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Risk and Cost Sharing in Firm-to-Firm Trade

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Abstract

Firms are exposed to important risks and costs when trading across borders. Based on a set of standardized rules known as Incoterms, firms decide *ex ante* how to delimit their responsibilities throughout the shipping process to reduce the inherent contractual frictions. This paper investigates how sellers and buyers share risks and costs in international trade transactions depending on the characteristics of the exchanged product. We rely on a highly detailed dataset involving all Russian exporters and their foreign customers during 2012-2015. Our results suggest that buyers are more likely to bear responsibilities for goods that are (a) more distant from final use and (b) less tailored to their specific needs. These results are reinforced for products that constitute important inputs for buyers but reversed when there is a positive difference between the buyer and the seller size.

JEL Codes: F14, D22, D23, L11
Keywords: Risks, Costs, Incoterms, Firms Exports

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1 Introduction

International shipment is a complex process that ties together importers, exporters, customs authorities, transporters and many other entities. The two key partners – the seller and buyer – remain involved across all of the many stages. At each of these stages, transaction-related costs and risks inevitably arise. Cooperation between international buyers and sellers has recently gained attention in the international trade literature. However, the question of how they split nonnegligible costs and risks has not yet been covered. Basically, there are three options: the costs and risks might be borne by the seller, borne by the buyer or shared. This study aims to shed light on the factors underlying the mutual decision to split trade costs and responsibilities.

In practice, trading partners usually make such decisions *ex ante* and base their choice on the existing schemes of risks and costs, known as International commercial terms (Incoterms). This contractual instrument was developed by the International Chamber of Commerce (ICC) in an attempt to facilitate the conduct of international trade. Instead of drafting entire pages of explanations that might be subject to interpretation, by means of a three-letter abbreviation incorporated into the sales contract, trading firms clearly delimit their responsibilities for each transaction (International Chamber of Commerce, 2010).

Incoterms are widely applied in international transactions and are accepted worldwide in common business practice and by governments and therefore *de facto* define a uniform legal framework. However, despite their widespread use and acknowledged importance, Incoterms have been understudied in the academic literature. While a few case studies exist in the logistics management literature, to the best of our knowledge, only two economics studies have treated this question in one form or another. Teshome (2018) argued that the division of delivery-related tasks between sellers and buyers is a significant trade margin. The property rights model with sequential bargaining predicts that delivery rights are reallocated from seller to buyer to reduce the distortionary effects of bargaining externalities. In another study closely related to ours, Ardelean and Lugovskyy (2020) investigated the relationship between the size of firms and freight rates. They employed the data on Incoterms to identify the organizers of international transportation. A model with a two-sided market between sellers and buyers demonstrated that freight rates decrease with firm size. We contribute to these studies by investigating the product dimension of the decision to allocate costs between buyers and sellers. More precisely, we differentiate transactions of goods with different levels of upstreamness, contractability and differentiation.

Several recent papers have analyzed how sellers and buyers decide upon the conditions governing their contracts. Trading partners *ex ante* negotiate contract terms with respect to four aspects: transfer of costs, transfer of risks, title transfer and payment

terms (O'Meara, 2017). The vast majority of studies investigating contract conditions have focused exclusively on payment terms. For instance, relying on the characteristics of financial markets and contract enforcement in both the origin and destination countries, Schmidt-Eisenlohr (2013) studied how firms optimally select payment terms. Antràs and Foley (2015) documented broad patterns in the use of financing terms based on data from a US exporter of poultry products and built a model to explain firms' choices. Niepmann and Schmidt-Eisenlohr (2017) explored the conditions under which and the extent to which firms use terms requiring bank intermediation to alleviate the risks in trade transactions. Finally, Demir and Javorcik (2018) analyzed how firms adjust to increased competitive pressure through the choice of financing terms. In addition, according to O'Meara (2017), the negotiations between sellers and buyers are centered around the terms addressing the transfer of risks and costs (i.e., Incoterms), reducing contract uncertainty to a large extent. Once these terms have been selected, the other conditions (i.e., title transfer and payment terms) follow. This study directly contributes with an analysis of the Incoterms component within international trade contracts. Therefore, we contribute to the research on trade contracts with a study of nonfinancial terms.

This study further adds to the work on incomplete contracts. Sales contracts are incomplete by nature because firms cannot foresee the outcomes of contracts under all possible states of the world. Furthermore, conditioning contracts on every alternative state would bring the costs to a prohibitive level. There are two competing concepts within the incomplete contracts literature. The first is the property rights approach, developed by Grossman and Hart (1986) and Hart and Moore (1990), which analyzes whether buyers outsource the production of an intermediate good to a supplier or integrate the latter. Under the transaction costs approach, first introduced by Coase (1937), firms decide how much to subcontract to upstream partners and how much to produce in-house.[1] This study fits the transaction costs approach. We contribute with an investigation of how the transaction costs are attributed.

This study relies on a highly detailed dataset including the universe of daily shipments between Russian exporters and their international customers over the 2012-2015 period. For each transaction, we observe the exporting firm, the importing firm in a given destination, the traded product and the Incoterms rule that governs the sales contract. We focus our analysis on the dimension of traded products. Relying on the observed Incoterms rules, we construct three classes of the split of risks and costs be-

[1]Within the international trade literature, the theory of incomplete contracts has been used as a tool to explain *the boundaries of firms* (i.e., the number and size of existing firms). Antràs (2015) and Chor (2018) provided comprehensive insights into the theory of incomplete contracts in international trade. Recent applications of property rights include Antràs and Chor (2013) and Alfaro et al. (2019). The transactions costs approach has recently been applied to international trade by Fally and Hillberry (2015) and Kikuchi et al. (2018).

tween trading partners: responsibilities principally on the buyer, shared responsibilities, and responsibilities principally on the seller.

We motivate the empirical analysis with stylized facts on the patterns of splitting costs and risks in international trade shipments. Based on these data regularities, we empirically investigate how product characteristics affect the division of responsibilities in international trade transactions. Using the data on Incoterms, we generalize the split of risks and costs into three larger groups. Then, we compare *On buyer*, *Shared* and *On seller* responsibilities. We employ a linear probability estimator (LPM) and control for multidimensional unobservable characteristics with an extensive set of fixed effects.

The results suggest that the characteristics of traded products significantly affect the splitting of risks and costs between sellers and buyers. More precisely, the place of a product in the production chain matters. For instance, it is less probable that the buyer bears responsibilities if the product is a capital, consumer or intermediate good, compared to raw materials. We confirm this evidence by testing an empirical specification with a continuous measure of upstreamness in the spirit of Antràs et al. (2012). The buyer indeed tends to bear the responsibilities for more upstream goods, such as raw materials.

We further differentiate traded products with respect to their specificity for the buyer-seller relationship.[2] The evidence suggests that it is the seller who tends to bear the costs and risks over shipment of more relationship-specific products. The robustness of this result is confirmed with regressions for three alternative measures of relationship specificity. More precisely, we investigate the role of product differentiation (Rauch (1999) classification), contract intensity (Nunn, 2007) and product contactibility (Antràs and Chor, 2013).

We aim to explain the obtained results by exploring the underlying channels of the effects transmission. We hypothesize that buyers should be more motivated to exercise control over the shipment of a product if it serves as a crucial input for their production. We compute the importance of traded goods as an input following the approach of Antràs and Chor (2013) and introduce it to the estimated LPM specifications as an interaction term. The results suggest that the buyers are indeed more likely to accept the responsibilities over transactions of the input on which they depend. Furthermore, the input importance shapes the role of other product characteristics for the split of risks and costs.

