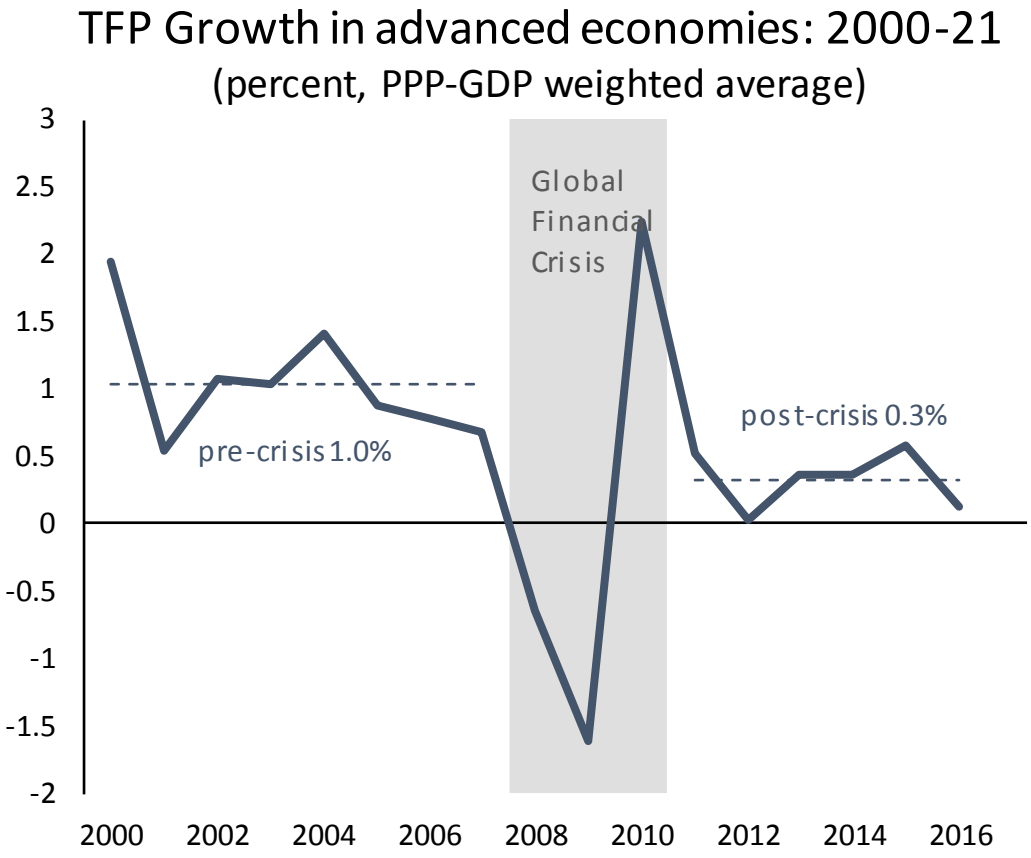
Financial Frictions and the Great Productivity Slowdown

Romain Duval
Senior Advisor and Head of Structural Reforms Unit
IMF Research Department

Joint with Gee Hee Hong (IMF) and Yannick Timmer (Trinity College, Dublin)

