University of Sussex
Business, Management & Economics

Economics Department Working Paper Series

No.54-2013

The Determinants of Outward Processing: Evidence from Offshoring Intermediates by the European Union

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Abstract: This paper analyses the determinants of outward processing (OP) trade; specifically, imports of intermediates subsequent to processing abroad. A model where firms choose between OP and importing intermediates directly from a third country (generic offshoring, GO) predicts higher tariffs, lower monitoring costs and higher quality make OP more likely, while better institutions and rule of law abroad lower contractual breakdown risk under GO making OP less likely. Analysis of EU trade data from 2002 to 2008 emphasizes proximity, quality differentiation and weaker rule of law as OP determinants. Results suggest relationship-specific investments and monitoring under OP may offset contractual uncertainty.

JEL Classification: F14, D23, L23

Key Words: Outward processing, offshoring, European Union

Acknowledgements: We would like to thank Alan Winters, Ingo Borchert, Torfinn Harding, Michael Gasiorek, as well as participants of the Sussex Trade Study Group and LSE International Workshop for their comments. Any errors and omissions are ours.

1 Introduction

The way we understand trade and production has changed dramatically in recent decades. Three key aspects deserve special consideration when analyzing the change in trade patterns over this period. First, there has been extensive fragmentation of production beyond the boundaries of the production plant, firm and country. Production processes have been fragmented and outsourced, assisted by innovations in information systems and management services. Thus, the production cycle for most products no longer occurs within the boundaries of the firm. Processes and inputs are outsourced and offshored, with firms in different countries specializing in particular stages of the production process.[1] Several types of intra- and inter-firm production relationships have emerged as a result, ranging from vertical integration to different types of contract outsourcing with independent suppliers.

Vertical fragmentation of production has translated into rapid changes in trade patterns, not confined solely to manufactured goods, but extending also to services, and to agricultural and primary products linked to global retailers. These changes have prompted a large literature on the determinants of international outsourcing and choice of organizational forms, which emphasizes the role of incomplete contracts in explaining organizational forms and locations (e.g. Spencer, 2005).

Second, the same product, defined at a very high level of disaggregation, is usually exported by different countries to the same market at different prices. These price differentials can be very large, and tend to be the result of significant quality differentiation, which in turn is correlated with countries' income per capita and endowments (Schott, 2004). Richer countries tend to export high quality goods and obtain higher prices, with goods competing in different quality segments (Hummels and Klenow, 2005), but also tend to import relatively more from countries that produce high quality goods (Hallak, 2006). There is thus considerable scope for differentiation and quality upgrading within narrowly defined products.

Third, different types of offshoring modes have emerged, requiring different degrees of inter-firm governance, contractual relations and relationship-specific investments. One specific offshoring mode that merits consideration is outward processing trade, where goods are re-imported subsequent to being exported for processing abroad, to be used as either intermediates or final products.

[1] See Hummels *et al.*, 2001, for an overview.

This allows countries to specialize in specific assembly and processing tasks. Despite the proliferation of export processing zones worldwide in the last two decades, participation in processing trade has been very concentrated in China, the ASEAN region and countries in Eastern Europe. Other regions, especially Sub-Saharan Africa, remain largely isolated from participation in global production sharing. Understanding the determinants of the vertical fragmentation process could, therefore, be a key step towards facilitating the engagement of poorer regions into this type of trade.

This paper analyses the determinants of participation in a particular type of outward processing (OP) trade, where intermediate goods are sent abroad to be processed and re-imported, as compared to generic offshoring (GO), where EU firms offshore inputs directly from abroad without processing. OP and GO are trade modes that reflect offshoring of intermediates, since they both require the transfer of parts of the production process abroad. Generic offshoring itself encompasses is sufficiently broad so as to encompass both "international outsourcing", where offshoring of production is transferred to an independent supplier, as well as trade within a vertically-integrated firm.

While OP imports are a small share of "international outsourcing", there are several advantages of analyzing this type of trade. Compared to input-output estimates of intermediate goods, OP trade can be directly identified through custom declarations. EU customs regime 3, in particular, allows importers to pay duty only on the added value from processing outside the EU, rather than on the full value of the good normally due. As a result of these tax rebates, OP trade flows are recorded by customs authorities. Moreover, re-importing goods following processing abroad constitutes an interesting type of offshoring, since it involves the transfer of a middle stage in the production process abroad, which incurs significant value chain governance costs, as opposed to the direct offshoring of intermediates from foreign suppliers. Finally, OP trade tends to be concentrated in destination countries with relatively poor institutions or rule of law. Understanding possible mechanisms driving OP can serve to shed some light on the determinants of offshoring and global production fragmentation.

We develop a model where firms choose the offshoring mode for sourcing intermediates from abroad, in a setting where input specificity renders contracts incomplete under OP, whereas weak institutions give rise to a probability of contractual breakdown under GO. The model predicts that firms in the North (buyers) prefer to engage in OP trade when the quality and complexity of the final good they produce is relatively high, as reflected by a larger price premium, thereby compen-

sating costs of monitoring firms in the South (suppliers). At the same time, relationship-specific investments are required on the supplier side to engage in processing; their choice to participate in OP depends on the price of their input, the size of sunk costs to adjust production to the type of processing required, and the potential value of the input they produce for other firms as an outside option. The quality of institutions and rule of law also play an important role through their impact on the likelihood of contract breakdown under GO.

The predictions of the model are tested using the COMEXT database, which decomposes imports into the European Union (EU) at the product level (HS-8) according to whether flows use the outward processing regime, which gives an entitlement to a rebate on import duties, or the "normal imports" regime. The paper contributes to the literature on offshoring mode choice, incorporating quality differentiation when analyzing this choice. It also contributes to the literature on the role of institutions in explaining trade flows and offshoring mode. While most papers analyzing processing trade focus on China, we provide evidence on the location and importance of this type of offshoring in other developing countries.

The main findings of the paper are that OP trade is more likely with closer proximity countries, where trade costs are lower and in products with higher tariffs. Also, OP trade is more prevalent in products where there is more scope for product differentiation, as proxied by larger differences in unit values. An interesting result relates to the quality of institutions; although greater political stability of a country makes OP trade with that country more likely, on average, more effective rule of law and better quality of other institutions appear to favor generic offshoring trade with that country, all other things equal. This is perhaps unsurprising given the high concentration of processing of products originating from the EU that takes place in Eastern European countries, such as Albania, Armenia, the Ukraine or Moldova. This be explained by several factors; first, that contractual breakdown is also important for generic offshoring, since delays or non-delivery may have large costs on EU firms. Second, because relationship-specific investments from suppliers and monitoring costs incurred by buyers under OP trade tend to increase inter-firm coordination, which in turn may work as a substitute to institutions. A final explanation is the role of export processing zones in providing more legal certainty in countries where the quality of institutions is poor.

This paper is organized as follows. Section 2 summarizes the determinants of organizational forms of outsourcing and offshoring as identified by the literature. Section 3 presents the theoreti-

cal model, drawing testable hypotheses regarding determinants of OP trade versus GO. Section 4 analyzes the determinants of OP trade empirically using import data for the European Union. The final section concludes.

2 Choice of organizational form

Offshoring occurs when part of the production process is transferred abroad. When it is specifically transferred outside the boundaries of the firm it is also referred to as international outsourcing. Offshoring can arise in many different organizational forms with varying degrees of intra-firm coordination; ranging from vertically integrated suppliers, to sourcing goods from spot markets, with intermediate modes characterized by different degrees of contractual relationships and relationship specific investments. A large literature has analyzed firm decisions to outsource part of the production process outside the boundaries of the production plant, either domestically or internationally (offshoring). For example, Antràs (2003), Antràs and Helpman (2004, 2006), Grossman and Helpman (2004) and Feenstra and Hanson (2005) focus on the choice between vertical integration and contractual outsourcing. In contrast, Spencer and Qiu (2001), Qiu and Spencer (2002), Head *et al.* (2004), Spencer (2005) and Feenstra *et al.* (2012), among others, focus on the choice between specialized inputs under incomplete contracts and outsourcing from spot markets.

The transaction costs literature establishes that the degree and form of production fragmentation (e.g. arms-length trade, long-term contract, vertical integration) result from cost minimization by firms, where hold-up and governance costs are key determinants organizational mode choice. Factors emphasized include the cost of searching for alternative suppliers (Grossman and Helpman, 2002), the thickness of input markets (McLaren, 2000) and the need for relationship-specific investments.