The firm characteristics might shed some additional light on how features of traded products shape mutual decisions on the costs and risk allocation between buyers and sellers. In this study, we test for the role of firm heterogeneity by comparing the sizes

[2]In this regard, our study is also interconnected with the research on firm-to-firm matching along the global supply chain (Dragusanu, 2016) and heterogeneity and granularity in individual buyer-seller relationships (Eaton et al., 2019).

of the buyer and seller. [3] We source firm size (total assets) and a number of other firm-level characteristics from the Orbis dataset by Bureau van Dijk. We introduce to the principal estimations the interaction between product characteristics and a dummy variable set to 1 if the buyer is larger than the seller. We reveal rather robust empirical evidence that, when the buyer is larger, it tends to take on responsibilities. Moreover, the size differences shape the impact of other product characteristics.

The remainder of this paper is organized as follows. Section 2 describes the data and provides stylized facts regarding the sharing of costs and risks in international trade transactions. In Section 3, we detail our estimation strategy. Section 4 presents the empirical results on how product characteristics shape the split of risks and costs between sellers and buyers. In Section 5 we run a series of regressions to provide testable interpretations of the principal results. Finally, Section 6 concludes the study.

[3] A nascent and increasing body of research analyzes the heterogeneity of both exporters and importers and the various implications for exporter-importer relationships. Bernard et al. (2009), Castellani et al. (2010) and Muûls and Pisu (2009), for example, explored both seller and buyer heterogeneity among US, Italian and Belgian firms, respectively. A detailed review of the current literature is provided by Bernard and Moxnes (2018). We contribute to this strand of research by analyzing how the sizes of both sellers and buyers shape the decision of how to split responsibilities throughout the shipping process.

2 Data

This study is based on a highly detailed dataset including the universe of export transactions from the Russian Federation over the 2012-2015 period. More precisely, the database encompasses all export declarations submitted to the Russian Customs Authorities on a daily basis during this time span. A declaration corresponds to a shipment and includes the following information: the identification number (ID) of the Russian exporting firm (seller) and its location, the name of the importing firm (buyer) and its exact address, the product(s) exchanged detailed at the HS10 level, the ID of the customs point through which the transaction is processed and the exact date on which the shipment is registered and released by customs authorities. Moreover, for each shipment, we have information on the value (in dollars) and the volume (in kilograms), the terms of the contract sales (i.e., Incoterms), the transport mode(s) within and beyond borders, and whether the goods are transported in containers.

While sellers, HS10 products and customs control points are uniquely identified in the dataset, for buyers, we rely on names and addresses to construct a unique identifier. However, since export declarations are completed manually, potential errors can occur. Thus, creating an ID using firm names and addresses as reported in the raw data could artificially inflate the number of buyers. To overcome this issue, we perform extensive cleaning of the buyer names before attributing unique identifiers. The procedure used to create unique buyer IDs and to compute distances is explained in Appendix A. We employ the information on the locations of customs control points and decompose the total distance into an international part (from seller to the customs control point) and domestic part (from customs control point to the buyer).[4]

During the period under observation, more than 46,163 different Russian sellers delivered 4,007,908 shipments of 9,553 different HS10 products to more than 133,366 buyers across 221 destinations.[5] The detailed statistics by year are presented in Table 1. The number of sellers increases over time, from 20,558 in 2012 to 25,177 in 2015; the same trend is observed for buyers. Moreover, the annual number of buyers is approximately 2.5 times larger than the number of sellers. The number of seller-buyer pairs increases from 84,045 in 2012 to 99,894 in 2015. From 2012-2015, the overall number of shipments also increases. Furthermore, we note that the export value (in millions of

[4]The customs control points are scattered within the territory of Russia and the other members of Eurasian Customs Union, such as Armenia, Belarus, Kazakhstan and Kyrgyzstan.

[5]These statistics are based on the entire dataset, corresponding to 4,007,908 different shipments. However, the identities of sellers and buyers are missing for some shipments. Thus, the 46,163 Russian sellers and the 133,366 international buyers refer to 96.8% and 92.1% of all shipments, respectively. The existing sellers and buyers combined cover 75% of the total export value over the 2012-2015 period.

dollars) is relatively stable during 2012-2014 and decreases drastically in 2015.[6] This decline can be explained by the international sanctions following the political tensions between Russia and Western countries. Although the export value decreases over the period considered, the export volume (in thousands of tons) does not vary drastically.

Table 1
Overall annual summary statistics

Statistics	Year			
	2012	2013	2014	2015
Nb of shipments	895711	969903	1021760	1120534
Nb of seller-buyer pairs	84045	87569	91684	99894
Nb of sellers	20558	21353	22113	25177
Nb of buyers	51220	53103	54626	63162
Nb of destinations	200	205	204	200
Nb of HS10 products	7428	7681	7635	7996
Export value (millions of $)	463639.9	464336.7	448544.4	308437.8
Export volume (thousands of tons)	727307.3	688107.3	730258.6	765338.1

Note: The statistics are based on the entire sample.

In what follows, we focus on the subsample in which both the seller and buyer are identified. Moreover, we exclude the sectors of mineral fuels and oils for two reasons. First, Incoterms are designed for the sale of goods that can be unitized and are not used for oil delivered via pipelines (O'Meara, 2017). Second, this sector dominates Russian trade and is likely to induce biases in our analysis.

2.1 Incoterms

Our goal is to understand how sellers and buyers choose to divide their obligations, risks and costs in international trade transactions based on the product characteristics. We rely on Incoterms, which "define the responsibilities of sellers and buyers for the delivery of goods under sale contracts. They are authoritative rules for determining how risks and costs are allocated to the parties" (International Chamber of Commerce, 2010). The Incoterms rules were first introduced by the ICC in 1936 and have been widely used in international trade ever since. Their abbreviation through a set of three

[6] A comparison with the BACI database shows very similar figures. In 2012, the value of exports is approximately 4% lower in our dataset than in BACI; however, for subsequent years, the gap between the two datasets decreases systematically. The differences that we observe are due mainly to BACI including information on Belarus and Kazakhstan, countries that are part of the Eurasian Customs Union with Russia. Trade with these countries is not recorded in our customs data. Moreover, BACI is constructed relying on a specific procedure that reconciles the declarations of the exporter and the importer: http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=1. Thus, BACI does not provide real trade as declared by customs but the most likely trade based on the declarations of both partners.

letters is extensively recognized and reflects business-to-business practices. Incoterms have been regularly amended to keep up with the latest developments in terms of international transactions (i.e., evolution of transport practices, use of electronic communications, etc.). The last revision of the Incoterms rules by the ICC dates to 2019.

In all international transactions, sellers and buyers must address ten main issues (O'Meara, 2017): (i) provision of goods; (ii) customs procedures for both exports and imports; (iii) organization of international transportation and insurance; (iv) delivering and accepting goods; (v) transfer of risks from seller to buyer; (vi) allocation of costs between seller and buyer; (vii) notifications from seller to buyer and vice-versa; (viii) provision of documentation (i.e., proof of delivery, etc.); (ix) operations such as checking, packaging, marking, etc.; and (x) assistance with information. The Incoterms rules show how these different responsibilities are split between the seller and buyer. As of 2010, there are 11 rules, as shown in Figure 1.[7] The individual terms are presented in ascending order of obligation of the seller and descending order of obligation of the buyer. To illustrate this progression, the main stages of the shipping process are also presented, emphasizing where delivery occurs. In the case of Incoterms, the concept of delivery indicates where the risk of loss of or damage to the goods passes from the seller to the buyer (International Chamber of Commerce, 2010).[8]

Incoterms can be grouped based on the share of obligations between the seller and buyer (Malfliet, 2011). Thus, four categories can be distinguished: E, F, C, and D. In the case of E-terms (EXW), the goods are made available to the buyer at the seller's premises; that is, goods are *ready to be collected*. The F-terms (FCA, FAS, FOB) imply that the buyer is accountable for all risks and costs associated with the main international transportation: goods are *sent from*. For the C-terms (CFR, CIF, CPT, CIP), the seller pays for the main international transportation but does not bear the associated risks: goods are *sent to, freight prepaid*. Finally, the D-terms (DAT, DAP, DDP) state that the seller is held responsible for all risks and costs related to the main international carriage up to the delivery point in the country of destination: goods are *delivered at*. In summary, for the E- and F-terms, the buyer bears more responsibility than the seller; for the C-terms, the responsibility is shared between the seller and buyer; and for the D-terms, the seller bears more responsibility than the buyer. Our analysis relies on these last groupings of risks and costs: *On buyer* responsibilities (i.e., E+F), *Shared* responsibilities (i.e., C), and *On seller* responsibilities (i.e., D). The choice of these groupings is motivated by several reasons. First, there might be errors in recording the individual Incoterms by customs authorities (e.g., the Incoterms CIF and CIP can be easily confounded). Second, some sellers and buyers might use versions of Incoterms that

[7] A detailed description of the Incoterms rules is presented in Appendix B.

