Industry-University links and firms' resilience during the Great Recession: Evidence from Spain.

work in progress

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Innovation, Firm Growth, and Employment: Empirical Evidence and Policy Perspectives Worshop

Introduction

- Firms cope differently when facing an adverse shock.
- Importance to study the determinants of firms' resilience for policy and management.
- We focus on the role of industry-university links as a source of firm resilience.
  - Industry-university links contribute to innovation, which is considered as a source of a firm's resilience (Hall 1987; Antonioli et al. 2013; Gupta 2019)
  - Industry-university links lead to greater organizational flexibility: firms adjust better to changing environments and new market opportunities
  - Firms with university links benefit from R&D cost reduction, shared resources, risk decentralization and complementarities.

Previous literature

- We contribute to:
  - The open innovation literature (Chesbrough 2003) and the role played by universities (Añón 2016; Bellucci and Pennacchio 2016; García-Vega and Vicente-Chirivella 2020; Vega-Jurado et al. 2017).
  - The literature on determinants of firms' resilience (Alfaro and Chen 2012; Aghion et al. 2021; Bertschek et al. 2019; Chodorow-Reich 2014; Giroud and Mueller 2017; Gupta 2019).
  - The inovation (R&D) and the business cycle (Aghion et al. 2012; Berchicci et al. 2013; Caballero and Hammour 1994; Hall 1991; Geroski and Walter 1995).

Paper's contributions

- We estimate the differential effect of a negative demand shock on the performance of firms with university links:
  - We analyze the differential effects of two modes of links (cooperation and R&D contracting) on firm resilience.
  - We explore whether firm size plays a role in this relationship.
- We look at the mechanisms behind the higher resilience of firms that carry out agreements with universities: i.e., product differentiation

Methodology

1. Baseline specification (Aghion et al. 2021, Gupta 2019)

1. $\Delta y_{ijt} = y_{ijt+1} - y_{ijt-1} = \alpha Uni_{ij0} + \beta Uni_{ij0} * Shock_j + \gamma x_{ij0} + \phi_{jt} + \epsilon_{ij}$
   - β represents a measure of the differential effect of a severe negative demand shock on the performance of firms with university links relative to their counterparts.

2. Extended version considering pre-recession years:

2. $\Delta y_{ijt} = \beta_1 Uni_{ijt-1} + \beta_2 GFC * Shock_j + \beta_3 Uni_{ijt-1} * GFC + \beta_4 Uni_{ijt-1} * GFC * Shock_j + \gamma x_{ijt-1} + \phi_{jt} + \epsilon_{ijt}$

Data

- Source: PITEC dataset (manufacturing firms)
- Period:
  - Basic specification: 2007-2011
  - Extended version: 2004-2011
- Measure of resilience: real sales growth $\Delta y_{ijt} = y_{ijt+1} - y_{ijt-1}$
- Firms in the sample provide information on university links: R&D services acquired from universities & R&D collaborations with universities

