Governing offshoring in a stringent environmental policy setting: evidence from Italian manufacturing firms

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Abstract

This paper provides evidence of how environmental regulatory stringency relates to firms' offshoring decisions, while controlling for firms' characteristics and (environmental) strategies. Relying on an original dataset of Italian manufacturing firms, a distinction is drawn between international outsourcing and foreign direct investments, and between offshoring destinations in Northern versus Southern regions. Our estimates show that a stricter environmental regulation is related to a higher probability of production being outsourced to foreign suppliers in the South, but not to foreign direct investments. The magnitude of this effect is very low, however. Offshoring decisions are mainly affected by firms' ICT endowment, marketing and internationalization strategies, and adoption of environmental product innovations and standards. In particular, eco-innovative firms are found more likely to adopt governance decisions that enable a stricter control over the supply chain, as in the case of foreign direct investments.

Keywords: environmental policy stringency; foreign direct investment; international outsourcing; pollution haven hypothesis; environmental innovation

JEL: F18, F23, L60, Q56

Highlights:

- We analyze the relationship between environmental regulatory stringency and offshoring.
- The analysis refers to FDI and international outsourcing in the North and South.

- Environmental regulatory stringency affects outsourcing decisions in the South.
- The marginal effects of environmental regulatory stringency on outsourcing are small.
- What drives offshoring are ICT, marketing, sustainability and internationalization strategies.

1. Introduction

Addressing the environmental impacts of production activities is becoming a priority for firms in response to increasing pressure from consumers, policy-makers and stakeholders at large. Studies agree that policy pressure and, to a lesser extent, stakeholder pressure, are the most important drivers for reducing the environmental impacts of industry (Testa et al., 2012; Berrone et al., 2013). This pressure may spur firms to implement green practices and mitigate the negative environmental implications of their production and distribution activities, focusing on how to produce or conceive more environment-friendly products and services (Vezzoli et al., 2012).

Globalization allows for a variety of governance modes, however, that may turn increasingly stringent environmental policies simply into a relocation of polluting activities to less environmental-aware countries, with no net improvement in terms of global pollution (Cole et al., 2014). To obtain genuinely green products, meaning products 'that avoid or reduce environmental harms' (Beise and Rennings, 2005) considering their components and life cycle as a whole, it is important for all activities involved in their production to be oriented towards the same sustainability goals (Seuring and Müller, 2008), but this goal becomes more complex the more the activities are spread across different firms located in countries with different environmental standards (De Marchi et al. 2013).

This paper focuses on how governance decisions concerning the international organization of value chain activities (i.e. between ownership and sourcing) relate to pressure from national environmental policy-makers. In particular, it attempts to answer the key question of whether environmental regulatory stringency affects decisions on how to organize value chain activities at international level, after controlling for firms' strategies.

The relationship between the management of environment-related issues and firms' internationalization decisions has been studied from two opposing perspectives. On the macroeconomic level, the debate has focused on the 'pollution haven hypothesis' (PHH), i.e. that highly polluting activities are likely to be offshored where environmental policies are laxer (Copeland and Taylor, 2003; Levinson and Taylor, 2008; Cole et al., 2014, among others), with mixed empirical results. On the microeconomic level, scholars have claimed instead that governance choices involving proximity between different production stages, and even between production and consumption systems, better support greening outcomes and firm performance (Roberts, 2004; Da Ronch et al., 2013), after controlling for reputational aspects (De Marchi et al., 2013). This is the case when firms are pursuing strategies of differentiation based on the "eco-friendly" features of their products or processes (Orsato, 2006). For these strategies to be successful, the best governance model should apparently be based on vertical integration, as in the case of foreign direct investments (FDI), or on networks allowing close cooperation with suppliers (De Marchi et al., 2013).

Exploiting a novel dataset, this paper links these two perspectives and provides new evidence on the relationship between environmental regulatory stringency and firms' internationalization governance choices. It makes four main contributions to the literature.

First, both industry-level variables of environmental policy stringency and firm-level proxies for a firm's characteristics, resources, strategies and attitudes to environmental issues are taken into consideration, enabling an appraisal of how external pressure regarding environmental impacts influences a firm's overall strategy and organization of its value chain. The findings thus contribute to the literature on cleaner production, showing how strategic considerations at firm level might strongly influence the incentive for firms to avoid costs deriving from environmental policies by offshoring dirty activities.

Second, the present findings add to the literature on PHH by considering two different international governance options: foreign direct investments (FDI), and international outsourcing (IO). Cole et al. (2014) suggest that the two forms of internationalization may allow for a different response to the same external (policy) pressure, but so far the literature has focused separately on either FDI or global sourcing.

Third, destinations for offshore production are divided into developed (Northern) and developing (Southern) countries, another aspect rarely considered in the literature (Seuring and Gold, 2013).

Fourth, small and medium-sized enterprises (SMEs) are considered, for which any decisions to adapt to new environmental standards and/or to offshore production are particularly important and costly (Klewitz & Hansen, 2014), whereas the literature has focused mostly on large firms and multinationals. Italy was chosen as an ideal empirical setting for our purposes because it is characterized by a strong presence of SMEs operating in low- and medium-tech manufacturing industries. It also enables the results to be generalized similar settings hitherto under-investigated in the literature (see Del Rio et al., 2015) with respect to countries like Germany, which are characterized by a more environment-aware local demand (European Commission, 2014).

The paper is organized as follows: section 2 provides a review of the literature on the relationship between the pressure brought to bear for a better environmental performance and both global sourcing and FDI; section 3 presents the data (3.1), variables (3.2), and empirical strategy (3.3); the results of the estimates are given in section 4 ; and the conclusions and some policy implications in section 5.

2. Global sourcing, FDI and pressure for improving environmental performance

In order to deliver their goods or services, firms might choose between different approaches to organizing their activities, different 'ways of combining physical assets, human capital, and know-how' (Menard, 2014: 569). Starting with the seminal contribution from Williamson (1975), New Institutional Economics (NIE) supports the theory that companies need to choose what to make in-house (hierarchy) and what to buy (market). A third option was subsequently added, that of hybrid forms of governance , which entail 'long-term contractual relations that preserve autonomy but provide added transaction-specific safeguards, compared with the market' (Williamson 1996: 378). The choice between the three forms, which might be used concurrently under certain circumstances (Parmigiani, 2007; Menard, 2013), depends on asset specificities, frequency and uncertainty (Williamson, 1996), the strategic relevance for the firm (core/non-core activities) (Quinn, 1999), or resource characteristics (Barney and Hesterly, 2006). In the global arena, a second and concomitant choice that firms face is where to locate such activities of the value chain, in the home country or abroad (the latter is known as offshoring) (Contractor et al, 2010). When it comes to offshoring, the focus is on FDI if production is accomplished in-house by proprietary plants, and on international or global outsourcing (IO) if activities are accomplished by external producers, via either market or hybrid types of governance[1].

