Partnering for productivity

The impact of cooperation on firm performance

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Introduction

Motivation

- Innovation is important in economic growth and firm productivity.
- Firms need increasing resources - complex development
- Seek cooperation partners.
  - knowledge flow
  - complementary resources

Research question

- Innovation has a positive effect on firm productivity.
- Does cooperation have additional effect on firm productivity?
- Useful for firm decision makers and policymakers to choose cooperation partners.

This paper

- Empirical analysis using DiD on the panel data of the Hungarian Community Innovation Survey (CIS).
- No other paper investigated the topic in an emerging innovator country, where firms are far from the frontier.
- Cooperating vertically increases productivity growth by around 3% after 4 years of the innovation.

Outline

Cooperation in the innovation activity

Partner types

To understand the effect of cooperation we need to differentiate between partner types.

- Vertical: suppliers, customers
- Horizontal: competitors
- Scientific institution: experts, research institutes and universities

▸ Cooperation definition

What we already know

- Information flow management
  - Maximize incoming spillover: absorptive capacity (Cohen & Levinthal, 1990)
  - Minimize information outflow: strategic and legal protection (Cassiman & Veugelers, 2002; De Faria et al., 2010)
- Cooperation mostly in manufacturing, especially in complex industries (Abramovsky et al., 2009).
- Cooperation in radical and incremental innovation (Belderbos et al, 2004; Tether, 2002).
- Cooperation needs 'incubation time' (Belderbos et al, 2015).

Data and methodology

Community Innovation Survey (CIS)

- Period: 2004-2016 (7 waves)
- Harmonized, bi-annually collected survey
- Representative sample of 10+emp firms, questions are asked from innovative(ly active) companies.
  - The effect of cooperation is interpreted as an additional effect on top of the effect of innovation.
- Constraint: The waves represent activities of firms in the preceding 3 years, there are overlapping years.
  - I link every CIS wave to the earliest year it has information about.
  - e.g.: CIS2012: 2010-2011-2012, link to 2010

Balance sheet

- Period: 2000-2020
- Firm balance sheets and income statements collected by the Hungarian National Tax Authority.
- All double-entry bookkeeping firms, covers more then 95% of the business sector.
- Nominal variables are deflated using 2-digit industry-level deflators.
- Labor productivity: ln(value added/number of employees)
- Total factor productivity: Levinsohn & Petrin (2003) method for every 2-digit NACE industry on the entire balance sheet.

