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Innovation and Export in SMEs: The role of concentrated bank borrowing

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Motivation

- Firm's innovation and international activities are often associated with severe financial constraints (FC) because of *high sunk costs* and *information asymmetries*.

- This issue is particularly relevant for Small and Medium Enterprises (SMEs) since they are usually less transparent, have higher relative transaction costs and fewer assets that can be used as collateral (Beck and Demirguc-Kunt, 2006).

- Concentrated bank-borrowing proxies for the strength of the lending relationship with the main bank (Elsas, 2005; Guiso and Minetti, 2010; Ongena et al., 2012), which might help fostering SMEs' access to external financing, by increasing informational tightness and the exchange of "soft" information (Berger and Udell, 1995).

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Our contribution

- Using an integrated framework, we study how concentrated bank borrowing as a proxy for Relationship Banking (RB), i.e. the firm's credit relationship with its main bank, affects its innovation and export activities.

- In particular, we distinguish between a ***direct*** benefit of a tight firm-bank relationship on firm's export extensive and intensive margins, and an ***indirect*** positive effect, operating through the firm's higher propensity to introduce an innovative product.

- We focus on **Italy**, where **banks** represent the main source of external finance (Beck et al., 2008) and **SMEs** represent a particularly large share of the overall firm population (Ayyagari et al., 2008).

- We also provide some evidence on the channels through which relationship lending may operate

Background literature

1. ***Financing constraints and innovation***

- A number of papers have recently studied the negative effect of credit rationing on R&D investment (Aghion et al 2012, Mancusi and Vezzulli 2014a, 2014b) and innovation (Savignac 2008)

- Herrera and Minetti (2007): the duration of credit relationship with the main bank promotes firm's innovation; the effect is more significant for product than for process innovations.

- Benfratello et al. (2008): banking development (branch density) affects the probability of process innovation, particularly for small firms in high-tech sectors. For product innovation the evidence is much weaker and not robust.

Background literature

2. ***Financing constraints and export***

- FC affect exports because of high sunk cost thresholds (Manova et al., 2011; Bellone et al,, 2010) and high variable trading costs (Manova, 2013).

- Minetti and Zhu (2011): credit rationing has a negative impact on firm's probability of exporting (*extensive margin*) and on the percentage of its foreign sales (*intensive margin*).

- De Bonis et al. (2011): the intensity of the bank-firm relationship positively influences several firm's internationalization activities.