The Global Value Chain (GVC) framework is a particularly useful complement to the NIE perspective in depicting the complexity of organizational modes in the international setting. Starting from the evidence that industries are ruled more and more by powerful actors that own no production facilities, but manage long-term relationships with suppliers overseas (Gereffi, 1999), the GVC framework is particularly powerful in explaining the variety of forms between hierarchy and market (Gereffi et al. 2005), labeled as 'hybrid' in the NIE.

Both frameworks (the GVC e NIE) allow for important differences in the governing structures that firms might adopt to organize their activities at international level. The GVC framework particularly stresses differences in terms of the ability to control and retain the value generated along the chain (by means of power asymmetries between the lead firm and its suppliers), and the need for explicit coordination by the lead firm, which tends increasingly towards hierarchy (FDI) (Gereffi et al., 2005). Another key difference between the different ways of governing activities at international level regards the cost structure. FDI (hierarchy) involves a major initial investment (and is therefore less volatile), while international outsourcing represents a more flexible and less costly way of internationalizing (Kotabe and Mudambi, 2009) in the short term at least. Such a difference in the cost structure is consistent with evidence of SMEs (which are liable to more budget constraints) being less likely to follow a proprietary path of

[1] It is worth noting at this point that the decision to become internationalized, and to do so through in-house, market or hybrid organizational solutions, might be made at single activity (value chain) level rather than for all the firm's activities, depending on the transaction costs, value contribution in terms of resource rarity or inimitability, and risks related to the knowledge to be managed (Contractor et al., 2010).

investments such as FDI, and more likely to adopt network-based mechanisms (e.g., Lu and Beamish, 2001). An interesting commonality, however, lies in that both frameworks can explain why a firm's strategic decisions depend on its specific characteristics (e.g. its endowment of resources; its ability to manage transactions) as well as on characteristics that stem from the product category it deal with (e.g. complexity).

In this scenario, whatever way firms choose to internationalize their activities, the growing pressure from environmental policy-makers and stakeholders to improve sustainability poses a challenge, because environmental regulation, technological capabilities and consumer awareness vary significantly from one country to another (Christmann, 2004).

The literature on the PHH (Copeland and Taylor, 2003; Copeland, 2008; Levinson and Taylor, 2008; Millimet and Roy, 2016) suggests that such an increasing pressure relates to how firms decide to organize their activities at global level (from local to global), as this represents an additional cost driving the decision to move activities abroad. The basic assumption of the PHH is that, when a firm comes under increasing pressure to improve its environmental performance at home, it may decide to offshore its dirtiest activities – via FDI or IO – to places where environmental regulations are less stringent, or their enforcement is laxer, instead of reducing the pollution levels at its existing facilities. This is presumably more relevant for highly polluting industries for which the costs of abatement measures to comply with environmental policy may be higher than the costs of relocation and might spur more IO than FDI (market or hybrid vs. hierarchy). The vast body of literature on the topic has produced plenty of empirical evidence, but is inconclusive, partly due to the different estimation methods adopted (Levinson and Taylor, 2008; Millimet and Roy, 2016). Among others, Cole et al. (2014) consider data on Japanese manufacturing companies and find that firms engaging in environment-polluting activities are more likely to offshore, but they do not investigate which countries might be involved. Manderson and Kneller (2012) find no evidence to support the PHH among UK manufacturing firms, and they conclude that dirtier multinational enterprises (MNEs) are no more likely to relocate to environmentally lax countries than greener MNEs.

This paper supports the impression that such inconclusive evidence is also driven by the fact that this literature fails to consider many important confounding factors in this analysis, in addition to the higher costs related to environmental regulatory stringency. Management studies indicate that the increasing pressure for 'greener production' might influence governing decisions differently, since they might motivate MNEs even to exceed policy requirements instead of looking for ploys to avoid them. In particular, such studies suggest that greening pressure supports a shortening of the value chains (local) and/or moves towards governing forms that enable greater control (hierarchy). Firms may be motivated to keep their production at home (either producing in-house or outsourcing to a network of local suppliers) to facilitate the efficient management of processes designed to reduce their environmental impact – as in the case of industrial districts (Chiarvesio et al., 2013; Daddi et al. 2010; Da Ronch et al., 2013). Local production and a strong integration of upstream activities (via hierarchies or networks characterized by a strong control over the value chain) has been found especially relevant in enabling the development of new green products, especially in the case of high-end or radically innovative products (De Marchi et al., 2013), or improving control over suppliers' environmental features. Along this line, the lower costs that a firm might achieve by offshoring (part of) its production activities to countries with laxer environmental regulation could be offset by the greater benefits associated with pursuing a green competitive advantage.

Rather than exploiting laxer local regimes, firms might export their (higher) environmental standards to countries with lower environmental requirements (Jeppesen and Hansen, 2004), especially when they want to compete on the market for the sustainability characteristics of their products (Orsato, 2006). This is also true in the case of branded corporations wishing to avoid the reputational risks associated with the poor environmental performance of suppliers or foreign subsidiaries (Nadvi, 2008). Studies on MNEs such as IKEA indicate that the firms' development and enforcement of a Code of Conduct means that their suppliers in developing countries have to reach their high standards too, and they even invest in improving the latter's environmental performance and competences (Andersen and Skjott-Larsen, 2009, De Marchi et al., 2014, Ivarsson and Alvstam, 2010). Consistently, based on survey data, Christmann and Taylor (2001) find that Chinese companies forming part of MNEs or serving foreign customers in developed countries are more likely to exceed local standards and to adopt voluntary environmental management schemes like ISO 14001.

In this context, different forms of governance might be conducive to similar environmental outcomes, even if they entail a different cost structure and achieve more or less rapid results; and, according to De Marchi et al. (2013), they are chosen considering the size of the company (large vs. small), the strategy adopted (efficiency vs. differentiation), and the geographical extension of the value chain (global vs. local).

Against this background, the aim of this paper is to ascertain the impact of environmental regulatory stringency on firms' decisions to internationalize their production activities, be it via FDI or international outsourcing, after controlling for the firms' characteristics, as well as market and environmental strategies. In doing so, the choice of area for offshoring production is also considered, distinguishing between developed (Northern) and developing (Southern) countries.

3. Data and variables

Our hypotheses are tested on a dataset of 684 manufacturing firms located in Italy, administered by the TeDIS Center[2] and representative of the textiles and garments, home products and furniture, mechanics and machine tools, electronics, rubber and plastics industries. Firms are randomly selected from an initial population with a turnover of more than one million euros (in 2009) and stratified by two-digit industry code and size. The survey refers to 2011, and provides information on a number of firms' characteristics and activities including: the structure of their (global) value chain, their marketing strategies, R&D and innovation, design and technology endowments and investments.