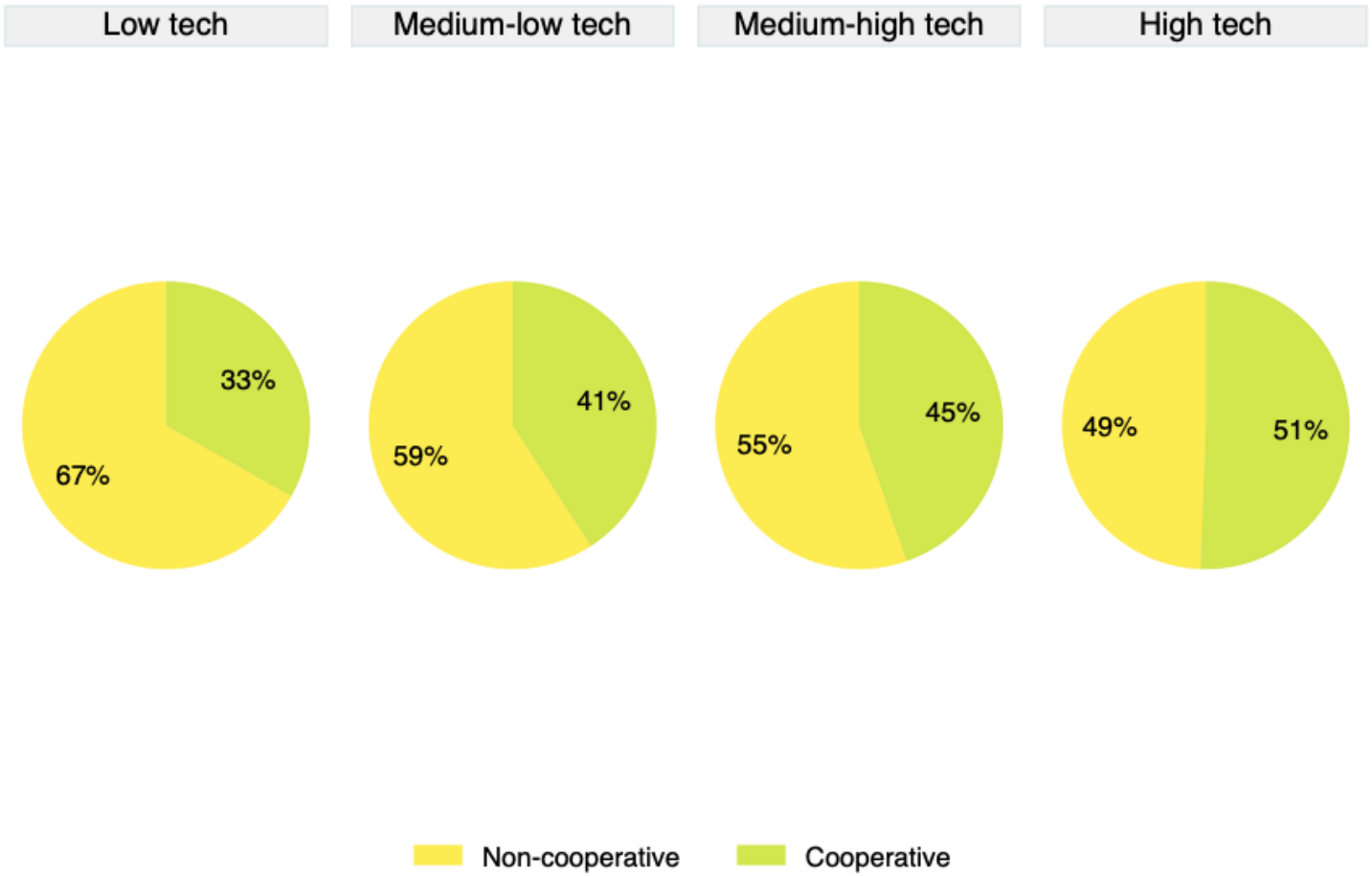
Final sample

Observation type	Raw merge	10+ emp	Final sample
Only BS	7 512 623	561 325	79 661
Only CIS	4 050	0	0
Match	35 499	34 458	19 492
Total	7 552 172	595 783	99 153

Sample restriction

- firms with more than 10+ employees that are present in at least one CIS wave
- manufacturing firms: cooperation mostly present here, partner types are clearly defined

Cooperative observations within technology innovative firms by technology intensity groups



The more complex and technology-intensive is the industry, the more firms will choose to cooperate with other actors.

Correlation between partner types

	Supplier	Customer	Competitor	Science
Supplier	1			
Customer	0.6754	1		
Competitor	0.5320	0.5860	1	
Science	0.5375	0.5129	0.4739	1

Strongest connection is among vertical partners. Firms engage with multiple partner types.

Difference between non-cooperative and cooperative

Variable	Non-cooperative	Cooperative
ln(Employees)	4.419	5.120
ln(Capital)	12.76	13.67
ln(Sales)	14.07	15.03
ln(Value added)	12.83	13.77
Labor productivity	8.410	8.636
TFP	8.108	8.478
Foreign	0.385	0.477
Exporter	0.817	0.883
Funding	0.280	0.478
Own R&D occasionally	0.229	0.271
Own R&D continuously	0.213	0.397
Number of observations	3312	2180

The observations are on firm-year level, and covers only technology innovative firms or firms with ongoing or abandoned technology innovation activity.

