

# Governing offshoring in a stringent environmental policy setting: evidence from Made in Italy firms

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IV IAERE Conference, Bologna, 11-12 February 2016

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## (Upstream) internationalization and environmental regulation

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- Macro-economic level:
  - globalization enables firms to take advantage of low environmental regulations worldwide → Pollution-Haven Hypothesis (Copeland and Taylor, 2003; Levinson and Taylor, 2008)
- Mainstream explanation:
  - Trade flows and role of capital mobility: marginal product of capital decreases in countries imposing compliance with environmental standards → firms producing pollution-intensive goods move capital internationally to equalize rates of return
  - Economic vehicle = foreign direct investment
  - Firms (MNEs) in polluting industries relocate assets to countries with lax environmental regulations
- Empirical evidence: weak support at best (Jeppesen et al., 2002; Keller and Levinson, 2002; Millimet and List, 2004)



## (Upstream) internationalization and environmental regulation

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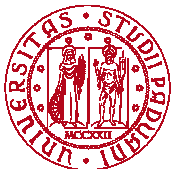
- Micro-economic level – mixed relations:
  - Costs for environmental protection are not a key determinant of the firms' internationalization choices
  - Firms have private incentives to exceed environmental policy requirements at all facilities/suppliers (even in developing countries)
  - Evidence that internationalized firms require higher regulation standards, control the implementation, export best practice and support local upgrading to avoid reputational risks and easy management of global activities (Jeppesen and Hansen 2004; Christmann and Taylor, 2001; Andresen and Skjott-Larsen, 2009; Ivarson and Alvstam, 2010)
  - Evidence that having local (national) suppliers and production facilities is related to higher environmental (innovation) performance, to reassure the market and allow higher environmental performance (Chiarvesio et al., 2012, De Marchi et al 2013)



# Aim and main contributions

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- How the decision to offshore production is related to a more stringent environmental regulation, once accounting for firm strategies?
- Main contributions:
  - Evaluating the role of environmental stringency (industry-level) while controlling for firms' characteristics and strategy (firm-level)
  - Considering different offshoring choices
    - subcontracting abroad (end-off) vs. outward FDI (end-on)
    - looking at the role of the geography of offshoring: North vs. South
  - Consider not only large firms, but also small and medium
  - Control for endogeneity



- Both firm-level strategies and industry-level environmental regulation influence the propensity to offshore production
- Stricter environmental regulatory stringency is related to a higher propensity to outsource production, rather than engage in FDI, but small magnitude
- Outsourcing directed to Southern regions → outsourcing-based PHH
- FDI choice (and outsourcing to the North) is more related to environmental innovation, ICT endowment, reputation-related strategies (trademarks), marketing strategies (B2C)
- Results robust to alternative ES proxies + endogeneity
- Limits:
  - Not all manufacturing industries represented → Made in Italy (about 70% of total manufacturing employment in 2012), but no high polluting industries (e.g. chemicals, coke...)
  - Cross-sectional data
  - Environmental stringency at industry-level



- Original survey on a sample of Italian firms stratified by industry and size (684 firms)
  - SMEs and large (turnover > 1 million Euros, AIDA)
  - Made in Italy sectors (manufacturing)
- Survey conducted in May-July 2011 through phone interviews with the entrepreneur or general/sales manager (reference period: end of 2010)
- Structured questionnaire asking about firm's characteristics, sourcing strategies, commercial organization, innovation strategies, ICT adoption
- Source: Centre for Studies on Technologies in Distributed Intelligent Systems (TeDIS) by Venice International University (VIU)