The firms' industrial sector, size and geographical distribution are presented in Table 1.

< Table 1 >

Although the dataset does not include the most polluting industries (e.g. chemicals), the sectors included account for around 70% of the total manufacturing employment in 2011 according to ISTAT Census data. The offshoring of these industries may therefore lead to potential high losses in terms of employment and value added, and that is why they deserve special attention from the academic

[2] TeDIS is the Center for Studies on Technologies in Distributed Intelligence Systems of Venice International University. For more information, please visit the website: http://www.univiu.org/research-training/research-tedis.

community and policy-makers. The main advantage of this firm-level survey lies in that of providing detailed information on the environmental content of products and innovation, jointly with information on offshoring decisions, by area of destination, and in that it refers to a recent period of time, 2011.

Offshoring. Section B1 of the questionnaire provides information on a firm's value chain. A set of questions specifically asks whether the firm outsources at least part of its production process in 2011 and, if so, whether it uses external suppliers. If the answer is 'yes', a further question asks where suppliers are located, including foreign countries. If firms outsource to foreign suppliers, they are asked to indicate the main destinations involved, distinguishing between: Europe 15, USA/Canada, Japan, Eastern Europe, Far East countries (mainly China and India), Africa, Latin America, and a few other countries (including Turkey, Switzerland, Australia and New Zealand). Such information is used to obtain a dummy value of 1 if the firm is an international outsourcer (IO). Then another two dummy variables are defined to distinguish between outsourcing to a developed country (IO NORTH), such as the European Union (EU15), Eastern Europe, USA/Canada, Japan and other countries, and outsourcing to a less developed country (IO SOUTH), such as Far East, Latin America and Africa. According to the World Economic Forum (2006), the former are areas where environmental regulations are considered among the world's most stringent, whereas the latter (and particularly China, India and many African countries) are considered among the laxest.

Sub-section B1-A focuses on FDI. As before, firms are asked whether they engage in any FDI and, if so, where. FDI is a dummy with a value of 1 if the firm engaged in FDI in 2011, while FDI NORTH and FDI SOUTH are two dummies with a value of 1 if such FDI takes place in an area in the North or in an area in the South, respectively[3].

Figures 1 and 2 respectively show the distribution of FDI and IO by area of destination. The majority of firms made their FDI particularly in the Far East, (mainly China), and in the European Union. As for IO, most of the firms outsourced to countries in the EU-15, but also to the Far East, and to Eastern European countries, especially Romania.

< Figure 1 >

< Figure 2 >

The most offshoring-intensive industries are manufacturers of garments (14%), non-metallic mineral products (18%), and machinery and equipment (27%).

Summary statistics for all the dependent variables are presented in Table 2. Firms in our sample tend to offshore production more through IO (17%) than through FDI (13%). When outsourcing, they also tend to choose Northern (15.2%) rather than Southern countries (8.5%), whereas firms engaging in FDI are equally distributed between countries in the North and South.

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[3] We also adopted an alternative criterion to distinguish between northern and southern countries. We took the World Economic Forum (WEF) survey, which asks business executives about their countries' environmental regulatory stringency. Their answers are arranged on a scale from 1 to 7, where 1 stands for extremely lax environmental regulations, and countries are ranked on the basis of their answers. We took the ranking for the 2006/07 survey and considered countries with an average environmental regulatory stringency index higher than Italy's as 'North', and countries with the same index or lower as 'South'. Using this alternative specification of the dependent variables, there was no significant change in the results of our estimates.

< Table 2 >

Industry-level variables. Environmental regulatory stringency is measured in many ways in the environmental economics literature (see Brunel and Levinson (2013) for a review). The two most popular measures are based on air emissions and pollution abatement cost expenditure. For this empirical analysis, the former is also used to consider the potential impact of stakeholder pressure[4]. Considering that no firm-level information was available on air emissions or pollution abatement costs, this information is used at two-digit industry code level, using the National Accounting Matrix for Environmental Accounts (NAMEA) provided by the Italian Statistics Institute (ISTAT) for the latest year available, i.e. 2008. On the one hand, using industry-level proxies for environmental regulatory stringency might represent a limit of the analysis. On the other, it is also true that environmental policies aimed at mitigating air emissions mainly target industries rather than single firms or installations. Measuring environmental regulatory stringency at a more aggregate level also enables vertical and horizontal linkages among firms within the same two-digit industry to be taken into account.

Relying on the shadow-price approach to pollution proposed by van Soest et al. (2006)[5], and the cost-based approach developed by Keller and Levinson (2002), emission intensity in CO_2 and acidifying gases (ACID) are used as proxy for the

[4] Although pollution abatement cost expenditure is widely adopted as a proxy for regulatory stringency, it is impossible to say whether pressure for more stringent environmental regulations is policy driven or induced by stakeholders such as society, NGOs, trade unions, mass media, and so on.

[5] The idea is that air pollution can be considered a production factor, like labor and capital. Stricter environmental regulations make the cost of pollution higher, so a rational, profit-maximizing firm is induced to reduce the amount of its pollutants (e.g. CO_2) until their marginal revenue product corresponds to their new price. Therefore, more stringent environmental regulations coincide with lower emissions per euro of value added (i.e. a lower emission intensity).

stringency of environmental regulations (Costantini and Crespi, 2008; Brunel and Levinson, 2013)[6]. The lower the emissions per unit of value added, the more stringent the environmental regulations to which the industry is subject[7].

A second variable measured at two-digit industry level is trade openness (TRADE), computed as the ratio between the values of imports + exports and the value added in 2008. The higher this ratio, the more the industry is open to international trade. In the absence of corresponding firm-level data, this variable should account for industry-specific transport costs and tariffs that can potentially reduce the incentive to trade with foreign countries (Cole et al., 2014).

Firm-level variables. Among the available firm-specific variables, those potentially correlated with the decision to offshore production are considered. After controlling for a firm's *structural characteristics*, three dummies are included to identify the geographical area where firms are located, distinguishing between the NORTH WEST of Italy (Piedmont, Lombardy and Liguria), the NORTH EAST (Veneto, Trentino Alto-Adige, Friuli Venezia-Giulia and Emilia Romagna), and the CENTER-SOUTH (all the other Italian regions, taken for reference). These dummies can also capture any cross-border effects for firms located close to Italy's northern borders, which would find it relatively easy to offshore production.

[6] Their pairwise correlation is 0.55 (significant at 1% level).

