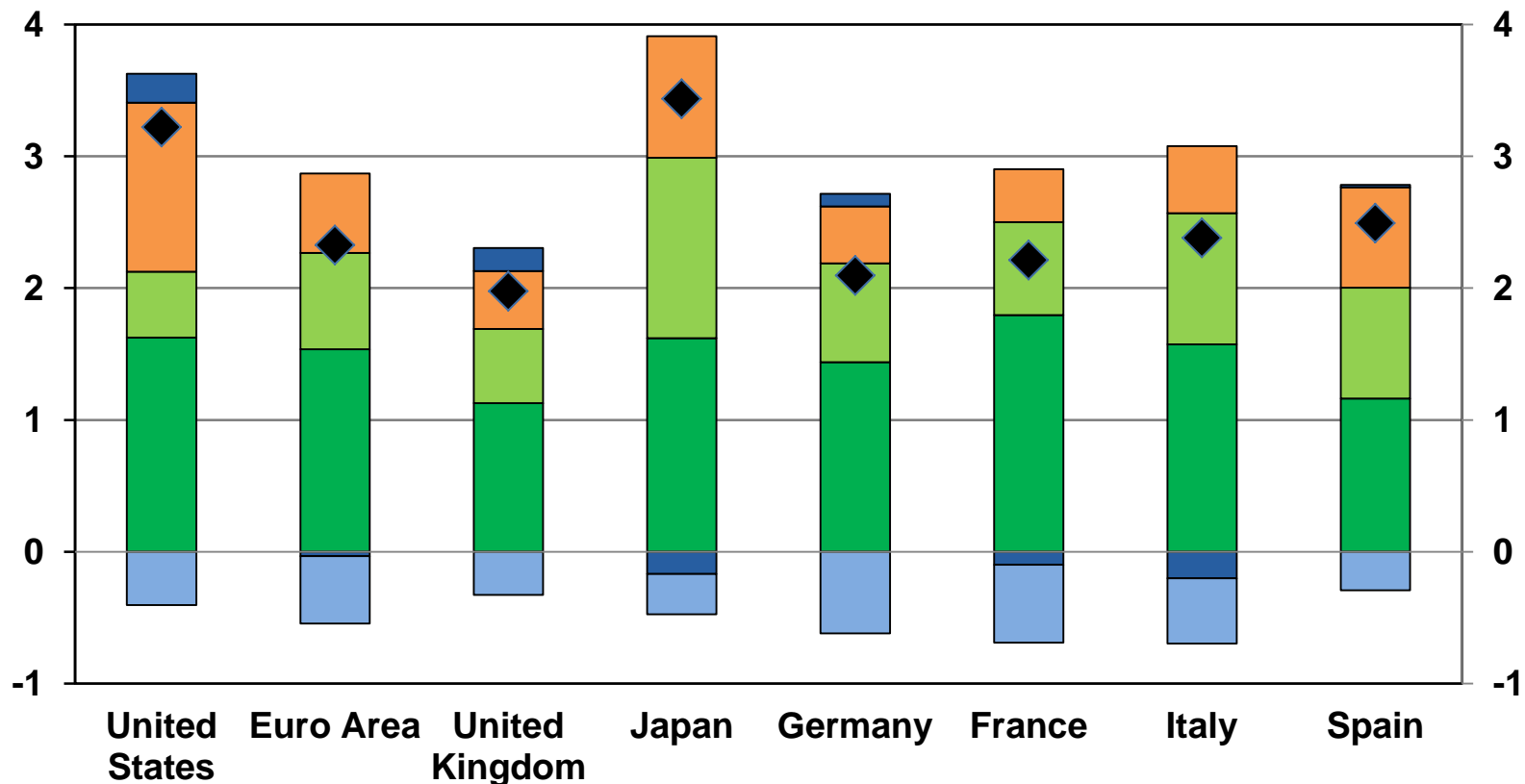
Main messages

- **Since the 1990s, increase in the dispersion of productivity** between firms as a consequence of the **lower cleansing mechanisms**
- **During the financial crisis, lower interest rates weighed on productivity growth** but supported activity and employment by keeping alive less productive firms
- **In the upturn, increasing interest rates will support productivity growth**

1. Introduction: a general productivity slowdown

GDP annual growth (in %) and contributions (in pp) 1890 – 2016 - Whole economy

Source: Bergeaud, Cette and Lecat (2016) - See: www.longtermproductivity.com



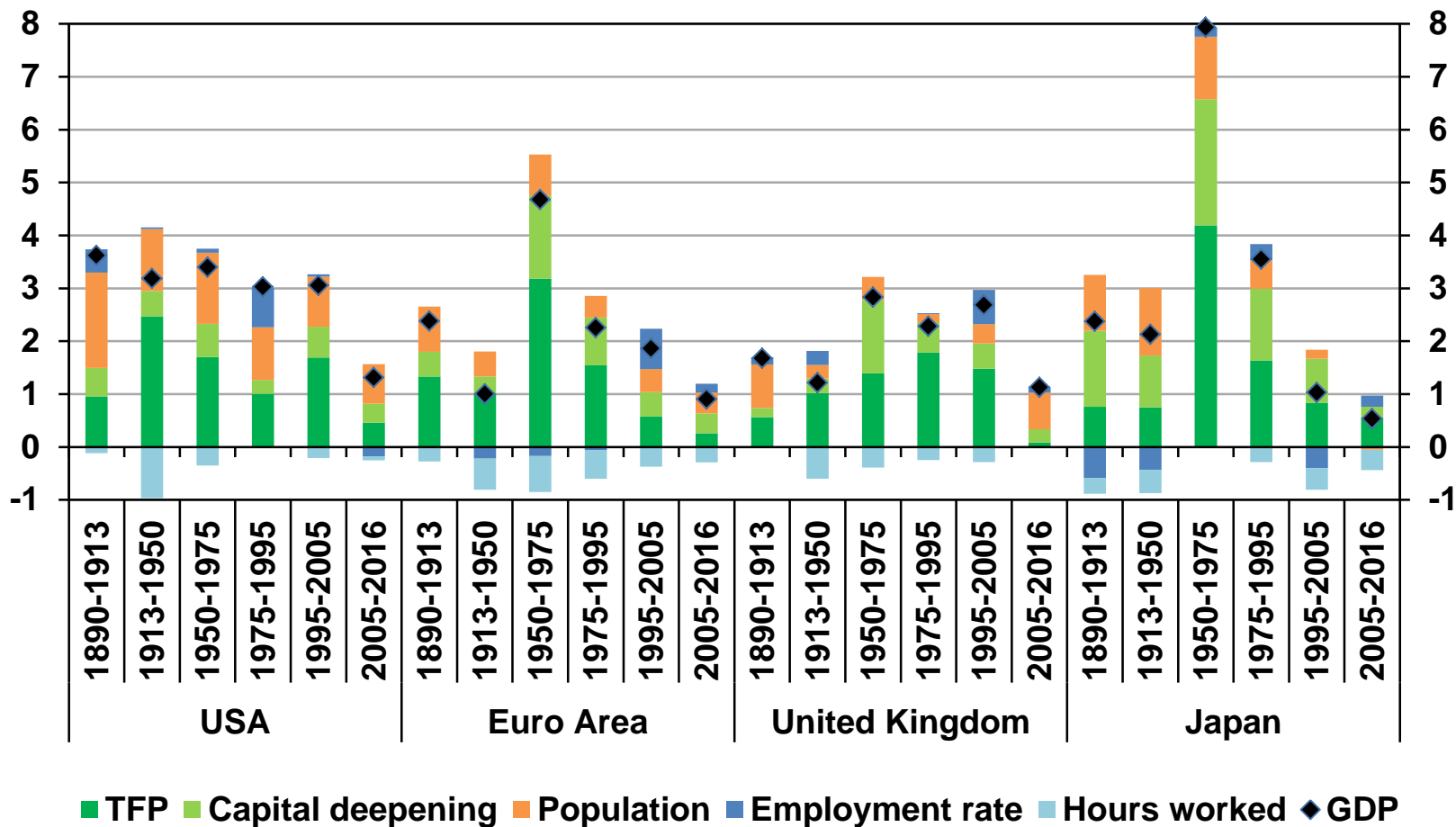
■ TFP ■ Capital deepening ■ Population ■ Employment rate ■ Hours worked per worker ◆ GDP