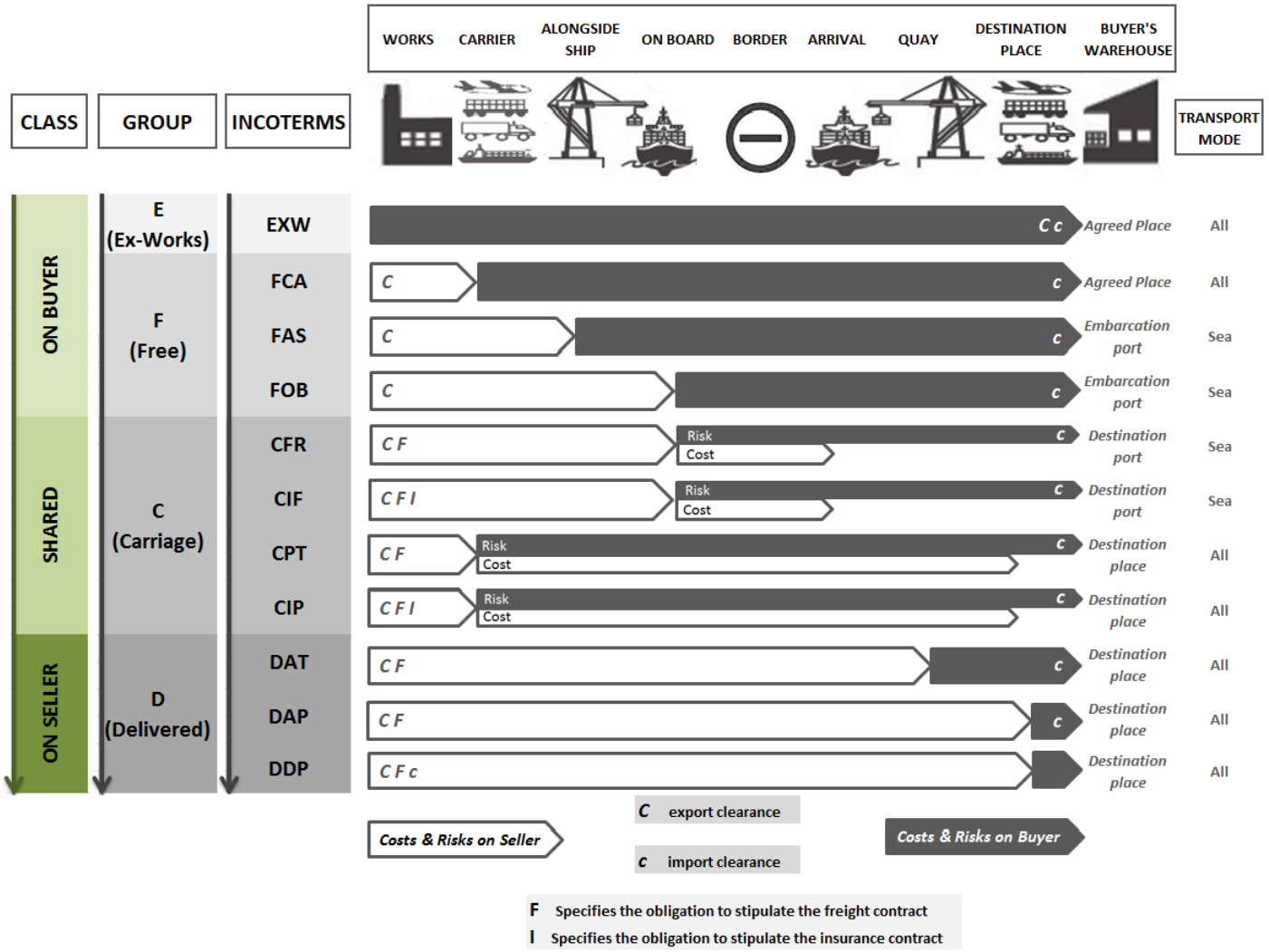
[8] Concerning the C-terms, Although the risk passes from the seller to the buyer at an early stage of the shipping process, the costs for the next stages are still borne by the seller.

have become obsolete, but beyond some specificities, the overall split of responsibilities is similar from one version to the other. Thus, to overcome these issues, we group Incoterms into three broad categories.

To illustrate how Incoterms diminish contract uncertainty, consider the following example. A buyer located in Buzău (Romania) orders five pallets of radio-electronic components from a seller located in Ekaterinburg (Russia). The trading partners agree to use terms that place risks and costs up to the Romanian border on the seller. The trucker employed by the seller collects the goods. After leaving the Russian territory and entering Ukraine, due to poor infrastructure, the truck is involved in an accident. Following the accident, the goods end up in the Dniester River: the radio-electronic components are drenched and become useless. Since both parties had agreed that the seller bears all risks and costs up to the delivery point at the Romanian border, the buyer is entitled to ask for compensation or a replacement shipment. Now, assume that the contracting parties decide to use terms indicating that risks and costs are shared between the seller and the buyer. The same accident as before occurs. With these terms, the parties implicitly agree that the seller organizes and pays for the main carriage, while the buyer bears all risks thereof. In this case, the buyer is not entitled to ask for compensation or a replacement shipment. Hence, these terms reduce contract uncertainty by clearly stating whether the seller or buyer bears the transaction-related risks and costs.

Certain Incoterms rules are adapted to any transport mode (EXW, FCA, CPT, CIP, DAT, DAP, DDP), including multimodal, whereas certain rules are recommended for maritime and inland waterway transport (FAS, FOB, CFR, CIF) (International Chamber of Commerce, 2010). Since each of the three groupings of previously defined terms (*On buyer*, *Shared*, *On seller*) includes rules used for both maritime and nonmaritime transportation, the transportation mode is controlled for in our empirical analysis.

Figure 1. Balance of obligations, risks and costs between the seller and buyer



Source: This figure was created by the authors based on a chart designed by the ICC and available at: https://www.export.org.uk/page/Incoterms_Online. Delivery occurs where the white wide arrow ends, and the black wide arrow begins. For the C-group, where the white wide arrow ends, two other narrower arrows begin: one white and one black. The white arrow indicates that costs are still borne by the seller, whereas the black arrow indicates that the risks are on the buyer. The presence of a letter on the white/black arrow implies that the seller/buyer is in charge of the corresponding activity. *C*/*c* refers to the obligation for export/import clearance. *F* indicates the responsibility to stipulate the freight contract. *I* specifies the responsibility to stipulate the insurance contract.