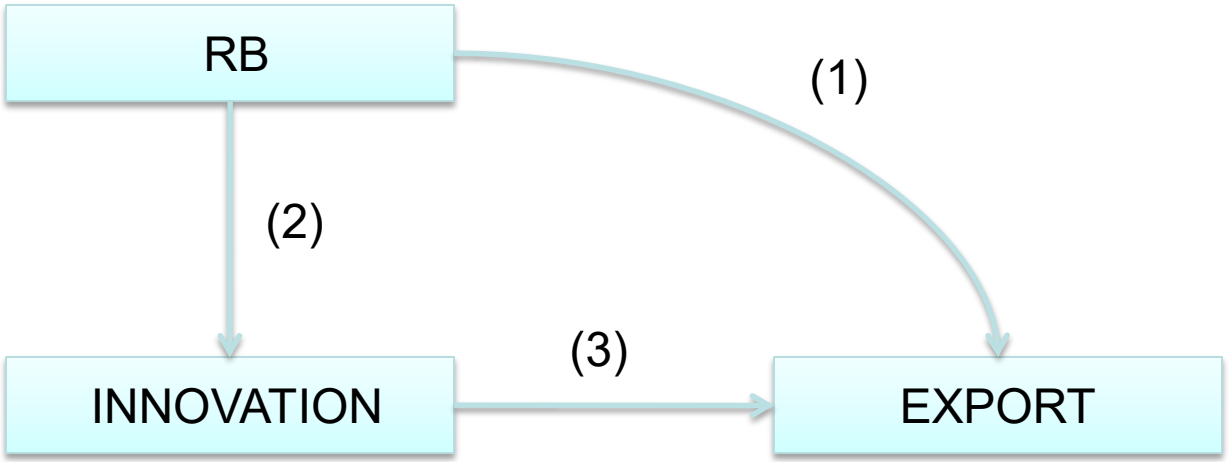
Background literature

3. *Innovation and export*

- ***Self-selection hypothesis*** (Melitz, 2003): innovation may foster firm's productivity and therefore promote export -> firms self-select into innovation in anticipation to export (Costantini and Melitz, 2007; Van Beveren and Vandenbussche, 2010).
  - Empirical support: Cassiman and Golovko (2011): product innovation has a positive impact on the decision to enter a foreign market.
- ***Learning by exporting hypothesis***: knowledge flows from international buyers and competitors may help to improve the innovation performance of exporters
  - No clear empirical support (Damijan et al., 2010; Bustos, 2011; Bratti and Felice, 2012).

Empirical specification

We try to disentangle the direct effect (1) of the strength of the credit relationship (RB) on firm's export decision and the intensity of its foreign sales from the indirect effect (2)*(3) operating through the promotion of product innovation.



Empirical specification

Three equations to be estimated:

- intensity of the credit relationship:

$$conc\_bank_i = \alpha_0 + \alpha_1 X_i + \alpha_2 Z_{1i} + u_i$$

- firm's (product) innovation:

$$\Pr(innoprod_i = 1) = \Pr(\beta_0 + \beta_1 conc\_bank_i + \beta_2 X_i + \beta_3 Z_{2i} + \varepsilon_{1i} > 0)$$

- firm's export equations:
  (a) probit specification for the firm's exporting decision
  (b) tobit specification for the observed percentage of exported sales

$$\text{export}_i^* = f(\gamma_0 + \gamma_1 conc\_bank_i + \gamma_2 innoprod_i + \gamma_3 X_i + v_i)$$

where: X = exogenous covariates; Z = excluded instruments.

Data

- Main source for innovation, internationalization, financial strategies and credit relationship and firm characteristics:
  - **UCS**: 10th UniCredit Corporate Survey on Italian manufacturing firms (2007)
  - **EFIGE**: survey on European Firms in a Global Economy (2010)
  - Representative samples of 5137 (UCS) and 3019 (EFIGE) Italian manufacturing enterprises.
  - Focus on SMEs → drop enterprises with more than 250 employees.
- Other sources:
  - **AIDA** (Amadeus): Balance sheet data
  - **ISTAT** (Italian Office of National Statistics) and **Bank of Italy**: regional economic and (historical) financial development
  - **CRIOS-PATSTAT** database: patent and patent citations (industry level)
- Final sample (excluding missing values and outliers): 4,334 SMEs

Relationship banking

- Boot (2000): RB is the provision of financial services by a financial intermediary
  a) that invests in obtaining customer-specific information, often proprietary in nature; and
  b) evaluates the profitability of these investments through multiple interactions with the same customer over time and/or across products".
- closely linked to "bank debt concentration" (Berger and Udell, 1995).
- $$conc\_bank = quota\_bank \times \frac{bank\_debts}{total\_assets} \times 100$$

  (quota_bank = share of firm's total bank debts financed by the main bank)
- alternative to other proxies used in the literature:
  - duration of the relationship with the main bank (nyears_bank);
  - the number of bank relationships the firm maintains (n_banks).
- Good proxy for RB: Principal Component Analysis on a set of questions in the UCS survey (available for about 1000 firms)

Relationship banking

Principal Component Analysis:	**Variable**	**Factor1**	**Factor2**	**Uniq.**
1) The bank knows well the firm's main business;	dum1		0.7163	0.4713
2) The bank knows some of the firm's managers or owners;	dum2		0.7879	0.3755
3) The bank knows well the firm's industry;	dum3		0.7296	0.3843
4) The bank knows the firm's local economy;	dum4		0.7031	0.4515
5) The bank knows the firm's market conditions;	dum5		0.6125	0.4798
6) High frequency of meetings or other contacts between the firm and the bank's local branch manager.	dum6		0.4640	0.6081
7) The bank takes quick decisions;	dum7	0.6678		0.4916
8) The bank provides multiple services;	dum8	0.7875		0.3486
9) The bank provides a wide international network;	dum9	0.6710		0.4932
10) The bank provides efficient internet-based services;	dum10	0.6488		0.5235
11) The bank provides stable credit lines;	dum11	0.7338		0.4424
12) The cost of the bank loans and services are affordable;	dum12	0.7794		0.3612
13) The bank's loan conditions are simple and clear;	dum13	0.7493		0.4203
14) The bank is well strategically located.	dum14	0.6529		0.4884

rel_bank shows a positive and significant pairwise correlation with Factor2 (0.1009).
Alternative measures display lower correlations: *nyears_bank* (0.0268) and by *n_banks* (0.0422).