○ Main GDP growth driver: Productivity growth. And within productivity: TFP growth

1. Introduction: a general productivity slowdown

GDP annual growth (in %) and contributions (in pp) – Whole economy

Source: Bergeaud, Cette and Lecat (2016) - See: www.longtermpredictions.com

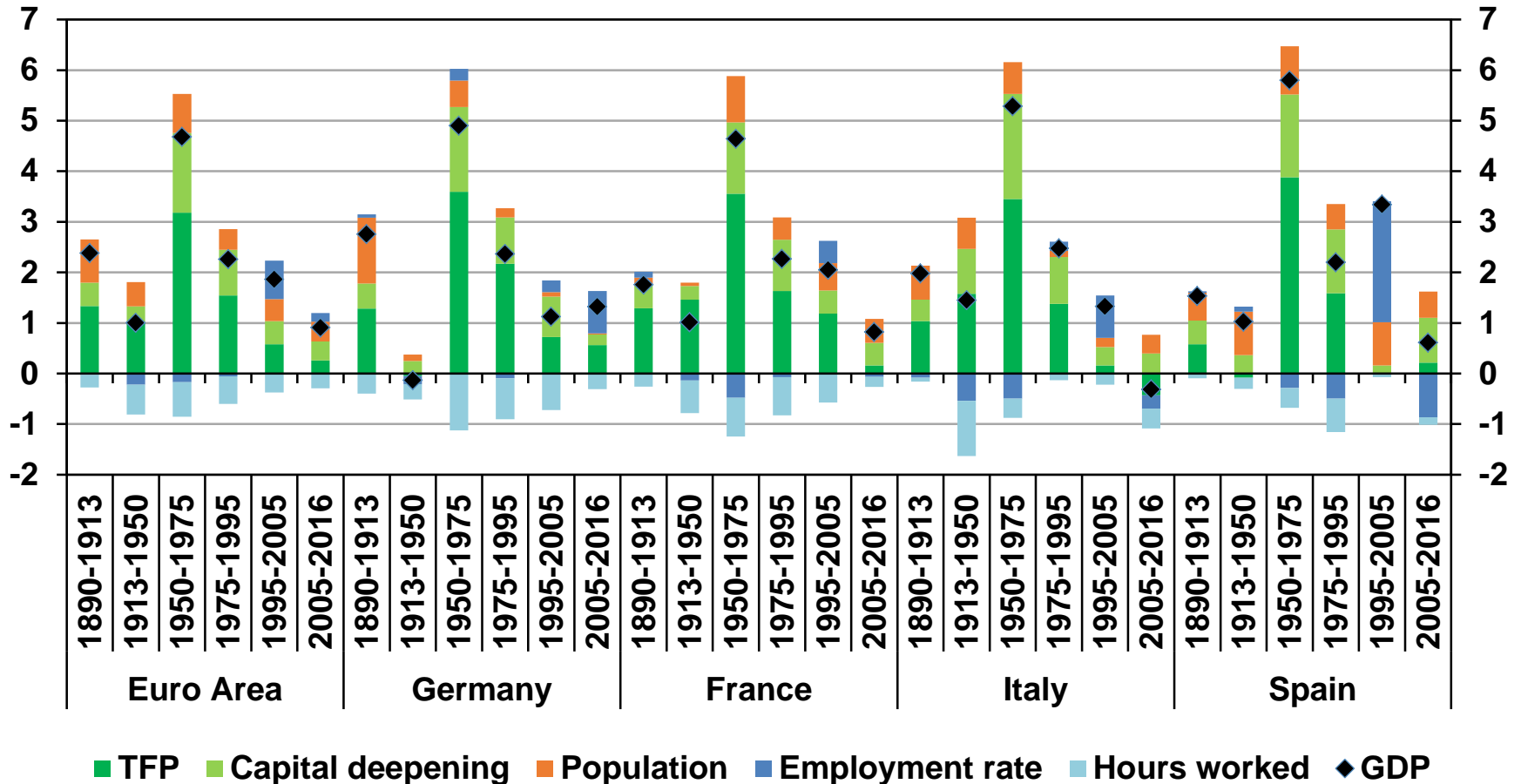


- Since WW2, growth decrease in the main developed areas except for 1995-2005 in US and UK thanks to ICT
- Main factor of this growth decrease: TFP slowdown. **Risk of Secular Stagnation?**

1. Introduction: a general productivity slowdown

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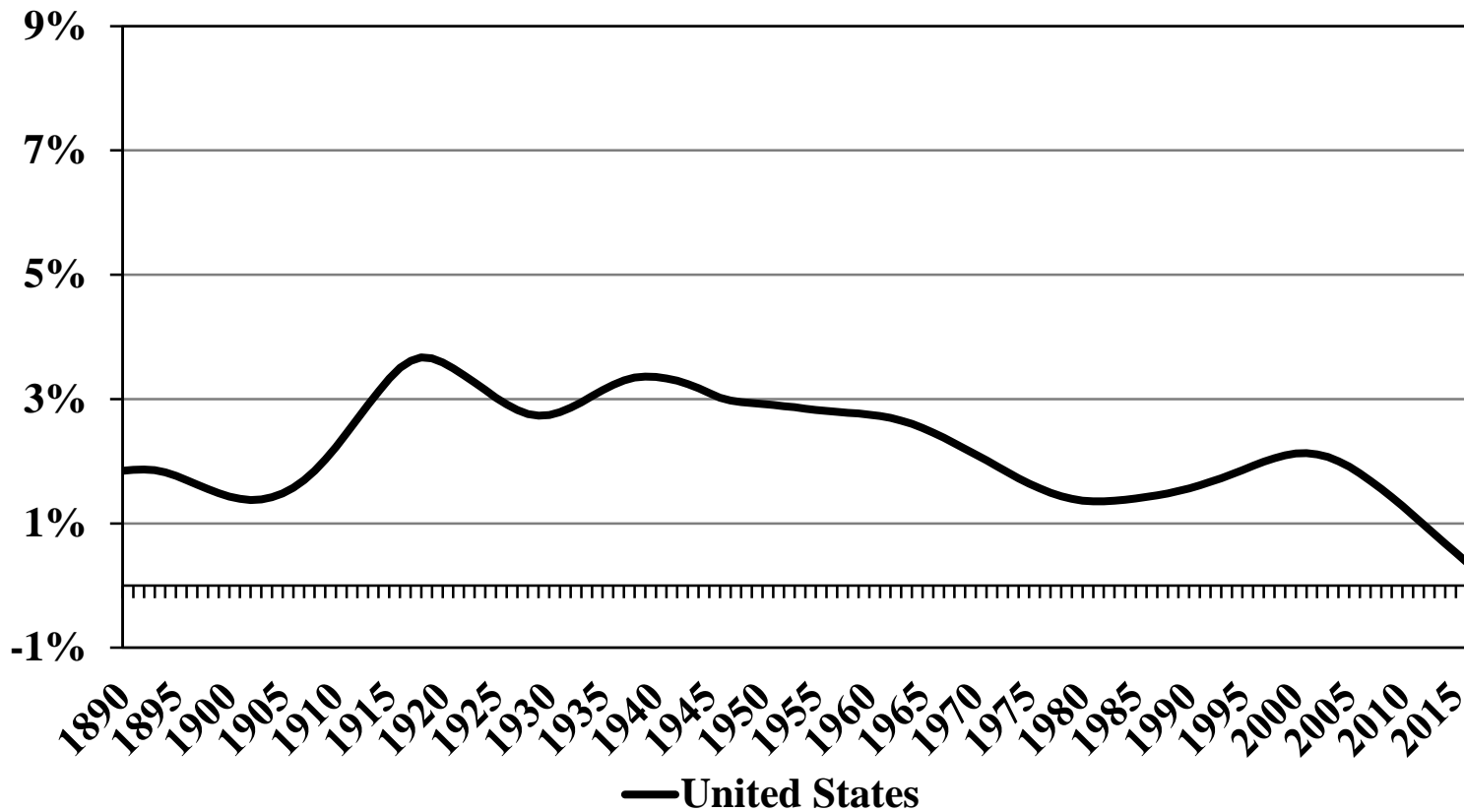
- Same slowdown in the main EA countries
Except in Spain, over 1995-2004, but unsustainable growth
- Main factor of this growth decrease: TFP slowdown. **Risk of Secular Stagnation?**