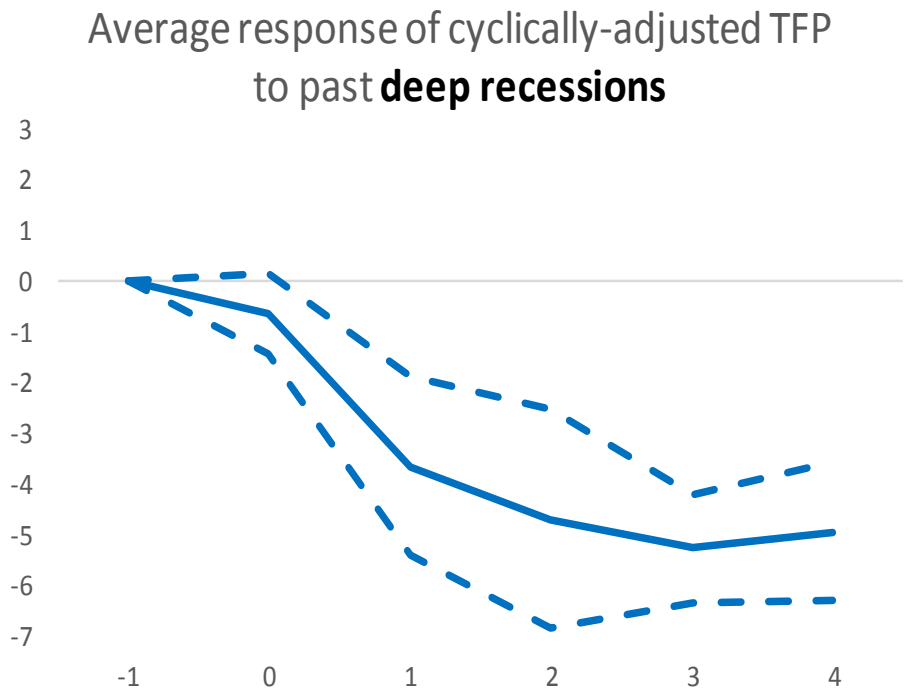
Seminaire Fourgeaud
Ministere des Finances, Paris
October 11th, 2017

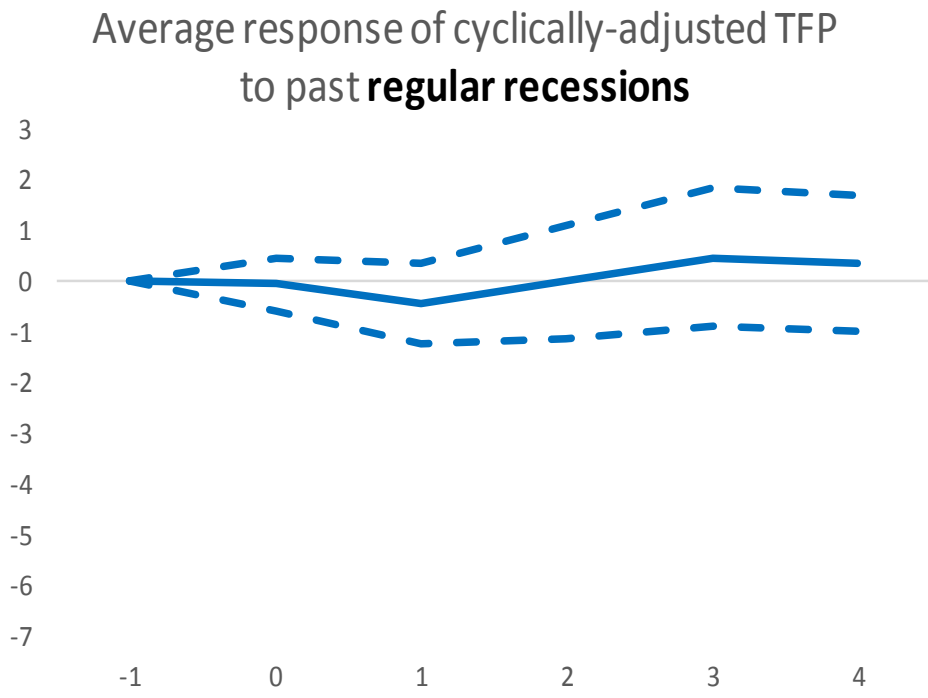
Sharp and persistent productivity slowdown since the GFC, casting doubt on dominant view that it is just a structural issue…



Sources: Penn World Table 9.0; World Economic Outlook, and IMF staff
Note: Weighted averages (using PPP-GDP as weights) are reported for a
20 largest advanced economies.

…and indeed major past recessions also seem to have entailed "TFP hysteresis", just like the GFC…





Sources: KLEMS; Blanchard, Cerutti, Summers (2015); IMF staff calculations.