Descriptive statistics

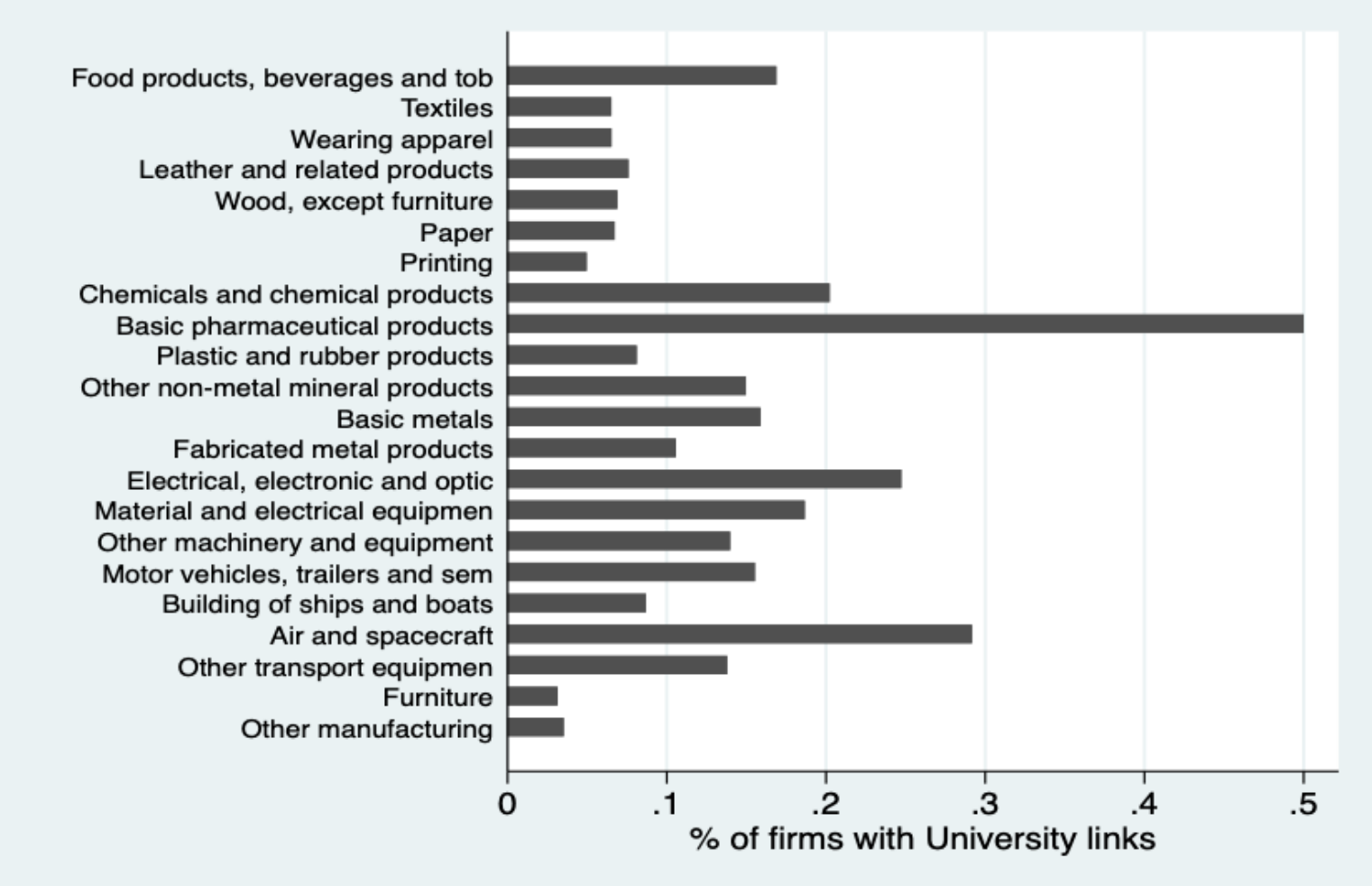

Figure 1: Share of firms with university links in 2006, by industry

Demand shock

We use real export growth to proxy for the crisis intensity (Aghion et al. 2021; Gupta 2019) - Data from UN COMTRADE

1. shock

$$shock_j = -\Delta X_{j2008} = -(\overline{x}_{t,t+1} - \overline{x}_{t-2,t-1})$$