1. Introduction: a general productivity slowdown

Average annual growth rate of labor productivity per hour

Smoothed indicator (HP filter, $\lambda = 500$) - Whole economy – 1891-2016 – In %

Source: Bergeaud, Cette and Lecat (2016) - See: www.longtermproductivity.com



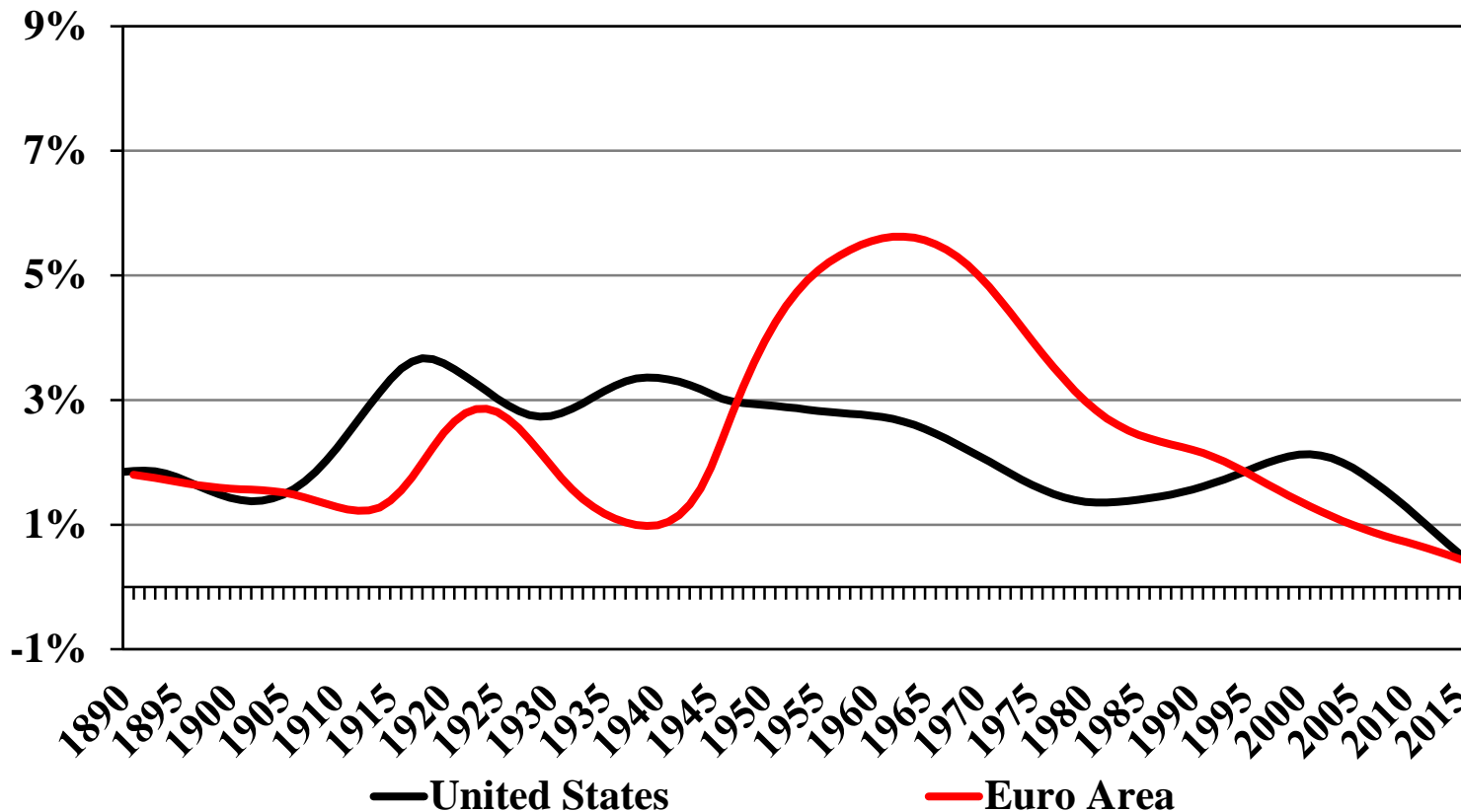
- US: one big wave over the 20th Century, pause during Great Depression, small wave between 1995-2005

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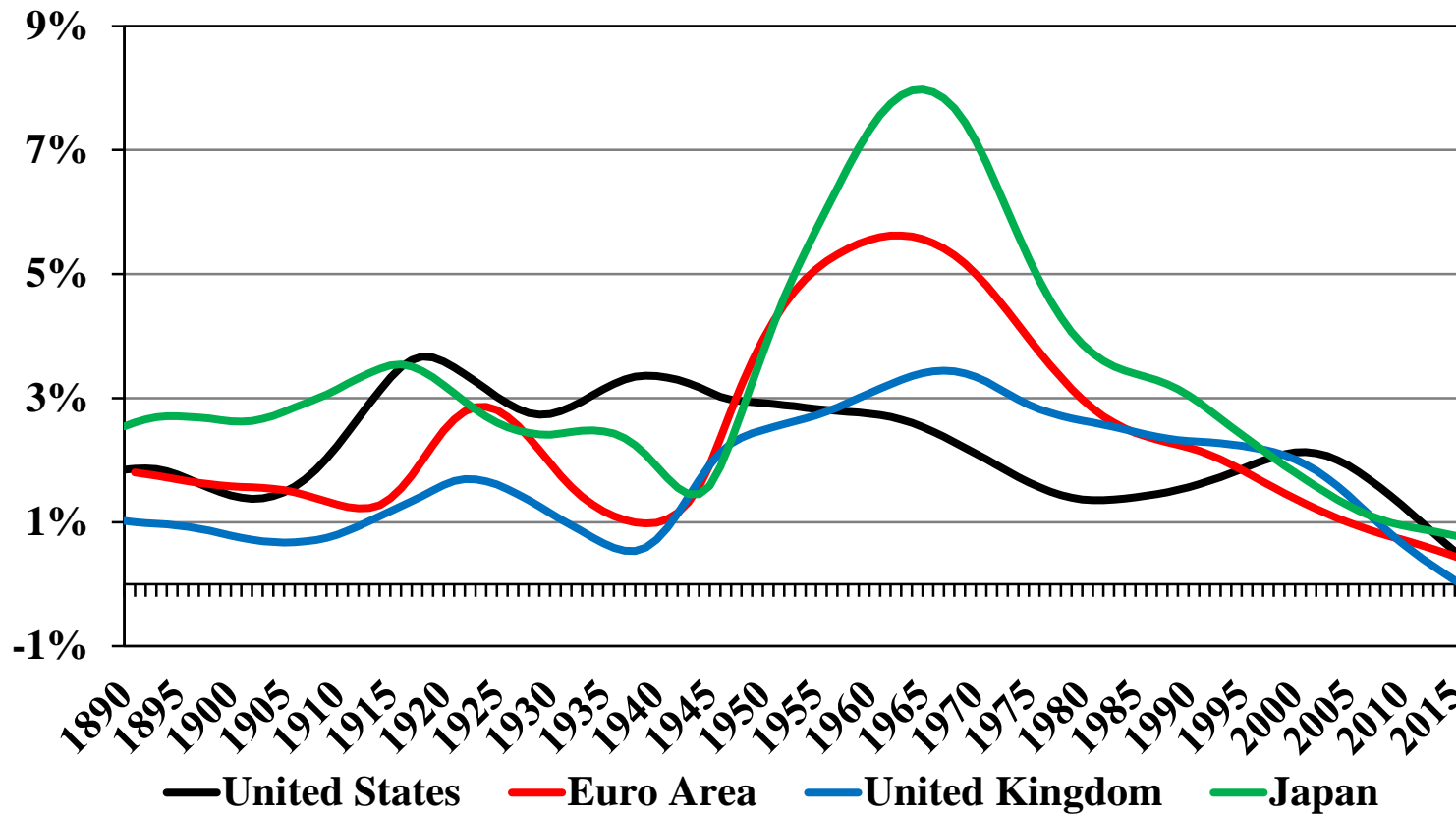
- US: one big wave over the 20th Century, pause during Great Depression, small wave between 1995-2005
- Slowdown to historical lows from the mid 2000s in all areas. Already shown in an abundant literature, see Crafts et O'Rourke, 2013...