Note: The cyclically-adjusted measure of TFP based on Basu, Fernald and Kimball (2006) is used. Major recessions are the biggest 10% falls in GDP in the first two years of a recession episode across 17 advanced economies over 1970-2007. The response of cyclically-adjusted TFP to major past recessions is estimated using a local projections method (Jorda 2005), 90 percent confidence intervals are shown. See Adler, Duval, Fur Koloskova and Poplawski-Ribeiro (2017) for details.

What could account for the magnitude and persistence of post-GFC TFP slowdown?

- ***Not*** Secular headwinds:

Waning ICT boom and innovation, slowing technology diffusion, possible roles of global trade slowdown, slowdown in human capital, ageing, etc.

➔ Already at play prior to the GFC

- But possibly crisis-related setbacks:

Balance sheet vulnerabilities, tight credit conditions, weak aggregate demand, elevated policy uncertainty

➔ Could affect investment in a broad sense—in tangibles and intangibles—with adverse effects on TFP

This paper: focus on role of balance sheet vulnerabilities and credit conditions

Unresolved ongoing policy debate on role of credit conditions for productivity

- Contradictory views regarding impact on misallocation of capital *across firms*:
  - Easy credit conditions can *reduce* misallocation of capital among existing firms (and even more so facilitate entry of new firms) by easing collateral constraints (Midrigan and Xu, 2013) …
  - …but easy credit conditions may *increase* misallocation of capital if financial intermediation is poor (Gopinath et al., 2015)…
  - …and lead to busts with further misallocation post-bust (Borio et al., 2015; ongoing interest in zombie firms?)
- Impact on *within-firm* productivity growth largely unknown:
  - Tight credit conditions may lead financially vulnerable firms to cut R&D spending (Holmstrom and Tirole 1997; Aghion et al., 2010, 2012)

This paper: focus on role of balance sheet vulnerabilities and credit conditions for *within-firm* productivity growth

Key Question(s)

Q: What is the role of financial frictions in explaining *firm-level* TFP slowdown since the financial crisis?

Q1. Can firm-specific pre-crisis financial vulnerabilities account for some of the post-crisis TFP growth slowdown? **Short answer: YES**

Q2. Did tighter credit conditions also play a role? If so, did they interact with corporate balance sheet vulnerabilities? **Short answer: YES**

Q3. If answer to Q1 and/or Q2 is yes, what are the channels?

Impact of financial frictions on intangible asset investment in distressed firms is one

Data

- **ORBIS cross-country firm-level data (15 OECD countries)**
  - Provided by Bureau van Dijk (BvD)
  - Balance sheet and income statements
  - Both small and large firms, listed and non-listed
  - Industry Category: 2 digit NACE
  - Time: 1998-2013 (annual frequency) ➔ Unique, constructed by combining different vintages of ORBIS (2005, 2010, 2015) (Gal and Hijzen, 2016)

- **TFP estimation**
  - Residual from estimation of firm-level production function (using 2-digit sectoral deflators)
  - One-step GMM approach by Woolridge (2009). Uses intermediate inputs to proxy for unobserved productivity for production function estimation to deal with simultaneity problem (builds on Levinsohn and Petrin 2003; Olley and Pakes 1996).

Q1. Empirical Approach

$$\Delta TFP_{isc}^{growth} = \alpha_{sc} + \beta_1 Vulnerabilities_i^{pre} + \gamma' \mathrm{X}_i + \varepsilon_{isc}$$