The property rights approach instead focuses on internal incentives and the ownership of assets in determining the type of outsourcing, such as in the property rights model in Antràs (2003). Others emphasize the role of proximity, cultural and geographical, on increasing contractual outsourcing via lowering monitoring costs and facilitating contract enforcement (Antràs, 2005; Feenstra and Spencer, 2005). Incomplete contracts are emphasized in papers that consider outsourcing via spot markets or arms-length trade as outside options (Schwartz and Van Assche, 2010; Head *et al.* 2004).

Critical to the choice of organizational mode is that suppliers of specialized inputs are potentially

required to make relationship-specific investments where contracts cannot be written conditional on the level of investment. In this context, the allocation of rents takes place through bargaining, in which case the outside options available to both firms become key determinants of outsourcing mode. Such a framework is well-suited for the analysis of OP trade, since output processing necessitates interactions between the offshoring firm and supplier that go beyond those required under offshoring through spot markets. The specificities of processing typically require investments to allow transformation of the specific inputs, as well as firm coordination to guarantee quality standards and timely delivery.

Since OP regimes provide partial relief of tariff duties, tariff margins are likely to be an important factor for firm decisions to offshore using OP.[2] Under the EU outward processing relief (OPR) regime, importers can claim relief of duties on re-imported processed products, which otherwise would have lost EU status and incurred full duties.[3] While OP trade clearly benefits from import tariff exemptions, firm decisions to offshore using OP depend on factors other than tariff margins. One of these is quality differentiation. EU data shows that at very disaggregated product levels (HS-8), the same product is offshored through OP trade while also sourced from the same country under the normal imports regime. One potential explanation is higher product quality or greater complexity of the production process, which requires stronger inter-firm governance and coordination.[4] As an example, if a European firm wants to produce a highly sophisticated mobile handset, it can offshore part of the production process to China and use OP trade, providing inputs and monitoring the process. Alternatively, the same firm could offshore low quality handsets purchased in spot markets from China if the objective is to sell cheap mobile phones. One should therefore observe more OP trade in products with larger quality premia.

[2] In practice, importers are required to pay the duty on the final product, but are subsequently refunded the duties applicable to the intermediate product they exported for processing. Regime 3 also provides duty relief for faulty goods returned to a third country for repair or replacement.

[3] It is important to note that OP imports are only observed in the data when these have been declared by firms. OP may still *de facto* occur in some products that can be re-imported duty free; with no incentive for a tariff rebate (e.g. where MFN rate is zero) the trade flow is likely to be registered as a normal import. Nevertheless, OP trade is still observed in cases where products are eligible for preferential treatment. The most likely explanation for this is the costs of compliance required to obtain preferential status. Brenton and Manchin (2003) suggest that the costs of proving origin (documentation costs, risk of delays or stringent Rules of Origin) can be higher than obtaining duty relief through OP. The relevant variable in determining OP is therefore the preference margin.

[4] Consider the strategies of clothing retailers ZARA and HM The former uses OP as part of a very sophisticated process with very short product cycles with just-in-time production techniques, keeping textile production facilities and using captive sewing workshops (Bonnin, 2002). The latter has opted for a less complex production fragmentation, directly outsourcing final products.

A large literature emphasizes the role of institutions in facilitating trade[5] through making contracts binding and predictable. In the case of international outsourcing, this is important since contracting costs are higher when negotiating with an external supplier than with an internal agent within a single corporation.[6] Feenstra *et al.* (2012) examine contractual versus non-contractual trade and the role of institutions in Chinese provinces and find quality of institutions to be especially important for processing trade. Further, Nunn (2007) shows that institutions are more important in facilitating trade of goods characterized by greater asset specificity. While the COMEXT database does not allow us to distinguish between OP with a vertically integrated firm versus an independent supplier, we can explore the role of asset specificity and the quality of institutions for OP in general.

This paper serves to elucidate two aspects that remain unclear in the literature. First, the role of institutions on decisions between different offshoring modes. The value chain literature has focused on the role of governance costs on production fragmentation[7], where governance structure varies from more flexible forms, such as arms-length market transactions or modular networks, to more rigid ones, such as captive suppliers. This is important when thinking about OP trade, which often requires monitoring, supervision and transfer of know-how between firms. The more "captive" relationship between buyers and suppliers implied by OP may compensate for a lack of efficient legal and government institutions, in turn explaining why countries with poorer institutional quality are able to attract OP trade.

Second, while generic offshoring does not require relationship-specific investments, it still requires contracts to be binding. This is particularly so under just-in-time production processes where it is critical for buyers to be able to enforce penalties to suppliers for delays, damage or non-deliveries. While the literature emphasizes the role of institutions in facilitating input specific trade, in some cases GO may require even better institutions than OP trade, especially if value chain captivity under OP replaces the role of institutions.

[5] See for example Anderson and Marcoullier (2002), Rauch and Watson (2004) or Levchenko (2007).

[6] Feenstra and Hanson (2005) endogenize the degree of foreign ownership of Chinese suppliers engaging in processing activities.

[7] Gereffi *et al.* (2005) classify the types of value chain governance according to three main factors: the degree of complexity and knowledge transfer for transaction, the extent to which information required for the transaction can be codified and the capabilities of the supplier to carry out the transaction.

3 The model

The partial equilibrium model of offshoring presented is similar to Schwartz and Van Assche (2010) and focuses on the decision between producing a final good through generic offshoring *vis-à-vis* outward processing. OP trade is modeled as a function of quality differences, tariff levels, asset specificity and contract enforceability.

The structure of the model is depicted in Figure 1. To generate a variety of a final product an EU producer, buyer (B), can contract with a firm located overseas in order to acquire a necessary input, z, produced at cost C_Z. This reflects generic offshoring in the model. Buyers can further decide whether to produce a low quality or a high quality variety of the final product, for which the prevailing exogenous market prices are P^L and P^H, respectively where $P^H > P^L$. To make a low quality final product, the buyer must import a low quality input from an overseas supplier and incur transformation cost δ^L. Let P_Z^L denote the exogenous spot market price for a low quality input, assumed to be supplied perfectly elastically at this price. Moreover, imported low quality inputs incur an import duty $(1+\tau)$, where τ denotes the *ad valorem* tariff rate.

Alternatively, the EU producer can produce a high quality product variety in one of two ways. Either through generic offshoring, by transforming a low quality imported input into a high quality final good, by incurring a higher transformation cost $\delta^H > \delta^L$. Alternatively, the firm can produce an input, or intermediate good, at cost C_Y and send it to an external supplier, S, for processing and subsequent re-import. OP requires relationship specific investments by both parties; the EU producer incurs monitoring costs, h, in order to guarantee a high quality level in the processing stage.[8] The overseas supplier must invest K to adapt production capacity to high quality production.

Contracts are incomplete under OP, in the sense that the EU producer and overseas supplier cannot pre-commit to a particular price P_Z^H for the processed good. In particular, the supplier can threaten non-delivery after investing K and after the EU firm has produced the raw input and shipped it out. *Ex post* bargaining between B and S over P_Z^H is modeled as a symmetric Nash bargaining game, where the two parties share *ex post* surplus equally. If bargaining is unsuccessful, then the EU firm has the outside option of producing through GO. If successful, then the processed

[8] A key determinant of monitoring costs is likely to to be distance between the EU producer and its overseas supplier, as well as corruption levels overseas. h may also reflect the transport costs of exporting the intermediate and re-importing it after processing.

good is re-imported to the EU; to reflect OPR, we assume no import duties are applied when the processed input is re-imported.[9]

The supplier is assumed to retain residual rights over the processed input, giving it the right to put it to alternative use if the relationship between B and S breaks down. A key assumption is that inputs are not entirely specific to the requirements of a particular buyer, so S can supply the processed input to an alternative buyer if bargaining breaks down, but must incurs search costs C_S. Moreover, since the processed input is of higher quality than a generic input purchasable on the spot market, S can expect to receive a premium over the spot price. Suppose S has the outside option of receiving $P_Z^L(1+\sigma)$ from an alternative buyer, where σ reflects the degree to which the higher quality characteristics of the processed input can be put to use by another buyer. Setting $\sigma = 0$ corresponds to the case where all high quality features embedded into the processed input are specific to B. Alternatively, σ could reflect market thickness on the buyer side; the more potential buyers there are, the more likely it is to find an alternative buyer willing to pay a premium for the particular characteristics of the processed input.

We further assume a risk of contractual breakdown under GO, where θ reflects the probability that the input does not arrive, or is delayed. If this occurs the EU firm can enforce the contract through legal or other channels at a cost F. Finally, assume B and S are risk-neutral.

In the analysis that follows we solve for the optimal organizational structure through backward induction.