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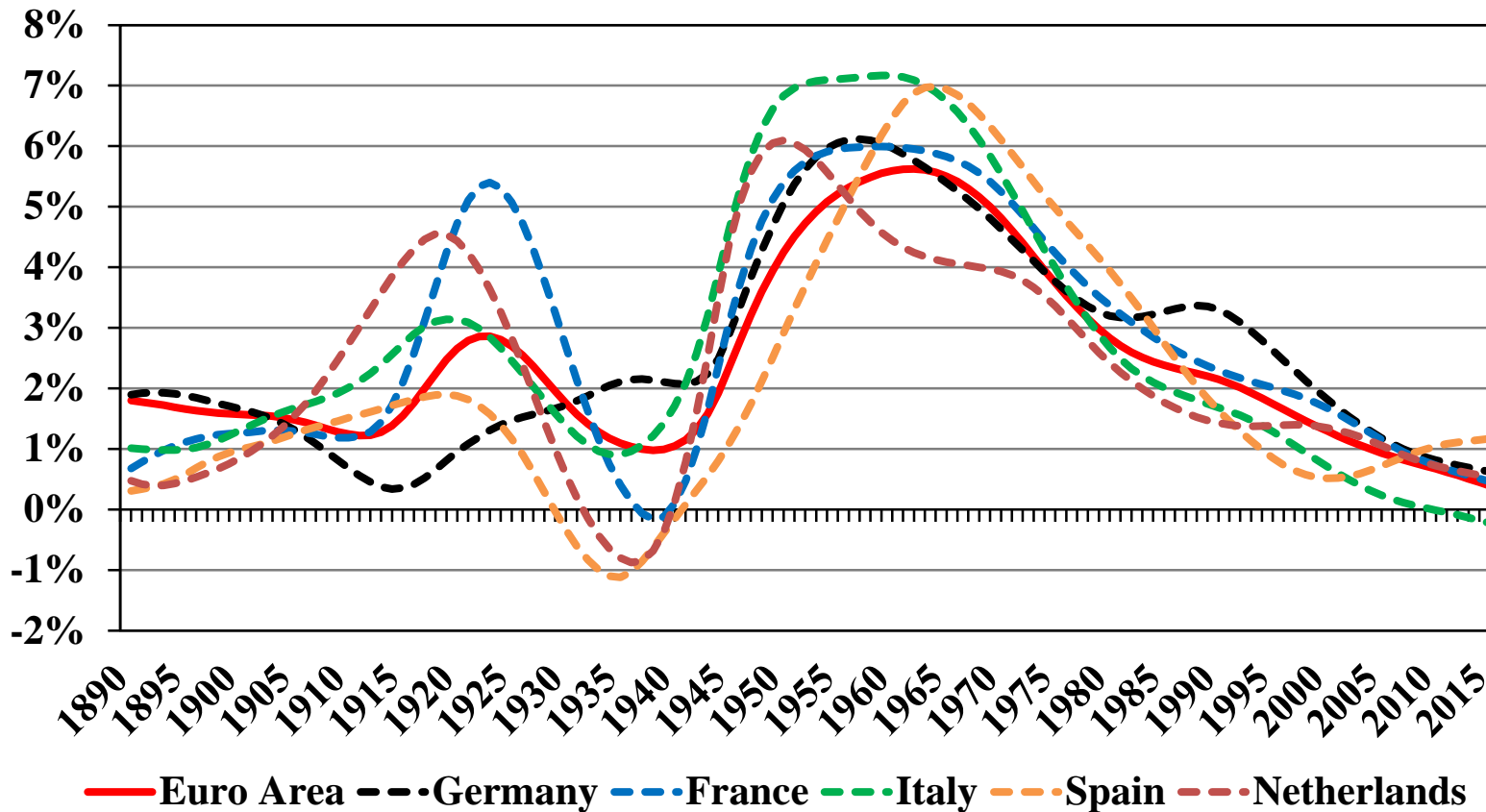
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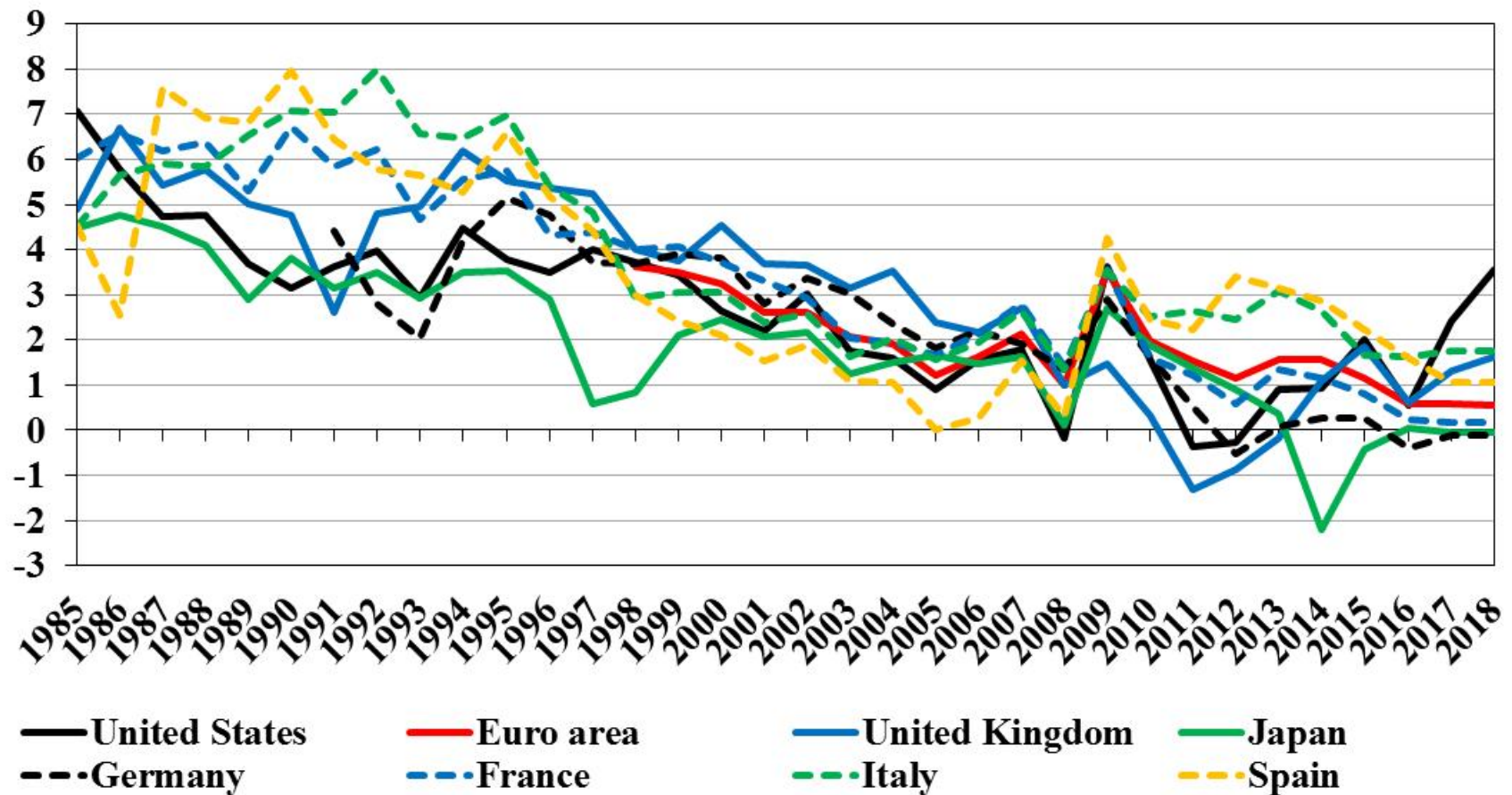


- o Euro area countries: lagged big wave during the Golden age, no small wave except for the UK
- o Slowdown to historical lows from the mid 2000s in all areas

1. Introduction: a general productivity slowdown ...

Real long-term interest rate (In %) - 10-year sovereign bonds

Source: OECD



- Long term real interest rate decline in all areas since the mid-1980s
- Which relationship with the productivity slowdown?