Table 2
Share of transactions and export value (%) by classes of risks and costs

Responsibilities	2012		2013		2014		2015	
	Trans.	Exp. Val.	Trans.	Exp. Val.	Trans.	Exp. Val.	Trans.	Exp. Val.
On buyer	53.4	57.3	53.6	53.8	52.0	52.4	54.9	53.9
Shared	21.9	24.1	22.8	28.0	24.0	27.3	22.5	26.2
On seller	24.6	18.6	23.6	18.2	24.0	20.3	22.6	19.9

Note: For each year, the first and second columns present the share of transactions and the share of export value, respectively, occurring on a given class of responsibilities: *On buyer* (E- and F-terms), *Shared* (C-terms), and *On seller* (D-terms). The statistics are based on the entire sample

The use of the three classes of responsibilities over the period 2012-2015 is detailed in Table 2. For each year, the first column reports the share of transactions covered by a given class of terms, and the second column shows the share of total exports (in value) occurring on a specific type of terms. Overall, we note the stable use of the different classes of risks and costs during the period under observation. On average, in slightly more than half of all annual transactions (53.5%) and for slightly more than half of the export value (54.4%), the risks and costs are borne mainly by the buyer. The responsibilities are shared between the seller and buyer in approximately 22.8% of all transactions, amounting to approximately 26.4% of the total export value, on average. Finally, the seller bears the majority of the responsibility in 23.6% of the cases, representing 19.2% of the export value of all Russian firms, on average.[9]

To explore the sources of variation in the use of the different groupings of terms, we proceed as follows. We separately regress a dummy set to one for transactions occurring on a given class of responsibilities on several sets of fixed effects: seller, buyer, seller-buyer, product, and destination country.[10] Table 3 presents the R-squared of the different regressions. Seller, buyer and seller-buyer pair characteristics explain a large proportion of the variation in the use of the different types of terms. Across all classes of risks and costs, the R-squared values of the regressions on seller and buyer fixed effects are, respectively, approximately 0.6 and 0.7. The differences across products explain approximately 20% of the use of the different groupings of terms, and the destination country characteristics account for less than 20% of the variance.

[9]To further understand the composition of each class of risks and costs, the same exercise is conducted on the individual Incoterms rules. The results are presented in Table C1.

[10]This approach follows Antràs and Foley (2015). While an ANOVA test would have provided a clear decomposition of the variance, convergence issues appear due to the sizable sets of fixed effects.

Table 3
Sources of variation in the use of the different classes of risks and costs (2012)

Source	Responsibilities		
	On buyer	*Shared*	*On seller*
Seller	0.591	0.591	0.623
Buyer	0.728	0.742	0.718
HS10 Product	0.209	0.244	0.285
Destination	0.148	0.084	0.192
Seller-Buyer	0.896	0.899	0.907
Seller-HS10 Product	0.667	0.666	0.693
Buyer-HS10 Product	0.814	0.841	0.808

Note: This table reports the R-squared corresponding to simple regressions of a dummy variable set to 1 for a given class (*On buyer*, *Shared*, *On seller*) on different sets of fixed effects described in Column *Source*.

2.2 Incoterms and product characteristics

This paper advocates that the characteristics of traded goods largely explain how sellers and buyers split responsibilities throughout the shipping process. In this section, we explore the variation in Incoterms across product dimensions. Table 4 reports statistics for the top 10 HS2 sectors, which account for more than 70.0% of Russian trade (after the exclusion of oil) over 2012-2015. The sectors with an important share of total exports (> 5%) are *Iron and steel*, *Precious metals*, *Fertilizers*, *Aluminum and articles thereof*, *Wood and articles of wood*, and *Cereals*.

According to the data, the *On buyer* responsibilities prevail in *Iron and steel*, *Aluminum and articles thereof* and *Cereals*. Although almost half of trade in *Fertilizers* and *Wood and articles of wood* also occurs via *On buyer* responsibilities, we note an increase in the use of *On seller* risks and costs. By contrast, in the case of *Precious metals*, the vast majority of trade occurs via *Shared* responsibilities. Moreover, for some specific sectors, we note that the split of risks and costs varies over time to a large extent. For instance, in the case of *Precious metals*, the use of *On seller* responsibilities more than doubles in 2014 compared to 2013, while the use of *On buyer* responsibilities shrinks. All in all, there is an important variation in the use of the different classes of risks and costs, not only across sectors but also within sectors over time.

Table 4
Split of risks and costs for the top 10 HS2 sectors in terms of export value over the 2012-2015 period

Sector	Description	2012	2013	2014	2015
72	Iron and steel.	18.3	16.2	16.7	15.4
	On buyer	*85.6*	*83.2*	*82.3*	*75.7*
	Shared	*8.6*	*11.5*	*13.2*	*19.7*
	On seller	*5.8*	*5.3*	*4.5*	*4.7*
71	Precious metals.	11.1	12.8	10.5	8.6
	On buyer	*29.7*	*22.6*	*4.5*	*5.4*
	Shared	*42.5*	*58.6*	*45.4*	*39.7*
	On seller	*27.7*	*18.9*	*50.1*	*54.9*
31	Fertilizers.	9.3	8.1	7.9	9.2
	On buyer	*56.1*	*51.7*	*56.1*	*66.6*
	Shared	*15.9*	*15.5*	*11.9*	*8.0*
	On seller	*28.0*	*32.9*	*32.0*	*25.4*
76	Aluminum and articles thereof.	7.1	7.1	6.8	9.3
	On buyer	*93.0*	*93.1*	*92.0*	*92.9*
	Shared	*4.9*	*4.2*	*4.5*	*3.7*
	On seller	*2.1*	*2.6*	*3.5*	*3.4*
44	Wood and articles of wood.	5.6	6.3	6.7	6.7
	On buyer	*51.8*	*49.9*	*48.5*	*48.8*
	Shared	*10.1*	*13.0*	*15.8*	*18.8*
	On seller	*38.1*	*37.1*	*35.7*	*32.4*
10	Nuclear reactors, machinery.	5.2	4.0	6.1	5.4
	On buyer	*89.3*	*89.0*	*89.9*	*86.7*
	Shared	*4.1*	*3.5*	*2.8*	*3.0*
	On seller	*6.6*	*7.5*	*7.3*	*10.3*
84	Cereals.	4.2	5.2	6.1	7.0
	On buyer	*29.0*	*36.0*	*23.5*	*21.4*
	Shared	*27.6*	*26.9*	*46.6*	*46.5*
	On seller	*43.3*	*37.2*	*29.9*	*32.0*
29	Organic chemicals.	3.7	3.9	3.9	3.1
	On buyer	*30.5*	*26.5*	*36.5*	*35.8*
	Shared	*50.3*	*54.8*	*49.9*	*52.3*
	On seller	*19.2*	*18.7*	*13.6*	*11.9*
74	Copper and articles thereof.	3.5	3.2	3.2	3.1
	On buyer	*46.1*	*55.4*	*59.4*	*59.4*
	Shared	*41.0*	*41.4*	*37.2*	*39.8*
	On seller	*12.8*	*3.2*	*3.4*	*0.8*
28	Inorganic chemicals.	2.9	3.2	3.4	2.9
	On buyer	*31.7*	*28.7*	*24.1*	*31.7*
	Shared	*47.1*	*53.2*	*58.1*	*45.4*
	On seller	*21.2*	*18.1*	*17.7*	*22.9*

Note: The top 10 HS2 sectors account for more than 70.0% of total exports (excluding oil). The row presenting the HS2 sector reports its share in the total export value for a given year. The next three rows show the split of risks and costs for the type of goods in question. For instance, *Iron and steel* represents 18.3% of Russian exports in 2012, and 85.6% of all exports in the *Iron and steel* sector occur with *On buyer* responsibilities.