[7] As a robustness check, the index developed by Brunel and Levinson (2013) is also used. This variable is computed as the ratio between predicted CO_2 emissions per euro of value added and actual emissions in an industry. The former are computed as the weighted average of industry emissions, with weights given by the shares of industry value added, to account for the industry composition of Italian manufacturing. Industries subject to more stringent regulations are expected to have lower than predicted emissions. Using this variable does not change the estimated results.

Then, another four dummies are considered to identify the firm's industrial sector. To avoid collinearity with the industry-level variables, the OECD classification is used, which divides industries according to their technological intensity. A dummy is therefore included for the sectors as follows: low-technology (LT) (textiles, apparel, leather and footwear, wood, pulp and paper, furniture, other manufacturing n.e.c., used as the reference term); medium-low technology (MLT) (rubber and plastics, non-metallic mineral products, fabricated metal products); medium-high technology (MHT) (electrical machinery, motor vehicles, other transport goods, machinery and equipment); and high-technology (HT) (computer and electronics).

Since the literature has so far documented stark differences between small and large firms in terms of their capability and level of engagement in internationalization and sustainability issues (see e.g., Lu and Beamish, 2001, Klewitz & Hansen, 2014), firm size is also considered, based on the number of employees in 2010 (SIZE).

As a proxy for a firm's experience, its age is included, computed as 2011 minus the year of its establishment (AGE).

Another important variable that can affect firms' offshoring decisions is the cost of labor (Abraham and Taylor, 1996). The dataset used in this study is merged with the AIDA by the Bureau Van Dijk, which provides balance sheet information on joint stock companies, to compute a measure of labor cost per employee (LABCOST) for the year 2010. Savings on labor costs are one of the main reasons for outsourcing, so firms with high unit labor costs are more likely to outsource production. It was impossible to distinguish labor cost by type of employee, however, and a high LABCOST may also be due to the composition of a firm's internal workforce – if it has a large proportion of highly-skilled (and consequently well-paid) personnel. In this case, LABCOST would be a proxy for labor quality (Cole et al., 2014). The sign of the coefficient therefore cannot be predicted *a priori.*

A second set of control variables concerns the firm's *technological endowment*: the dummy R&D takes a value of 1 if the firm has its own R&D structure, considered as a proxy for its internal innovation capabilities. The dummy ICT takes a value of 1 if the firm is endowed with ICT equipment and software capable of supporting any offshoring activities – i.e. videoconference facilities, extranet for suppliers, extranet for logistics, and supply chain management solutions.

Variables capturing the firm's strategy are included to examine to what extent it mediates the influences of external pressures for sustainability (from policy-makers or stakeholders) on its international governance choices, and its market and sustainability strategy in particular.

Concerning firms' *market strategy*, B2C (business-to-consumer) is a dummy capturing the company's closeness to its customers, which takes the value of 1 if the firm's main clients are a commercial activity or an end consumer; TRADEMARK is a dummy that takes the value of 1 if the firm has registered a trademark. These two variables should capture the role of the relationship with final customers in influencing the firm's internationalization strategy and its attitude to environmental issues. The more the firm is visible to its final customers through its branding activities, the more the customers' pressure is likely to induce it to reduce its emissions and the greater the reputational risk it runs if its activities (in-house or abroad) are found non-compliant with the highest international standards.

A firm's strategy concerning its *environmental sustainability* is accounted for by means of two dummies. ENVSTD takes the value of 1 if the firm's production process is certified under an environmental standard (e.g. eco-labels or ISO 14000); this is a widely-used proxy for assessing the environmental performance of a firm's activities. ECOPROD and ECOPROC, respectively, take the value of 1 if the firm has introduced a product or a process innovation entailing a reduction in environmental impacts. The purpose of including these variables is to control for the firm's 'environmental behavior', i.e. to test the potential impact of its environmental sustainability strategy (whether it has modified any of its products, processes or activities) on offshoring strategies.

Finally, additional variables are included to control for other aspects of a firm's *internationalization strategy*. The dummy FOREIGNGROUP is used to control for the firm's international governance, and it takes the value of 1 if the firm is part of a foreign-owned business group, be it the headquarters or a branch. The dummy EXPORT, taking the value of 1 if the firm exports its goods, controls for downstream internationalization modes that may be adopted at the same time, also serving as a proxy of the firm's international experience.

Table 3 summarizes all the firm-level and industry-level covariates considered.

< Table 3 >

4. Empirical strategy

The basic regression equation is given by:

$$(1)\quad \Pr(Y_i = 1 \mid \mathbf{X}_i, \mathbf{X}_j) = \Phi(\boldsymbol{\beta}_0 + \mathbf{X}'_i \boldsymbol{\beta}_i + \mathbf{X}'_j \boldsymbol{\beta}_j)$$

where Y is *FDI* or *IO* in 2011, Φ is the standard normal cumulative function, $\boldsymbol{\beta}_0$ is the vector of the constant terms, $\mathbf{X}'_i$ is the vector of the firm-level covariates and $\mathbf{X}'_j$ is the vector of the industry-level covariates described in Table 3 and all measured between 2008 and 2010.

Since there are 36 firms that engage in both FDI and IO activities (this applies to 42% of the FDI firms and 31% of the IO firms), equation 1 is estimated by means of a bivariate probit model. It is assumed that there is a latent, continuous propensity variable Y_i^* proportional to the unobserved offshoring choice and the other firm- and industry-specific attributes. The latent offshoring choice is determined by the following model:

(2) $$Y_i^* = \mathbf{X}_i'\boldsymbol{\beta}_i + \mathbf{X}_j'\boldsymbol{\beta}_j + \varepsilon_i \, .$$

In the present case, a binary variable Y_i indicates whether the firm chooses a specific offshoring strategy, i.e. FDI or IO; Y_i takes the value of 1 for positive values of the corresponding latent variable Y_i^*, and 0 for values of zero or less.

Based on the assumption that choices concerning FDI and IO are correlated, it is also assumed that the error terms in the corresponding latent equations (2), one for FDI and one for IO, are jointly distributed according to a multivariate normal function. After estimating the model, the marginal effects for the univariate marginal probabilities of FDI (i.e. Pr [FDI=1]) and IO (Pr [IO=1]), and the marginal effects for the bivariate predicted probabilities, Pr (FDI=1, IO=0) and Pr (IO=1, FDI=0) are computed. While the former is the probability of a firm engaging in FDI (IO) irrespective of any decision to engage in IO (FDI), the latter is the probability of the firm engaging in FDI (IO) alone.