Dependent and control variables

- Dependent variables:

  innoprod: dummy = 1 if the firm introduces at least one innovative product during the survey's reference period

  export: dummy = 1 if the firm exports in the last year of the survey's reference period.

  export_share: percentage of total sales from export.

- Control variables for:
  - firm's characteristics (size, financial structure, etc.)
  - provincial characteristics (level of economic and banking development)
  - industry and geo dummies

Instrumental variables

- IVs needed to deal with potential endogeneity of *conc_bank* (in the innovation and export equations) and *innoprod* (in export equations)
- predetermined variables describing financial development and the historical structure of local banking market
  - in 1936 (Guiso, Sapienza, Zingales, 2004):

    nbranches_p: number of bank branches per 1000 inhabitants in the firm's province
  - in 1991-2004, after liberalization reform (Herrera and Minetti, 2007):

    new_branch_inc: average number of new branches created by incumbent banks per 1000 inhabitants in the firm's province
- proxy for the intensity of localized (national) knowledge spillovers
  - ***bcit_ITA***: number of backward citations per 1000 inhabitants from EPO patents (with priority date 1990-2004) held by applicants located in the same province (NUTS3) and active in the same economic sector (NACE rev1.1) as the focal firm to national patents (self cites are excluded).

Estimation and main findings: innovation equation

VARIABLES	AMEs	Std. Err.
conc_bank	0.0308***	(0.0102)
ltot_assets	0.0154**	(0.0071)
debts	0.0134	(0.0380)
cash_flow	-0.123	(0.133)
Age	-0.0005	(0.0146)
Young	0.0197	(0.0308)
Group	-0.0246	(0.0218)
valueadded_p	0.0042	(0.0027)
branches_04	-0.0809	(0.0855)
HHI	0.0349	(0.176)
bcit_ITA	0.215**	(0.0902)

Positive and statistically significant impact of the **intensity of bank-firm relationship** on product innovation.

Heteroskedastic ML Probit model

Dependent variable: Pr(*innoprod*=1)

Observations: 4,341. Significant at 1%(***), 5%(**) and 10%(*) level.

Industry and geo controls not reported but included

Exogeneity tests for *rel_bank* not rejected.

Estimation and main findings: export extensive margin

VARIABLES	Coeff.	Std. Err.
innoprod	1.954***	(0.025)
conc_bank	0.347***	(0.0203)
ltot_assets	0.098***	(0.017)
debts	-0.330***	(0.099)
cash_flow	0.001	(0.383)
age	0.0382	(0.029)
young	-0.0306	(0.0701)
group	0.0921*	(0.0495)
valueadded_p	-0.0069	(0.0053)
branches_04	0.211	(0.164)
HHI	-0.146	(0.337)
Constant	-2.278***	(0.245)

- Positive and statistically significant impact of the **intensity of credit relationship** and of **product innovation** on firm's export decision.
- Estimated AMEs are economically significant:
  - *rel_bank:* 0.2474
  - *innoprod:* 0.6130

Heteroskedastic FIML-IV Probit model
Dependent variable: Pr(*export*=1)
Observations: 4,341. Significant at 1%(***), 5%(**) and 10%(*) level.
Industry and geo controls not reported but included
Exogeneity tests for *rel_bank* and *innoprod* rejected.