Table 4 suggests that buyers are more likely to bear risks and costs for raw materials and intermediate goods compared to other types of products. To further explore this aspect, we classify goods into two categories according to the stages of processing (SoP), as defined by the UNCTAD-SoP classification. The category *Final goods* regroups capital and consumer goods, while the category *Intermediate goods* regroups intermediate products and raw materials. As presented in Panel *A* of Table 5, Russian exports are largely dominated by intermediate goods, representing approximately 80.0% of all exports. Final goods only account for 20.0% of all exports. Moreover, when analyzing the split of risks and costs for these categories of products, we note that, in the case of intermediate goods, buyers tend to take on more responsibilities. Almost 60.0% of the exports of intermediate goods occur with *On buyer* responsibilities, followed by *Shared* and *On seller* responsibilities. When it comes to final goods, the split of risks and costs is more evenly distributed across the three categories. *On buyer* and *Shared* responsibilities display similar shares of use, with each class accounting for approximately 35.0% of the exports of final goods. While *On seller* responsibilities account for less, their share is still important, amounting to more than 20% across all years.

Furthermore, in Panel *B* of Table 5 we rely on the upstreamness measure constructed by Antràs et al. (2012) to analyze the split of risks and costs for different types of goods according to their positions in the production process. Upstreamness is a continuous measure indicating the "distance of a good from final use." The lower the upstreamness is, the closer the product is to final use. We split the sample into two categories: products with upstreamness less than and greater than the median. These figures mirror to a large extent those based on the UNCTAD-SoP classification. We note that products with an upstreamness greater than the median largely dominate Russian exports, indicating that Russian exporters mainly trade intermediate goods. Moreover, exports of goods with an upstreamness greater than the median mostly occur on *On buyer* responsibilities, followed by *Shared* and *On seller* responsibilities. As for the goods with upstreamness less than the median, the split of risks and costs is more evenly distributed across the three categories.

Table 5
Split of risks and costs for different stages of the production process over the 2012-2015 period

Type of goods	2012	2013	2014	2015
A: UNCTAD-SOP2 classification				
Final goods	17.3	19.7	19.8	20.1
On buyer	*37.9*	*40.7*	*33.7*	*34.6*
Shared	*35.7*	*35.7*	*45.5*	*41.4*
On seller	*26.4*	*23.6*	*20.7*	*24.1*
Intermediate goods	82.7	80.3	80.2	79.9
On buyer	*61.4*	*57.0*	*57.0*	*58.7*
Shared	*21.7*	*26.1*	*22.8*	*22.4*
On seller	*16.9*	*16.9*	*20.2*	*18.8*
B: Upstreamness by Antràs et al. (2012)				
Upstreamness < median	20.5	24.0	23.6	24.5
On buyer	*47.5*	*46.0*	*28.6*	*29*
Shared	*32.6*	*30.7*	*37.6*	*36*
On seller	*20*	*23.3*	*33.8*	*34.9*
Upstreamness > median	79.5	76.0	76.4	75.5
On buyer	*62.5*	*59.7*	*61.1*	*62.7*
Shared	*21.4*	*23.5*	*23.1*	*22.5*
On seller	*16.1*	*16.9*	*15.7*	*14.8*

Note: The row presenting the type of goods reports its share in the total export value for a given year. The next three rows show the split of risks and costs for the type of goods in question. Panel *A* splits the sample in two categories based on the UNCTAD-SoP classification: *Final goods* (consumer + capital goods) and *Intermediate goods* (intermediate products + raw materials). For instance, *Final goods* represent 17.3% of total exports in 2012, and 37.9% of exports of *Final goods* occur with *On buyer* responsibilities. Panel *B* splits the sample into two categories based on the upstreamness measure constructed by Antràs et al. (2012), indicating the "distance of a good from final use": goods with *Upstreamness < median*, which are closer to final use; and *Upstreamness > median*, which are further from final use. For instance, goods with an *Upstreamness < median* represent 24.3% of all exports, and 47.8% of exports of goods with an *Upstreamness < median* occur on *On buyer* responsibilities.

We further investigate the variation in the use of the three classes of costs and risks with respect to product differentiation. In Panel *A* of Table 6, we analyze trade in differentiated and homogeneous goods based on the Rauch classification. Over the period of 2012-2015, approximately 20.0% of total Russian exports refer to differentiated goods, while slightly less than 80.0% refer to homogeneous goods. In terms of the split of responsibilities across these two types of products, *On buyer* responsibilities are used less frequently in the case of differentiated goods (approximately 40%) than in the case of homogeneous goods (approximately 60%). Furthermore, we observe higher use of *Shared* and *On seller* responsibilities for differentiated products (approximately 35%

and 25%, respectively) than for homogeneous goods (approximately 22% and 18%, respectively). In Panel *B* of Table 6, we rely on the contract intensity measure constructed by Nunn and Trefler (2008), which "measures the proportion of an industry's inputs, weighted by value, that require relationship-specific investments in their production." To identify inputs that are relationship specific, Nunn and Trefler (2008) used data from Rauch (1999). More precisely, the authors considered differentiated inputs (i.e., that are neither traded on an exchange nor reference priced) as being relationship specific. The higher the contract intensity is, the higher the relationship specificity (i.e., the more differentiated the goods are). We split the sample into two categories: products with contract intensity less than and greater than the median. In line with the figures based on the Rauch classification, approximately a quarter of Russian exported goods are characterized by a contract intensity greater than the median, meaning that they are differentiated and not easily contractible. The goods with a contract intensity less than the median represent approximately three quarters of all Russian exports, indicating that these goods are homogeneous and readily contractible. When it comes to the split of responsibilities, *On buyer* responsibilities are used less frequently in the case of goods with higher contract intensity than in the case of goods with lower contract intensity. Furthermore, we observe a higher use of *Shared* and *On seller* responsibilities for goods with higher contract intensity than for those with lower contract intensity.

Table 6
Split of risks and costs for different types of goods over the 2012-2015 period

Type of goods	2012	2013	2014	2015
A: Rauch classification				
Differentiated goods	19.1	20.9	20.4	21.2
On buyer	*43.0*	*44.4*	*40.1*	*40.9*
Shared	*33.2*	*33.4*	*38.2*	*36.7*
On seller	*23.8*	*22.2*	*21.7*	*22.4*
Homogeneous goods	80.9	79.1	79.6	78.8
On buyer	*61.9*	*57.9*	*57.7*	*60.4*
Shared	*21.5*	*25.8*	*22.6*	*21.3*
On seller	*16.6*	*16.3*	*19.7*	*18.3*
B: Contract intensity by Nunn and Trefler (2008)				
Contract intensity > median	22.6	26.5	26.2	26.4
On buyer	*47.0*	*45.4*	*29.9*	*29.4*
Shared	*25.4*	*24.6*	*31.3*	*30.8*
On seller	*27.6*	*29.9*	*38.8*	*39.8*
Contract intensity < median	77.4	73.5	73.8	73.6
On buyer	*64.0*	*61.2*	*62.8*	*64.6*
Shared	*21.8*	*24.1*	*23.3*	*22.5*
On seller	*14.2*	*14.7*	*13.9*	*13.0*

Note: The row presenting the type of goods reports its share in the total export value for a given year. The next three rows show the split of risks and costs for the type of goods in question. Panel *A* splits the sample in two categories based on the Rauch classification: *Differentiated goods* and *Homogeneous goods* (homogeneous + reference priced goods). For instance, *Homogeneous goods* represent 80.9% of total exports in 2012, and 61.9% of exports of *Homogeneous goods* occur with *On buyer* responsibilities. Panel *B* splits the sample into two categories based on the contract intensity measure constructed by Nunn and Trefler (2008), which describes the specificity of the relationship between the seller and buyer: goods with *Contractibility < median* and *Contractibility > median*.

3 Estimation strategy

The descriptive evidence shows that responsibilities can be divided differently across various types of products, and this variance is important to investigate. This section provides an econometric analysis of how the product characteristics determine the split of risks and costs between sellers and buyers in international trade transactions.

