

The Impact of Innovation on Firm's Trade Margins: Evidence from France

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Introduction

Innovation and technological development play a key role in enhancing **firms' productivity**: **firms' performance** may be explained by their ability to be successful **innovators**

Impact of innovation on international trade: firms that invest more in R&D enhance productivity and self-select into international markets

Different predictions in theoretical literature and **contrasting empirical findings** on relationship between innovation and export performance at the firm-level

Innovation even more important in the light of **competition from newly emerging countries** (e.g. China, India, Brazil etc.)

Theoretical Predictions

Heterogeneous firms in International Trade: productivity premia of exporters (Melitz, 2003; Mayer and Ottaviano, 2007; Bernard et al. 2003; etc.)

Analysis of the effect of firms' **endogenous investments** on the link between firms' productivity and export propensity (Yeaple, 2005; Bernard et al. 2006, 2007; Costantini and Melitz, 2008; Corcos et al. 2012; Becker and Egger, 2013)

Complementarity between investments in productivity and entry to export markets (Aw et al. 2005; 2008; 2011; Van Long et al. 2011)

Disaggregated analysis export performance looking at **trade margins** (Hummels and Klenow, 2005; Hallak, 2006; Chaney, 2008; Berthou and Fontagnè, 2008; Arkolakis and Muendler, 2010; Crozet and Koenig, 2010)

Empirical Findings

Positive correlation between innovation and exporting:

- **Innovation and the productivity premia of exporters** (Cassiman et al., 2010; Bellone et al. 2009; Crespo, 2012; Altomonte et al. 2013)
- **Investments in R&D activities** (Huergo and Jaumandreu, 2004; Harrison et al. 2005; Griffith et al. 2006; Parisi et al. 2006; Damijan et al. 2010; Harris and Moffat, 2011)
- **Product and process innovations** (Roper and Love, 2002; Haaland and Kind, 2008; Van Beveren and Vandenbussche, 2009; Cassiman et al. 2010; Becker and Egger, 2010; Hallak and Sivadasan, 2013)

Direction of Causality Link

- **Learning-by-exporting** (Damijan and Kostevc, 2006; De Loecker, 2007, 2013; Salomon and Shaver, 2005; Bustos, 2011; Bratti and Felice, 2012; Dai and Yu, 2013;)
- **Exporting-by-innovating** (Cassiman and Martinez-Ros, 2007; Haaland and Kind, 2008; Caldera, 2010; Cassiman and Golovko, 2011; Altomonte et al. 2013; LoTurco and Meggioni, 2014)
- **Export/Innovation Complementarity** (Aw et al. 2007, 2011; Bellone and Guillou, 2011; Harris and Moffat, 2011; Esteve-Perez and Rodriguez, 2013)

Effect of Innovation on Trade Margins

Recent studies (Chen, 2013) on the impact of innovation on **trade margins**:

- **product mix** and **quality**
- access to **new markets**
- increase of **existing flows**

Aims and Contribution

- 1 Investigate the role of **innovation** in firms' international **trade performance**
- 2 Disentangle the effect of innovation into **extensive and intensive margins** of trade
- 3 Distinguish between **different measures of innovation** (input and output)
- 4 Test for **causality** between innovation and exports

Data Sources

Firm-level analysis on French firms over the period 1999-2007:

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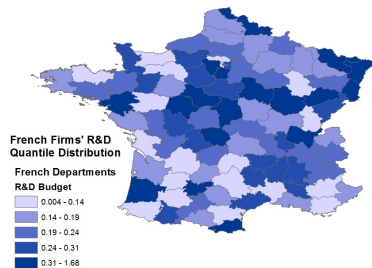
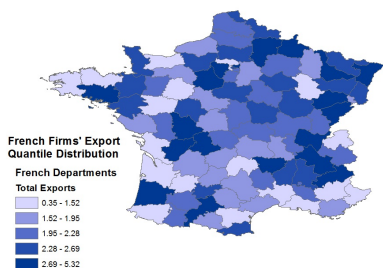
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- 4 Different sources of Trade and R&D data:**
 - total exports EAE vs Custom Agency
 - total R&D EAE vs MER

Why France?