Estimation and main findings: export intensive margin

VARIABLES	Coeff.	Std. Err.
innoprod	239.6***	(3.230)
conc_bank	27.69***	(1.764)
ltot_assets	6.313***	(1.641)
debts	-29.93***	(9.356)
cash_flow	4.057	(37.61)
age	1.844	(3.456)
young	-3.407	(7.494)
group	9.784*	(5.005)
valueadded_p	-1.325**	(0.639)
branches_04	21.61	(18.24)
HHI	-13.60	(48.04)
Constant	-223.3***	(27.97)

- Positive and statistically significant impact of the **intensity of the firm-bank relationship** and of **product innovation** on firm's export sales
- Estimated AMEs:
  - *rel_bank:* 2.98
  - *Innoprod:* 11.74

Heteroskedastic FIML-IV Tobit model
Dependent variable: *export_share*
Observations: 4,276. Significant at 1%(***), 5%(**) and 10%(*) level.
Industry and geo controls not reported but included
Exogeneity tests for *rel_bank* and *innoprod* rejected.

conc_bank: direct vs. indirect effect

- Disentangle the estimated effect of an increase in the strength of the firm-bank relationship on exports into:
  - direct effect
  - indirect effect (through the increased propensity to introduce an innovative product)
- Extensive margin (probability) of export:
  - direct effect: 0.247
  - indirect effect: 0.613*0.0308=0.019.
- Intensive margin of export:
  - direct effect: 2.98%
  - indirect effect: 11.74*0.0308=0.36%.
- → Estimated effect of informational tightness mostly independent from innovation activity b/c RB boosts SMEs innovation output only to a mild extent

The bank lending channel

- ***Bank lending channel***

  borrowing concentration as a way to mitigate informational asymmetries and to encourage banks in investing in soft information, thus reducing credit constraints

Table 6: Borrowing concentration and access to credit.

	(1)	(2)	(3)
Estimation method	**Bivariate Probit with Selection**		**Probit**
Variables	***morecredit***	***rationed***	***exp_fin***
innoprod	0.0101		0.285**
	(0.0569)		(0.142)
conc_bank	0.101***	-0.0687*	0.517*
	(0.0252)	(0.0376)	(0.293)
ltot_assets	0.0112	0.00063	0.173***
	(0.0274)	(0.0369)	(0.0614)
debts	0.866***	0.206	-0.0604
	(0.168)	(0.200)	(0.399)
cash_flow	-3.082***	0.486	-0.263
	(0.507)	(1.187)	(1.094)
age	-0.0217	0.0184	-0.0493
	(0.0514)	(0.0732)	(0.135)
young	0.126	-0.128	-0.0975
	(0.107)	(0.145)	(0.297)
group	0.173**	0.126	-0.134
	(0.0758)	(0.117)	(0.176)
vvat_popres	0.00569	0.00882	0.0114
	(0.0090)	(0.0133)	(0.0252)
branch_04	-0.107	-0.463	-0.607
	(0.316)	(0.462)	(0.726)
HHI	-0.0953	0.164	-3.329*
	(0.611)	(0.854)	(1.763)
Constant	-1.078**	0.220	-3.670***
	(0.445)	(0.611)	(1.370)
rho	-0. 8567** (0.1399)		
Wald test of indep. eqns. (rho = 0)	5.93 p-val(0.0149)		
Observations	4,268	774	835

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Dummies for years 2004-2006, NACE 2 digits sector and NUTS1 macro-area included

The bank lending channel

- ***Bank lending channel***

  borrowing concentration as a way to mitigate informational asymmetries and to encourage banks in investing in soft information, thus reducing credit constraints

  - RB negatively affects the probability that the request for additional credit is denied
  - RB is statistically significant, with an estimated marginal effect of +3.04% on the firm's probability of being involved in export finance operations with its main bank (available only in the UCS survey)

The non financial services channel

- ***Non-financial services channel***:
  - Large banks provide more effective services for supporting firm's export activities with respect to small local banks (Del Prete and Federico, 2014)
  - Large banks can also provide information spillovers arising from its portfolio of exporting client firms (Inui et al. 2013) or from the presence of own subsidiaries in the target foreign market (Bronzini and D'Ignazio 2012)
  - → both reduce export costs
  - Estimate export equations for two separate sub-samples (UCS survey only):

    (1) 532 firms with a *large* main bank ("large national bank" or "international bank")