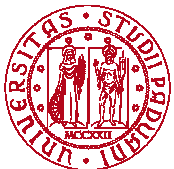


# Empirical methodology

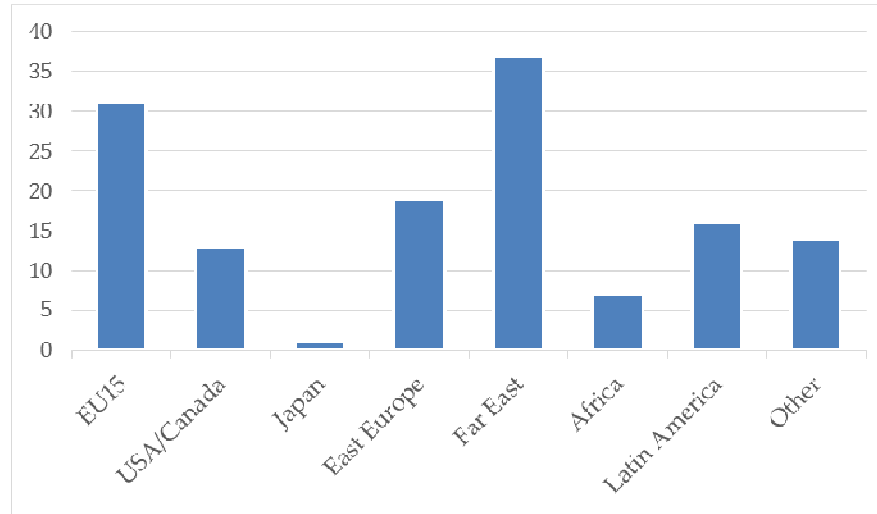
- We estimate the following bivariate probit model:

$$\Pr(Y_i = 1 | \mathbf{X}_i, \mathbf{X}_j) = \Phi(\beta_0 + \mathbf{X}'_i \beta_i + \mathbf{X}'_j \beta_j)$$

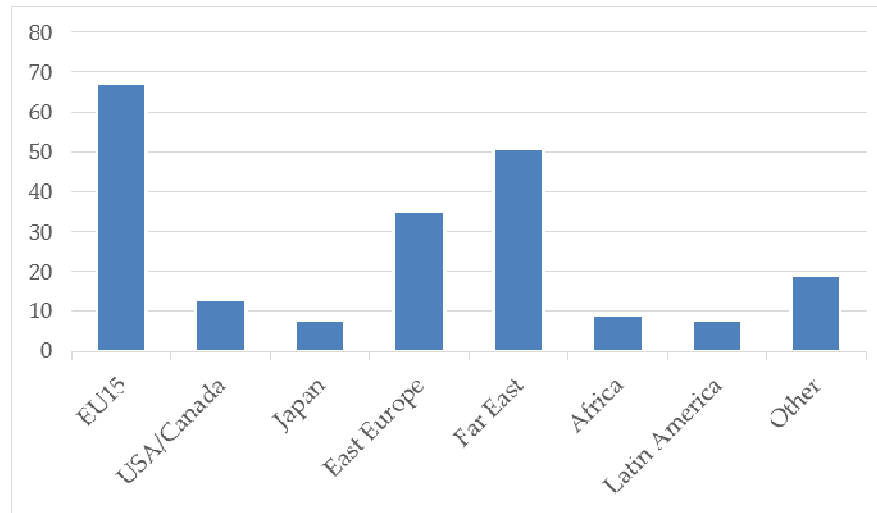
- where:  $i$ =firm;  $j$ =industry (two-digit manufacturing)
- $Y_i$ = offshoring dummy, which can be further defined as
  - FDI or international outsourcing (IO)
  - FDI: North Vs South
  - IO: North vs South
  - North: EU-15, USA/Canada, Japan; South: Africa, Far East, Latin America, East Europe
- Test for endogeneity:
  - IV probit models
- Clustered standard errors at industry-NUTS1 area level



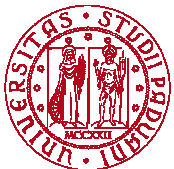
# Areas of destination



FDI



IO





# Summary statistics

Variable	Description	Mean	SD	Min	Max
IO	Dummy = 1 if the firm outsources (all or some) production stages to foreign suppliers	0.171	0.377	0	1
IO_NORTH	Dummy = 1 if the firm outsources (all or some) production stages to foreign suppliers located in developed countries (North)	0.111	0.314	0	1
IO_SOUTH	Dummy = 1 if the firm outsources (all or some) production stages to foreign suppliers located in developing or transition countries (South)	0.114	0.318	0	1
FDI	Dummy = 1 if the firm owns production facilities in foreign countries	0.126	0.332	0	1
FDI_NORTH	Dummy = 1 if the firm owns production facilities in developed foreign countries (North)	0.054	0.226	0	1
FDI_SOUTH	Dummy = 1 if the firm owns production facilities in developing foreign countries (South)	0.088	0.283	0	1