Our empirical strategy is grounded on the estimation of the following generalized equation with a Linear Probability Model (LPM) estimator:

$$Choice_{sbpT} = \text{Product charact.}_{pT} + \text{Controls} + \text{FE} + \varepsilon_{sbpT} \quad (1)$$

The dependent variable $Choice_{sbpT}$ describes the choice of a class of responsibilities for transaction T occurring between the seller s and buyer b exchanging the HS10 product p. We arrange the three groups of responsibilities in a "ladder" with two steps and run estimations based on an LPM for each step. Thus, in the first step, $Choice_{sbpT}$ represents a dummy set to 1 for *On buyer* or *Shared* responsibilities and 0 otherwise. In the second step, $Choice_{sbpT}$ is a dummy variable that takes the value of 1 for *On buyer* responsibilities and 0 otherwise. Together, the two steps closely follow the progression of responsibilities from the seller to the buyer. More precisely, the ladder goes toward the maximum responsibilities on the buyer (in the second step). The two-step LPM regressor allows for relying on sizable fixed effects to control for unobservable characteristics.[11]

The main explanatory variable includes alternately various product attributes as follows. First, we rely on the UNCTAD-SoP classification of products according to the different stages of processing: consumer, capital, intermediate goods and raw materials.[12] The vector **Product charact.**$_{pT}$ includes three dummy variables corresponding to consumer, capital, and intermediate goods. Raw materials, which are the least processed goods, are used as the baseline category. Second, we include the continuous *Upstreamness* measure constructed by Antràs et al. (2012), which indicates the "dis-

[11] While applying of an ordered logit estimator would have better served to illustrate the progression toward maximum responsibilities on the buyer, that it does not allow the inclusion of sizeable fixed effects prevents us from exploring the role of mere product characteristics. However, we proceed with a robustness test for the LPM estimator for each step of the ladder. Thus, relying on the "bife" R package developed by Stammann et al. (2016), we apply the logit estimator based on the unconditional likelihood approach. The advantage of this approach is that it allows for the inclusion of individual fixed effects and corrects for the bias generated by their inclusion, as in Hahn and Newey (2004). While the estimator supports multiple sets of fixed effects, the bias correction is only possible for one of them. Given this limitation, we only consider specifications with *buyer* $\times$ *year* fixed effect. If we introduce other fixed effects, the estimations do not converge. The regressions based on this estimator are qualitatively similar to the principal estimations based on the LPM estimator and the same set of fixed effects. The results are available upon request.

[12] This order reflects the various stages starting with the most processed and ending with the least processed category of goods.

tance of a good from final use." More precisely, the higher the upstreamness is, the further the product is from final use.[13] Third, we rely on Rauch (1999)'s liberal classification: organized exchange, reference priced and differentiated goods. Thus, the vector **Product charact.**$_{pT}$ includes one dummy variable corresponding to differentiated goods. The baseline category is formed by organized exchange and reference priced goods, which are considered homogeneous. Fourth, we include a measure of *Contract Intensity* constructed by Nunn and Trefler (2008), which describes the importance of relationship-specific investments. The higher the contract intensity is, the higher the relationship specificity (i.e., the more differentiated the goods are). Thus, if an input is differentiated, then the market for this input is thin, and the scope for hold-up is important. A buyer cannot easily find another seller and vice-versa. Finally, we use the *Contractibility* measure constructed by Antràs and Chor (2013). The authors first compute the fraction of HS10 constituent codes classified by Rauch (1999) as neither reference priced nor traded on an organized exchange, under the "liberal" classification. Then they took one minus this value to compute the own contractibility of each industry. The higher the contractibility is, the lower the relationship specificity. More precisely, the higher the contractibility is, the easier it is for the seller and buyer to find partners.[14]

To isolate the role of product characteristics, we control for a number of confounding factors that are likely to influence how sellers and buyers share responsibilities in international trade transactions. First, the estimated specifications include characteristics of shipment: value and volume. We further control for the characteristics of the relationship between the seller and buyer, assuming that they are likely to influence the split of responsibilities for each transaction. Thus, we introduce the controls for the total value of trade and the total number of transactions that occurred within a seller-buyer pair prior to the current transaction. We also consider the number of buyers for a seller within a given world sub-region as defined by the United Nations.

The transportation cost is a crucial component in the costs structure of international trade shipments. Therefore, it might largely affect the split of costs between sellers and buyers. The following controls are intended to capture the importance of proximity between partners and transportation mode. We introduce the distance from a seller to the customs control point when exporting to a given buyer, as well as a dummy variable for water transportation inside Russia. We also include the distance between the customs point and the buyer when importing from a given seller and a dummy variable for water transportation outside Russia. The use of these distances (instead of the

[13]The *Upstreamness* measure has been computed using the 2002 I-O Tables as a benchmark. The correspondence between the 2002 I-O Tables and the 2002 HS Classification has been achieved based on the tables available at: `https://are.berkeley.edu/~fally/data.html`.

[14]Note that this measure should be interpreted in opposite terms compared to that constructed by Nunn and Trefler (2008).

direct distance between the seller and the buyer) is motivated by their corresponding to different stages of the shipping process, and the responsibilities for each stage might be split differently between the seller and buyer. Also, since, within a group of terms, certain individual rules are not designed for waterway transportation (International Chamber of Commerce, 2010), we aim to control for this aspect. Furthermore, shipping containers might facilitate the use of different transport modes and might impact transport costs (Coşar and Demir, 2018). We introduce a dummy variable set to 1 for the use of containers.

Finally, we capture unobservables with the following sets of fixed effects: seller-year, buyer-year and HS2-sector. Seller-year and buyer-year fixed effects control for any seller and buyer characteristics, respectively, that can affect the split of responsibilities in a given year (e.g., size, bargaining power, supply/demand shocks). We also introduce HS2-sector fixed effects to account for any industry characteristics that might differently influence the split of responsibilities. Thus, the variation that we exploit is due to the detailed product dimension.

4 Empirical results

4.1 Place of a product in a global value chain

Our regression analysis revolves around the role of product characteristics for the split of responsibilities between the trading partners. We begin by addressing the place of traded products in a production chain. The results are presented in Table 7 with groups of two columns that correspond to the two previously defined ladders and imply an order that goes toward maximum responsibilities on the buyer.

The most straightforward way to identify the position of a good in the global value chain (GVC) is by referring to a common classification. Thus, in Columns (1) and (2) of Table 7, we follow the UNCTAD-SoP classification and consider raw materials as the baseline category. The coefficients on the dummy variables for capital, consumer and intermediary goods are all negative and significant. These results suggest that, after controlling for other potentially confounding factors, buyers have a lower probability of bearing responsibilities during the shipping process if a transaction involves capital, consumer or intermediate goods, compared to raw materials. While qualitatively the same, note that the coefficients in Column (2) are systematically higher than those in Column (1). Since the second column implies maximum responsibilities for the buyer, these results imply that the buyer is more likely to bear an important load of responsibilities in the case of the least processed goods, which are raw materials.

We enhance the analysis with the continuous measure of product *Upstreamness*, which was proposed by Antràs et al. (2012). The corresponding results are reported in Columns (3) and (4). The coefficients on this variable are positive and significant, suggesting that the higher the upstreamness is, the greater the probability is for the buyer to bear responsibilities throughout the shipping process. Stated differently, the more distant the good is from final use, the higher the probability that the buyer takes on responsibilities. As in the previous case, the coefficient is higher in the second column, reflecting maximum responsibility for the buyer. Overall, the results for the continuous upstreamness measure support the evidence that buyers tend to take more risks and costs throughout the shipping process for goods that are further used in the production process.