2. The story tested

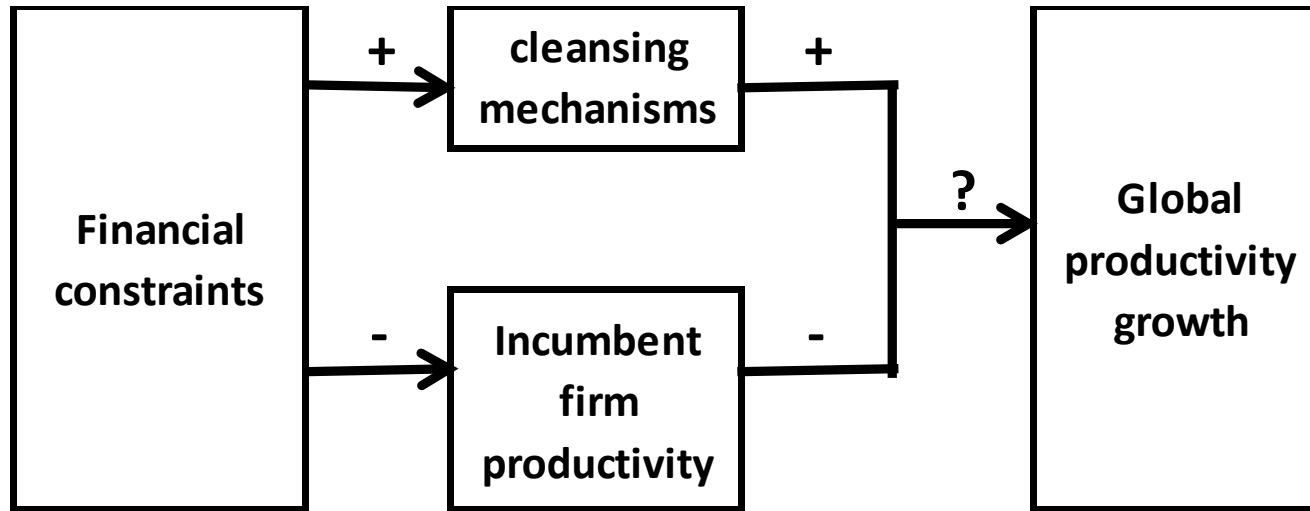
- **On individual data, results apparently contrasted in the literature regarding the impact of financial constraints/high real interest rates on average productivity growth**
 - **Favorable impact**

Through cleansing mechanisms (closing of low-productivity firms and reallocation of their labour and capital to more productive firms)
Gropp, Rocholl and Saadi (2017); ...
 - **Detrimental impact**

Through IT investment, R&D, innovation, management quality...
Aghion *et al.* (2012); Duval, Hong and Timmer (2017); Manarasi and Pierri (2018); ...

2. The story tested

- If the two mechanisms coexist, **which one dominates currently at the macro level?**



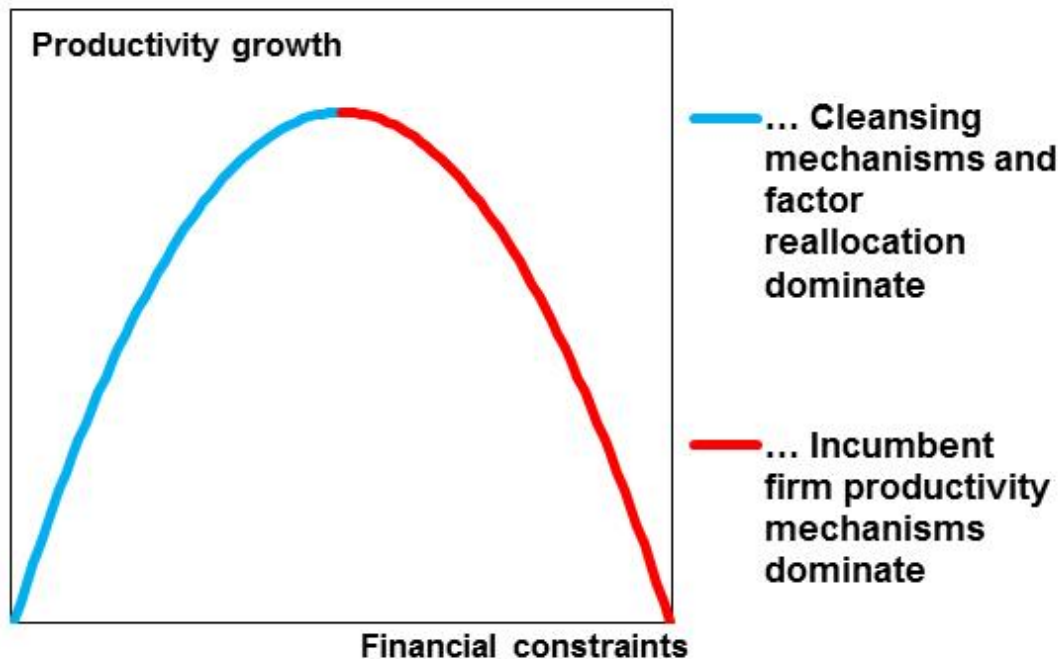
- **Seems to be the first one** (favourable impact)
See Reis (2013) ; Gopinath *et al.* (2015), Gorton-Ordenez (2015) ; G. Cetto, J. Fernald and B. Mojon (2016), C. Borio, E. Kharroubi, C. Upper and F. Zampolli (2016), ...
- **But the two are playing**

2. The story tested

The two opposite impacts of financial constraints at the macro level

- **Productivity impact of financial constraints at the aggregate level:
An inverted U curve**

We would currently be in the left part of the curve



2. The story tested

At the macro level ...

- ... **Circular relation between TFP growth and real interest rates**
 - **Real interest rates** + factor quality + (institutions, technology) \Rightarrow **TFP growth**
Consistent with an abundant literature (see above)
 - **TFP growth** + other factors (demography ...) \Rightarrow GDP growth \Rightarrow **real interest rates**
Consistent with an abundant literature, see among numerous papers M. Marx, B. Mojon and F. Velde (2017); ...
- ... Without technology shocks and appropriate institutions, **risk of Secular Stagnation**

2. The story tested

- **First country-level estimate results - Country level data** (Bergeaud, Cette and Lecat, 2018)

Circular relationship between TFP growth (Δtfp_t) and real interest rates (TXR_t)

○ Estimate results	Dependent variable	Δtfp_t	TXR	Δtfp_t	TXR
	Estimation method	Arellano-Bond		Lewbel	
17 countries					
Annual data - 1950-2016	$\Delta tfp_{i,t-1}$	0.266*** [0.049]		0.279*** [0.047]	
○ TXR: Sovereign 10-year real interest rate	$\Delta tfp_{i,t}$		0.061 [0.059]		0.304** [0.144]
	$TXR_{i,t}$	0.089*** [0.024]		0.138*** [0.032]	
○ TXR decrease contribution to Δtfp decrease (Column 3 results) From 1985 TXR decrease: 5pp 5 x (0,138 / (1 - 0,279)) = 1pp	$TXR_{i,t-1}$		0.682*** [0.052]		0.653*** [0.044]
	EDUC	2.809 [1.789]		3.174** [1.403]	
	ICT	0.306* [0.165]		0.279** [0.138]	
	POP	1.287*** [0.221]		1.347*** [0.185]	
	ELEC	0.051*** [0.015]		0.052*** [0.012]	
	POP35-59		0.073** [0.031]		0.110*** -0.035
	VARINFL		0.097** [0.044]		0.055** [0.026]
	R ²	0.164	0.488	0.158	0.467
	Number of observations	986	986	986	986

