QUALITY, INNOVATION, AND CREDIT CONSTRAINTS IN EXPORTING

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QUALITY IN INTERNATIONAL TRADE

- determines terms of trade

  Schott (QJE 2004), Hallak (JIE 2006), Hallak and Schott (QJE 2011), Feenstra and Romalis (QJE 2014)

- shapes firm-level trade activity

  Crozet et al. (RES 2012), Gervais (CJE 2015), Manova and Zhang (QJE 2012)

INNOVATION AND TRADE

what encourages/hinders innovation at the firm-level

- import competition
- export opportunities
- access to imported intermediaries
- credit constraints

- innovation improves export performance
- introduction of new products to the market or expansion of the range of products

INNOVATION AND QUALITY

- innovation increases the intensive margin

  Flam and Helpman (AER 1987), Grossman and Helpman (QJE 1991)

- increased spending on R&D enables firms to increase quality

  Grossman and Helpman (RES 1991, QJE 1991)

- the impact on the intensive margin is higher

  Chen (WE 2013)

QUALITY AND CREDIT CONSTRAINTS

- firm's export activity depends on financial factors

  Bellone et al. (WF 2010), Minetti and Zhu (JIE 2011)

- less financially-constrained firms increase the quality of their products

  Fan et al. (JCE 2015), Dinopoulos et al. (JIMF 2020)

- financial structure matters for a firm's ability to compete in international markets

  Bernini et al. (JBF 2015)

QUALITY, INNOVATION AND CREDIT CONSTRAINTS

- positive relationship between innovation and product quality
- credit constraints have a negative impact on quality
- financing constraints may affect an exporter's investment decisions on R&D activity

  Brown et al. (EER 2012), Crino and Ogliari (JIE 2017), Jin et al. (EJOR 2019)

A THEORETICAL MODEL OF ENDOGENOUS QUALITY, INNOVATION, AND CREDIT CONSTRAINTS

- demand structure follows Feenstra and Romalis (QJE 2014), Dinopoulos et al. (JIMF 2020)

- utility of consumer *j*

$$U_j = \sum_{i=1}^{n} \beta_j \lambda_i \ln\left(x_{ij} + \theta\right) + x_{0j}$$

- cost function

$$C(q, \lambda) = \frac{(\lambda r)^2}{2} + \delta \frac{q\lambda}{r}$$

EQUILIBRIUM

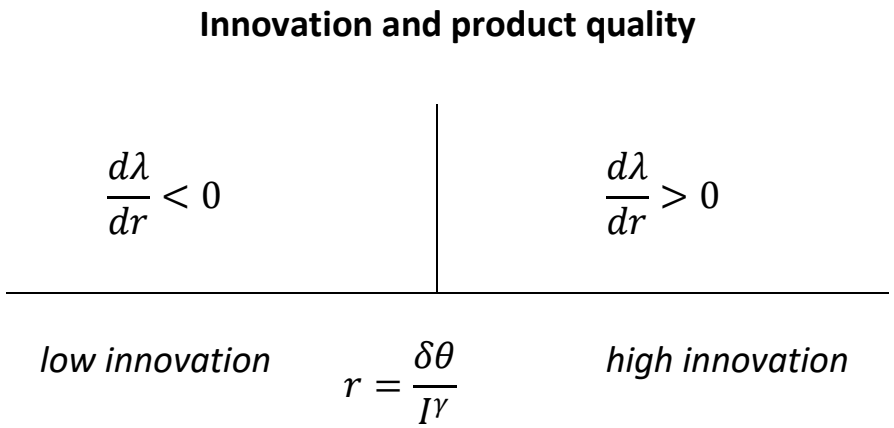
- Each firm maximizes expected profit from exporting by *choosing output and product quality,* and by taking the level of credit constraints and innovation expenditures as given

$$\pi(q,\lambda) = \frac{I^{\gamma}\,\lambda q}{qN^{-1}+\theta} - \frac{(\lambda r)^2}{2} - \delta\frac{q\lambda}{r}$$

QUALITY AND INNOVATION

the relationship between product quality and innovation at the firm level is

- *positive* when the firm's innovation expenditures are above a threshold
- becomes *negative* when firm's innovation expenditures are below this threshold



DATA

- Greek exports and imports at the firm level, *Eurostat*

  highly disaggregated (HS6) value and quantity, 2002-2014

outliers: product classification inconsistencies through time; rounding errors and misreporting; large variations

- information at the firm-level, Annual Manufacturing Survey by the *Hellenic Statistical Authority*, 2002-2014

  employees and wages by employment category

  operating costs

  R&D expenses/personnel

outliers: on variables of interest

- firm-level data on credit constraints, ICAP database by the *ICAP Group SA*, 2001-2014

  total assets/debt

  real/intangible assets

  firm age

outliers: on variables of interest

CROSS-COUNTRY COMPARISON

Cross-country comparison

	Greece	Belgium	France	Hungary	Sweden	Portugal
Avg exports per firm (in mn euro)	1	6.2	0.4 - 2.6	0.3 - 1.4	9.2 - 60.6	1.3
Avg number of export destinations	2.5	-	1.3 - 2.2	1.1 - 1.3	1.4 - 3.2	3.8
Avg number of exported products	7.8	9.3	3.7 - 7.1	3.4 - 6.7	5.7 - 7.1	8.7