    (2) 2151 firms have a *small* main bank
  - RB has a stronger positive effect on both margins of export in (1):
    - Extensive margin: 0.237 (small bank) vs. 0.889 (large bank)
    - Intensive margin: 2.99 (small bank) vs. 12.54 (large bank)

Conclusions

- A tight relationship with the main bank plays a significant role in explaining firm's export decision (extensive margin) and the share of exports on total sales (intensive margin).
- These effects are:
  - *direct*: the more intense the bank-firm relationship, the higher the propensity of exporting and the share of exports on total sales, ceteris paribus
  - *indirect*, i.e. mediated by the enhanced propensity to introduce new products
- However, estimated direct effects are much larger then the indirect ones b/c relationship banking can only improve SMEs' innovation performance to a mild extent
- The positive effect of RB on export likely operates through different channels as it significantly decreases firm's probability of being credit constrained and increases firm's access to export finance loans (*bank lending channel*) and is stronger for firms with a large main bank (*non-financial services channel*).

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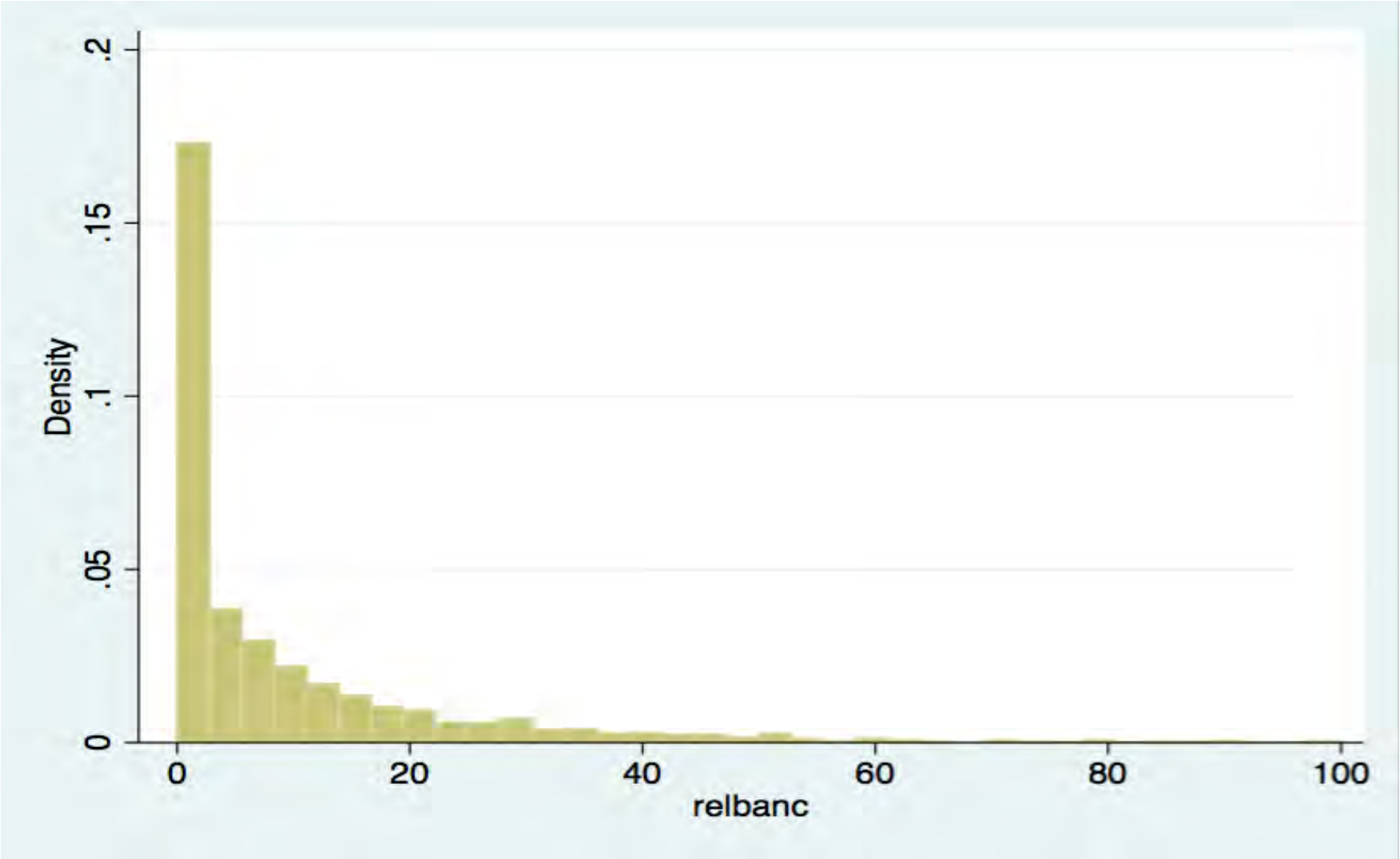
Thank you!