3.1 Quality selection under GO

Let $\Pi_{GO,H}^B$ and $\Pi_{GO,L}^B$ denote the profits of the EU buyer under GO, when producing a high or low quality variety respectively, where

$$\Pi_{GO,H}^B = P^H - P_Z^L(1+\tau) - \delta^H - \theta F \quad (1)$$

$$\Pi_{GO,L}^B = P^L - P_Z^L(1+\tau) - \delta^L - \theta F. \quad (2)$$

[9] In practice, duties are applied on the value added only from outward processing, with the EU producer claiming relief for the rest. For simplicity, no duties are applied on re-imported outward processed inputs in the model. We also abstract from transport costs.

The profits of the external supplier are given by $\Pi^S_{GO} = P^L_Z - C_Z$, irrespective of final product quality. Let $P^L_Z \geq C_Z$, so S is willing to supply an input at the spot price[10]. It follows from (1) and (2) that B prefers to produce a low quality variety under GO if the output price quality premium satisfies:

$$P^H - P^L < \delta^H - \delta^L. \tag{3}$$

If condition (3) is satisfied then B has the choice of producing a low quality variety through GO or a high quality variety through OP. Otherwise, B produces a high quality variety irrespective of organizational structure and the choice between GO and OP hinges on factors other than the quality premium. Each case is considered in turn.

3.2 GO versus OP for high quality production

Suppose condition (3) is violated, so high quality GO is the only relevant alternative to OP. If Nash bargaining fails, then B purchases a low quality input from the spot market and transforms it into a high quality variety[11], while S incurs search costs and sells the processed input to an alternative buyer. The payoffs from these outside options, denoted by $\Pi^B_{OO,H}$ and Π^B_{OO}, are

$$\Pi^B_{OO,H} = P^H - P^L_Z(1+\tau) - \delta^H - \theta F - C_Y - h \tag{4}$$

$$\Pi^S_{OO} = P^L_Z(1+\sigma) - C_S - K. \tag{5}$$

Let P^{H*}_Z denote the agreed price if *ex post* bargaining is successful. Corresponding payoffs from OP, denoted by Π^B_{OP} and Π^B_{OP}, are thus

$$\Pi^B_{OP} = P^H - P^{H*}_Z - C_Y - h \tag{6}$$

$$\Pi^S_{OP} = P^{H*}_Z - K. \tag{7}$$

[10] We could assume the spot market is perfectly competitive, so $P^L_Z = C_Z$.
[11] Running the risk that with probability λ an enforcement cost F will be paid.

The minimum price acceptable to S, $P^H_{Z,\min}$, is that which makes Π^S_{OP} just equal to Π^S_{OO}, while the maximum price B is willing to pay, $P^H_{Z,\max}$, is that which makes payoff Π^B_{OP} exactly equal to $\Pi^B_{OO,H}$. It follows from (4) - (7) that:

$$P^H_{Z,\min} = P^L_Z(1+\sigma) - C_S \tag{8}$$

$$P^H_{Z,\max} = P^L_Z(1+\tau) + \delta^H + \theta F. \tag{9}$$

Hence, the higher are P^L_Z and σ and the lower is C_S, the better is the supplier's outside option and thus the higher the minimum acceptable price for S. Similarly, the lower are P^L_Z, τ, $\delta^H$and θF, the better is the buyer's outside option and thus the higher the maximum price B is willing to pay. Any price $P^H_Z \in \left[P^H_{Z,\min}, P^H_{Z,\max}\right]$ can be supported as a Nash equilibrium, but we assume an equal split of quasi-rents for simplicity.[12] Hence

$$P^{H*}_Z = \frac{1}{2}\left(P^H_{Z,\min} + P^H_{Z,\max}\right) = P^L_Z\left(1 + \frac{\tau+\sigma}{2}\right) + \frac{\delta^H}{2} + \frac{\theta F}{2} - \frac{C_S}{2}. \tag{10}$$

This price is mutually acceptable so outside options are never exercised. Substituting (10) into (6) and (7) gives the equilibrium payoffs under OP from the Nash solution:

$$\Pi^{B*}_{OP} = P^H - P^L_Z\left(1 + \frac{\tau+\sigma}{2}\right) - \frac{\delta^H}{2} - \frac{\theta F}{2} + \frac{C_S}{2} - C_Y - h \tag{11}$$

$$\Pi^{S*}_{OP} = P^L_Z\left(1 + \frac{\tau+\sigma}{2}\right) + \frac{\delta^H}{2} + \frac{\theta F}{2} - \frac{C_S}{2} - K. \tag{12}$$

Π^{B*}_{OP} must be at least as large as $\Pi^B_{GO,H}$ for the EU buyer to (weakly) prefer OP to GO, while Π^{S*}_{OP} must be at least as large as Π^S_{GO} for the supplier to accept. The EU buyer weakly prefers OP if (13) is satisfied:

$$P^L_Z\left(\frac{\tau-\sigma}{2}\right) + \frac{\delta^H}{2} + \frac{\theta F}{2} + \frac{C_S}{2} - C_Y - h \geq 0. \tag{13}$$

It follows that high quality producing EU firms are more likely to choose OP the greater the

[12] Quasi-rents from OP are $\Pi^B_{OP} + \Pi^S_{OP} - \Pi^B_{OO,H} - \Pi^S_{OO} = P^L_Z(\tau-\sigma) + \delta^H + \theta F + C_S$.

financial incentive to avoid import duties (i.e, the higher is τ and the higher the price of the input, P_Z^L), the greater the cost of transformation under GO, δ^H, the worse the quality of institutions, θF, the lower the buyer's costs associated with OP i.e. C_Y and h, the greater are the supplier's search costs for an alternative buyer, C_S, and the smaller the price the supplier stands to receive from an alternative buyer (i.e. σ, which reflects the degree of product specificity).

The supplier will accept to engage in OP provided (14) is satisfied:

$$P_Z^L\left(\frac{\tau+\sigma}{2}\right)+\frac{\delta^H}{2}+\frac{\theta F}{2}+C_Z-\frac{C_S}{2}-K\geq 0. \tag{14}$$

Higher search cost, C_S, and a smaller premium, σ, worsen the supplier's outside option once investments K is sunk, *ceteris paribus*, making it less likely S will accept. Conversely, lower costs of modifying the production process to carry out the processing, K, also make it more likely S accepts.

3.3 GO versus OP under quality switching

Now suppose condition (3) is satisfied, so OP implies switching from low to high quality production. If the OP contract breaks down and Nash bargaining fails, then B purchases a low quality input from the spot market and transforms it into a low quality variety. $\Pi_{OO}^S$is unchanged, but B's outside option payoff denoted by$\Pi_{OO,L}^B$, and$P_{Z,\max}^H$are now:

$$\Pi_{OO,L}^B=P^L-P_Z^L(1+\tau)-\delta^L-C_Y-h-\theta F \tag{15}$$

$$P_{Z,\max}^H=\left(P^H-P^L\right)+P_Z^L(1+\tau)+\delta^L+\theta F. \tag{16}$$

The larger the output price quality premium, the higher the maximum price B is willing to pay, which in turn impacts on P_Z^{H*}:

$$P_Z^{H*}=\frac{P^H-P^L}{2}+P_Z^L\left(1+\frac{\tau+\sigma}{2}\right)+\frac{\delta^L}{2}+\frac{\theta F}{2}-\frac{C_S}{2}. \tag{17}$$

Conditions for OP participation are found following similar steps to the former case. B engages in OP if (18) is satisfied and S accepts if (19) is satisfied:

$$\frac{P^H - P^L}{2} + P_Z^L\left(\frac{\tau - \sigma}{2}\right) + \frac{\delta^L}{2} + \frac{\theta F}{2} + \frac{C_S}{2} - C_Y - h \geq 0 \quad (18)$$

$$\frac{P^H - P^L}{2} + P_Z^L\left(\frac{\tau + \sigma}{2}\right) + \frac{\delta^L}{2} + \frac{\theta F}{2} + C_Z - \frac{C_S}{2} - K \geq 0. \quad (19)$$

Results are similar to the former case, except OP is now more likely the larger is the output price quality premium.

3.4 Predictions of the model

The model yields testable hypotheses regarding cross-country and cross-product differences for explaining OP trade of intermediate goods. Concretely, a larger share of OP should be observed in low cost countries with higher quality capability (corresponding to C_Y), lower contract enforcement quality (higher θF), larger MFN rate and hence tariff exemptions under OP (higher τ), closer proximity (distance, common language etc), lower corruption and greater political stability (corresponding to transport and monitoring cost h) and greater search costs, C_S.

Cross-product differences in OP trade may result from the degree of complexity of transactions, the asset specificity required, the degree of standardization of the transaction, the thickness of input markets. In particular, a larger share of OP should be observed the higher the quality premium ($P^H - P^L$), the higher the spot price, $\left(P_Z^L\right)$, the lower the cost of the initial input sent for processing (C_Y), the higher are transformation costs under GO (δ^L, δ^H), the greater are search costs for the supplier to search for another importer and transport input, C_S, and the lower is the premium from adaptability in higher quality, σ.