Then, equation 1 is estimated using FDI and IO by destination, i.e. North or South. To keep the analysis as simple as possible, equation 1 is estimated using two bivariate probit models: one referring to FDI North vs South, and one referring to IO North vs South[8]:

$$(3.1)\ \Pr(Y_i^{North} = 1 \mid \mathbf{X}_i, \mathbf{X}_j) = \Phi(\boldsymbol{\beta}_0 + \mathbf{X}'_i\,\boldsymbol{\beta}_i + \mathbf{X}'_j\,\boldsymbol{\beta}_j)$$

$$(3.2)\ \Pr(Y_i^{South} = 1 \mid \mathbf{X}_i, \mathbf{X}_j) = \Phi(\boldsymbol{\beta}_0 + \mathbf{X}'_i\,\boldsymbol{\beta}_i + \mathbf{X}'_j\,\boldsymbol{\beta}_j)$$

where Y=FDI, IO. As for FO and IO, once the bivariate probit model has been estimated, the marginal effects on the corresponding univariate and bivariate marginal probabilities are computed[9].

5. Results

The main estimation results are presented in Tables 4 and 5, while Tables 6 and 7 show the results of two robustness tests. Table 4, Columns 1 and 2 show the estimated coefficients of equation 1, one for FDI (Column 1) and one for IO (Column 2), while Columns 3 to 6 relate to the bivariate estimates of equations 3.1 and 3.2, and respectively show the estimated coefficients for FDI in the North (Column 3), FDI in the South (Column 4), IO in the North (Column 5), and IO in the South (Column 6). The ρ coefficient shows the correlation between the error terms of the various couples of equations (i.e. equation 1 in Columns 1 and 2, and

[8] Since there are variables measured at both firm and industry level, but a limited number of two-digit industries, the standard errors are clustered at two-digit industry-NUTS 1 area level to account for the potential correlation within groups of observations (Moulton, 1990).

[9] Since the number of offshoring firms is limited, for computational reasons it is impossible toestimate a two-stage model, where firms first decide whether to offshore production (through FDI or IO) and then choose a destination. Instead, it is implicitly assumed that the decision to offshore coincides with the choice of destination.

equations 3.1 and 3.2 in Columns 3 to 6): its high statistical significance confirms that a bivariate probit model was a good choice.

< Table 4 >

Columns 1, 3 and 4 indicate that the probability of production being offshored through FDI is higher for large and more experienced firms, located in the North of Italy. Concerning technology, only ICT is related to a higher probability of investment in the South. Among the internationalization variables, being part of a foreign-owned business group is the only statistically significant, whereas the EXPORT coefficient is never statistically different from zero. As for the firm's market strategy, having registered a trademark correlates positively with a greater propensity to engage in FDI, especially in the South, while B2C is statistically significant (at 10% level) only in the case of FDI in the North. The presence of an explicit sustainability strategy within the firm also relates to the other offshoring modes. In particular, adopting environmental standard certifications is positively associated with an increase in the probability of engaging in FDI, regardless of the destination. The adoption of environmental product innovations relates only to FDI in the North. Firms more likely to introduce environmental product innovations tend to be located in countries with a high environmental awareness and commitment, where the profitability of these innovations is higher, and they tend to opt for FDI in order to maintain control over the production process and gain easier access to these large markets.

Environmental regulatory stringency is apparently related to FDI only when concerning a reduction in the emissions of acidifying gases such as nitrogen oxides, sulfur oxides and ammonia, which are used more in industries of low- and medium-low technology, e.g. to manufacture non-metal mineral products, textiles and furniture. When distinguishing between FDI in the North and South, the ACID coefficient is not statistically significant, however.

Looking now at columns 2, 5 and 6, among the industry-level variables, stricter environmental regulations on CO2 emissions correlate with a greater propensity to outsource production abroad and towards Southern regions in particular. The propensity to subcontract production is higher in medium- to low-tech industries and lower in high-tech industries, especially for IO in the South. This is also more likely to apply to firms with a lower quality of labor, as proxied by the negative sign of the LABCOST coefficient. The probability of IO is also positively related to R&D (only in the South) and ICT, as well as to market strategy through B2C (only in the North) and registration of trademarks. The results suggest that firms with an environmental strategy are less likely to engage in IO. In fact, ENVSTD correlates negatively with IO. This is not surprising, because obtaining a certification demands a certain degree of control over production activities, which is achieved more easily through proprietary forms of governance than through interaction with independent organizations (suppliers). The negative or null relation between the adoption of process innovations and FDI or IO supports this view. Finally, being part of a multinational group and/or being an exporter increases the likelihood of IO, both in the North and in the South.

Table 5 shows the marginal effects of environmental regulatory stringency on the univariate and bivariate probability of offshoring.

< Table 5 >

The top of the table refers to the marginal effects related to the bivariate estimation of the FDI and IO equations, and the bottom to those related to the bivariate estimates of FDI and IO by destination. The numbers in the cells confirm that environmental regulatory stringency does not imply a higher propensity to engage in FDI: the weak significance of the marginal effect of ACID in affecting the univariate probability of FDI vanishes for the bivariate marginal probability of FDI when IO is zero. Conversely, a lower CO_2 emission intensity correlates positively with a higher probability of outsourcing production to foreign suppliers. The magnitude is low, however: a 100% decrease in CO_2 emissions per unit of value added is related to a 0.02% increase in the probability of outsourcing production. No effect is found for ACID.

At the bottom of the table, here again only CO_2 emission intensity is related to the probability of IO, specifically to Southern regions, but with a very low marginal effect[10].

Tables 6 and 7 present two robustness tests. In the first, an effort is made to account for the possibility of firms subcontracting production to Southern regions being motivated by other characteristics of the destination, as well as a more stringent environmental regulation at home. This can be considered as a source of unobserved heterogeneity in offshoring decision where unobserved location-specific variables can be correlated with the IO decision, but not with CO_2 emissions. Two variables that capture the impact of offshoring on a firm's activities are used in an effort to address this issue. Specifically, the TeDIS questionnaire asks firms that have offshored production to Southern regions if such a strategy had an impact in terms of: (i) reducing production costs; (ii) reducing the number of plant operators; (iii) increasing skilled personnel; (iv) developing new market opportunities; (v) developing new opportunities for innovation and R&D; (vi) improving environmental performance; (vii) other.

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[10] These results are confirmed when IO is specifically directed to Far Eastern countries, mainly China. It is impossible to estimate separate equations for IO in Latin America and Africa due to the small number of IO firms.

Assuming that the impact of offshoring reflects its underlying motivation, the answers were pooled: (i) and (ii) to define a new dummy variable, which takes the value of 1 if the firm has outsourced production to the South (i.e. IO_SOUTH=1) and this strategy led to a reduction in production and/or labor costs. The remaining answers, from (iii) to (vii), are pooled in a second dummy, which takes the value of 1 when IO_SOUTH takes the value of 1 and this strategy led to an increase in the firm's market or in its innovative performance. This procedure should enable a distinction between firms offshoring production to reduce costs and those offshoring to find new business opportunities.