Distribution of rel_bank



Variables' description

Variable	Description
conc_bank	Percentage of firm's main bank loans on Total Assets
conc_bank_std	Standardized version of *conc_bank*
innoprod	Dummy = 1 if the firm introduced an innovative product
export	Dummy = 1 if the exported
quota_export	Percentage of firm's export over Total Sales
ltot_assets	Logarithm of Total Assets
debts	Total Debts on Total Assets
cash_flow	Cash Flow on Total Assets
age	Logarithm of firm's age in years
young	Dummy = 1 if the firm is less than 10 years old
group	Dummy = 1 if the firm belongs to a group
north_east	Dummy = 1 if the firm is located in the North-East Italian macro region
centre	Dummy = 1 if the firm is located in the Centre Italian macro region
south	Dummy = 1 if the firm is located in the South Italian macro region
valueadded_p	Value added (in millions of Euro per 1000 inhabitants) in 2004, NUTS3 level
branches_04	Avg. number of bank branches per 1000 inhabitants in the period 1991-2004, NUTS3 level
HHI	Avg. HH Index of bank deposits concentration during the period 1991-2004, NUTS3 level
nbranches_p	Number of bank branches per 1000 inhabitants in 1936, NUTS3 level
new_branch_inc	Avg. number of new branches created by incumbent banks per 1000 inhabitants in 1991-2004, NUTS3 lev.
bcit_ITA	Number of backward patent citations per 1000 inhabitants from citing patents filed during 1990-2004 by applicants from the same province (NUTS3) and industry (NACE 2 dig.) and citing other national patents.

Descriptive statistics

Variable	Mean	St. Dev	Min	Max
Dependent/endogenous variables				
conc_bank	9.204	14.282	0	100
conc_bank_std	-0.002	1.002	-0.648	6.366
innoprod	0.661	0.473	0	1
export	0.655	0.475	0	1
quota_export	24.712	29.202	0	100
Exogenous control varables				
ltot_assets	12.657	3.631	3.040	19.102
debts	0.679	0.225	0.006	6.292
cash_flow	0.056	0.060	-0.250	0.304
age	3.148	0.718	0	5.553
young	0.113	0.317	0	1
group	0.155	0.362	0	1
valueadded_p	24.292	4.867	11.242	33.388
branches_04	0.524	0.127	0.210	0.976
HHI	0.099	0.048	0.036	0.425
Exogenous instrumental variables				
nbranches_p	0.208	0.079	0.037	0.618
new_branch_inc	0.021	0.009	0.002	0.045
bcit_ITA	0.070	0.148	0	1.020

Table 3: Determinants of innovation

	Coefficients	Marginal Effects (AMEs)
Variables	***innoprod***	***innoprod***
rel_bank	0.0869***	0.0308***
	(0.0289)	(0.0102)
ltot_assets	0.0434**	0.0154**
	(0.0201)	(0.0071)
debts	0.0379	0.0134
	(0.107)	(0.038)
cash_flow	-0.347	-0.123
	(0.377)	(0.133)
age	-0.0013	-0.0005
	(0.0411)	(0.0146)
young	0.0561	0.0197
	(0.0889)	(0.0308)
group	-0.0686	-0.0246
	(0.0603)	(0.0218)
vvat_popres	0.0118	0.0042
	(0.0075)	(0.0027)
branch_04	-0.228	-0.0809
	(0.241)	(0.0855)
HHI	0.0984	0.0349
	(0.497)	(0.176)
bcit_ITA	0.608**	0.215**
	(0.255)	(0.0902)
Constant	0.528	
	(0.332)	
Observations	4,341	4,341