The broader literature also suggests a larger share of OP should be expected the larger the differences in relative factor endowments, reflecting Hechkscher-Ohlin theory, and the larger are market size differences, reflecting new trade theory (e.g. Egger and Egger, 2005).

The predictions complement the literature in new ways. First, they emphasize the role of quality differentiation/complexity as a determinant of the choice of offshoring mode. Second, they stress the importance of trade and monitoring costs for OP trade. Third, they show that the impact of input specificity on the choice of offshoring mode is ambiguous. On the one hand, larger input specificity requires larger relationship-specific investment, K, making S's condition for engaging in OP more

stringent. On the other hand, input specificity influences the premium from adaptability in higher quality, σ, with conflicting effects on B 's willingness to engage in OP and the S 's willingness to accept to engage in OP. Fourth, better institutions lower the likelihood of contractual breakdown (θF) making the OP conditions more stringent and thus GO more likely.

4 The determinants of outward processing trade in the European Union

This section tests the predictions of the model presented in section 3.

4.1 Data and variable construction

We use trade statistics from the COMEXT database for the period 2002 to 2008. This database, provided by EUROSTAT, disaggregates monthly imports into the EU by origin, destination and by statistical regime. Products are defined at 8 digits of the Combined Nomenclature (CN), which uses the Harmonized System (HS). This allows us to differentiate imports into the EU under the OP import regime (regime 3) from those under the "normal imports" regime. Monthly values on imports and quantities are aggregated by country of origin and destination within the EU for each year. Observations below 5,000 Euros are dropped since these are not meaningful trade flows and may reflect goods sent abroad for repair under the OP regime.

An important consideration is that not all products are suited to outward processing. This is especially the case for agricultural products and primary commodities, as well as some types of manufactures. Analyzing which types of products are more suited to OP is beyond the scope of this paper, though is likely to depend largely on technological and demand considerations. To deal with this issue, we restrict the dataset to those products that experience at least one flow of outward processing trade to the EU at some point between 2002 and 2008. Concretely, the final dataset includes 4,404 product lines that at some point during the period had positive imports under the outward processing regime; this represents around 34% of total product lines over the period. We also aggregate flows to the EU, treating it as a single destination, since OP imports by the same EU firm can potentially enter the EU via different countries in order to supply different plants across the EU. The final dataset includes more than 600,000 observations, between 80,000 and 90,000 for

each year from 2002 to 2008. The unit of observation corresponds to an import flow into the EU from country i in product k in year t. There is at least one observation for each, corresponding to normal imports, outward processing or both. We thus define the OP share ratio for each country i in product k in year t as the share of outward processing imports in total imports:

$$S_{ikt} = \frac{outward_{ikt}}{normal_{ikt} + outward_{ikt}} \tag{20}$$

Table 1 summarizes all the variables used to test the predictions of the model. Since OP trade in the EU is associated with a duty drawback system for imports, it is expected that larger product tariffs increase the attractiveness of OP trade. For each observation we use the TARIC database and obtain the tariff paid for each flow and the MFN tariff for each particular product. Besides tariffs, we use standard gravity variables, in particular distance, contiguity, common language and colony from the CEPII database, as well as the political stability index developed by Kaufmann *et al.* (2010) to reflect monitoring costs and the importance of proximity.

Measuring relationship-specific investments arising due to asset and input specificity is difficult since specificity may arise in the context of specific assets or tasks required, or else as complexity in the production process. We use the specificity measures proposed by Nunn (2007), which consider, for each product, whether its input are sold in an organized exchange or whether they are reference priced in a trade publication using the Rauch (1999) classification. The measures treat asset specificity as the degree of product differentiation embedded in the inputs required to produce an output. The main assumption is that inputs traded in organized exchanges, or that are reference priced, have thicker markets reducing potential hold up problems. Therefore, the lower the input content traded in an organized exchange or reference priced, the more asset specific is a product. We use available EU input-output tables from 2000 to 2007 to compute, for each sector, the share of each type of input and calculate the two measures proposed by Nunn (2007). The first measure considers inputs neither sold in organized exchanges nor reference priced (nunn1), while the second measure considers inputs not sold in organized exchanges only (nunn2). To capture other dimensions of asset specificity, we complement the Nunn (2007) measures with the Pavitt (2000) measure of sector R&D intensity, since more R&D intensive sectors may require larger inter-firm coordination during offshoring, as well as with the degree of capital intensity proxied by the capital to labor ratio, since

more capital intensive sectors are less contract intensive than skill intensive sectors (Nunn, 2007).

For the cost of transforming inputs into high quality goods, we use as a proxy the number of OP flows divided by the number of flows using normal imports. The assumption here is that more flows imply more countries involved in this transformation, which presumably implies the use of more mature technologies, which are therefore less costly. To control for low cost producing capacity we use population from the World Development Indicators (WDI, 2011) and to capture the quality premium we use the ratio of the 90th to the 10th percentile in the unit values of each product.

Search costs have two components. First, to measure market thickness we use the number of EU countries that engage in OP for each product. Second, to capture ease of exporting to a different buyer we use air traffic volume. To capture the premium for product adaptability we use the ratio of the average unit value premium for OP flows (over normal flows) to the average unit value of normal flows for each product. This measure captures the scope for sellers to obtain higher prices from selling OP products to other buyers. At the same time, this premium is also likely to depend on the rigidity of input specificity, which is also captured by the Nunn (2007) measures. Finally, the rule of law index developed by Kaufmann *et al.* (2010) measures the quality of contract enforcement, property rights and courts.

4.2 OP trade shares: main countries and sectors

OP imports represent a small share of imports to the EU. In 2008, OP imports were only 0.9% of total imports. Considering only the products that experienced at least one OP flow during the sample period, this regime accounts for around 3.45% of total imports and 7.7% of all observations. Clearly, this type of trade is far less prevalent that normal trade, but is also less important than inward processing[13], which in 2008 represented 3.3% of total imports.

Table 2 shows the top 20 countries, ranked by the share of OP imports to total imports from these countries into the EU[14] The table shows some interesting results. First, the relative importance of this type of trade in some Central and Eastern European countries is striking. This suggests that proximity may play a very important role in explaining this type of offshoring by significantly

[13]Where imported products are processed in the EU to be subsequently re-exported.

[14]This share is calculated for each country of origin as the weighted average share of OP imports to total imports for each product and year and excludes other processing regimes such as the textile regime and the inward processing regimes.

reducing monitoring costs and increasing delivery reliability. Second, while institutions and the rule of law may still be important factors in explaining total trade, it is less clear how important rule of law is for OP in total trade. The correlation coefficient between OP share and the rule of law index is negative and small, -0.14. Furthermore, it is interesting that China, one of the main processing platforms, only exports around 0.24% of its exports to the EU as OP trade;[15] while this share for the US exceeds 12%, on average.

A first look at the data also reveals the unclear role of nominal tariffs on outward processing. As discussed, importers can claim for a duty drawback equivalent to the tariff that would be applied to the input exported for processing, with tariff duties paid only on the value added from processing. Surprisingly, some of the countries in Table 2 enjoy preferential access to the EU market for a large number of products. For example, in 2000 the EU granted preferences to most products coming from the Western Balkans.[16] Moreover, countries eligible for the Everything But Arms (EBA) scheme also have positive, although small, shares of outward processing exports. Two elements may explain this fact; first, in some cases importers can claim VAT relief. This implies that, even in the case of preferential access, there may remain an incentive to apply for outward processing relief. Second, and more important, is the well known fact that there are significant compliance costs for eligibility for preferential access.[17] It is possible, therefore, that it is less costly for importers to apply for outward processing relief than for exporters to request the preference.

Regarding the sectoral composition of outward processing shares, Table 3 shows the 20 HS-2 chapters with the largest share of OP imports on total imports. The main sector where OP trade takes place is "87 Vehicles other than railway", with around 28% of imports. This sector is followed by "28 Inorganic chemicals", "88 Aircraft, spacecraft,.." and "62 Articles of apparel and clothing, not knitted..", with OP shares for these sectors ranging from 11.5% to 7.35%, on average. Outward processing represents more than 5% of EU imports for only five sectors, and there is also evidence of OP, although to a lesser extent, of agricultural products.[18] An analysis of sectoral concentration

[15] While many processed goods from China enter the EU as final products, EU firms export relatively few intermediates to China for processing followed by subsequent re-import into the EU. Nevertheless, given the large scale of Chinese exports to the EU, in absolute terms OP trade from China in 2008 was worth approximately 1 billion Euros.