# Firm-level covariates, $X_i$

- Resources and capabilities/characteristics:
  - Size: MICRO (ref.), SMALL, MEDIUM, LARGE
  - Area of location: NW, NE, Centre-South (ref.)
  - R&D dummy, ICT dummy (videoconference, extranet for suppliers, extranet for logistics, SCM)
- Internationalization strategies
  - Being part (or leader) of a foreign owned business group dummy
  - Export dummy
- Market strategy
  - B2C dummy: main customer = commercial activity or final consumer
  - Trademark dummy
- Environmental strategy
  - Environmental standard certification
  - Environmental product innovation



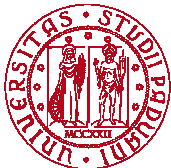
# Industry-level covariates, $X_j$

- Unit Labour cost (ULC) = LC per worked hour, average 2008 (source: Istat)
- Proxies to capture **environmental regulatory stringency**
  - ES= predicted CO<sub>2</sub> emissions/actual CO<sub>2</sub> emissions (following Brunel and Levinson, 2013, source: NAMEA), where predicted CO<sub>2</sub> emissions = weighted average of CO<sub>2</sub> emissions (weight=value added share of the industry), 2008 → higher ES higher stringency
  - RES = ES<sub>2008</sub>/ES<sub>2006</sub> → dynamic effort to reduce emissions: higher RES higher stringency
  - Other checks: CO<sub>2</sub>/VA emission intensity; Pollution Abatement Cost Expenditures (PACE), 2008



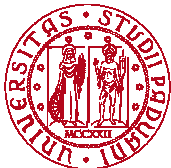
## Results: FDI vs IO

	(1)	(2)	(3)	(4)	(5)	(6)
	FDI	IO	Pr(FDI=1)	Pr(IO=1)	Pr(FDI=1, IO=0)	Pr(IO=1, FDI=0)
ES	0.020 (0.018)	0.073*** (0.026)	0.003 (0.003)	0.015*** (0.006)	0.000 (0.002)	0.012*** (0.005)
ULC	-0.016 (0.025)	-0.031 (0.045)	-0.002 (0.003)	-0.006 (0.009)	-0.001 (0.002)	-0.005 (0.007)
SMALL	-0.282 (0.247)	-0.137 (0.288)	-0.039 (0.036)	-0.028 (0.060)	-0.027 (0.024)	-0.015 (0.047)
MEDIUM	-0.067 (0.305)	0.114 (0.316)	-0.009 (0.040)	-0.024 (0.066)	-0.010 (0.027)	0.023 (0.053)
LARGE	0.611** (0.304)	0.237 (0.428)	0.121** (0.060)	0.054 (0.107)	0.082** (0.044)	0.015 (0.076)
R&D	0.262 (0.226)	0.126 (0.148)	0.036 (0.031)	0.026 (0.030)	0.025 (0.024)	0.014 (0.029)
ICT	0.292** (0.140)	0.153 (0.110)	0.041* (0.021)	0.031 (0.024)	0.027* (0.015)	0.018 (0.018)
B2C	0.013 (0.262)	0.204 (0.171)	0.002 (0.036)	0.045 (0.043)	-0.004 (0.024)	0.039 (0.034)
TRADEMARKS	0.489*** (0.145)	0.296* (0.171)	0.071*** (0.022)	0.061* (0.037)	0.046*** (0.016)	0.036* (0.021)
STDPROC	0.268 (0.162)	-0.508** (0.198)	0.042 (0.029)	-0.083*** (0.029)	0.048 (0.029)	-0.077*** (0.024)
ECOPROD	0.381** (0.186)	-0.260 (0.176)	0.065* (0.038)	-0.046 (0.030)	0.061** (0.031)	-0.050* (0.029)
FOREIGNGROUP	0.494*** (0.146)	0.484*** (0.153)	0.085*** (0.029)	0.116*** (0.041)	0.044** (0.020)	0.075** (0.031)
EXPORT	0.341 (0.232)	0.688*** (0.204)	0.042 (0.034)	0.115*** (0.033)	0.020 (0.020)	0.093*** (0.027)
NORTH WEST	0.583*** (0.215)	0.468** (0.238)	0.090** (0.035)	0.102* (0.056)	0.053** (0.021)	0.065* (0.032)
NORTH EAST	0.501** (0.196)	0.549** (0.272)	0.073** (0.030)	0.117* (0.063)	0.039** (0.019)	0.083* (0.051)
CENTRE-SOUTH	Ref. (0.025)	Ref. (0.045)	Ref. (0.003)	Ref. (0.009)	Ref. (0.002)	Ref. (0.007)
N	684					
$\rho$	0.315***					