For reasons of space, Table 6 only shows the marginal effects of the environmental regulatory stringency proxies used. While the estimated coefficients and the univariate marginal effects of CO2 are negative and statistically significant for both types of firm, the marginal effect on the bivariate probabilities remains significant only for firms that reduced their production and labor costs, whereas it no longer differs statistically from zero for firms exclusively pursuing new market and/or innovation opportunities. This is interpreted as evidence of environmental regulatory stringency being seen by these firms as a source of additional costs, which can be reduced by relocating production where such regulation is less stringent. On the other hand, firms with more complex internationalization strategies, or that are more sensitive to innovation and reputation, do not consider environmental regulatory stringency an important driver of their offshoring strategy.

< Table 6 >

As a final robustness check, the potential endogeneity in the relationship between CO2 and IO (and IO_SOUTH) is also considered. Relocating the dirtiest phases of production to a foreign country may reduce the total amount of an industry's emissions, reversing the direction of causality from offshoring to environmental regulation (see Millimet and Roy (2016) for a review). An instrumental variable (IV) probit model is used to account for this. Following Carrion-Flores and Innes (2010), the number of establishments (N_EPRTR) subject to the European Pollution Release and Transfer Register (E-PRTR) in 2007[11] is used to instrument CO2. For each industry, the number of facilities that fulfill the following criteria is considered: belonging to one of the 65 economic E-PRTR activities; exceeding a certain threshold in transferring waste off-site; and releasing pollutants that exceed specific thresholds according to the E-PRTR regulations. The identification strategy is as follows: given all other covariates, a higher number of facilities falling under the E-PRTR does not affect the probability of outsourcing production directly, but only after it has induced stricter environmental regulations.

< Table 7 >

The results in Table 7 show that, in the first stage, a higher N_EPRTR corresponds to a higher environmental regulatory stringency. The F statistics well above both the threshold value of 10 and the threshold value of 16.38 in the Stock and Yogo weak identification test confirms that the instrument is strong. In the second stage, the estimated coefficient of CO2 remains negative and significant, and the Wald test does not reject the null hypothesis of exogeneity of the instrumented variable. With these results, a more robust direction of causality can be identified between environmental regulatory stringency and IO: more stringent environmental

[11] Data are available on: http://prtr.ec.europa.eu/IndustialActivity.aspx .

regulations at home drive firms to outsource production to foreign suppliers, particularly when located in Southern regions.

6. Discussion and conclusions

The effectiveness of policy and stakeholder pressure in engendering firms' better environmental performance is a hot issue on the current policy agenda, but the chance for firms to relocate their activities where environmental regulations are less stringent may undermine the effectiveness of the policy instruments designed to reduce polluting emissions (Martin et al., 2014).

This paper investigates whether the decision to offshore production, through FDI or outsourcing to foreign suppliers, relates to such external pressure for sustainability when considering firms' characteristics and strategies. A key contribution of the analysis lies in that it distinguishes between offshoring decisions involving countries located in the South (where policy pressure and stakeholders' awareness on environmental issues are generally lower) rather than in the North (where minimum environmental standards have to be met by all industries).

After controlling for firm-specific factors and business strategies, it emerges that environmental policy stringency does not play a key part in firms' decisions regarding their internationalization, contradicting the PHH theory. Consistently with the PHH, environmental regulatory stringency (in CO_2 emissions) is related only to IO decisions when the destination is the South of the world. The effect on Italian manufacturing firms is very small, however; stricter environmental regulations may not be a key driver of the propensity of manufacturing firms to relocate their production. This is especially true in the case of FDI, which implies high sunk costs and a greater control over the firm's global value chain. This is consistent with the increasing relevance of codes of conduct and corporate social responsibility strategies, through which multinationals are pursuing the same environmental standards in all their facilities. These standards are usually those required in the most stringent countries (see e.g., Dam and Scholtens, 2008; Ivarson and Alvstam, 2010); the result is that multinationals export best practices to less-developed countries rather than exploiting the advantages of the latter's less stringent environmental regulations (Jeppesen and Hansen, 2004). That is not to say that environmental sustainability issues do not influence governance decisions relating to the distribution of activities at global level, or that any governing structure is equally conducive to environmental improvements. Instead, the picture emerging from our analysis seems to indicate that the external pressure on firms to adapt to higher environmental standards is not likely to be a crucial factor in driving such decisions. These decisions relate more to a firm's self-imposed pressure to reduce its environmental impact by means of an appropriate environmental sustainability strategy (Orsato, 2006). Further empirical analyses should test to what extent such a result is peculiar to our chosen setting, Italy, where environmental regulations are relatively lax (Ghisetti and Quatraro, 2013), and so is the propensity of manufacturing firms to invest abroad. Our work seems a promising basis to support the relevance of including firms' strategic elements when investigating the impact of environmental policies and the existence of a PHH.

Firms that have a clear environmental innovation strategy are more likely to organize their value chain using governance structures that afford greater control, i.e. by maintaining the ownership of activities being offshored (FDI) rather than opting to purchase from international suppliers (IO). This is in line with previous case-study evidence of a clear relationship between green innovation and the choice of a governance model that affords the greatest control over upstream supply chain activities (De Marchi et al., 2013). The fact that the proxies used for the importance of a firm's reputation (i.e. having registered a trademark, and having a direct presence on the market) correlate significantly with FDI and IO in the North, but not in the South, supports such an explanation.

Our analysis suffers from some limitations. First, despite being rich in firm-level information on environmental innovation, technology and offshoring, the dataset is representative of a subset of manufacturing sectors in Italy, and this limits the generalizability of our results in terms of the industries and countries involved (European Commission, 2014). Second, the cross-sectional nature of our data does not permit a proper handling of endogeneity, despite the IV strategy adopted. Third, information on pollution abatement expenditure at firm level was lacking, so it was only possible to consider industry-level environmental policy stringency variables. Further research should generate a more fine-grained analysis and consider the firm-level impact of different sources of environmental pressure, i.e. from policy-makers and stakeholders.

Acknowledgments

This research was funded by the National Research Project PRIN-MIUR 2010-11 (2010SLHSE) "Climate changes in the Mediterranean area: evolutionary scenarios, mitigation policies and technological innovation".