Empirical approach

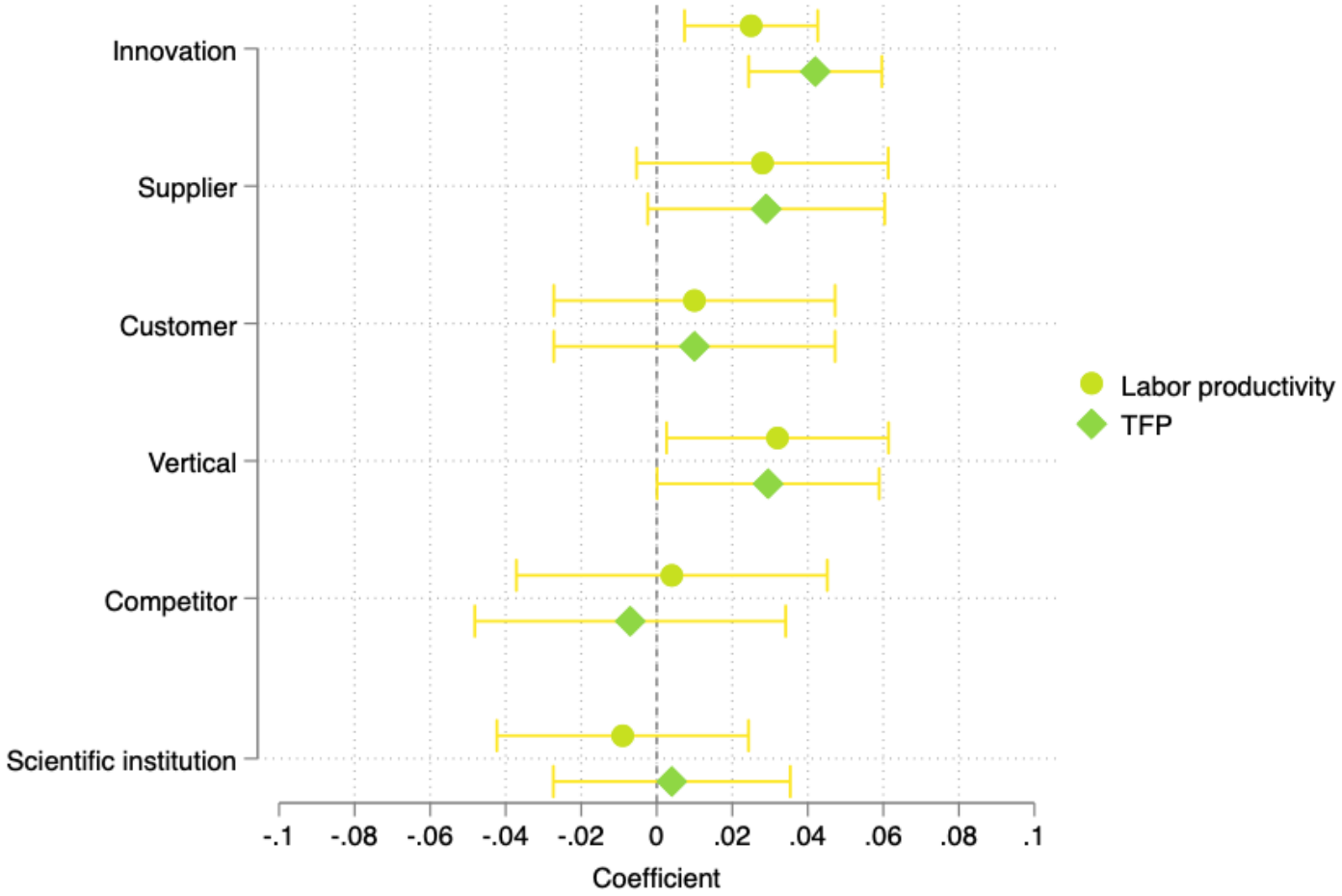
Long difference regression with industry-year fixed effects (Caroli & Van Reenen, 2001)

$$\Delta y_{it} = \delta \mathit{innovation}_{it} + \beta \mathit{cooperation}_{it} + \gamma X_{it} + \phi y_{it-1} + \lambda_{kt} + \varepsilon_{it}$$

- Δy_{it}: change in productivity between $t+4$ and t, winsorized (5%)
- $\mathit{innovation}_{it}$: product, process or organizational innovative at time t
- $\mathit{cooperation}_{it}$: cooperates at time t by partner types
- X_{it}: absorptive capacity (no/occasionally/continuously in-house R&D), funding
- y_{it-1}: lagged value of productivity