2. The story tested

Productivity of frontier and laggard firms in France (Cette, Corde and Lecat, 2018)

Decreasing cleansing mechanisms seems observed (Data from FIBEN)

➤ **Frontier = most productive firms each year**

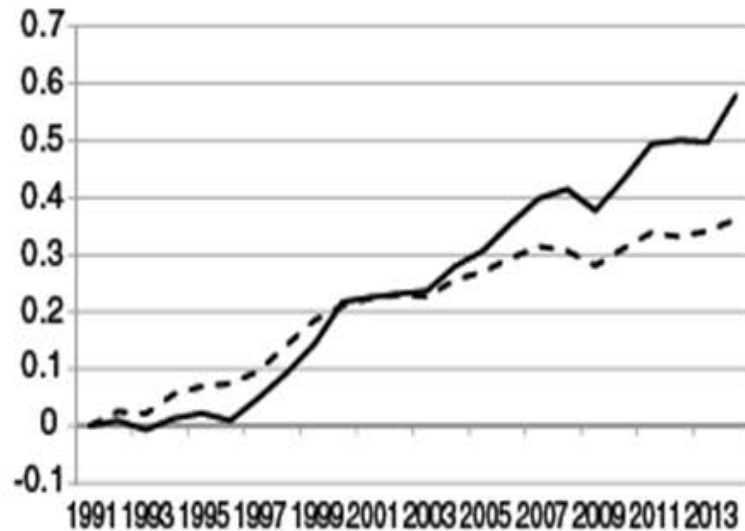
No slowdown at the frontier

Declining diffusion from the frontier to laggard firms?

Similar results as Andrews *et al.* (2016)

A – Productivity per employee – unbalanced sample

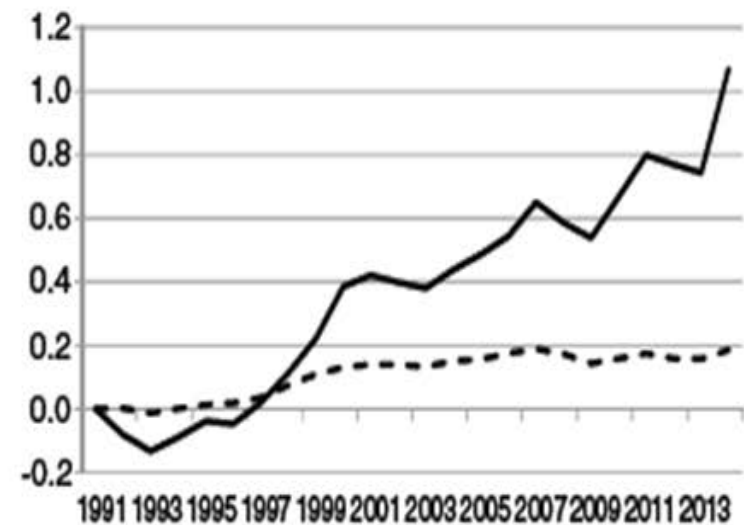
log, median by category,
0 base in 1991



— 5% most productive each year
- - - 95% least productive each year

B – Total factor productivity – unbalanced sample

log, median by category,
0 base in 1991



— 5% most productive each year
- - - 95% least productive each year

2. The story tested

Productivity dispersion in France (Cette, Corde and Lecat, 2018)

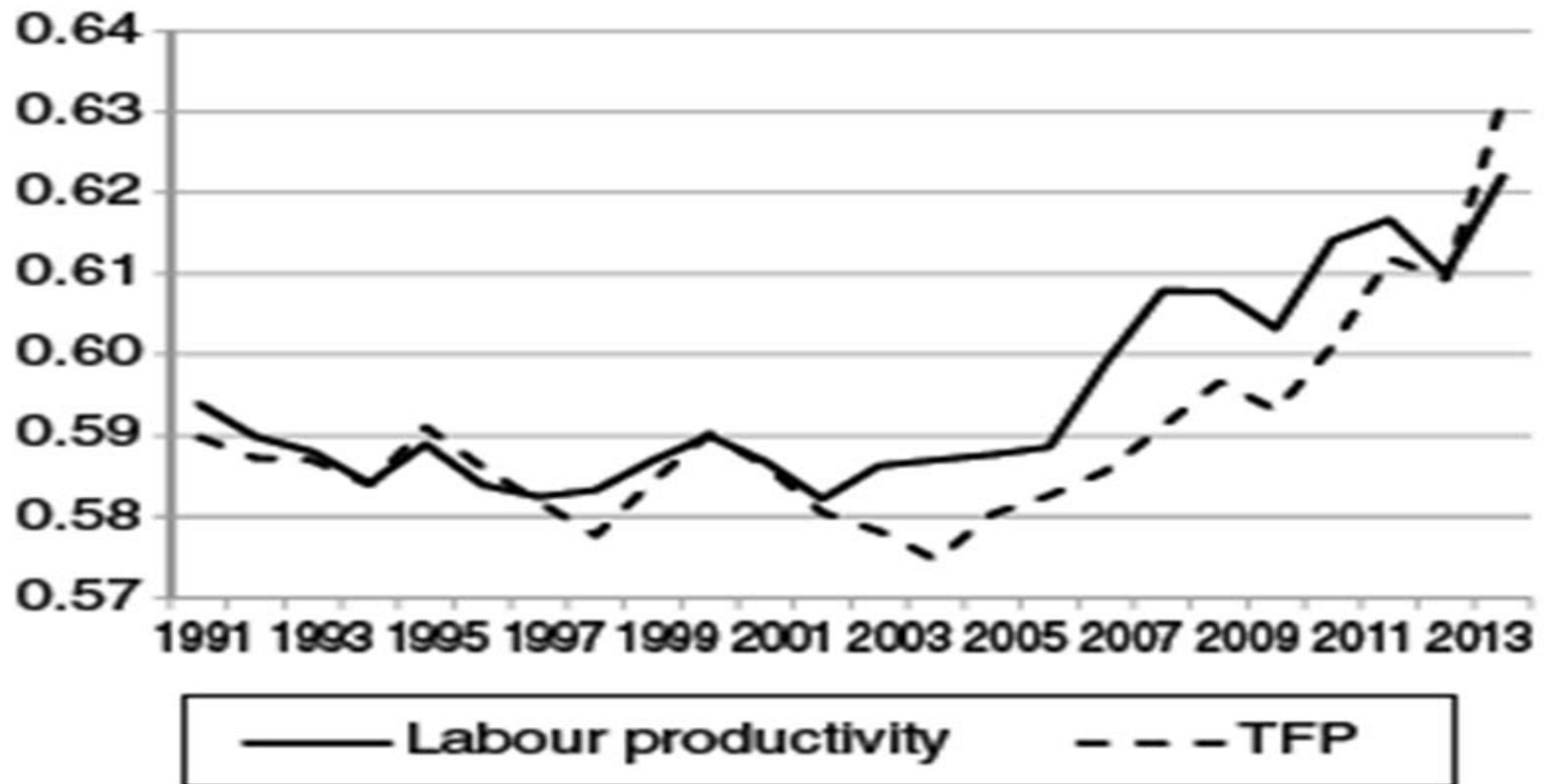
Decreasing cleansing mechanisms seems observed (Data from FIBEN)

➤ **Apparent σ divergence since the early 2000s, before the crisis**

This could explain the average productivity slowdown

Slowdown in the destructive creation process?