- 1 Second largest exporter and innovator in the EU:
- 2 EU countries remarkably similar from a firm-level point of view
(Mayer and Ottaviano, 2007; Bekes et al. 2011; Rubini et al. 2012)
- 3 Lively internal debate on globalisation and its consequences
(Strauss-Kahn, 2003; Hijzen et al. 2011; Corcos et al. 2011; Mion, 2013)

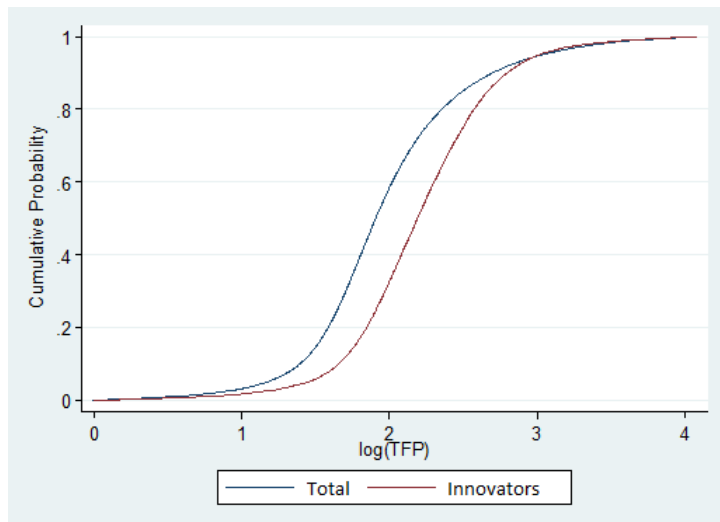


The Characteristics of Exporters and Innovators

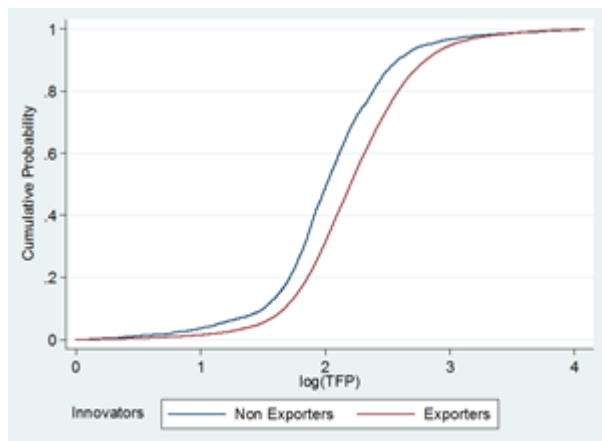
ALL FIRMS	Exporter	Non-Exporter	All Firms
Nb. of firms	15,589	10,177	25,766
Sh. total sample	60.5%	39.5%	100%
Employment	192	56	148
Average Salary	26,728	23,312	25,624
Total Sales	49,764	7,907	36,230
R&D Intensity	0.008	0.002	0.006
Export Intensity	0.25	0.00	0.17
INNOVATORS	Exporter	Non-Exporter	All Firms
Nb. of firms	3,367	324	3,691
Sh. total sample	91.2%	8.8%	100%
Employment	648	250	638
Average Salary	30,890	27,370	30,723
Total Sales	185,290	48,630	181,896
R&D Intensity	0.05	0.06	0.05
Export Intensity	0.40	0.00	0.38

(Sample Period 1999-2007)

Productivity Premia of Innovators



Productivity Premia of Exporters



R&D Activities and Trade Margins

Trade Margins	All Firms	Innovators	R&D Activities	Exporter	Non-Exporter
No. Exporters	15,589	3,367	Total R&D Budget (EUR th)	8,246	2,403
Tot. Exports (EUR bln)	173.78	97.49	R&D Intensity	7.15%	19.72%
Tot. No. Shipments	756,768	266,998	External R&D Funds	20.68%	16.87%
Sh. Tot. Exporters	0.21	0.02	Outsourced R&D	6.19%	1.85%
Sh. Tot. Exports	0.63	0.35	Foreign R&D Funds	10.68%	2.36%
Av. Tot. Exp. (EUR th)	11,789	56,022	AV. Empl. in R&D	56	20
Av. No. Shipments	51	152	Av. Salary Researchers	53,140	50,090
Av. No. Products	14	34	An. No. Patents	8	2
Av. No. Destinations	13	30	Pr. Product Inn.	67.35%	53.61%
Av. Value Shipment (EUR th)	229	365	Pr. Process Inn.	55.64%	51.73%