Table 7
Position in a global value chain

	UNCTAD SoP2 classification		Upstreamness (Antràs et al., 2012)	
	B+Sh->S (1)	B->Sh+S (2)	B+Sh->S (3)	B->Sh+S (4)
=1 if capital good	-0.118[a]	-0.146[a]		
	(0.001)	(0.001)		
=1 if consumer good	-0.113[a]	-0.142[a]		
	(0.001)	(0.001)		
=1 if intermediary good	-0.129[a]	-0.155[a]		
	(0.001)	(0.001)		
upstreamness			0.030[a]	0.041[a]
			(0.000)	(0.000)
value of the shipment	0.001[a]	-0.003[a]	-0.001[a]	-0.004[a]
	(0.000)	(0.000)	(0.000)	(0.000)
volume of the shipment	-0.002[a]	0.001[a]	-0.001[a]	0.003[a]
	(0.000)	(0.000)	(0.000)	(0.000)
total value S-B (cum)	-0.011[a]	-0.023[a]	-0.011[a]	-0.023[a]
	(0.000)	(0.001)	(0.000)	(0.001)
nb relations S-B (cum)	0.015[a]	0.028[a]	0.015[a]	0.028[a]
	(0.000)	(0.001)	(0.000)	(0.001)
nb buyers in a region (cum)	-0.004[a]	-0.017[a]	-0.003[a]	-0.017[a]
	(0.000)	(0.001)	(0.000)	(0.001)
distance S-CP	0.005[a]	0.038[a]	0.003[a]	0.036[a]
	(0.001)	(0.001)	(0.001)	(0.001)
distance CP-B	0.002[a]	-0.006[a]	0.001[b]	-0.008[a]
	(0.000)	(0.000)	(0.000)	(0.000)
=1 if trsp insd via water	0.024[a]	0.051[a]	0.024[a]	0.050[a]
	(0.002)	(0.002)	(0.002)	(0.002)
=1 if trsp bord via water	0.149[a]	0.091[a]	0.146[a]	0.088[a]
	(0.001)	(0.002)	(0.001)	(0.002)
=1 if container	0.001	-0.077[a]	-0.000	-0.079[a]
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	4858044	4858044	4829553	4829553
Adjusted R^2	0.905	0.897	0.905	0.896
Fixed effects:				
ST&BT&HS2	Yes	Yes	Yes	Yes

Note: The results are based on an LPM estimator. The three groups of responsibilities are arranged in a "ladder" with two steps and follow the progression of responsibilities from the seller to the buyer. In the first step (Columns 1 and 3), the dependent variable is a dummy set to 1 for *On buyer* or *Shared* responsibilities and 0 otherwise. In the second step (Columns 2 and 4), the dependent variable is a dummy variable that takes the value of 1 for *On buyer* responsibilities and 0 otherwise. Robust standard errors appear in parentheses, with [a], [b] and [c] denoting significance at the 1%, 5% and 10% levels, respectively.

Several studies have shown that, in the case of intermediate products that are further used in the production chain, timely delivery and predictability of delivery are crucial (Li and Wilson, 2009; Gamberoni et al., 2010; Baniya, 2017). Furthermore, the production capacities of the buyers might be tailored to operate with specific foreign inputs. The switch to inputs of another origin or another supplier might provoke excessive costs. Hence, buyers importing intermediate goods and raw materials might aim to have better control over the shipping process to ensure that their production chain is not affected in case of unexpected disruptions. As a consequence, such buyers are likely to bear additional risks and costs. For instance, the transportation costs might be larger for intermediate goods, which are more sensitive to distance than final goods (Conconi et al., 2020).[15] Further, the sunk and fixed costs of importing are crucial for the trade in the intermediate inputs (see Zhang (2017)).

4.2 Relationship specificity

The split of costs and risks throughout the shipping process should be specific to the trading partners' relationship. We find some confirming evidence in a large share of seller-buyer component of variation in the choice of Incoterms rules (see Table 3). We further hypothesize that the specificity of a traded product for the seller-buyer relationship is an important factor underlying the split of costs and risks. We test this hypothesis empirically and report the corresponding results in Table 8.

We first rely on product differentiation as defined in a seminal paper by Rauch (1999). In Columns (1) and (2), we introduce a dummy variable for differentiated products and consider homogeneous goods the baseline category. The results show that the corresponding coefficient is negative. We naturally conclude that buyers are less likely to bear transaction-related risks and costs in the case of differentiated goods. While qualitatively the same, note that the coefficient in Column (2) is larger than that in Column (1). Since the second column implies maximum responsibilities for the buyer, these results suggest that the buyer is the least likely to exclusively bear responsibilities in the case of differentiated goods.

In what follows, we aim to interpret our findings through the lenses of existing research. Buyers and sellers exchanging differentiated goods appear to be involved in longer relationships, compared to those exchanging homogeneous goods (Besedeš and Prusa, 2006). Therefore, the durability of the relationship might cause buyers to be more inclined to delegate the responsibilities of the shipping process to sellers. Moreover, Boehm and Oberfield (2020) noted that, since differentiated inputs are more relationship specific, buyers might benefit from better formal contract enforcement within the relationship. As a consequence, they could be less likely to take responsibilities.

[15] Miroudot et al. (2009) argued that imports of intermediates are more sensitive to trade costs.

Looking from a different angle, the trade in differentiated goods might incur specific additional costs. Some studies have pointed to the larger transportation costs of differentiated goods. Conconi et al. (2020) demonstrated that the trade flows in differentiated inputs are the most elastic with respect to the distance. According to Baniya (2017), with increasing product differentiation, risks and costs might rise substantially since product-specific shipment conditions might be required. A seller is the counterpart that is more likely to have greater ability to effectively meet these conditions and, for the sake of optimally, should bear the associated responsibilities.

The international trade in differentiated goods might further involve excessive communication and coordination costs. For instance, Tang (2006) emphasized the substantial role of communication costs associated with products of this type. Costinot et al. (2013) built a theoretical framework in which coordination costs arise once the inputs cross the border. Since the differentiated goods are complex[16] and thus composed of a larger number of inputs, the associated coordination costs of avoiding defects in the final product are high. Therefore, to compensate for excessive coordination costs, buyers might pass on the transaction-related costs and risks to sellers.

Finally, differentiated goods are more likely to be subject to tariff evasion (Javorcik and Narciso, 2008) since it is difficult to accurately assess their price and quality. Therefore, differentiated goods might be more prone to the excessive administrative burden of customs controls. This fact might cause buyers to diverge from bearing responsibilities over import operations, although it might be less costly for them to do so due to better knowledge of the local language, legislation and experience with customs procedures.

We further explore how the specificity of a traded product for the relations of buyer and seller impacts the decision to share responsibilities along the international trade transaction. To do so, we employ the measure of *Contract Intensity* developed by Nunn (2007). This measure is based on Rauch (1999) and considers the US input-output tables. Contract intensity reflects the proportion of inputs within an industry, weighted by value, requiring relationship-specific investments for their production. The corresponding regression results are reported in Columns (3) and (4). The estimations suggest that, with greater contract intensity the probability that the buyer accepts risks and costs throughout the shipping process decreases. Stated differently, the more differentiated and not easily contractible that the goods are, the less likely that the buyer is to bear responsibilities throughout the shipping process.

For the sake of robustness, we run a regression using the *contractibility* measure developed by Antràs and Chor (2013) as an alternative way to capture input specificity. The higher the values of contractibility are, the less specific the relationship is. In other

[16] Berkowitz et al. (2006) noted that complex goods are differentiated. They further noted that associated contracts are highly incomplete.

words, for products with higher contractibility, sellers can find buyers more easily. We report the results in Columns (5) and (6). The coefficients are positive and significant: the higher the contractibility is, the greater the probability is that the buyer bears risks and costs throughout the shipping process. Stated differently, the less specific the relationship is (i.e., sellers can easily find buyers for their products and vice-versa), the more likely the buyer is to bear responsibilities. These results are in line with the conclusions derived from the estimations using the *contract intensity* measure developed by Nunn (2007) and the discrete classification of Rauch (1999).