Interdecile productivity dispersion $(D9-D1)/(D1+D9)$



3. Data (ABCLM)

Cat.	L	Y	Age	TFP	Liquidation	Obs.
A	18	1075	20	4.79	0.48	162,385
B	18	800	18	4.55	2.49	105,035
C	18	702	16	4.42	8.76	42,314
Total	17	871	18	4.65	2.60	338,541

➤ **Cotations aggregated into 3 categories**

- Category A: 3++, 3+, 3 et 4+
- Category B: 4 et 5+
- Category C: less than 5 (including firms that experienced a payment incident)

➤ **Sources**

- FiBEn 2004-2014 ~30k firms per year (private manufacturing sector)
- Interest rate comes from Mcontran (new loans with various maturity)
- Cotation (rating) comes from Banque de France

3. Data (ABCLM)

- Good ratings are related :
 - Negatively with the level of interest rates granted
 - Positively with the loan amount
- Poor ratings are related:
 - Positively with the level of interest rates granted
 - But not with the amount granted
- => **Ratings are related to financial constraints**

Dependent variable	r		log(Q)	
	Short Term	Long Term	Short Term	Long Term
Credits				
Rating category				
A	-0.348*** (0.024)	-0.400*** (0.031)	0.250*** (0.046)	0.311*** (0.070)
B (ref)				
C	0.312*** (0.052)	0.280** (0.121)	-0.026 (0.073)	0.012 (0.164)
$Log(L_{t-1})$	-0.085*** (0.013)	-0.112*** (0.018)	0.671*** (0.031)	0.430*** (0.042)
Age	-0.002*** (0.001)	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)
Fixed Effects	$s \times t$	$s \times t$	$s \times t$	$s \times t$
R ²	0.675	0.628	0.354	0.310
Observations	5761	1458	5761	1458

4. Financial constraints and productivity (ABCLM)

$$g_{s,t} = \beta_1 Spread_{s,t} + \beta_2 (Spread_{s,t})^2 + \nu_s + \varepsilon_{i,t},$$

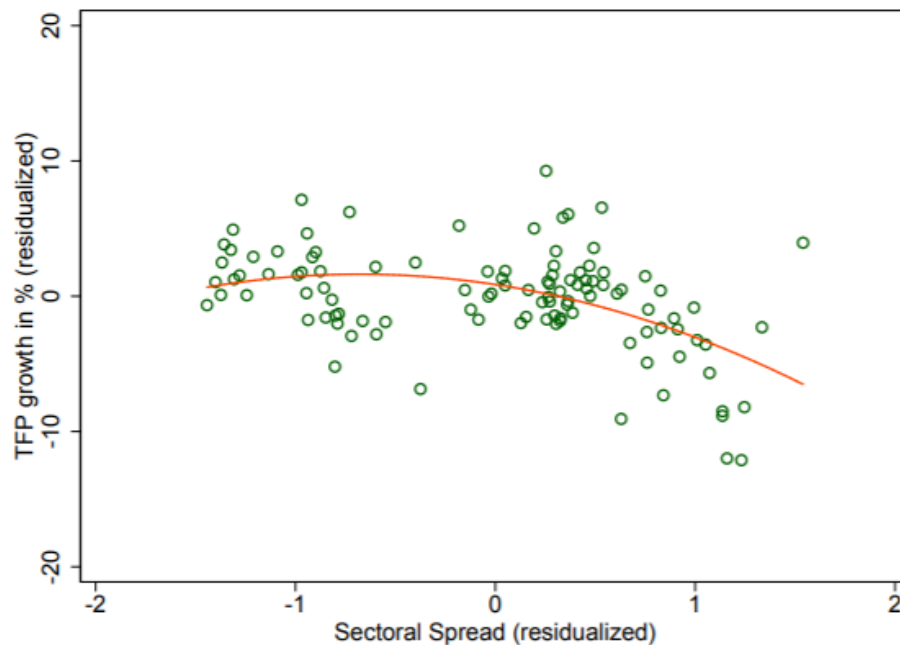
Dependent Variable	Sectoral TFP growth				
	All	RZ, high	RZ, low	US, high	US, low
Dependence Indicator (EFDI)					
Spread	3.206* (1.728)	4.208 (2.550)	1.812 (2.571)	4.734** (1.974)	1.497 (2.820)
Spread Squared	-1.194** (0.475)	-1.577** (0.709)	-0.675 (0.699)	-1.664*** (0.525)	-0.665 (0.792)
Fixed Effects	Sector	Sector	Sector	Sector	Sector
R ²	0.297	0.436	0.126	0.421	0.197
Observations	198	108	90	99	99

- Spread is defined as the average interest rate in a given sector at a given year minus the EONIA
- **Higher spreads increase TFP growth up to a threshold and then decrease TFP growth in sectors that depends the most on external financing**

4. Financial constraints and productivity (ABCLM)

The two opposite impacts of financial constraints

- Empirical evidence of the productivity impact of financial constraints at the industry level: An inverted U curve



- Each dot represents a sector in a specific year from 2004 to 2014
- TFP growth and interest rate spread have been residualized on a sector fixed effect
- Manufacturing sector with an index of external financial dependence set to 1 (based on the RZ indicator).

4. Financial constraints and productivity (ABCLM)

Dependent variable	Individual TFP (log)			Growth rate of TFP		
	(1)	(2)	(3)	(4)	(5)	(6)
Rating Category						
A	0.773 (0.478)	0.160*** (0.003)	0.151*** (0.003)	0.218*** (0.052)	0.154*** (0.004)	0.145*** (0.004)
B (ref)						
C	0.378 (0.641)	-0.151*** (0.005)	-0.148*** (0.005)	-0.188*** (0.046)	-0.145*** (0.006)	-0.142*** (0.005)
$\text{Log}(L_{t-1})$	0.423*** (0.152)	0.020** (0.010)	0.009 (0.010)	0.424*** (0.105)	-0.009 (0.013)	-0.020 (0.013)
Age	0.020 (0.022)	0.017*** (0.001)		-0.002*** (0.000)	0.015*** (0.001)	
$\text{Log}(TFP)_{t-1}$				-0.743*** (0.182)	-0.975*** (0.023)	-0.975*** (0.023)
Fixed Effects	$s \times t$	i	$i + s \times t$	$s \times t$	i	$i + s \times t$
R ²	0.005	0.928	0.930	0.723	0.959	0.960
Observations	252,705	247,784	247,784	238,928	234,223	234,223

- TFP level and growth in better-rated firms are higher than in other firms
- => Financial constraints damage productivity of incumbent firms

4. Financial constraints and productivity (ABCLM)

$$E_{i,t} = \sum_{k=1}^3 \alpha_k Cot_k + \sum_{k=1}^3 \beta_k Cot_k \times D_{i,t-1} + X_{i,t-1}\gamma + \nu_{s,t} + \varepsilon_{i,t}.$$