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Tables and Figures

Table 1. Industry, size and geographical distribution of firms in the sample

Industry (NACE Rev. 2)	N	%
13. Textiles	45	6.58
14. Wearing apparel	41	5.99
15. Leather and related products	34	4.97
16. Wood	22	3.22
17. Paper	21	3.07
22. Rubber and plastics	58	8.48
23. Non-metallic mineral products	53	7.75
25. Fabricated metal products	157	22.95
26. Computer and electronics	28	4.09
27. Electric and domestic apparel	38	5.56
28. Machinery and equipment	97	14.18
29. Motor vehicles	16	2.34
30. Other transport goods	13	1.90
31. Furniture	37	5.41
32. Other manufacturing	24	3.51
Size (number of employees)	N	%
Micro: 1-9	71	10.38
Small: 10-49	362	52.92
Medium: 50-249	211	30.85
Large: 250+	40	5.85
Geography (NUTS 1 region)	N	%
North-West Italy	250	36.55
North-East Italy	289	42.25
Central Italy	107	15.64
Southern Italy	38	5.56

Table 2. Summary statistics: IO and FDI

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)	0.152	0.359	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)	0.085	0.279	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 Northern foreign countries (N)	0.086	0.281	0	1
FDI_SOUTH	Dummy = 1 if the firm owns production facilities in Southern foreign countries (S)	0.072	0.258	0	1

Notes: N includes Europe-15 countries, Eastern Europe countries, USA/Canada, Japan and other countries; S includes East Asia, Africa, and Latin America.

Table 3. Summary statistics: firm-specific and industry-specific variables

Variable	Description	Mean	SD	Min	Max
	Industry-level variables				
Environmental regulatory stringency		Mean	SD	Min	Max
CO2	CO2 emission intensity: CO2 emissions/value added, 2008	872.48	1382.4	50.577	4322.5
ACID	Acidifying gases emission intensity: (NOx +SOx+NH3)/value added, 2008	0.331	0.808	0.030	3.088
Trade openness					
TRADE		1.648	1.138	0.574	4.123
	Firm-level variables				
Firm characteristics					
NORTH WEST	Piedmont, Lombardy and Liguria	0.423	0.494	0	1
NORTH EAST	Veneto, Friuli Venezia Giulia, Trentino Alto Adige and Emilia Romagna	0.365	0.482	0	1
CENTRE-SOUTH	Tuscany, Lazio, Marche, Umbria, Campania, Abruzzo, Molise, Apulia, Basilicata, Calabria, Sardinia and Sicily	0.212	0.409	0	1
LT	Low-tech industry	0.327	0.470	0	1
MLT	Medium- to low-tech industry	0.162	0.369	0	1
MHT	Medium- to high-tech industry	0.414	0.493	0	1
HT	High-tech industry	0.096	0.295	0	1
AGE	2011- start-up year of the firm	34.25	21.31	1	211
SIZE	Number of employees, 2010	70.07	132.2	2	2340
LABCOST	Total labor cost per employee, 2010	56.97	130.4	0	2877
Technology					
R&D	Dummy = 1 if the firm invested in R&D in year 2011	0.503	0.500	0	1
ICT	Dummy = 1 if the firm adopts the following ICT facilities: videoconference, extranet for suppliers, extranet for logistics, supply chain management solutions	0.453	0.498	0	1
Market strategy					
B2C	Dummy = 1 if the firm's main customer is a commercial activity or a final consumer (Business-to-Consumer)	0.415	0.493	0	1
TRADEMARKS	Dummy = 1 if the firm has registered a trademark	0.430	0.495	0	1
Environmental strategy					
ENVSTD	Dummy = 1 if the firm has environmental standard certification	0.224	0.417	0	1

ENVPROD	Dummy = 1 if the firm introduced an environmental product innovation	0.085	0.279	0	1
ENVPROC	Dummy = 1 if the firm introduced an environmental process innovation	0.382	0.486	0	1
Internationalization strategy					
FOREIGNGROUP	Dummy = 1 if the firm belongs to a business group led by a foreign company, or if at least one of the members of the group is located in a foreign country	0.181	0.386	0	1
EXPORT	Dummy = 1 if the firm exports to foreign markets	0.743	0.437	0	1

Table 4. Environmental regulatory stringency and FDI/IO: bivariate probit estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	FDI	IO	FDI_N	FDI_S	IO_N	IO_S
CO2	-0.001	-0.001***	-0.001	0.001	-0.001	-0.002***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)
ACID	-0.338**	-0.017	-0289	-0.209	0.120	0.306
	(0.131)	(0.143)	(0.233)	(0.175)	(0.145)	(0.288)
TRADE	-0.041	0.055	-0.089	0.026	0.035	0.095
	(0.063)	(0.081)	(0.113)	(0.083)	(0.079)	(0.088)
NORTH WEST	0.450**	0.427*	0.868**	0.225	0.310	0.268
	(0.224)	(0.219)	(0.384)	(0.243)	(0.227)	(0.214)
NORTH EAST	0.418**	0.459*	0.603	0.425*	0.489**	0.248
	(0.205)	(0.241)	(0.416)	(0.236)	(0.248)	(0.272)
CENTRE-SOUTH	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
LT	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
MLT	2.144*	4.260**	3.874	1.230	3.524*	5.237**
	(1.265)	(1.817)	(3.004)	(1.693)	(1.901)	(2.505)
MHT	0.162	0.084	0.260	0.147	0.328*	-0.180
	(0.131)	(0.202)	(0.270)	(0.196)	(0.197)	(0.241)
HT	-0.082	-0.556**	0.104	-0.074	-0.180	-0.912***
	(0.245)	(0.204)	(0.314)	(0.304)	(0.235)	(0.345)
AGE	0.005*	0.003	-0.002	0.009***	0.004	0.008*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
SIZE	0.002***	0.000	0.002***	0.001	0.001	0.001
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
LABCOST	0.000	-0.000	-0.000	0.000	-0.000	-0.001**
	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)
R&D	0.229	0.221	0.083	0.432	0.206	0.438**
	(0.230)	(0.167)	(0.231)	(0.263)	(0.135)	(0.204)
ICT	0.235	0.222**	-0.108	0.474***	0.002	0.299***
	(0.145)	(0.099)	(0.146)	(0.139)	(0.121)	(0.095)
B2C	0.007	0.236	0.536*	0.057	0.383**	0.266
	(0.278)	(0.180)	(0.280)	(0.341)	(0.194)	(0.283)
TRADEMARKS	0.498***	0.320**	0.446	0.290*	0.296*	0.263**
	(0.158)	(0.175)	(0.272)	(0.165)	(0.166)	(0.115)
ENVSTD	0.309**	-0.454**	0.426***	0.398***	-0.309	-0.209
	(0.148)	(0.202)	(0.153)	(0.144)	(0.244)	(0.342)
ECOPROD	0.397*	-0.149	0.823***	0.158	0.049	-0.416
	(0.212)	(0.196)	(0.286)	(0.208)	(0.219)	(0.251)
ECOPROC	0.096	-0.190	0.154	0.021	-0.284***	-0.179
	(0.119)	(0.147)	(0.180)	(0.131)	(0.109)	(0.226)
FOREIGNGROUP	0.474***	0.531***	0.435**	0.381**	0.578***	0.319**
	(0.159)	(0.154)	(0.176)	(0.165)	(0.143)	(0.160)
EXPORT	0.320	0.663***	0.327	0.337	0.873***	0.463**
	(0.241)	(0.171)	(0.271)	(0.295)	(0.218)	(0.263)
N	684		684		684	
ρ	0.324***		0.542***		0.608***	