- DID framework: comparison between more and less vulnerable firms post- vs. pre-Crisis (6 years after vs. 6 years before), in spirit of Giroud and Mueller (QJE 2017)
- $\Delta TFP_{isc}^{growth}$:
  - Difference in average TFP growth post- vs. pre-Crisis (6 years after vs. 6 years before)
  - Implicit firm fixed effects
- Vulnerability:
  - (1) Debt maturing in 2008 (Current liabilities in 2007) = rollover risk
  - (2) Other vulnerabilities as extension and robustness check: interest coverage ratio; average pre-crisis leverage (Debt/Total Assets) = debt overhang
- α_{sc}: Country* Sector Fixed Effect
  - Absorbs time-variant unobserved heterogeneity at country-sector level
  - Implies *within* country-sector comparison
- X: Age, Size and EBITDA, Employment

Q1. Stylized facts

Post-GFC TFP Level path for firms with different pre-GFC vulnerabilities

(Index 100 = 2005; high (low) vulnerability = 75th (25th) percentile of distribution)

Q1. Baseline regression results

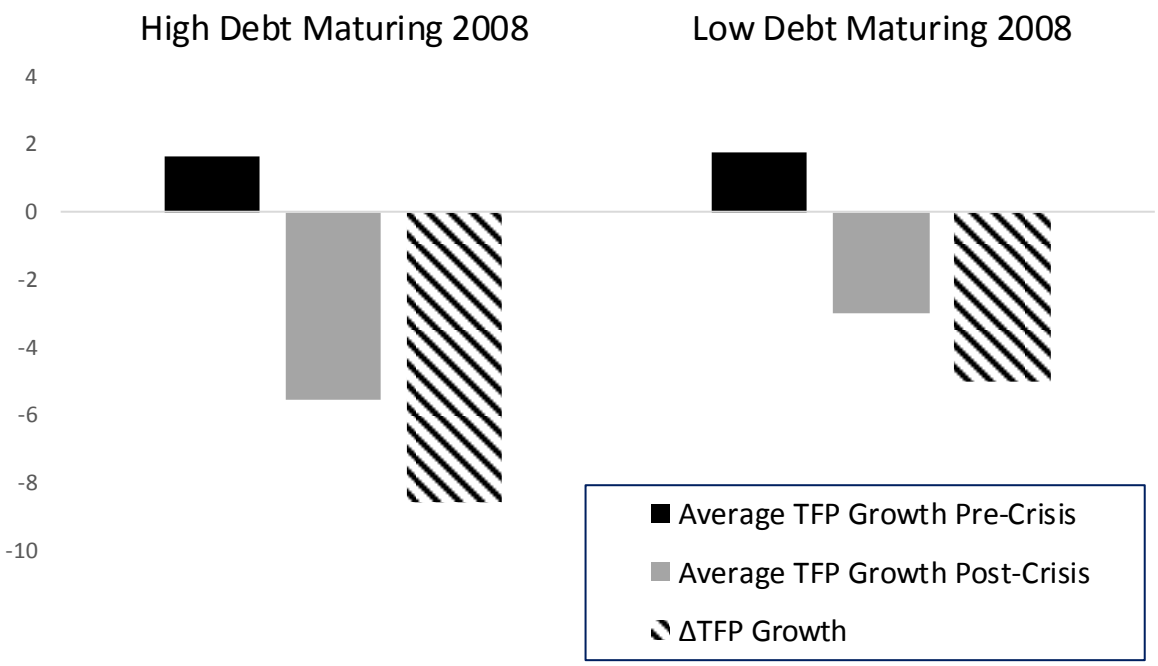
Baseline regression results

	(1)	(2)	(3)	(4)
	ΔTFP growth			
Debt Maturing 2008	-0.0693***	-0.0704***	-0.0674***	-0.0935***
	(0.007)	(0.006)	(0.006)	(0.008)
R-squared	0.127	0.131	0.142	0.151
N	134838	134838	134838	134838
Country*Sector FE	No	No	Yes	Yes
Sector FE	No	Yes	-	-
Country FE	Yes	Yes	-	-
Controls	No	No	No	Yes

Note: The dependent variable `ΔTFP Growth' is the difference in the average TFP growth rate between post- and pre-crisis periods. `Debt Maturing in 2008' is the amount of debt maturing in 2008 divided by average total sales pre-crisis. The post-crisis period starts in 2008. Firm-specific controls include firm age, size of assets and earnings (EBITDA). Standard errors in parentheses. Standard errors are clustered at the country-sector level. *: significant at 10% level; **: significant at 5% level; ***: significant at 1% level.