- As IV we use US real exports

2. GFC = 1 for t = 2008, 2009, 2010.

Descriptive statistics

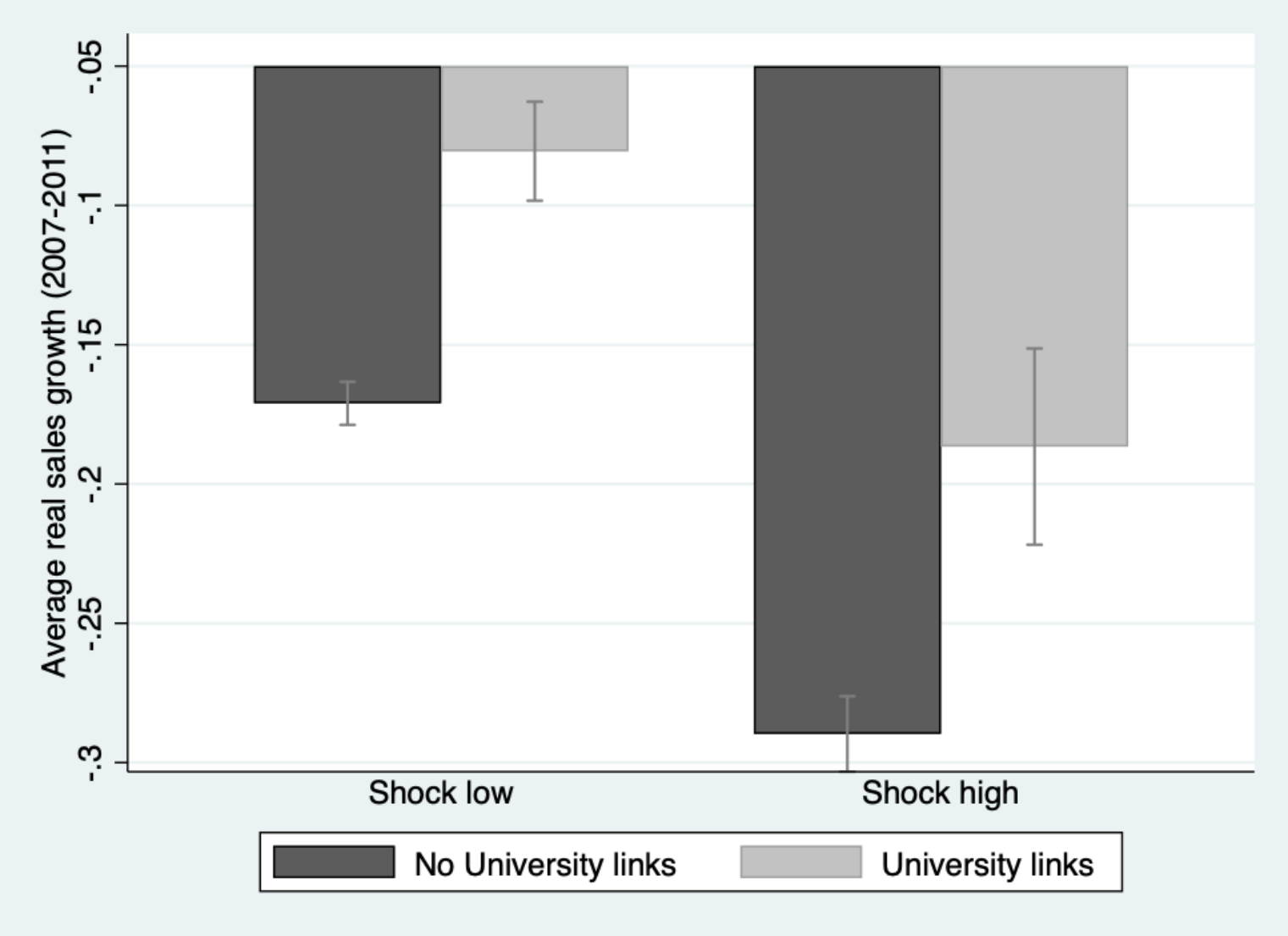

Figure 2: Changes in real sales by shock and university links

Baseline Results

	Dependent variable: Sales growth (Two-year difference)			
	OLS	OLS	OLS	IV
	(1)	(2)	(3)	(4)
University links$_{2006}$	0.067***	0.064***	0.052***	0.052***
	(0.011)	(0.011)	(0.015)	(0.014)
Shock	-0.566***	-0.603***		
	(0.103)	(0.104)		
University links$_{2006}$ # Shock		0.224***	0.221**	0.233**
		(0.080)	(0.084)	(0.094)
Industry FE	Yes	Yes		
Industry-year FE			Yes	Yes
Firm controls			Yes	Yes
Weak instruments (F-stat)				66.8
Observations	15,148	15,148	15,148	15,148
R^2	0.052	0.052	0.162	0.162