[16] Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Serbia and Kosovo.

[17] Carrère and de Melo (2004) estimate such costs for EU preferential schemes and FTAs (PANEURO) lie between 4.7% and 8.2% of the *cif* export price. Manchin (2006) obtains a similar estimate of around 4.5%.

[18] In addition to the general OP regime, firms in the textile and clothing sectors have access to a special OP regime specifically for these sectors. For reasons we do not know, some firms opt for the general OP regime and others for

for the 10 countries with the largest OP share shows that only OP imports from Moldova are all concentrated in clothing sectors[19] 61 and 62. Although textiles and clothing sectors 50 to 63 are also prominent in the OP imports from the other countries, there are other important sectors. In general, OP imports from particular countries are not driven exclusively by a few sectors.

The preliminary analysis of the data shows that OP trade appears to be concentrated heavily in the vehicles sector and in countries with closer proximity to the EU. The next sections test the predictions of the model developed in Section 3.

4.3 Outward processing trade and the quality premium

One important aspect of the model is the motivation of firms to engage in OP trade as compared to generic offshoring in order to produce products with higher quality, complexity or sophistication attributes. High quality production takes place either by starting the production process in-house, sending an input abroad for processing and then re-importing it as a higher quality intermediate (OP trade) or else by transforming a low quality intermediate sourced directly from abroad (generic offshoring); low quality production is assumed to take place only via transformation of low quality inputs. These differences in quality should arguably translate into a price premium of imported products under the OP regime *vis-à-vis* imports of the same product under the normal regime.

Despite not having price data available, we can proxy prices using unit values. We compute unit values by dividing total imports by total quantities under each regime for each year, product and country pair. Our unit of observation is each specific trade flow, so for country pairs with normal and OP flows for a given product in the same year we have two observations. Furthermore, in order to minimize distortions in unit values arising from aggregation of flows we use the initial disaggregated dataset with the each country in the EU treated as a distinct import destination. There are 4.5 million observations in total.

To test for the existence of a price premium in OP trade reflecting quality/complexity differentiation of inputs we estimate the following equation:

the special OP regime. We do not use data for the specific regime so our analysis underestimates the importance of OP trade for the textile and clothing sectors.

[19]Sector 61 is "Articles of apparel and clothing accessories - knitted or crocheted", while sector 62 is "Articles of apparel and clothing accessories - not knitted or crocheted".

$$ln(uv)_{ijkt} = \alpha + \beta_1 Out_{ijnt} + \beta_2 GDP_{it} + \beta_3 GDP_{jt} + \sum \lambda_t + \sum \lambda_{ij} + \sum_{k}^{K} \lambda_k + e_{ijkt}. \quad (21)$$

The log of the yearly unit value for each country pair ij, product k and year t, is regressed on a dummy variable Out_{ijkt}. which takes the value one if the import flow is registered under the outward processing regime, and zero otherwise. β_1 thus captures the price premium associated to OP trade *vis-à-vis* normal imports. We also introduce a range of controls to capture other factors that may affect prices. In line with the literature we use GDP per capita of the origin country and the EU destination market to control for supply and demand factors that may affect prices[20]. We use time dummies, λ_t, to control for business cycle factors in EU markets and changes in demand. Finally, in one specification we also control for country pair fixed effects, λ_{ij}, and product fixed effects, λ_k.

The results are summarized in Table 4. OLS estimates with only year dummies are reported in column (1). Column (2) reports results with product fixed effects and year dummies, while column (3) reports results where we further control for GDP per capita levels. Finally, column (4) controls for all other factors by adding country pair, year and product fixed effects in the estimation.

The R^2 is large for most specifications, ranging from 0.295 for the OLS specification to 0.656 for fixed effects specifications. The coefficients on GDP per capita are positive and significant in the product fixed effects specification. The coefficient on the export premium is statistically significant for all specifications. Since the OLS specification lacks adequate controls for product and country specific effects, the effects of these are mainly absorbed in the export premium coefficient. When controlling for product, year and country pair fixed effects, the estimated coefficient suggests unit values of imports under outward processing are, on average, around 13% higher than normal imports. This is consistent with the model, which suggests outward processing flows reflect more sophisticated or complex products, where product quality or complexity is translated into higher unit values.

[20] Richer countries tend to export more sophisticated products and export prices tend to be higher in higher income markets.

4.4 Determinants of outward processing

To test the predictions of the model we use the dataset that aggregates observations over EU countries, treating the EU as one destination market. Most exporters to the EU during the period 2002 to 2008 are included.[21] Since the model focuses on the choice between two modes for offshoring inputs, we restrict our sample to include only intermediate goods[22]. To select intermediate goods only, we map the Broad Economic Categories (BEC) classification, which classifies sectors as intermediate, capital, and consumption goods, to the CN using the EU conversion tables. Only the product lines corresponding to intermediate product sectors are selected.[23] This reduces the dataset to 1,938 product lines of intermediate goods that, in at least one year of the sample period, had positive imports under regime 3; this corresponds to more than 250,000 observations, around 35,000 observations for each year from 2002 to 2008.

The model yields predictions regarding the choice of offshoring mode between OP and GO. We therefore need to examine the determinants of the choice between offshoring modes, rather than OP trade *per se*. To capture offshoring choice we construct two variables. The first variable is an OP indicator, D_{ikt}, which takes the value one when country i exports good k to the EU in period t *only* under the OP regime, and 0 otherwise. This dummy variable captures total specialization in OP trade. The second variable measures OP intensity of flows of good k from country i to the EU in period t, S_{ikt}, and has already been defined as the share of OP trade in total trade for each product.

The following general equation is estimated:

$$y_{ikt} = \alpha_0 + \alpha_1 \tau_{ikt} + \sum \beta_n x_{kt} + \sum \delta_l z_{it} + \sum \lambda_t + u_{ikt}, \tag{22}$$

where y_{ikt} is one of the OP trade choice variables defined above (D_{ikt} or S_{ikt}), τ_{ikt} is the tariff applied to normal imports of product k imported from country i to the EU in period t, z_{it} is a vector of country specific variables in period t, x_{kt} is a vector of product specific variables in period t, λ_t are year dummies and u_{ikt} is a normally distributed error term, $N \sim (o, \sigma^2)$. The variables

[21] Countries without available macro data are dropped. This corresponds mainly to small Caribbean and Pacific islands, some European territories such as the Canary Islands or Melilla, and Kosovo and Taiwan.

[22] The model is also arguably consistent with the offshoring of final goods, since the degree of transformation by domestic firms can be small. Section 4.3.3. presents results where final goods are also included as a robustness check.

[23] Specifically, we use BEC intermediate sectors 111, 121, 21, 22, 31, 322, 42 and 53.

used and their construction are summarized in Section 4.1 and Table 1.

A probit estimator is used to estimate the decision to use OP using the D_{ikt} indicator. When analyzing the determinants of OP trade intensity using share index S_{ikt}, the dependent variable is a proportion bounded between 0 and 1, which results in biased OLS estimates. The error term is heteroscedastic since the errors are, by definition, smaller when observations are closer to 0 and 1. The model is thus estimated using the generalized linear model (GLM) with a logistic function, as in Cameron and Trivedi (2005).

4.4.1 Results on OP specialization

Table 5 shows the results for the estimates of the choice of OP. Specification (1) uses the nunn1 measure, while specification (3) uses the alternative nunn2 measure of asset specificity. Specifications (2) and (4) add a further interactive term, in line with Feenstra *et al.* (2012), which interacts the nunn1 and nunn2 measures, respectively, with a dummy variable that takes the value one if the law index is above average in the country of origin, and zero otherwise.

Table 5 reports the marginal effects of the probit estimates directly, to facilitate interpretation. As expected, tariffs increase the probability of specializing completely in OP; a marginal change in the tariff increases the probability of OP specialization by 2%. Distance reduces the probability of OP specialization, confirming the importance of proximity in OP trade stressed by Feenstra and Spencer (2005). Moreover, political stability increases the probability of OP specialization; in particular, a unit increase in the political stability index increases the probability of OP choice by around 13%. The coefficients for common language and contiguity are negative but mainly non-significant; similarly for former colony, suggesting these are not key determinants of offshoring mode.

Both Nunn (2007) measures have a positive coefficient but are not always statistically significant. Interestingly, however, when specificity is interacted with whether the country has better than average rule of law, the results suggest the positive impact of input specificity on OP choice is significantly reduced in countries with better institutions. One possible explanation is that inter-firm relationships arising from OP are important in stimulating trade when rule of law is weak as they serve to compensate for poor institutions when outsourcing inputs; where the rule of law is strong, it is factors other than specificity that drive OP choice. Moreover, the estimates suggest that

more R&D intensive sectors are more likely to use OP trade; increases in R&D intensity increase the probability of OP trade by around 14%.