Notes: All figures reported refer to annual values. Author's own calculations for Greece calculated over the 2002-2014. Calculations for Belgium, France, Hungary, and Sweden are from Baldwin et al. (2008), while statistics for Portugal are from Bastos et al. (2018) for the year 1997. Statistics for France, Hungary and Sweden are calculated in ranges as they are based on calculations that depend on destination country groups, for the year 1999.

PRODUCT QUALITY

- unobserved attribute

  definition of product quality: any intrinsic characteristic that improves the consumer appeal of a product given its price

- common proxy: export price ('unit value')

  high product prices do not necessarily suggest high product quality (see Henn et al., IMF ER 2020)

  may vary for reasons other than quality

QUALITY MEASURES

- *expert assessments on quality*

  Crozet et al. (RES 2012), Atkin et al. (QJE 2017), Chen and Juvenal (JIE 2016; JDE 2018)

- *country-level quality estimates* (Hallak and Schott QJE 2011)

  among countries with identical export prices, the country with the higher trade balance is revealed to possess higher product quality

- *product-level quality estimates* (Khandelwal RES 2010)

  higher quality is assigned to products with higher market shares conditional on prices

- price endogeneity
- instruments do not vary across firms within a market

FIRM-PRODUCT QUALITY: AN INSTRUMENTAL APPROACH

- Piveteau and Smagghue (JIE 2019)
- CES demand system with quality as a utility shifter
- real exchange rate shocks on inputs are cost shocks

  exogenous to demand shocks
- endogeneity of prices addressed by real exchange rates interacted with firm-specific importing shares

POSSIBLE BIASES AND SOLUTIONS

- instrument endogenous to quality

  higher quality producing firms import higher quality inputs from countries with stronger currencies

  add variety-specific fe

- unclear-shifting bias

  improved competitiveness to an exporting destination due to importing higher quality inputs; exporting higher quality products to that destination

  export- and import-weighted gdp per capita

DEMAND ESTIMATION

- 1st stage

$$\log p_{fgdt} = \eta RER_{ft} + entry_{fgdt} + \beta \overline{gdpc}_{ft} + \delta_{fgds} + \delta_{gdt} + u_{fgdt}$$

where p denotes the export price of variety fgd at time t

- 2nd stage

$$\log s_{fgdt} = (1-\sigma)\log \hat{p}_{fgdt} + entry_{fgdt} + \alpha \overline{gdpc}_{ft} + \gamma_{fgds} + \gamma_{gdt} + \varepsilon_{fgdt}$$

where s denotes the sales of variety fgd at time t

- Quality measure

$$\lambda_{fgdt} = \hat{\alpha} \overline{gdpc}_{ft} + \hat{\gamma}_{fgds} + \hat{\varepsilon}_{fgdt}$$

ESTIMATED PRODUCT QUALITY

- quality at the firm, destination, product (HS6 category) and year level

- identified relatively to the average quality in a destination market

Aggregate demand estimation

	(1) OLS	(2) IV	(3) IV
Panel A (1st stage)	Dependent Variable : log price exports		
RER_{ft0t}		8.457***	8.352***
		(2.344)	(2.262)
RER_{ft0t-1}			.165
			(.539)
$GDPCex_{ft}$		.036	.036
		(.030)	(.030)
$GDPCim_{ft}$		-.003	-.003
		(.006)	(.006)
entry		-.042	-.042
		(.046)	(.046)
Panel B (2nd stage)	Dependent Variable: log export volume		
$log(price_{fgdt})$	-.515	-2.252*	-2.221*
	(.102)	(1.160)	(1.175)
$GDPCex_{ft}$	.240	.297	.296***
	(.193)	(.189)	(.190)
$GDPCim_{ft}$	-.012	-.015	-.015
	(.023)	(.030)	(.030)
entry	-.932***	-.949***	-.948***
	(.246)	(.276)	(.275)
Kleibergen-Paap F-test		13.01	6.87
obs.	49,384	49,384	49,384

Notes: Pooled estimation including spell × firm × product × destination and product × destination × year fixed effects. Standard errors are clustered at the firm level. * p < 0.1, ** p < 0.05, *** p < 0.01.