Q1. Quantitative implications: large

Implied impact of pre-GFC firm vulnerabilities on post-GFC slowdown



Note: `ΔTFP Growth' is the difference in the average TFP growth rate between the post- and pre-crisis periods. `Average TFP Growth Pre (Post) -Crisis' is the average TFP growth rate pre-crisis (post-crisis). `Debt Maturing in 2008' is the amount of debt maturing in 2008 divided by average total sales pre-crisis. `High (Low) Debt Maturing 2008' corresponds to the 75th percentile (25th percentile) of the cross-firm distribution of `Debt Maturing 2008'. The post-crisis sample starts in 2008.

Q2. Exploring country heterogeneity: extended empirical approach

$$\Delta TFP_{isc}^{growth} = \beta_1 Vulnerability_i^{pre} + \beta_2 Vulnerability_i^{pre} * \Delta CDS_c$$

$$+\gamma' \mathrm{X}_i + \alpha_{sc} + \varepsilon_{isc}$$

Where:

- ΔCDS_c: Change in average bank CDS spread in country c between the weeks before and after the collapse of Lehman Brothers

- Hypothesis: banking systems that were more exposed to Lehman shock tightened credit conditions more, amplifying the adverse TFP impact of firm vulnerabilities

Q2. Regression results

Extended Specification:

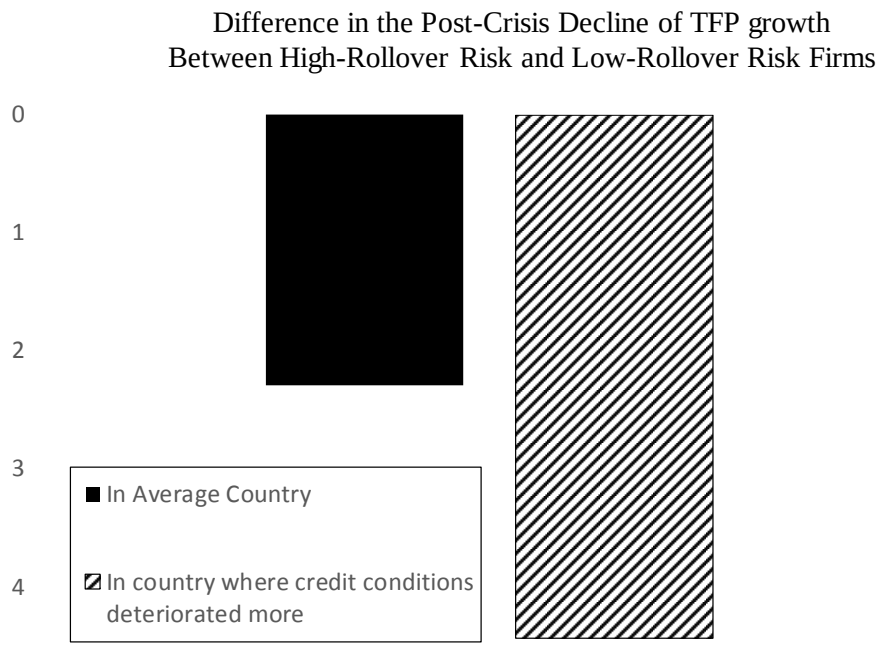
Accounting for Cross-Country Heterogeneity in Exposure to the Collapse of Lehman Brothers