The number of flows using the OP regime divided by the number of flows under the normal regime, as a proxy for cheaper transformation and more mature technology, is also statistically significant and increases the probability of OP trade. Interestingly, population as a proxy for labor costs reduces the probability of OP trade, suggesting that low costs are not an important determinant of specialization in this type of offshoring.

Input market thickness, proxied by the number of OP countries for a given product, decreases the probability of using OP trade by around 2%. This is somewhat puzzling, since thicker markets are presumed to imply lower search costs for alternative buyers, and could instead indicate that search costs are larger since alternative buyers also have more supplier options. The volume of air traffic, another proxy for search costs, increases the probability of OP trade, although coefficients are not always statistically significant. This variable may also plausibly be capturing the importance of in-time delivery for OP trade.

The coefficient on the unit value premium between OP and GO trade, reflecting the premium for adaptability of the input to alternative buyers, is not statistically significant. However, as discussed above, it is likely that the effect of this factor is captured by the input specificity proxies. Higher specificity imply lower value to alternative uses and greater likelihood of OP trade. The overall positive impact of specificity on OP trade suggests that the negative impact of sunk investment costs is outweighed by the gain from the premium of the outside option for specialized suppliers. Finally, as suggested by the model, strong institutions may be more important determinants of GO by reducing the risk of contractual breakdown. This is reflected in our estimates, since a unit increase in the rule of law index reduce the probability of using OP *vis-à-vis* GO by around[24] 49%.

4.4.2 Results on OP intensity

Table 6 reports the marginal effects for the Generalized Linear Model (GLM) estimates for OP trade intensity, as measured by the share of OP trade to total trade. The results are very similar to those from the probit estimation. Tariffs, geographical proximity and political stability are associated with

[24] The rule of law index ranges from -2.5 to +2.5, so a unit increase reflects a substantial improvement in institutions, which explains the large marginal effect.

greater OP intensity. As before, the asset specificity marginal effect is not statistically significant for intermediates, although the interactive term indicates a negative impact for countries with better institutions. Again, sectoral R&D intensity is associated with higher OP intensity. The main difference between these and the probit estimates lies in the role of labor costs, as proxied by population; lower labor costs are found to be associated with higher OP intensity. Finally, the results point to a strong negative effect of the rule of law index on the intensity of OP trade.

In general, the estimates confirm the main predictions of the model, emphasizing the role of tariffs, proximity, and especially the rule of law and asset specificity in explaining the choice of offshoring mode. The most interesting finding is the role of institutions; weaker rule of law is strongly associated with greater OP intensity for all specifications. While institutions are likely to facilitate trade in general, OP trade may serve, via relationship specific investments and monitoring, to compensate for poor institutions that make GO relatively less attractive due to the risk of delays or non-deliveries.

4.4.3 Robustness checks

Imports of final products are also consistent with the model described in section 3 if they experience some transformation by EU firms, albeit very small (e.g. packaging, branding or marketing). As a result, and as a robustness check, we re-estimate the same specifications using data on all sectors, intermediate and final, where at some point of the sample period at least one import flow under the OP regime is observed.

Tables 7 and 8 report the marginal effects for the choice of offshoring mode and the GLM results for OP intensity, respectively. The results are very similar to those reported in Tables 5 and 6 for intermediate products. Focusing on the most important variables, tariffs and political stability increase the probability of OP specialization and OP intensity. Once again, better rule of law significantly reduces the probability of OP and the degree of OP intensity, arguably making GO relatively less risky, and thus more likely. The main differences lies in the estimated coefficients of the Nunn specificity variables and capital intensity, which are now statistically significant and suggest a greater likelihood of OP trade in more asset specific and less capital intensive sectors. Again, the impact of asset specificity on the OP offshoring mode decreases in countries with better rule of law. Overall, the impact of specialized inputs in affecting trade is more significant when the

analysis includes both intermediates and final goods. Moreover, for the entire sample of products, the degree of price differentiation becomes statistically significant and positive, indicating OP trade is more prevalent in products with larger price differentiation, where there are likely to be more incentives for quality upgrading.

5 Conclusions

This paper explains participation in processing trade as a mode of offshoring of intermediates. We develop a model of firm choice of offshoring mode for sourcing an intermediate from abroad, that compares outward processing trade with generic offshoring. The model incorporates quality differentiation, input specificity, tariffs and monitoring costs as critical elements of the choice between OP and GO. Specifically, the model predicts that higher tariffs, lower monitoring costs, higher search costs for alternative suppliers or greater quality differentiation increase the likelihood of choosing OP trade *vis-à-vis* GO. It also predicts that institutions and the rule of law have an important effect through their impact on the likelihood of contract breakdown under GO. The impact of input specificity is shown to be theoretically ambiguous since higher specificity implies, on the one hand, larger sunk investments required to adapt production, while on the other hand, a smaller premium for selling the specialized input to alternative suppliers.

Testing these predictions using OP trade data in the EU for the period 2002 to 2008 generally confirms the predictions, and emphasizes the role of tariffs, proximity and quality differentiation as determinants of outward processing. A net positive effect of input specificity on OP trade is found empirically. The analysis also points to a strongly significant negative impact of the rule of law on both OP choice and OP intensity, consistent with the observed concentration of OP trade by European firms in some Eastern European countries. This suggests that relationship-specific investments and monitoring costs associated with OP trade may offset the effect of weak institutions and poor rule of law, which make GO relatively unattractive due to the risk of poor contract enforcement. Contractibility, related to specificity, may thus be replaced by stronger inter and intra-firm governance.

Further research can shed light on the different degrees of governance rigidity within value chains under both OP and GO, as well as how these overlap with different ownership structures.

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Figures and Tables

Figure 1. Model Summary

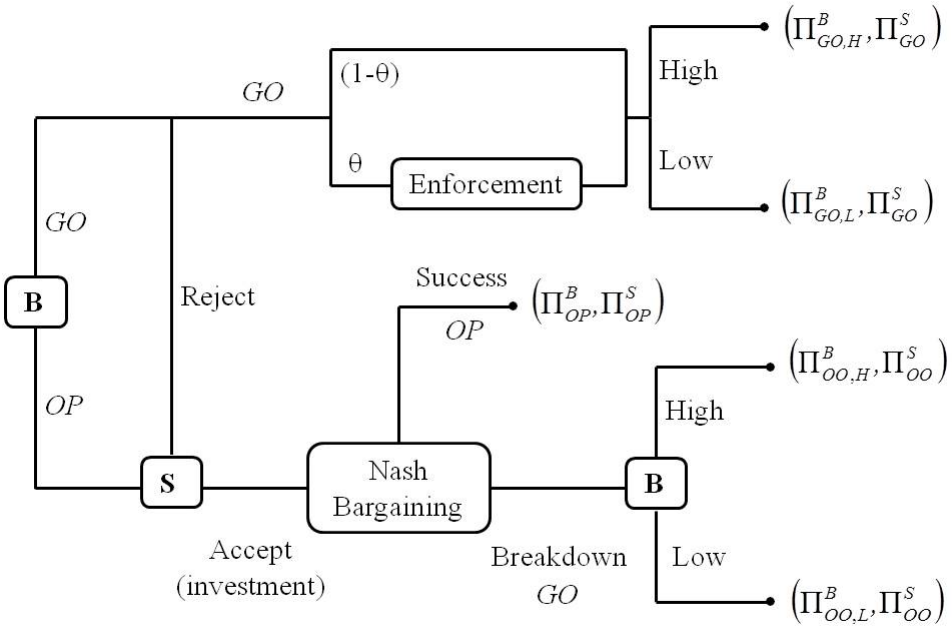

Table 1. Variable description and construction

Variable	Variable description	Proxies	Proxy description
τ	Tariffs	tariff	MFN tariff for each product and effective tariff paid for normal flows (TARIC)
h	Monitoring costs	distance, colony, contig, common	Distance, former colony, contiguity, common language (CEPII)
		pol.stab	Political stability index (Kaufmann *et al.*, 2010); ranges from -2.65 to 2.65.
K	Relation specific investments /specialized input	nunn1, nunn2	Nunn asset specificity measures (Nunn, 2007)
		R&D	R&D intensity (Pavitt, 2000)
		capital/lab	Sector capital to labor ratio (GTAP database)
δ^h	Transformation cost for high quality	OP/GO flows	Number of OP flows divided by number of normal import flows
C_Y	Input costs	population	Labor endowment (WDI, 2011)
$P^H - P^L$	Quality premium	price diff	Ratio of 90th percentile to 10th percentile in the unit value for each product
C_S	Search costs	number OP	Market thickness measured by the number of OP exporters
		air	Air traffic volume (WDI, 2011)
σ	Premium for adaptability in higher quality	OP/GO premium	Ratio of the average unit value premium for OP flows to the average unit value of normal flows for each product
		nunn1, nunn2	Asset specificity measures (Nunn, 2007)
θF	Cost of contract breakdown	law	Rule of law index (Kaufmann *et al.*, 2010); ranges from -2.5 and 2.5.