# FDI: North Vs. South

	(1)	(2)	(3)	(4)	(5)	(6)
	North	South	Pr(North=1)	Pr(South=1)	Pr(N=1, S=0)	Pr(S=1, N=0)
ES	0.029 (0.021)	0.030 (0.036)	0.001 (0.001)	0.003 (0.002)	0.000 (0.001)	0.002 (0.002)
ULC	0.018 (0.036)	-0.011 (0.034)	0.001 (0.002)	-0.001 (0.002)	0.001 (0.001)	-0.001 (0.003)
MICRO	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SMALL	-0.341 (0.361)	0.213 (0.373)	-0.018 (0.018)	0.019 (0.032)	-0.016 (0.012)	0.021 (0.027)
MEDIUM	-0.102 (0.324)	0.193 (0.428)	-0.005 (0.015)	0.018 (0.043)	-0.005 (0.009)	0.018 (0.038)
LARGE	0.418 (0.414)	<b>0.730**</b> (0.343)	0.030 (0.046)	0.110* (0.060)	0.010 (0.022)	0.090* (0.050)
R&D	0.092 (0.236)	<b>0.444*</b> (0.260)	0.005 (0.011)	0.040* (0.024)	-0.000 (0.009)	0.035* (0.022)
ICT	-0.054 (0.134)	<b>0.496***</b> (0.138)	-0.003 (0.007)	<b>0.047***</b> (0.017)	-0.006 (0.006)	<b>0.043***</b> (0.015)
B2C	<b>0.497*</b> (0.266)	0.051 (0.354)	0.038 (0.026)	0.005 (0.033)	0.030 (0.019)	-0.003 (0.024)
TRADEMARKS	<b>0.477*</b> (0.257)	<b>0.259*</b> (0.156)	0.026* (0.014)	0.024* (0.014)	0.018 (0.011)	0.016 (0.013)
STDPROC	<b>0.431***</b> (0.157)	<b>0.340**</b> (0.157)	0.029** (0.010)	0.037* (0.021)	0.018* (0.012)	0.026* (0.016)
ECOPROD	<b>0.770***</b> (0.244)	0.110 (0.205)	0.073** (0.033)	0.011 (0.021)	0.059** (0.028)	-0.004 (0.014)
FOREIGNGROUP	<b>0.488***</b> (0.163)	<b>0.409**</b> (0.160)	0.034** (0.016)	0.046** (0.020)	0.020* (0.012)	0.032* (0.017)
EXPORT	0.313 (0.243)	0.414 (0.293)	0.014 (0.012)	0.031* (0.017)	0.008 (0.008)	0.026 (0.016)
NORTH WEST	<b>0.847**</b> (0.391)	0.396 (0.244)	0.057** (0.029)	0.039 (0.027)	0.040* (0.023)	0.022 (0.023)
NORTH EAST	0.596 (0.410)	<b>0.523**</b> (0.226)	0.034 (0.026)	0.051** (0.024)	0.021 (0.020)	0.038* (0.022)
CENTRE-SOUTH	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
N	684					
$\rho$	0.532***					