	(1)	(2)	(3)	(4)
	ΔTFP growth			
Debt Maturing 2008	-0.0706***	-0.0686***	-0.0682***	-0.0960***
	(0.007)	(0.006)	(0.006)	(0.007)
Debt Maturing 2008*ΔCDS_c	-0.0823***	-0.0781***	-0.0824***	-0.0897***
	(0.024)	(0.023)	(0.020)	(0.020)
R-squared	0.143	0.148	0.156	0.167
N	104275	104275	104275	104275
Country*Sector FE	No	No	Yes	Yes
Sector FE	No	Yes	-	-
Country FE	Yes	Yes	-	-
Controls	No	No	No	Yes

Note: The dependent variable `ΔTFP Growth' is the difference in the average TFP growth rate between the post- and pre-crisis periods. `Debt Maturing 2008' is the amount of debt maturing in 2008 divided by average total sales pre-crisis. The post-crisis period starts in 2008. 'ΔCDS_c' is the standardized change in the country-level CDS between the weeks before and after the Lehman bankruptcy, where the change in the country-level CDS is calculated as an average of the changes in domestic banks' CDS spread over the same window. Firm-specific controls include firm age, size of assets and earnings (EBITDA). Standard errors in parentheses. Standard errors are clustered at the country-sector level. *: significant at 10% level; **: significant at 5% level; ***: significant at 1% level.

Q2. Quantitative implications

Implied impact of pre-GFC firm vulnerabilities on post-GFC slowdown: the role of country-wide credit conditions



Note: `Rollover risk' is the amount of debt maturing in 2008 divided by average total sales pre-crisis. `High (Low) Debt Maturing 2008' corresponds to the 75th (25th) percentile of the cross-firm distribution of `Debt Maturing in 2008'. The 'average country' corresponds to a no change in CDS spread after standardizing the variable. The `country where credit conditions deteriorated more' corresponds to one standard deviation larger change in standardized CDS spread compared to the average country CDS spreads. The post-crisis sample starts in 2008.

Q2. Exploring firm heterogeneity: further extended empirical approach

We further tighten up the identification strategy by estimating:

$$\Delta TFP_{isc}^{growth} = \beta_1 Vulnerability_i^{pre} + \beta_2 Vulnerability_i^{pre} * \Delta CDS_i$$

$$+\gamma' \mathrm{X}_i + \alpha_{sc} + \varepsilon_{isc}$$

Where:

- ΔCDS_i: Change in average CDS spread of the main creditor bank(s) of firm i between the weeks before and after the collapse of Lehman Brothers. Main creditor bank(s) identified by BANKER variable in AMADEUS

- Hypothesis: firms whose main creditor bank(s) were more exposed to Lehman shock tightened credit conditions more, amplifying the adverse TFP impact of firm vulnerabilities

Q2. Regression results

Extended Specification:

Accounting for Firm-Level Heterogeneity in Exposure to the Collapse of Lehman Brothers

	(1)	(2)	(3)	(4)
	ΔTFP growth			
Debt Maturing 2008	-0.112***	-0.112***	-0.114***	-0.163***
	(0.014)	(0.015)	(0.015)	(0.015)
ΔCDS_i	-0.140	-0.179	-0.176	-0.293
	(0.214)	(0.219)	(0.217)	(0.214)
Debt Maturing 2008*ΔCDS_i	-0.023**	-0.024**	-0.024**	-0.024**
	(0.010)	(0.010)	(0.010)	(0.011)
R-squared	0.0640	0.0719	0.0793	0.109
N	20798	20798	20798	20798
Country*Sector FE	No	No	Yes	Yes
Sector FE	No	Yes	-	-
Country FE	Yes	Yes	-	-
Controls	No	No	No	Yes

Note: The dependent variable `ΔTFP Growth' is the difference in the average TFP growth rate between post- and pre-crisis periods. `Debt Maturing in 2008' is the amount of debt maturing in 2008 divided by average total sales pre-crisis. The post-crisis period starts in 2008. 'ΔCDS_i' refers to the standardized change in the average CDS spread of the firm's main creditor bank(s) (up to five of them, drawn from the 'BANKER' variable in AMADEUS) between the weeks before and after the collapse of Lehman Brothers. Firm-specific controls include firm age, size of assets and earnings (EBITDA). Standard errors in parentheses. Standard errors are clustered at the country-sector level. *: significant at 10% level; **: significant at 5% level; ***: significant at 1% level.