Table 2. Countries with larger OP trade shares (weighted average ratio of outward to normal trade)

Country	2002	2003	2004	2005	2006	2007	2008	average
Albania	64.32%	57.79%	62.03%	65.02%	52.27%	50.29%	46.09%	56.83%
Armenia	18.70%	79.31%	24.91%	16.33%	48.37%	66.20%	61.14%	44.99%
Ukraine	52.66%	56.44%	41.13%	33.75%	30.31%	22.14%	19.11%	36.51%
Moldova	41.64%	38.67%	39.87%	33.98%	25.11%	24.57%	22.55%	32.34%
Macedonia	31.91%	30.78%	28.40%	29.27%	27.45%	35.36%	38.23%	31.63%
United States	7.52%	10.56%	12.87%	8.37%	15.28%	16.59%	14.57%	12.25%
Belarus	33.21%	15.08%	11.38%	6.51%	4.41%	4.64%	6.27%	11.64%
Romania	14.98%	12.50%	10.28%	9.76%	7.66%			11.04%
Bulgaria	9.07%	10.34%	10.20%	8.51%	7.28%			9.08%
Bosnia	9.75%	9.02%	9.77%	7.34%	6.29%	7.45%	7.69%	8.19%
South Africa	7.57%	7.68%	8.08%	10.69%	15.38%	1.82%	1.28%	7.50%
Brunei	0.00%	0.00%	0.14%	0.00%	7.93%	40.17%	1.81%	7.15%
Sao Tome	4.00%	41.93%	0.00%	0.00%	0.00%	0.95%	0.00%	6.70%
Iraq	35.01%	0.00%	0.00%	0.00%	0.00%	10.81%	0.00%	6.55%
Myanmar	2.64%	3.58%	3.09%	9.04%	8.61%	9.32%	9.03%	6.48%
Sri Lanka	12.66%	8.21%	9.29%	6.49%	2.39%	1.85%	1.81%	6.10%
Morocco	6.59%	6.11%	6.15%	5.61%	4.19%	4.54%	4.34%	5.36%
Somalia	0.00%	0.00%	35.80%	0.00%	0.00%	0.00%	0.00%	5.11%
Croatia	6.62%	4.57%	4.19%	4.74%	4.12%	3.89%	4.11%	4.61%
Brazil	0.15%	0.23%	0.08%	7.59%	6.60%	6.57%	10.55%	4.54%

Source: COMEXT database

Table 3. OP trade by HS-2 Chapter

HS-2 chapter	2002	2003	2004	2005	2006	2007	2008	Average
87 Vehicles other than railway	24.24%	26.74%	28.47%	22.36%	31.07%	32.36%	30.58%	27.97%
28 Inorganic chemicals,..	11.47%	11.47%	9.31%	15.24%	11.80%	8.71%	12.57%	11.51%
88 Aircraft, spacecraft,..	4.83%	11.91%	6.15%	6.88%	16.60%	13.67%	8.54%	9.80%
62 Articles of apparel and clothing, not knitted	9.86%	9.27%	8.54%	7.51%	6.72%	4.74%	4.80%	7.35%
13 Lac, gums, resins,..	16.09%	18.18%	2.33%	0.02%	0.00%	0.09%	0.00%	5.24%
21 Miscellaneous edible preparations,..	8.82%	9.88%	12.10%	1.80%	0.06%	0.06%	0.63%	4.77%
64 Footwear, gaiters,..	7.09%	6.17%	4.54%	3.77%	3.53%	1.72%	2.10%	4.13%
18 Cocoa and cocoa preparations	7.38%	5.41%	7.10%	3.11%	2.90%	0.19%	0.17%	3.75%
19 Preparations of cereal, starch,..	4.67%	6.01%	9.32%	1.75%	0.55%	0.84%	0.66%	3.40%
53 Other vegetable textile fibres	1.16%	4.70%	5.83%	1.73%	2.35%	2.00%	4.56%	3.19%
29 Organic chemicals	2.52%	3.62%	2.88%	2.11%	2.41%	2.05%	2.81%	2.63%
05 Products of animal origin	2.12%	3.68%	3.94%	2.86%	2.08%	0.74%	0.24%	2.24%
20 Preparations of vegetables, fruits, nuts	1.56%	1.65%	1.48%	1.67%	1.36%	3.46%	2.42%	1.94%
81 Other base metals	1.19%	2.30%	1.74%	1.26%	2.58%	1.56%	1.06%	1.67%
83 Miscellaneous articles of base metals	1.12%	2.59%	2.39%	1.51%	1.57%	1.30%	0.65%	1.59%
61 Articles of apparel and clothing, knitted	2.28%	1.95%	1.60%	1.23%	1.07%	1.17%	1.16%	1.49%
15 Animal and vegetable fats and oils,..	0.01%	0.08%	1.08%	2.91%	3.72%	1.08%	0.75%	1.38%
86 Railway and tramway locomotives	0.51%	0.35%	0.45%	0.57%	0.67%	3.42%	2.55%	1.22%
70 Glass and glassware	4.89%	0.39%	0.98%	0.55%	0.30%	0.40%	0.29%	1.12%
43 Furskins and artificial fur	0.32%	0.62%	1.29%	0.63%	0.30%	1.69%	2.70%	1.08%

Table 4. Estimates of the unit value premium of OP trade

VARIABLES	(1) OLS[a]	(2) FE[b]	(3) FE[b]	(4) FE[c]
outward	0.994***	0.104***	0.136***	0.133***
	(0.0238)	(0.00307)	(0.00289)	(0.00294)
gdp_cap			2.12e-05***	
			(2.85e-08)	
gdp_cap_d			8.46e-06***	
			(5.19e-08)	
constant	2.245***	2.243***	1.750***	
	(0.0220)	(0.00120)	(0.00168)	
Observations	4,456,753	4,456,753	4,181,140	4,456,7530
R-squared	0.295	0.606	0.656	0.646

[a]Year dummy coefficients not reported. Robust standard errors in parentheses
[b]Product fixed effects. Year dummy coefficients not reported
[c]Product and country pair fixed effects. Year dummy coefficients not reported
*** p<0.01, ** p<0.05, * p<0.1

Table 5. Probit marginal effects. OP specialization - intermediate goods

	(1)	(2)	(3)	(4)
tariff	0.0203***	0.0197***	0.0207***	0.0200***
	(0.0025)	(0.0025)	(0.0026)	(0.0026)
distance	-0.3156***	-0.3228***	-0.3152***	-0.3226***
	(0.0227)	(0.0225)	(0.0227)	(0.0225)
colony	0.0010	0.0483	0.0017	0.0479
	(0.0583)	(0.0579)	(0.0583)	(0.0579)
contig	-0.1125	-0.2034**	-0.1123	-0.1977**
	(0.0671)	(0.0690)	(0.0671)	(0.0689)
common	-0.0477	-0.1035	-0.0475	-0.1020
	(0.0669)	(0.0668)	(0.0669)	(0.0669)
pol.stab	0.1296***	0.1286***	0.1298***	0.1270***
	(0.0307)	(0.0306)	(0.0307)	(0.0306)
nunn1	0.1048	0.3047*		
	(0.1222)	(0.1265)		
nunn1*dlaw		-0.3808***		
		(0.0664)		
nunn2			0.4381	0.6048
			(0.3766)	(0.3757)
nunn2*dlaw				-0.2769***
				(0.0517)
capital/lab	-0.1013	-0.0964	-0.1347	-0.1222
	(0.1108)	(0.1108)	(0.0993)	(0.0990)
R&D	0.1462**	0.1385**	0.1456**	0.1388**
	(0.0494)	(0.0496)	(0.0482)	(0.0483)
population	-0.0812***	-0.0659***	-0.0815***	-0.0649***
	(0.0178)	(0.0184)	(0.0178)	(0.0185)
OP/GO flows	4.7563***	4.7519***	4.7629***	4.7426***
	(0.1914)	(0.1905)	(0.1916)	(0.1908)
price diff	-0.0014*	-0.0015*	-0.0014*	-0.0015*
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
number OP	-0.0192**	-0.0206**	-0.0193**	-0.0200**
	(0.0072)	(0.0072)	(0.0072)	(0.0072)
air	0.0294**	0.0192	0.0294**	0.0187
	(0.0113)	(0.0114)	(0.0113)	(0.0115)
OP/GO premium	-0.0212	-0.0232	-0.0211	-0.0228
	(0.0149)	(0.0149)	(0.0149)	(0.0149)
law	-0.4962***	-0.3431***	-0.4966***	-0.3437***
	(0.0389)	(0.0461)	(0.0389)	(0.0472)
constant	0.6895*	0.5950	0.3742	0.2369
	(0.3353)	(0.3392)	(0.4766)	(0.4780)
Observations	212046	212046	212046	212046
Pseudo R2	0.199	0.203	0.199	0.202