(Sample Period 1999-2007)

Benchmark Model

Firm fixed-effects model to estimate the role of Innovation on Export Performance:

$$X_{it} = \beta_0 + \beta_1 Z_{it-1} + \beta_2 R_{it-1} + \beta_3 I_{it} + \beta_4 X_{it-1} + k_t + \xi_{it}$$

- X : Export Performance of firm i at time t
(total exports, pr. exporter, extensive and intensive margins of trade)
- Z : Characteristics of firm i at time $t-1$
(size, av. salary, foreign ownership, TFP, cash-flow, R&D subsidies)
- R : R&D input measure for firm i at time $t-1$
- I : Innovation output for firm i at time t
(Product and Process Innovations)
- k : Year fixed effects

The Margins of Trade

- Intensive Margin: average value of export transactions
- Country extensive margin: number of export destinations
- Product intensive margin: number of exported products
- Unit Value: average unit value of export transactions

Fixed Effects Model - General

	(1)	(2)	(3)
	Pr.Exporter	Tot.Export(EAE)	Tot.Export(CA)
Tot. R&D	0.078***	0.016***	0.002
Product Inn.	0.365*	0.057*	-0.004
Process Inn.	-0.041	0.028	0.047
Tot. Employment	0.606***	0.608***	0.788***
Av. Salary	0.149	0.189***	0.332***
TFP	0.155**	0.174***	0.107***
R&D Public Funds	0.005	0.001	0.006
Cash-flow	-0.092	0.119**	0.122*
Observations	32,705	131,352	87,741
No. Firms	5,277	25,766	18,888

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Year, group dummies and export persistence included but not reported

Fixed Effects Model - Trade Margins

	(1)	(2)	(3)	(4)
	Int.Mar.	Unit Value	Product Ext.	Country Ext.
Tot. R&D	0.001	0.001	-0.0016**	0.0019***
Product Inn.	-0.015	0.005	0.017***	0.003
Process Inn.	0.035	0.011	0.003	0.005
Tot. Employment	0.421***	0.170***	0.339***	0.247***
Av. Salary	0.190***	0.044*	0.138***	0.074***
TFP	0.079***	-0.006	0.007*	0.028***
R&D Public Funds	0.004	0.001	0.009***	-0.0008
Cash-flow	0.067	-0.015	0.091***	0.015
Observations	87,741	87,741	63,331	63,331
No. Firms	18,888	18,888	10,902	10,902

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Diff-in-Diff

Difference-in-differences Propensity Score Matching in a Multiple Treatment approach:

$$\tau_{ATT} = E \left(X_{post}^a - X_{post}^b \mid S = a \right) = E \left(X_{post}^a \mid S = a \right) - E \left(X_{post}^b \mid S = a \right)$$

Multiple Treatments:

- 0 : Non Innovators
- $R\&D$: Start Investment in R&D
- Pd : First Product Innovation
- Pc : First Process Innovation
- $PdPc$: First Product and Process Innovation

Propensity Score Multinomial Logit

Treatment	(1) R&D	(2) Pd	(3) Pc	(4) PdPc
Tot. Employment	0.666***	0.681***	0.712***	0.850***
Av. Salary	0.803***	1.041***	0.295	1.172***
TFP	0.0690	0.183	0.313*	0.144
Export	1.331***	1.510***	1.237***	1.662***
R&D Public Funds	-2.450	1.094	1.095	1.1020
Cash-flow	1.570***	1.664***	0.0944	1.658***
Foreign Group	0.744***	0.833***	0.637***	0.723***
French Group	0.979***	0.762***	0.761***	0.761***
Observations	22,963	22,963	22,963	22,963

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Year fixed-effects included but not presented.