Robustness check. Incorporating other financial vulnerabilities in the baseline

Baseline regression results: incorporating other financial vulnerabilities

	(1)	(2)	(3)	(4)
	ΔTFP growth			
Debt Maturing 2008	-0.0900***	-0.0907***	-0.0917***	-0.0907***
	(0.007)	(0.007)	(0.007)	(0.007)
Cash Pre-Crisis	0.0284***			0.000564
	(0.007)			(0.008)
Leverage Pre-Crisis		-0.0363***		-0.0229***
		(0.008)		(0.009)
ICR Pre-Crisis			-0.0236***	-0.0193***
			(0.005)	(0.005)
R-squared	0.151	0.151	0.158	0.158
N	133272	134838	117882	116441
Country*Sector FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

Note: The dependent variable `ΔTFP Growth' is the difference in the average TFP growth rate between the post- and pre-crisis periods. 'Cash Pre-Crisis' is the ratio of average cash and cash equivalents to total assets before the crisis. 'Leverage Pre-Crisis' is average leverage, measured as the debt-to-asset ratio, before the crisis. 'ICR Pre-Crisis' is the average ratio of interest expenses to earnings (EBITDA) before the crisis. Firm-specific controls include firm age, size of assets and earnings (EBITDA). Standard errors are in parentheses. Standard errors are clustered at the country-sector level. *: significant at 10% level; **: significant at 5% level; ***: significant at 1% level.

Putting our analysis of Q1 and Q2 together…

- Firms with more debt maturing in 2008 experienced larger drop in productivity growth than firms with less debt maturing in 2008 (Rollover Risk)
- Relationship is stronger in countries where credit conditions tightened more in immediate aftermath of Lehman collapse, and for firms whose main bank creditor(s) were more affected by Lehman collapse
- Other financial vulnerabilities also mattered for within-firm productivity slowdown: interest coverage ratio, leverage (Debt Overhang)
- No systematic difference pre-crisis, and placebo test for the 2000-01 recession (which was *not* a banking crisis) are suggestive of causal relationship…

Was the GFC different from past recessions? Placebo Test: Was 2000 different from 2008?

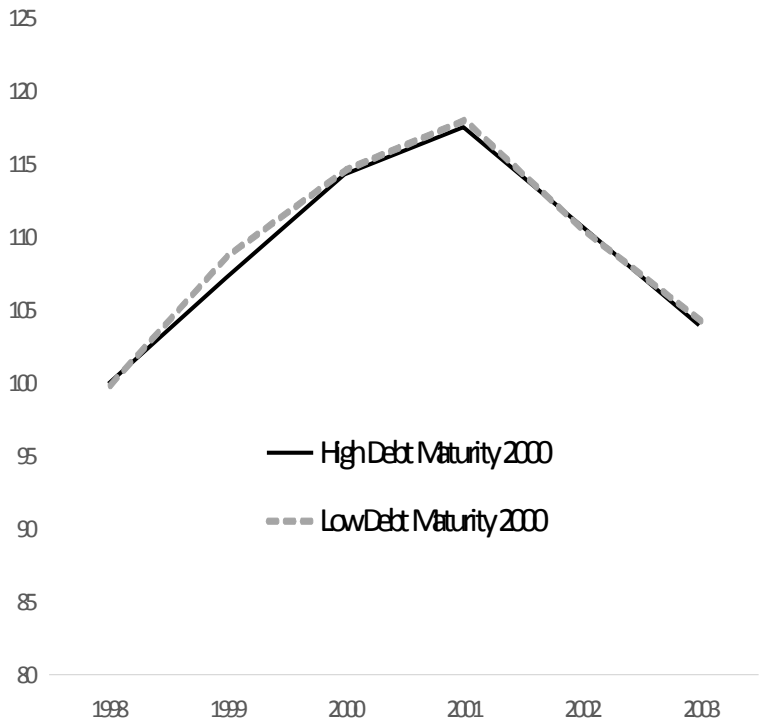
Placebo Test: Early 2000s Recession

	(1)	(2)
	ΔTFP growth (post-2000 minus pre-2000)	
Debt Maturing 2000	-0.0719	-0.0152
	(0.046)	(0.031)
R-squared	0.170	0.204
N	53139	53139
Country*Sector FE	Yes	Yes
Controls	No	Yes