Results

Effect of cooperation on firm productivity



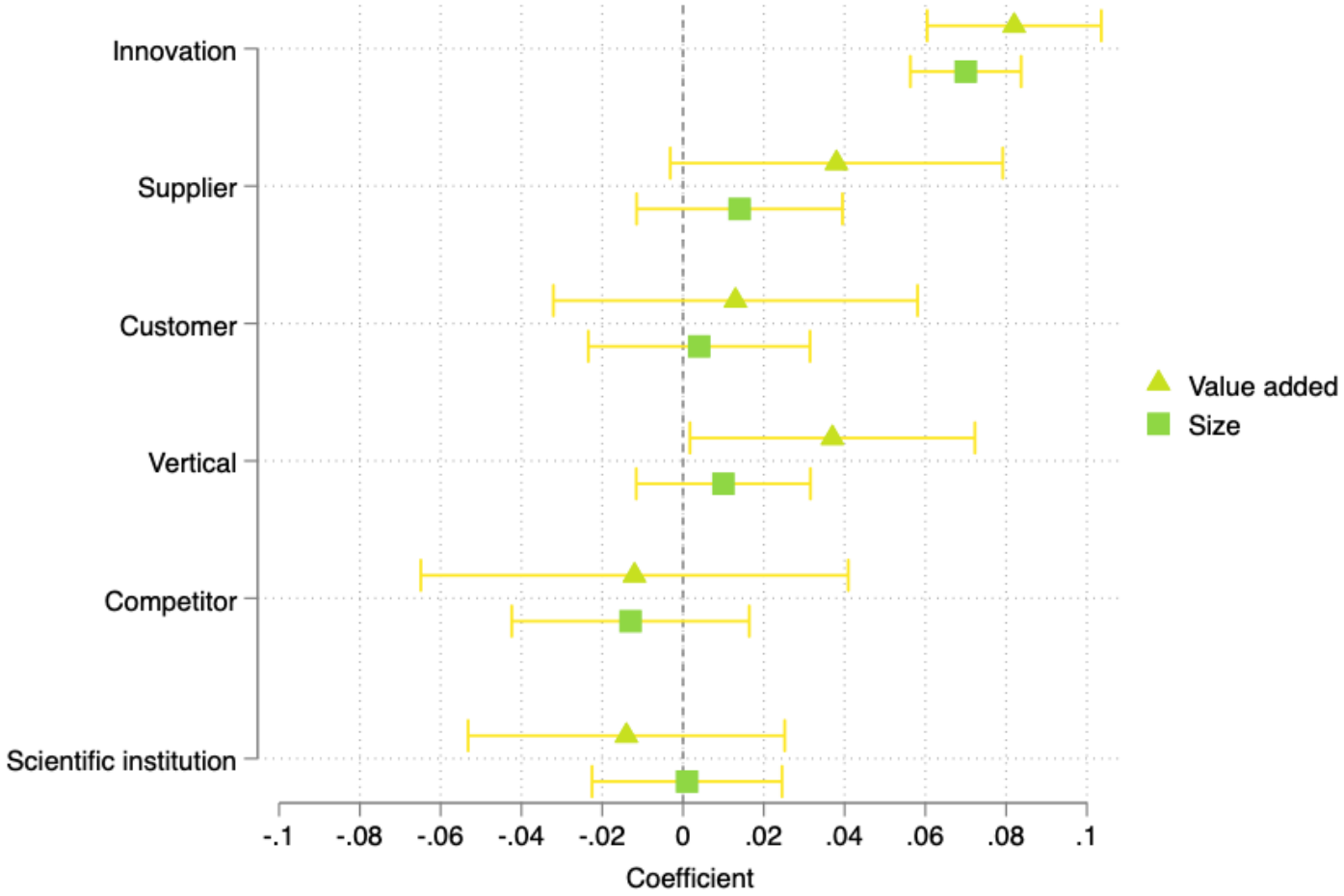
▸ Labor productivity table ▸ TFP table

Story behind productivity growth

- suppliers can help in decreasing the cost
  - develop unique products or processes
- customers can help in increasing the sales
  - information about customer needs
  - easier product commercialization - higher price, bigger quantity

Both should increase value added

Effect of cooperation on value added and size



▸ Value added table ▸ Size table

Conclusion

Conclusion

- Vertical cooperation partners as suppliers and customers are important.
- If a firm introduces an innovation and cooperates with its vertical partners 4 years later its productivity growth will increase by around 3% on top of innovation's effect.
- The productivity growth is a consequence of a value added increase, while cooperation has no impact on firm size growth.

Appendix

Number of firms in the CIS waves

CIS Wave	All	Innovative		Cooperative			
		All	Tech.	Supplier	Customer	Competitor	Scientific
2002-2004	2020	802	593	191	158	97	144
2004-2006	2440	907	700	213	155	93	206
2006-2008	2498	831	711	245	168	106	228
2008-2010	2511	838	670	236	176	133	238
2010-2012	2738	876	639	218	168	93	178
2012-2014	3723	934	789	223	138	68	137
2014-2016	3562	1004	848	228	166	100	143

Cooperation definition

▸ Back

The firm introduces product or process innovation, or has ongoing or abandoned technology innovation activity and cooperates vertically, horizontally or with a scientific institution. Innovation cooperation is active participation with other enterprises or organizations on innovation activities. Both partners do not need to commercially benefit. Exclude pure contracting out of work with no active cooperation.