# International outsourcing: North vs. South

	(1)	(2)	(3)	(4)	(5)	(6)
	North	South	Pr(North=1)	Pr(South=1)	Pr(N=1, S=0)	Pr(S=1, N=0)
ES	-0.003 (0.028)	0.087*** (0.030)	-0.000 (0.002)	0.012*** (0.004)	-0.002 (0.002)	0.010*** (0.003)
ULC	0.128* (0.040)	-0.095** (0.042)	0.013*** (0.004)	-0.013** (0.005)	0.011*** (0.003)	-0.015*** (0.004)
MICRO	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SMALL	-0.110 (0.332)	0.038 (0.309)	-0.011 (0.034)	0.005 (0.041)	-0.009 (0.020)	0.007 (0.028)
MEDIUM	0.278 (0.370)	0.129 (0.324)	0.031 (0.044)	0.018 (0.046)	0.018 (0.027)	0.005 (0.033)
LARGE	0.342 (0.630)	0.588 (0.426)	0.044 (0.099)	0.112 (0.107)	0.007 (0.040)	0.075 (0.061)
R&D	-0.061 (0.134)	0.417*** (0.148)	-0.006 (0.013)	0.056*** (0.020)	-0.014 (0.009)	0.048*** (0.015)
ICT	-0.046 (0.137)	0.128 (0.092)	-0.005 (0.014)	0.017 (0.011)	-0.006 (0.009)	0.016* (0.009)
B2C	0.489** (0.221)	0.217 (0.257)	0.068 (0.042)	0.033 (0.045)	0.041 (0.025)	0.006 (0.025)
TRADEMARKS	0.197 (0.194)	0.164 (0.128)	0.020 (0.020)	0.022 (0.018)	0.010 (0.013)	0.012 (0.015)
STDPROC	-0.500* (0.275)	-0.077 (0.218)	-0.038** (0.015)	-0.010 (0.027)	-0.024*** (0.008)	0.004 (0.021)
ECOPROD	0.045 (0.189)	-0.732** (0.260)	0.005 (0.020)	-0.062*** (0.015)	0.019 (0.016)	-0.047*** (0.011)
FOREIGNGROUP	0.408** (0.169)	0.498*** (0.137)	0.051** (0.024)	0.083*** (0.029)	0.017 (0.014)	0.050** (0.022)
EXPORT	0.926*** (0.263)	0.601** (0.253)	0.068*** (0.020)	0.065*** (0.022)	0.037*** (0.013)	0.034* (0.019)
NORTH WEST	1.276*** (0.439)	0.257 (0.217)	0.180** (0.072)	0.036 (0.032)	0.128** (0.054)	-0.017 (0.020)
NORTH EAST	1.479*** (0.460)	0.365 (0.272)	0.199*** (0.072)	0.051 (0.042)	0.137*** (0.050)	-0.011 (0.021)
CENTRE-SOUTH	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
N		684				
$\rho$		0.664***				



# Robustness check 1: RES

	(1)	(2)	(3)	(4)	(5)	(6)
	FDI	IO	FDI NORTH	FDI SOUTH	IO NORTH	IO SOUTH
RES	0.132 (0.120)	0.929*** (0.155)	0.272 (0.264)	0.247** (0.098)	0.633 (0.432)	1.477*** (0.392)
N	684		684		684	
$\rho$	0.310***		0.531***		0.627***	



# Robustness check 2: endogeneity

- Potential endogeneity due to: (i) unobservable industry-level variables; (ii) reverse causality
- IV probit strategy → which instrument(s)?
- We use n. plants out of compliance with environmental law (E-PRTR) (Carrion-Flores and Innes, 2010; Millimet and Roy, 2015)

<i>First-stage estimates</i>	IO	IO SOUTH
N_EPRTR	-0.367*** (0.036)	-0.367*** (0.036)
N_EPRTR <sup>2</sup>	0.003*** (0.000)	0.003*** (0.000)
<i>Second-stage estimates</i>		
ES	0.092** (0.036)	0.097** (0.042)
Partial R <sup>2</sup> of excluded instruments	0.677	0.677
<i>Wald test of exogeneity</i>		
X <sup>2</sup> (1)	1.07 (0.301)	0.62 (0.432)
<i>Weak identification tests</i>		
Cragg-Donald Wald F statistic	589.9	589.9
Stock-Yogo weak ID test critical value: 10% maximal IV size	19.93	19.93
<i>Overidentification test</i>		
Hansen J statistic	1.835 (0.176)	1.817 (0.177)





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Thanks for your attention