Year dummy coefficients not reported

*** p<0.01, ** p<0.05, * p<0.1

Table 6. Generalized linear Model. Marginal effects. OP intensity - intermediate goods

	(1)	(2)	(3)	(4)
tariff	0.0365***	0.0356***	0.0367***	0.0355***
	(0.004)	(0.004)	(0.004)	(0.004)
distance	-0.9023***	-0.9133***	-0.9022***	-0.9129***
	(0.029)	(0.028)	(0.029)	(0.028)
colony	0.3229***	0.3671***	0.3227***	0.3627***
	(0.081)	(0.08)	(0.081)	(0.08)
contig	-0.5790***	-0.6847***	-0.5789***	-0.6756***
	(0.099)	(0.1)	(0.099)	(0.1)
common	0.0616	0.0134	0.0619	0.0182
	(0.085)	(0.085)	(0.085)	(0.085)
pol.stab	0.5701***	0.5649***	0.5701***	0.5633***
	(0.044)	(0.044)	(0.044)	(0.044)
nunn1	0.0064	0.3096		
	(0.162)	(0.167)		
nunn1*dlaw		-0.4569***		
		(0.082)		
nunn2			0.1018	0.3539
			(0.463)	(0.462)
nunn2*dlaw				-0.3213***
				(0.0630
capital/lab	-0.1393	-0.1257	-0.1381	-0.1205
	(0.14)	(0.14)	(0.121)	(0.12)
R&D	0.2746***	0.2651***	0.2719***	0.2629***
	(0.063)	(0.063)	(0.062)	(0.062)
population	0.1921***	0.2172***	0.1921***	0.2170***
	(0.022)	(0.024)	(0.022)	(0.024)
OP/GO	11.3495***	11.3633***	11.3537***	11.3511***
	(0.264)	(0.263)	(0.265)	(0.264)
price diff	0.00000	0.00000	0.00000	0.00000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
number OP	0.0163*	0.0138	0.0161*	0.0144
	(0.008)	(0.008)	(0.008)	(0.008)
air	-0.0515***	-0.0673***	-0.0515***	-0.0670***
	(0.014)	(0.014)	(0.014)	(0.014)
OP/GO	-0.0699***	-0.0719***	-0.0700***	-0.0717***
	(0.019)	(0.018)	(0.019)	(0.018)
law	-0.6748***	-0.5149***	-0.6749***	-0.5220***
	(0.049)	(0.054)	(0.049)	(0.054)
constant	-1.0992**	-1.3406**	-1.1909*	-1.4733*
	(0.399	(0.408	(0.582	(0.587
Observations	212,046	212,046	212,046	212,046

Year dummy coefficients not reported

*** p<0.01, ** p<0.05, * p<0.1

Table 7. Probit marginal effects. OP specialization - all goods

	(1)	(2)	(3)	(4)
tariff	0.0265***	0.0246***	0.0273***	0.0255***
	(0.0005)	(0.0006)	(0.0006)	(0.0006)
distance	-0.3855***	-0.3905***	-0.3841***	-0.3886***
	(0.0053)	(0.0052)	(0.0053)	(0.0052)
colony	-0.1077***	-0.0316*	-0.1065***	-0.0307*
	(0.0148)	(0.0149)	(0.0148)	(0.0149)
contig	-0.1885***	-0.2945***	-0.1898***	-0.2917***
	(0.0152)	(0.0152)	(0.0152)	(0.0152)
common language	-0.0392*	-0.1461***	-0.0387*	-0.1420***
	(0.0171)	(0.0171)	(0.0171)	(0.0171)
pol.stab	0.4168***	0.3953***	0.4161***	0.3914***
	(0.0086)	(0.0087)	(0.0086)	(0.0086)
nunn1	0.4640***	0.9948***		
	(0.0358)	(0.0371)		
nunn1*dlaw		-0.8774***		
		(0.0147)		
nunn2			1.3408***	1.7172***
			(0.1234)	(0.1226)
nunn2*dlaw				-0.6990***
				(0.0123)
Capital/lab	-0.2925***	-0.2250***	-0.3777***	-0.3149***
	(0.0283)	(0.0284)	(0.0269)	(0.0268)
R&D	0.1079***	0.0720***	0.1084***	0.0765***
	(0.0143)	(0.0144)	(0.0144)	(0.0145)
population	-0.1365***	-0.0697***	-0.1366***	-0.0696***
	(0.0047)	(0.0051)	(0.0047)	(0.0051)
OP/GO flows	5.5401***	5.7083***	5.6803***	5.8301***
	(0.0675)	(0.0689)	(0.0660)	(0.0672)
price diff	0.0006***	0.0006***	0.0006***	0.0006***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
number OP	-0.0027***	-0.0037***	-0.0025***	-0.0033***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
air	0.0777***	0.0366***	0.0771***	0.0355***
	(0.0031)	(0.0032)	(0.0031)	(0.0032)
OP/GO premium	0.0027	-0.0011	0.0032	-0.0005
	(0.0058)	(0.0058)	(0.0057)	(0.0058)
law	-0.7680***	-0.4015***	-0.7669***	-0.4019***
	(0.0106)	(0.0118)	(0.0106)	(0.0120)
constant	1.9992***	1.1187***	1.1285***	0.2890*
	(0.0835)	(0.0871)	(0.1405)	(0.1414)
Observations	2177259	2177259	2177259	2177259
Pseudo R2	0.299	0.322	0.298	0.319

Year dummy coefficients not reported

*** p<0.01, ** p<0.05, * p<0.1

Table 8. Generalized linear Model estimates. OP intensity - all goods

	(1)	(2)	(3)	(4)
tariff	0.0429***	0.0395***	0.0441***	0.0410***
	(0.002)	(0.002)	(0.002)	(0.002)
distance	-1.0750***	-1.1181***	-1.0750***	-1.1129***
	(0.015)	(0.014)	(0.015)	(0.014)
colony	-0.0948*	0.0943*	-0.0936*	0.0878*
	(0.044)	(0.042)	(0.044)	(0.042)
contig	-0.8001***	-1.1888***	-0.8037***	-1.1635***
	(0.05)	(0.052)	(0.05)	(0.052)
common	-0.0301	-0.2180***	-0.0288	-0.2105***
	(0.05)	(0.05)	(0.05)	(0.05)
pol.stab	0.7858***	0.8198***	0.7842***	0.8107***
	(0.022)	(0.022)	(0.022)	(0.022)
nunn1	0.4467***	1.1929***		
	(0.098)	(0.097)		
nunn1*dlaw		-1.2990***		
		(0.038)		
nunn2			1.7155***	2.2766***
			(0.344))	(0.336)
nunn2*dlaw				-1.0106***
				(0.031)
capital/lab	-0.3719***	-0.2888***	-0.4153***	-0.3430***
	(0.072)	(0.071)	(0.069)	(0.068)
R&D	0.1148**	0.0677	0.1033**	0.0648
	(0.039)	(0.04)	(0.04)	(0.04)
population	0.0606***	0.1415***	0.0600***	0.1389***
	(0.012)	(0.013)	(0.012)	(0.013)
OP/GO	8.9531***	9.0579***	9.0300***	9.1155***
	(0.124)	(0.125)	(0.121)	(0.122)
price diff	0.0011***	0.0011***	0.0011***	0.0010***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
number OP	-0.0214***	-0.0252***	-0.0214***	-0.0247***
	(0.003)	(0.003)	(0.003)	(0.003)
air	0.0559***	0.0157*	0.0554***	0.0147
	(0.007)	(0.008)	(0.007)	(0.008)
OP/GO	-0.0301**	-0.0363**	-0.0307**	-0.0366**
	(0.011)	(0.012)	(0.011)	(0.012)
law	-1.2598***	-0.7233***	-1.2579***	-0.7356***
	(0.027)	(0.029)	(0.027)	(0.029)
constant	2.0935***	1.3494***	0.8440*	0.1167
	(0.206)	(0.216)	(0.379)	(0.377)
Observations	488,902	488,902	488,902	488,902

Year dummy coefficients not reported

*** p<0.01, ** p<0.05, * p<0.1