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Dummies for years 2004-2006, NACE 2 digits sector and NUTS1 macro-area included

Table 4. Determinants of the probability of export

Estimation method Variables	(1) FIML-IV Probit *export*	(2) FIML-IV Probit *rel_bank*	(3) FIML-IV Probit *innoprod*	(4) GMM-IV LPM *export*
innoprod	1.954***			1.541*
	(0.025)			(0.805)
rel_bank	0.347***			0.556
	(0.0203)			(0.526)
ltot_assets	0.098***	0.0153**	-0.053***	0.137
	(0.017)	(0.0069)	(0.012)	(0.0937)
debts	-0.330***	0.0241	0.752***	-0.487
	(0.099)	(0.0432)	(0.105)	(0.414)
cash_flow	0.001	-0.130	-0.314	0.834
	(0.383)	(0.159)	(0.248)	(0.715)
age	0.0382	0.00035	0.0074	0.0137
	(0.029)	(0.0115)	(0.025)	(0.0478)
young	-0.0306	0.0208	-0.0016	-0.0315
	(0.0701)	(0.0304)	(0.0617)	(0.0672)
group	0.0921*	-0.0256	-0.096***	0.0602
	(0.0495)	(0.0204)	(0.031)	(0.0438)
vvat_popres	-0.0069	0.0042*	-0.0006	-0.0049
	(0.0053)	(0.0021)	(0.0046)	(0.0066)
branch_04	0.211	-0.0120	-0.190	4.413
	(0.164)	(0.0815)	(0.202)	(25.39)
HHI	-0.146	0.0573	0.425	-0.0998
	(0.337)	(0.127)	(0.312)	(0.392)
nbranches_p		-0.139**	0.366*	
		(0.0648)	(0.205)	
new_branch_inc		0.256	4.408*	
		(0.757)	(2.462)	
bcit_ITA		0.170***	-0.062	
		(0.039)	(0.120)	
Constant	-2.278***	0.653***	0.427*	-1.451
	(0.245)	(0.101)	(0.224)	(1.177)
Observations	4,341	4,341	4,341	4,341

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Dummies for years 2004-2006, NACE 2 digits sector and NUTS1 macro-area included

Table 5: Determinants of the intensity of export

Estimation method	(1) FIML-IV Tobit	(2) FIML-IV Tobit	(3) FIML-IV Tobit
Variables	*rel_bank*	*innoprod*	*export_share**
innoprod			239.6***
			(3.230)
rel_bank			27.69***
			(1.764)
ltot_assets	-0.052***	0.016***	6.313***
	(0.012)	(0.006)	(1.641)
debts	0.751***	0.021	-29.93***
	(0.107)	(0.031)	(9.356)
cash_flow	-0.361	-0.147	4.057
	(0.244)	(0.137)	(37.61)
age	0.014	0.0006	1.844
	(0.025)	(0.0131)	(3.456)
young	0.006	0.0196	-3.407
	(0.062)	(0.0286)	(7.494)
group	-0.106***	-0.0204	9.784*
	(0.031)	(0.0184)	(5.005)
vvat_popres	0.0005	0.0047*	-1.325**
	(0.0047)	(0.0024)	(0.639)
branch_04	-0.210	-0.0383	21.61
	(0.206)	(0.0778)	(18.24)
HHI	0.502	0.0667	-13.60
	(0.323)	(0.188)	(48.04)
nbranches_p	0.449**	-0.0753	0.449**
	(0.209)	(0.0494)	(0.209)
new_branch_inc	3.986	-0.220	3.986
	(2.542)	(0.566)	(2.542)
bcit_ITA	-0.014	0.191***	-0.0144
	(0.130)	(0.0306)	(0.130)
Constant	0.449**	-0.075	0.449**
	(0.209)	(0.049)	(0.209)
Observations	4,276	4,276	4,276

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Dummies for years 2004-2006, NACE 2 digits sector and NUTS1 macro-area included