During the three years, did your enterprise cooperate on any of your innovation activities with other enterprises or organizations:

1. *Suppliers of equipment, materials, components, or software*
2. *Clients or customers*
3. *Competitors or other enterprises in your sector*
4. *Consultants or commercial labs*
5. *Universities or other higher education institutes*
6. *Government, public or private research institutes*

(4, 5 and 6 together: scientific institution)

Labor productivity regression result

Back

	(1)	(2)	(3)	(4)	(5)
Innovation	0.026***	0.020**	0.019**	0.025***	0.025***
	(0.007)	(0.008)	(0.008)	(0.009)	(0.009)
Supplier		0.026		0.028*	
		(0.017)		(0.017)	
Customer		0.010		0.010	
		(0.019)		(0.019)	
Vertical			0.029**		0.032**
			(0.015)		(0.015)
Competitor		0.000	0.003	0.001	0.004
		(0.021)	(0.021)	(0.021)	(0.021)
Scientific institution		-0.011	-0.011	-0.009	-0.009
		(0.016)	(0.016)	(0.017)	(0.017)
Controls	No	No	No	Yes	Yes
Dependent variable (t-1)	Yes	Yes	Yes	Yes	Yes
Industy-Year FE	Yes	Yes	Yes	Yes	Yes
Observations	15 134	15 134	15 134	15 134	15 134
R-squared	0.160	0.160	0.160	0.161	0.161

TFP regression result

Back

	(1)	(2)	(3)	(4)	(5)
Innovation	0.042***	0.035***	0.036***	0.042***	0.042***
	(0.007)	(0.008)	(0.008)	(0.009)	(0.009)
Supplier		0.027*		0.029*	
		(0.016)		(0.016)	
Customer		0.009		0.010	
		(0.019)		(0.019)	
Vertical			0.026*		0.029**
			(0.015)		(0.015)
Competitor		-0.013	-0.008	-0.012	-0.007
		(0.022)	(0.021)	(0.022)	(0.021)
Scientific institution		-0.000	0.001	0.002	0.004
		(0.016)	(0.015)	(0.016)	(0.016)
Controls	No	No	No	Yes	Yes
Dependent variable (t-1)	Yes	Yes	Yes	Yes	Yes
Industy-Year FE	Yes	Yes	Yes	Yes	Yes
Observations	14 357	14 357	14 357	14 357	14 357
R-squared	0.156	0.156	0.156	0.157	0.157

Value added regression result

Back

	(1)	(2)	(3)	(4)	(5)
Innovation	0.087***	0.080***	0.080***	0.082***	0.082***
	(0.010)	(0.011)	(0.010)	(0.011)	(0.011)
Supplier		0.044**		0.038*	
		(0.021)		(0.021)	
Customer		0.005		0.013	
		(0.023)		(0.023)	
Vertical			0.038**		0.037**
			(0.018)		(0.018)
Competitor		-0.017	-0.012	-0.019	-0.012
		(0.027)	(0.026)	(0.027)	(0.027)
Scientific institution		-0.014	-0.012	-0.017	-0.014
		(0.020)	(0.020)	(0.020)	(0.020)
Controls	No	No	No	Yes	Yes
Dependent variable (t-1)	Yes	Yes	Yes	Yes	Yes
Industy-Year FE	Yes	Yes	Yes	Yes	Yes
Observations	14 825	14 825	14 825	14 825	14 825
R-squared	0.136	0.136	0.136	0.137	0.137

Size regression result

Back

	(1)	(2)	(3)	(4)	(5)
Innovation	0.080***	0.075***	0.076***	0.069***	0.070***
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
Supplier		0.021*		0.014	
		(0.013)		(0.013)	
Customer		-0.001		0.004	
		(0.014)		(0.014)	
Vertical			0.014		0.010
			(0.011)		(0.011)
Competitor		-0.014	-0.011	-0.018	-0.013
		(0.016)	(0.015)	(0.016)	(0.015)
Scientific institution		0.009	0.010	-0.001	0.001
		(0.012)	(0.012)	(0.012)	(0.012)
Controls	No	No	No	Yes	Yes
Dependent variable (t-1)	Yes	Yes	Yes	Yes	Yes
Industy-Year FE	Yes	Yes	Yes	Yes	Yes
Observations	15 515	15 515	15 515	15 515	15 515
R-squared	0.107	0.107	0.107	0.110	0.110