Note: The dependent variable is firm real sales growth measured from t–1 to t + 1. Data are pooled for growth over 2007-2009, 2008-2010, and 2009-2011. Growth is winsorized at 1% on both tails. University links is measured at 2006 for the three cross-sections respectively. *Shock* is the export growth measured as the percentage change from 2006-07 to 2008-09 at the industry level. Columns (3) and (4) control for labor productivity, firm size, export status, inhouse R&D status, total R&D to sales ratio, and firm's financial barriers prior to the Great Recession in the year 2006. Standard errors are clustered at the industry level and reported in parentheses. Significance level: * p<0.1, ** p<0.05, *** p<0.01.

Figure 3: University-links and sales growth during the crisis (2007-2011)

Results (II)

	Dependent variable: Sales growth (Two-year difference)			
	OLS	OLS	OLS	OLS
	(1)	(2)	(3)	(4)
$Collaborate_{2006}$	0.030	0.033*	0.029	
	(0.018)	(0.019)	(0.018)	
$Outsource_{2006}$	0.047***	0.046***	0.049***	
	(0.009)	(0.009)	(0.013)	
$Collaborate_{2006}$ # shock	0.179		0.233**	
	(0.124)		(0.099)	
$Outsource_{2006}$ # shock	0.134	0.229***		
	(0.112)	(0.073)		
Only $Collaborate_{2006}$				0.035
				(0.023)
Only $Outsource_{2006}$				0.054***
				(0.014)
$Both_{2006}$				0.073***
				(0.021)
Only $Collaborate_{2006}$ # shock				0.188
				(0.179)
Only $Outsource_{2006}$ # shock				0.156**
				(0.066)
$Both_{2006}$ # shock				0.304**
				(0.119)

Figure 4: Collaborations, outsourcing and sales growth during the crisis (2007-2011)

Placebo analysis

	Dependent variable: Sales growth (Two-year difference)			
	2004-2007		2004-2011	
	OLS	OLS	FE	FE
	(1)	(2)	(3)	(4)
University links$_{t-1}$	0.019	0.023	-0.021*	-0.017
	(0.015)	(0.015)	(0.012)	(0.011)
University links$_{t-1}$ # Shock		-0.160		-0.144
		(0.123)		(0.097)
University links$_{t-1}$# GFC			0.050***	0.045***
			(0.014)	(0.014)
GFC # Shock				-0.231
				(2.681)
University links$_{t-1}$ # GFC # Shock				0.226*
				(0.121)
Firm FE	No	No	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Observations	10,530	10,530	31,254	31,254
R^2	0.476	0.476	0.468	0.468

Note: The dependent variable is firm real sales growth measured from *t*–1 to t + 1. Growth is winsorized at 1% on both tails. In columns (1) and (2), data is pooled for growth over 2004-2006 and 2005-2007; while in columns (3) and (4) data is pooled for pre- and post-crisis periods (2004-2006, 2005-2007, 2006-2008, 2008-2010, 2009-2011. The *University links* variable is measured at *t*-1. *Shock* is the export growth measured as the percentage change from 2006-07 to 2008-09the at the industry level. *GFC* is a dummy equal to 1 for *t* equal to 2008, 2009, and 2010. All columns control for labor productivity, firm size, export status, internal R&D status, R&D to sales ratio, and firm's financial barriers in *t*-1. Significance level: * p<0.1, ** p<0.05, *** p<0.01.

Figure 5: Robustness checks

Mechanism

- Knowledge from universities becomes more valuable during downturns.
- We aim to assess the mechanism by which university knowledge transfers contribute to firm's resilience.
- We focus on innovation strategies towards (horizontal / vertical) differentiation (Geroski & Walters 1995).
  - university knowledge helps firms to upgrade the quality of products or bring higher quality products to the market
  - general innovation measures do not distinguish new high quality products from incremental innovation. To address this, we use variables more related to product differentiation.