Note: The placebo post-crisis period runs from 2000 until 2005, with 2000 assumed to be the crisis year. The dependent variable `ΔTFP Growth' is the difference in the average TFP growth rate between the post- and pre-crisis periods. `Debt Maturing 2000' is the amount of debt maturing in 2000 divided by average total sales pre-2000. Firm-specific controls include firm age, size of assets and earnings (EBITDA). Standard errors are in parentheses. Standard errors are clustered at the country-sector level. *: significant at 10% level; **: significant at 5% level; ***: significant at 1% level.

Was the GFC different from past recessions? Placebo Test: Was 2000 different from 2008?

TFP Level Path for Firms with Different Rollover Risks: 2000 Recession



Note: The TFP level path is shown as an index taking value 100 in 1998. 'High (Low) Debt Maturing 2000' corresponds to the 75th (25^{th}) percentile of the cross-firm distribution of `Debt Maturing 2000'. `Debt Maturing 2000' is the amount of debt maturing in 2000 divided by average total sales pre-2000.

Q3. What are the channels? Cut in productivity-enhancing investment in intangibles is one

Financial frictions and investment in intangible assets

	(1)	(2)	(3)	(4)
	Δ Investment in Intangible Assets		Δ Share of Intangible Investments	
Debt Maturing 2008	-0.0188***	-0.0184***	-0.0633***	-0.0584***
	(0.002)	(0.002)	(0.010)	(0.010)
R-squared	0.0406	0.0407	0.373	0.379
N	97487	97487	101150	101150
Country*Sector FE	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Note: The dependent variable `ΔInvestment in Intangible Assets' for Columns (1) and (2) is the difference in the investment in intangible assets as a ratio of value added post vs. pre-crisis. The dependent variable `ΔShare of Intangible Assets' for Columns (3) and (4) is the difference in the share of intangible assets in total capital post vs. pre-crisis. `Debt Maturing 2008' is the amount of debt maturing in 2008 divided by average total sales pre-crisis. The post-crisis period starts in 2008. Firm-specific controls include firm age, size of assets and earnings (EBITDA). Standard errors in parentheses. Standard errors are clustered at the country-sector level. *: significant at 10% level; **: significant at 5% level; ***: significant at 1% level.

Conclusion I

- More vulnerable firms experienced larger and highly persistent drop in TFP growth post-Lehman
- Stronger impact of vulnerabilities on TFP slowdown in countries whose banking sector was hit harder by GFC, or whose main creditor bank(s) were hit harder
- Effects seem economically large: taken at face value, coefficients imply that up to a third of productivity slowdown in this sample of firms can be explained
- Weaker intangible investment was *one* channel—its drop was frontloaded and short-lived, while TFP growth decline was more gradual (dynamic analysis)
- Results are *not* driven by more vulnerable firms being low-productivity (level or growth) firms, or differing from less vulnerable firms along other dimensions

Conclusion II

- Financial frictions matter for within-firm productivity growth, and can lead to highly persistent/permanent productivity losses under certain macro shocks

➔ Policy implications: our findings strengthen the case for:

- Macro- and micro-prudential policies to dampen build-up of vulnerabilities: can raise potential output level in stochastic world with shocks to credit conditions

- More aggressive macro policies (monetary but also possibly fiscal) in downturns, particularly to stabilize intangible assets investment…

- …and more aggressive macro policies during upswings?