ESTIMATING TRADE QUALITY: THE CASE OF GREEK EXPORTERS

QUALITY AND INNOVATION: EVIDENCE FROM GREEK EXPORTERS

Quality and innovation

	(1)	(2)	(3)	(4)
	Dependent Variable: $quality_{fgdt}$			
$R\&Dexp_{ft}$	5.341***	5.415***		
	(1.441)	(1.428)		
$R\&Dper_{ft}$			2.048**	2.068**
			(.818)	(.810)
country f.e.	Yes	Yes	Yes	Yes
crisis f.e.	No	Yes	No	Yes
obs.	166,401	166,401	166,380	166,380

Notes: All estimations include destination fixed effects. Standard errors are clustered at the firm × product level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

QUALITY AND CREDIT CONSTRAINTS: EVIDENCE FROM GREEK EXPORTERS

Quality and leverage

	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
	Dependent Variable: $leverage_{fgt-1}$			
mean $leverage_{fgt-1}$			.127***	.127***
			(.028)	(.028)
	Dependent Variable: $quality_{fgdt}$			
$leverage_{ft-1}$	.079	.078	-3.679**	-3.678**
	(.113)	(.113)	(1.640)	(1.639)
country f.e.	Yes	Yes	Yes	Yes
crisis f.e.	No	Yes	No	Yes
obs.	76,668	76,668	64,826	64,826
Kleibergen-Paap F-test			19.44	19.43

Notes: All estimations include destination fixed effects. Standard errors are clustered at the firm × product level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

THE CASE OF GREEK EXPORTERS

- two alternative innovation measures
- three credit constraints categories
- simple model

$$q_{fgdt} = \beta_1 \widehat{innovation}_{ft} + crisis + \gamma_d + \varepsilon_{fgdt}$$

Quality and innovation regressions by firms' level of credit constraints

	(1)	(2)	(3)	(4)
	Dependent Variable: $quality_{fgdt}$			
Low credit constraints				
$R\&Dexp_{ft}$	7.343***	7.428***		
	(2.471)	(2.437)		
$R\&Dper_{ft}$			5.971***	6.068***
			(1.609)	(1.563)
obs.	18,720	18,720	18,658	18,658
Medium credit constraints				
$R\&Dexp_{ft}$	8.817***	8.738***		
	(2.505)	(2.532)		
$R\&Dper_{ft}$			2.975***	2.917***
			(.967)	(.940)
obs.	14,640	14,640	14,640	14,640
High credit constraints				
$R\&Dexp_{ft}$	-7.378**	-7.437**		
	(3.717)	(3.726)		
$R\&Dper_{ft}$			-5.745***	-5.837***
			(2.013)	(1.846)
obs.	11,758	11,758	11,744	11,744
country f.e.	Yes	Yes	Yes	Yes
crisis f.e.	No	Yes	No	Yes

Notes: All estimations include destination fixed effects and firm × crisis fixed effects. Standard errors are clustered at the firm × product level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Quality, innovation, firm maturity and capital intensity, regressions by firms' level of credit constraints

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable: $quality_{fgdt}$					
Low credit constraints						
$R\&Dexp_{ft}$	7.385***	7.212***	7.201***			
	(2.460)	(2.549)	(2.559)			
$R\&Dper_{ft}$				6.059***	5.890***	5.907***
				(1.555)	(1.631)	(1.619)
$log(age_{ft})$	.086		.073	.085		.073
	(.075)		(.076)	(.075)		(.077)
$log(real\ assets_{ft-1})$		.039	.037		.036**	.033
		(.026)	(.028)		(.065)	(.028)
obs.	18,299	18,601	18,238	18,237	18,539	17,176
Medium credit constraints						
$R\&Dexp_{ft}$	8.750***	7.546***	7.607***			
	(2.546)	(2.642)	(2.642)			
$R\&Dper_{ft}$				2.707***	2.145**	2.034**
				(.937)	(.930)	(.938)
$log(age_{ft})$	.202***		.162**	.208***		.165**
	(.064)		(.066)	(.064)		(.066)
$log(real\ assets_{ft-1})$		.103***	.089***		.108***	.094***
		(.025)	(.027)		(.026)	(.027)
obs.	14,170	14,533	14,118	14,170	14,533	14,118
High credit constraints						
$R\&Dexp_{ft}$	-1.510	-3.035	-1.199			
	(4.512)	(4.374)	(4.535)			
$R\&Dper_{ft}$				-4.165*	-4.434**	-4.134*
				(2.295)	(2.260)	(2.315)
$log(age_{ft})$	.008		.017	.017		.027
	(.060)		(.062)	(.060)		(.062)
$log(real\ assets_{ft-1})$		-.035	-.033		-.033	-.032
		(.026)	(.028)		(.026)	(.028)
obs.	10,923	11,480	10,765	10,909	11,466	10,751
country f.e.	Yes	Yes	Yes	Yes	Yes	Yes
crisis f.e.	Yes	Yes	Yes	Yes	Yes	Yes

Notes: All estimations include destination fixed effects and firm × crisis fixed effects. Standard errors are clustered at the firm × product level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

ROBUSTNESS

CONCLUSIONS

- complex relationship between product quality, innovation, and credit constraints at the firm level
- the relationship between product quality and innovation depends on credit constraints
- the relationship between product quality and innovation is positive for less credit constrained exporters, but negative for highly credit constrained ones