ATT Effects - General

	Tot. Exports (EAE)			Prob. Exporter			Tot. Exports (CA)		
	t	t+1	t+2	t	t+1	t+2	t	t+1	t+2
Only R&D vs Non-innovator									
ATT	0.299***	0.305**	0.463***	0.064***	0.078***	0.066***	0.071	0.054	0.077
b.s.e	(0.098)	(0.104)	(0.130)	(0.016)	(0.016)	(0.020)	(0.059)	(0.081)	(0.098)
Treated/Controls: 404/19,745									
Product Innovation vs Non-innovator									
ATT	0.306***	0.296***	0.441***	0.055***	0.056***	0.073***	0.058	0.011	0.144
b.s.e	(0.065)	(0.086)	(0.098)	(0.018)	(0.017)	(0.019)	(0.048)	(0.063)	(0.083)
Treated/Controls: 558/19,745									
Process Innovation vs Non-Innovator									
ATT	0.276***	0.250**	0.378**	0.083***	0.085***	0.067***	0.041	0.088	0.046
b.s.e	(0.107)	(0.124)	(0.167)	(0.018)	(0.019)	(0.023)	(0.088)	(0.105)	(0.126)
Treated/Controls: 302/19,745									
Product & Process Innovation vs Non-Innovator									
ATT	0.224***	0.224***	0.332***	0.037**	0.040**	0.056***	0.038	0.059	0.190**
b.s.e	(0.054)	(0.072)	(0.087)	(0.017)	(0.017)	(0.020)	(0.046)	(0.051)	(0.074)
Treated/Controls: 1,338/19,745									

ATT Effects - Intensive Margin

	Intensive Margin			Unit Value		
	t	t+1	t+2	t	t+1	t+2
Only R&D vs Non-innovator						
ATT	-0.106**	-0.087	0.023	0.029	0.074	0.186*
b.s.e	(0.052)	(0.066)	(0.069)	(0.064)	(0.072)	(0.098)
Treated/Controls: 314/8,267						
Product Innovation vs Non-innovator						
ATT	-0.076	-0.009	0.133**	0.034	0.079	0.103
b.s.e	(0.043)	(0.048)	(0.061)	(0.047)	(0.057)	(0.066)
Treated/Controls: 426/8,267						
Process Innovation vs Non-Innovator						
ATT	0.023	0.002	0.044	-0.019	-0.133	-0.070
b.s.e	(0.068)	(0.083)	(0.099)	(0.080)	(0.093)	(0.117)
Treated/Controls: 219/8,267						
Product & Process Innovation vs Non-Innovator						
ATT	-0.001	0.029	0.088	0.085	0.024	0.006
b.s.e	(0.041)	(0.052)	(0.067)	(0.052)	(0.054)	(0.070)
Treated/Controls: 1,093/8,267						

ATT Effects - Extensive Margin

	Country Ext. Margin			Product Ext. Margin		
	t	t+1	t+2	t	t+1	t+2
Only R&D vs Non-innovator						
ATT	0.527*	0.494	1.546**	0.586	1.399**	2.514**
b.s.e	(0.279)	(0.426)	(0.642)	(0.683)	(0.683)	(0.990)
Treated/Controls: 314/8,267						
Product Innovation vs Non-innovator						
ATT	0.494	1.039**	1.568***	0.405	0.501	0.237
b.s.e	(0.316)	(0.419)	(0.611)	(0.648)	(0.704)	(1.142)
Treated/Controls: 426/8,267						
Process Innovation vs Non-Innovator						
ATT	0.273	0.161	1.411**	-1.432*	-2.148**	-0.578
b.s.e	(0.333)	(0.509)	(0.687)	(0.703)	(1.000)	(1.572)
Treated/Controls: 219/8,267						
Product & Process Innovation vs Non-Innovator						
ATT	0.271	0.632**	2.265***	0.813*	0.782*	1.249*
b.s.e	(0.208)	(0.285)	(0.396)	(0.418)	(0.352)	(0.699)
Treated/Controls: 1,093/8,267						

Robustness Checks

- **All sectors** (agri, manufacture, service) but just for total exports and probability exporter
- Single and **individual treatment** for innovation
- Comparing **different innovation treatments**
- Different **Estimation Techniques** (Random-effects, System GMM)

Conclusion

- Impact of **different R&D measures** on firms' export performance (input and output)
- Different effects of innovation on firms' **intensive and extensive margins** of trade
- Role played by **starting innovative activities**:
 - positive effect on **total exports** (small shipments) and **prob. being an exporter**
 - no significant impact on **quality**
 - exporting **more products to more countries**
- Treatment is not random, **causality** between innovation and exports