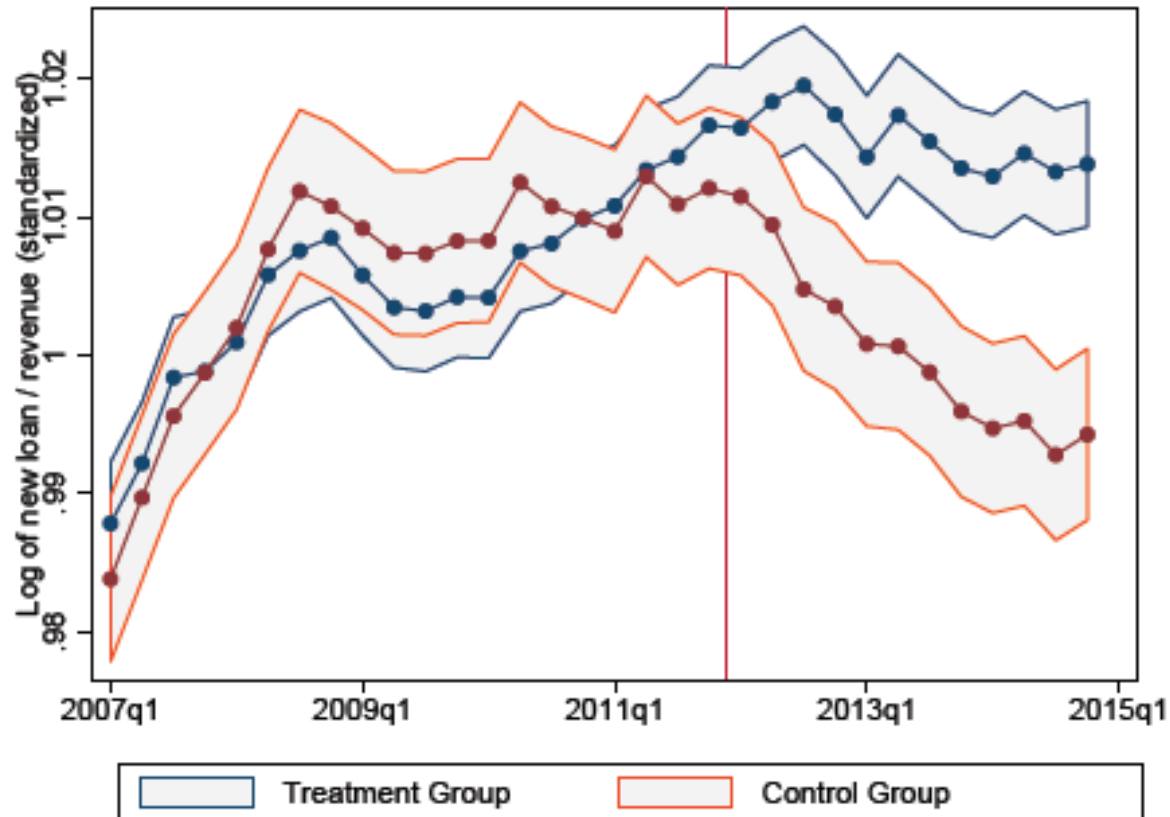
- Ratings efficiently capture default risk (col.1-2)
- Bad ratings, taken as an indicator of financial constraints, tend to increase the risk of default for low-productivity firms (col. 3-5)
- This illustrates the cleansing mechanism: financial constraints increase the default probability of low-productivity firms

Dependent variable	Liquidation at $t + 2$ dummy				
	(1)	(2)	(3)	(4)	(5)
	All		High RZ Low RZ		
Rating Category					
A	-0.017*** (0.000)	-0.015*** (0.000)	-0.015*** (0.000)	-0.017*** (0.001)	-0.013*** (0.001)
B (ref)					
C	0.054*** (0.001)	0.052*** (0.001)	0.047*** (0.001)	0.049*** (0.002)	0.044*** (0.002)
$\log(L_{t-1})$	-0.002*** (0.000)	-0.000* (0.000)	-0.000* (0.000)	-0.001** (0.000)	-0.000 (0.000)
Age	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
Low Prod.		0.026*** (0.001)			
Rat. Cat. A \times Low Prod			0.012*** (0.001)	0.014*** (0.002)	0.009*** (0.002)
Rat. Cat. B \times Low Prod			0.021*** (0.002)	0.025*** (0.002)	0.015*** (0.003)
Rat. Cat. C \times Low Prod			0.049*** (0.004)	0.058*** (0.005)	0.039*** (0.005)
Fixed Effects	$s \times t$	$s \times t$	$s \times t$	$s \times t$	$s \times t$
R ²	0.035	0.038	0.038	0.039	0.039
Observations	306,051	306,051	306,051	194,781	110,984

4. Financial constraints and productivity (ABCLM)

- **Euro area banks may use corporate loans as collateral in their refinancing operations with the ECB**
 - **Before 2012, only credits rated 4+ or higher were eligible**
 - **From 2012, extension to credit rating 4**
- Announcement was made at the end of 2011 and was largely unanticipated by companies. Result: **exogenous positive shock of access to credit for companies in rating 4 in 2012** compared to their situation at the end of 2011. Corresponds to a part of our category B
- This ACC program has already been the subject of two studies at the BdF: Cahn *et al.* (2017) and Mesonnier *et al.* (2017). The latter finds quantitatively low effect that mostly concern interest rates while the former finds positive effect on the loan supplied to single bank firms
- **We use this shock to avoid endogeneity biases**

4. Financial constraints and productivity (ABCLM)



- Treatment group: rating = 4 ; control group : rating = 5+ in 2011
- Prior to the ACC, the evolution of the value of new loans were not significantly different for firms rated 4 and 5+ in 2011.
- **The trends became significantly different from the ACC in 2012: financial constraints became lower for rating = 4 than for rating = 5+**
- **The ACC has modified the credit supply to firms with rating = 4**

4. Financial constraints and productivity (ABCLM)

$$g_{i,t} = \beta_1(Treated_i \times (postACC)_t) + X_{i,t}\gamma + \delta Treated_i \times t + \nu_i + \nu_{s,t} + \varepsilon_{i,t},$$

Dependent variable	TFP growth						
	All	RZ, high	RZ, low	All	All	All	All
Treated × (post ACC)	1.066*** (0.402)	1.277** (0.519)	0.750 (0.637)	0.518 (0.509)	0.136 (0.601)	0.415 (0.351)	-0.355 (0.596)
Log (L_{t-1})	3.728*** (0.369)	2.009*** (0.446)	6.448*** (0.653)	3.882*** (0.493)	3.764*** (0.403)	4.085*** (0.393)	2.928*** (0.518)
R ²	0.141	0.139	0.144	0.160	0.143	0.134	0.156
Observations	86,885	54,434	32,451	45,524	72,558	83,540	45,413

Notes: TFP growth is given in percentage. Columns 1 and 2 test our hypothesis while columns 3 to 7 act as placebos. Columns 4 and 5 replace the variable (post ACC) by a dummy for t being larger than respectively 2006 and 2010, columns 6 and 7 consider two different groups of rating (respectively 3 and 4⁺ and 5⁺ and 5). All regressions have individual, rating trend and year × sector fixed effects. Firm clustered standard errors are reported in parentheses.

- **TFP growth increases for firms that benefited from the eligibility shock (col.1)**
- It is valid **only for firms that are in sectors with strong dependance on external financing (col. 2-3)**
- Placebo tests (col. 4-7) support the fact that no other ratings effect is at play

4. Financial constraints and productivity (ABCLM)

$$E_{i,t} = \beta_1(Treated_i \times (postACC)_t) + \beta_2 Treated_i + X_{i,t-1}\gamma + \nu_{s,t} + \varepsilon_{i,t}.$$

Dependent variable	Default						
	All	All	Low Prod.	High Prod.	Low Prod. High RZ	Low Prod. Low RZ	
(Rating = 4)	-0.011*** (0.002)	-0.010*** (0.002)	-0.013*** (0.003)	-0.009*** (0.002)	-0.013*** (0.004)	-0.013** (0.005)	
(Rating = 4) × (post ACC)	-0.007*** (0.002)	-0.006** (0.002)	-0.012** (0.005)	-0.004 (0.003)	-0.015** (0.007)	-0.008 (0.007)	
Low Prod.		0.016*** (0.001)					
Fixed Effects	$s \times t$	$s \times t$	$s \times t$	$s \times t$	$s \times t$	$s \times t$	
R ²	0.009	0.011	0.016	0.010	0.011	0.023	
Observations	86,025	86,025	26,376	59,644	16,455	9,901	

- **Default risk decreased for firms which were hit by the eligibility shock (col. 1-3)**
- This effect is **stronger for low-productivity firms (col. 4-5)**

5. Conclusion

- **Two opposite impacts on productivity growth of financial constraints / real interest rates.** Increasing real interest rates / financial constraints ...
 - ... pushes up productivity through the cleansing mechanisms
 - ... makes more difficult to finance risky and innovative projects
- **During the crisis, the cleansing mechanism dominated**
 - low interest rates weighed on productivity growth ...
 - ... but supported activity and employment, as factor reallocation was slowed.
- **The productivity growth triggered by the digital economy will be boosted by interest rate increase and higher cleansing**