3. $I_{it} = \beta_1 Uni_{ijt-1} + \beta_2 GFC * Shock_j + \beta_3 Uni_{ijt-1} * GFC + \beta_4 Uni_{ijt-1} * GFC * Shock_j + \gamma x_{ijt-1} + \phi_{jt} + \epsilon_{ijt}$

Results (III)

Dep. Variable:	2005-2010			
	Number of patents	Increase product lines	Quality improvement	New markets
	Negative binomial	Probit	Probit	Probit
	(1)	(2)	(3)	(4)
University links	0.693***	0.087*	0.106**	0.062
	(0.081)	(0.052)	(0.046)	(0.050)
University links # Shock	-0.875***	0.355	-0.462***	0.246
	(0.303)	(0.279)	(0.151)	(0.189)
GFC # Shock	0.287**	0.089*	0.158***	0.256***
	(0.125)	(0.048)	(0.061)	(0.041)
University links # GFC	37.615***	1.721***	2.147***	13.841***
	(1.379)	(0.444)	(0.396)	(0.514)
University links# GFC # Shock	1.150**	-0.069	0.409*	0.314
	(0.507)	(0.263)	(0.224)	(0.314)
Industry-year FE	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Observations	33,024	33,024	33,024	33,024

Note: The dependent variable in column (1) is the number of patents. The dependent variable in columns (2) is a categorical variable for whether the firm ranks very or quite important the objective of increasing the number of product lines. The dependent variable in columns (3) is a categorical variable for whether the firm ranks very or quite important the objective of quality improvement. The dependent variable in columns (4) is a categorical variable for whether the firm the firm ranks very or quite important the objective of market expansion through innovation. In columns (1) to (4) data is pooled for the period 2005-2010 is pooled. Firm's controls include (dated at period t-1): firm's size, R&D status, total R&D intensity, financial obstacles, government funding, export status, foreign ownership, group ownership and whether the firm is a start-up. All columns control also for industry-year fixed effects. Standard errors are clustered at the industry level and reported in parentheses. Significance level: * p<0.1, ** p<0.05, *** p<0.01.

Figure 6: Industry-university links and product differentiation

Results: the role of firm size (IV)

	Dependent variable: Sales growth (Two-year difference)			
	2007-2011 (OLS)		2004-2011 (FE)	
	SMEs	Large	SMEs	Large
	(1)	(2)	(3)	(4)
University links$_{2006}$	0.057***	0.047		
	(0.014)	(0.030)		
University links$_{2006}$ # shock	0.343***	-0.029		
	(0.056)	(0.160)		
University links$_{t-1}$			-0.013	-0.037*
			(0.014)	(0.020)
University links$_{t-1}$# shock			-0.113	-0.139
			(0.105)	(0.140)
GFC# shock			1.401	-2.054
			(3.320)	(4.777)
University links$_{t-1}$# GFC			0.049***	0.027
			(0.018)	(0.023)
University links$_{t-1}$# GFC# shock			0.260*	0.128
			(0.145)	(0.175)
Industry-year FE	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Observations	12,349	2,806	25,085	6,169
R2	0.155	0.251	0.459	0.574

Figure 7: Firm size, university links and firms' resilience

Conclusions

- Our goal is to assess whether firms with university links are more resilient in downturns.
- The empirical evidence is based on data from the Spanish CIS (PITEC):
  - we focus on manufacturing firms
  - we exploit the negative shock of the 2008 crisis
- Using a diff-in-diff approach, we find that firms with university links performed better during the crisis. These links became relatively more relevant in sectors severely hit.
  - The resilience arises from outsourcing rather than from collaboration, although there are synergies

Conclusion

- Knowledge transfers from universities help firms invest more in product differentiation in downturns
  - firms with university links registered more patents, increase product lines, improve quality and expand to new markets in the event of the GFC
- The significant role of university transfers in the event of a crisis is found for SMEs
- Policy implications of the findings: the importance of firms' incentives to collaborate or outsource R&D from universities.

Conclusion

Thank you for your attention!