Notes: cluster-robust (two-digit industry-area) standard errors in brackets. All the estimates also include a constant term. *** Significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table 5. Environmental regulatory stringency and FDI/IO: marginal effects on univariate and bivariate probabilities

	FDI=1	FDI=1 I IO=0	IO=1	IO=1 I FDI=0
CO2	-0.00007	-0.00002	-0.00024***	-0.00020***
	(0.00005)	(0.00003)	(0.00008)	(0.00007)
ACID	-0.038*	-0.029	0.0001	0.008
	(0.020)	(0.024)	(0.0264)	(0.023)
	IO_N=1	IO_N=1 I IO_S=0	IO_S=1	IO_S=1 I IO_N=0
CO2	-0.00018**	-0.00011	-0.00013***	-0.00006**
	(0.00008)	(0.00007)	(0.00004)	(0.00002)
ACID	0.020	0.010	0.021	0.011
	(0.024)	(0.020)	(0.020)	(0.011)

Table 6. Environmental regulatory stringency and IO in the South

	(1)	(2)	(3)	(4)	(5)	(6)
	Cost	Market	Cost=1	Market=1	Cost=1|Mkt=0	Mkt=1|Cost=0
CO2	-0.0022***	-0.0022**	-0.00013***	-0.00005**	-0.00008***	-0.0000
	(0.0005)	(0.0009)	(0.00003)	(0.001)	(0.000)	(0.0000)
ACID	-0.060	0.836	-0.0035	0.019	-0.018**	-0.0045
	(0.223)	(0.531)	(0.0126)	(0.016)	(0.009)	(0.0037)
N	684					
ρ	0.934***					

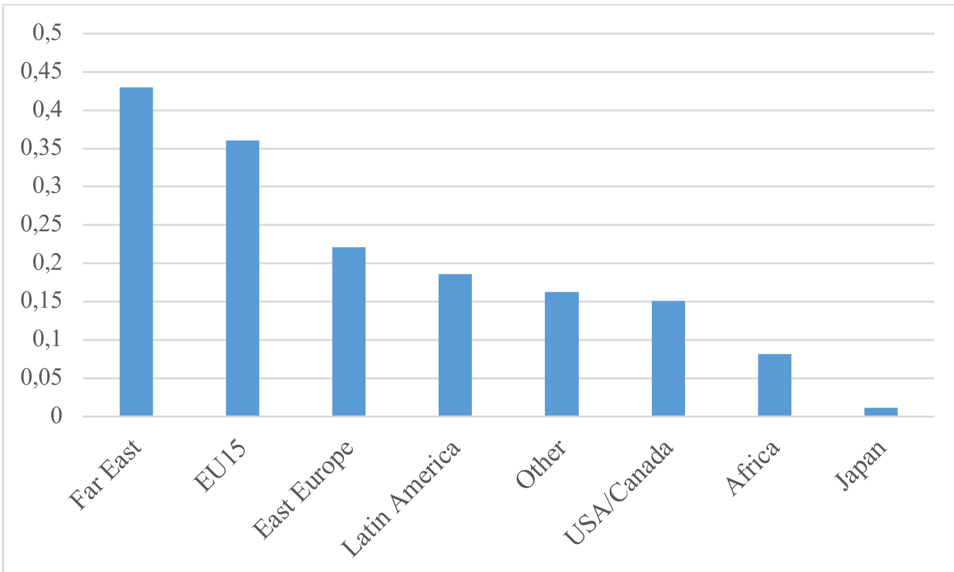
Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table 7. Environmental regulatory stringency and IO: IV probit estimates

First-stage estimates		
N_EPRTR	17.21***	
	(0.694)	
Second-stage estimates	IO	IO_S
CO2	-0.00011**	-0.0025**
	(0.00005)	(0.0011)
Wald test of exogeneity		
$X^2(1)$		0.57
		(0.449)
Weak identification tests		
Stock-Yogo F statistic		66.40
Stock-Yogo weak ID test critical value: 10% maximal IV size		16.38

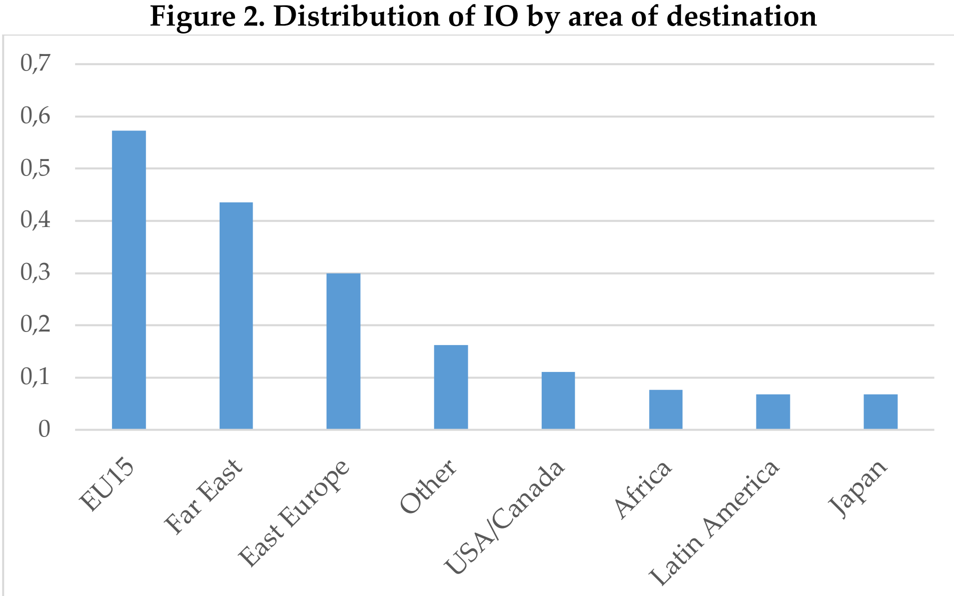
Notes: cluster-robust (two-digit, industry-area) standard errors in brackets. *** Significant at 1% level; ** significant at 5% level; * significant at 10% level.

Figure 1. Distribution of FDI by area of destination



Note: values on the vertical axis refer to the % of firms out of the total number of FDI firms

Figure 2. Distribution of IO by area of destination



Note: values on the vertical axis refer to the % of firms out of the total number of IO firms