In what follows, we aim to position our results with respect to the existing studies. It has been shown that, once trading firms must change their partners, it induces substantial search and switching costs (Barrot and Sauvagnat, 2016; Antras et al., 2017; Martin et al., 2020; Bernard et al., 2019).[17] According to Martin et al. (2020), "while switching costs might be limited for products anonymously purchased on spot markets, their size may be nonnegligible in presence of relationship-specific investments, of customization costs, or in markets displaying informational or contractual frictions." Moreover, Barrot and Sauvagnat (2016) showed that firm-level idiosyncratic shocks tend to strongly propagate in the case of specific inputs, and the impacted sellers pass on large output losses to buyers. In light of these findings, our result stating that buyers tend to bear full responsibilities over an international shipment appears to be very intuitive. A disruption of the shipment on the seller side might cause the buyer to look for another supplier (search costs) and initiate a costly and lengthy switch (switch costs). Therefore, the additional costs related to bearing full responsibilities over the shipment might be lower than those resulting from the transmitted shock.

[17] Besedeš (2008) showed that search costs are a crucial factor in the incidence and duration of import relationships.

Table 8
Relationship specificity

	Rauch (1999)		Contract intensity (Nunn, 2007)		Contractibility (Antràs and Chor, 2013)	
	B+Sh->S (1)	B->Sh+S (2)	B+Sh->S (3)	B->Sh+S (4)	B+Sh->S (5)	B->Sh+S (6)
=1 if differentiated good	-0.060^a	-0.076^a				
	(0.001)	(0.001)				
contract intensity			-0.067^a	-0.078^a		
			(0.001)	(0.001)		
contractibility					0.078^a	0.100^a
					(0.001)	(0.001)
value of the shipment	-0.001^a	-0.005^a	-0.001^a	-0.005^a	-0.001^a	-0.004^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
volume of the shipment	-0.002^a	0.002^a	-0.001^a	0.002^a	-0.001^a	0.002^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
total value S-B (cum)	-0.011^a	-0.023^a	-0.009^a	-0.021^a	-0.011^a	-0.023^a
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
nb relations S-B (cum)	0.015^a	0.029^a	0.012^a	0.027^a	0.015^a	0.029^a
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
nb buyers in a region (cum)	-0.004^a	-0.018^a	-0.003^a	-0.019^a	-0.004^a	-0.018^a
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
distance S-CP	0.005^a	0.037^a	0.004^a	0.038^a	0.005^a	0.038^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
distance CP-B	0.001^b	-0.008^a	-0.002^a	-0.010^a	0.001^a	-0.007^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
=1 if trsp insd via water	0.023^a	0.052^a	0.025^a	0.054^a	0.024^a	0.050^a
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
=1 if trsp bord via water	0.146^a	0.086^a	0.146^a	0.089^a	0.148^a	0.090^a
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)
=1 if container	0.002^c	-0.078^a	0.002	-0.078^a	0.001	-0.078^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	4668465	4668465	4525087	4525087	4855118	4855118
Adjusted R^2	0.904	0.895	0.905	0.895	0.905	0.897
Fixed effects:						
ST&BT&HS2	Yes	Yes	Yes	Yes	Yes	Yes

Note: The results are based on an LPM estimator. The three groups of responsibilities are arranged in a "ladder" with two steps, and they follow the progression of responsibilities from the seller to the buyer. In the first step (Columns 1, 3 and 5), the dependent variable is a dummy set to 1 for *On buyer* or *Shared* responsibilities and 0 otherwise. In the second step (Columns 2, 4 and 6), the dependent variable is a dummy variable that takes the value of 1 for *On buyer* responsibilities and 0 otherwise. Robust standard errors appear in parentheses, with ^{a}, ^{b} and ^{c} denoting significance at the 1%, 5% and 10% levels, respectively.

4.3 Robustness: ownership links

The baseline estimations pool together the firms involved in arm's length transactions and those that are vertically integrated. Alfaro et al. (2019) argued that the decision of a firm to integrate upstream or downstream suppliers is an important step in building up a GVC. The degree of such integration is demonstrated to depend on demand elasticity. We hypothesize that the ownership relations between buyers and sellers might influence the way in which product characteristics shape the split of costs and risks. As noted by Antràs and Yeaple (2014), the ownership typically results from cross-border acquisitions or greenfield investments. Therefore, an ownership relationship between buyer and seller essentially indicates that the former acts as a parent and substantially controls the activities of the latter.

To infer the ownership links, we merge the customs data with data on firm characteristics from the Orbis database. In this section, we are interested in the global owners of Russian sellers. Unfortunately, it appears that the unambiguous identification of the exact owner is not feasible due to the data limitations.[18] At the same time, the information of the country of the global owner is properly recorded for the subsample under consideration. Thus, we assume that the buyer and seller are vertically connected once the location of the buyer matches the country of the seller's global owner. In what follows, we reproduce the baseline estimations on a subsample composed of transactions between presumably integrated firms.

We run a number of regressions on a restricted subsample of the aforementioned vertically connected firms. In Table 9, we explore how the position of a good in the global value chain influences the split of risks and costs in case of the vertically connected firms. In Columns (1) and (2), we report the results for dummy variables for capital, consumer and intermediary goods. The associated negative coefficients suggest that, after controlling for other potentially confounding factors, buyers have a lower probability of bearing responsibilities during the shipping process if the transaction involves capital, consumer or intermediate goods, compared to raw materials. These results are further confirmed with regressions containing continuous measure of upstreamness à la Antràs et al. (2012) (see Columns (3) and (4)). The coefficients on this variable are positive and significant, suggesting that the more distant that the good is from final use, the greater that the probability is that the buyer bears responsibilities throughout the shipping process.

We conclude that these results are very much in line with those obtained for the baseline estimations (see Table 7). We further note that the magnitudes of the effects

[18]There are numerous omissions in the ownership data for emerging markets, such as Russia. We could not infer whether this information for a given Russian seller is not reported or whether there is in fact no global owner. Furthermore, for most cases, the identifiers of the global owner of a Russian seller and of an international buyer appear not to be properly recorded, preventing us from tracking the specific relationship between sellers and buyers.

for vertically connected trading firms are stronger. To explain this regularity, we refer to the study of Defever et al. (2016). They demonstrated that it is in the interest of headquarters to establish long-lasting relations with the upstream suppliers in which they have property rights. The relations might be framed with a relational contract, and this tool is frequently applied to enforce the contracts and overcome hold-up problems. We hypothesize that, within the framework of such a contract, the buyers might be more eager to transfer shipping-related responsibilities to integrated sellers.

Table 9
Robustness: Position in a global value chain and integrated trading partners

	UNCTAD SoP2 classification		Upstreamness (Antràs et al., 2012)	
	B+Sh->S (1)	B->Sh+S (2)	B+Sh->S (3)	B->Sh+S (4)
=1 if capital good	-0.475[a]	-0.432[a]		
	(0.013)	(0.013)		
=1 if consumer good	-0.478[a]	-0.484[a]		
	(0.013)	(0.013)		
=1 if intermediary good	-0.481[a]	-0.481[a]		
	(0.013)	(0.012)		
upstreamness			0.018[a]	0.044[a]
			(0.002)	(0.002)
Observations	260703	260703	259946	259946
Adjusted R^2	0.883	0.891	0.877	0.888
Fixed effects:				
ST&BT&HS2	Yes	Yes	Yes	Yes

Note: The results are based on an LPM estimator. The three groups of responsibilities are arranged in a "ladder" with two steps and follow the progression of responsibilities from the seller to the buyer. In the first step (Columns 1 and 2), the dependent variable is a dummy set to 1 for *On buyer* or *Shared* responsibilities and 0 otherwise. In the second step (Columns 2 and 4), the dependent variable is a dummy variable that takes the value of 1 for *On buyer* responsibilities and 0 otherwise. The estimations include the following control variables: the value and volume of the shipment, the total value and number of transactions for a seller-buyer pair prior to the current shipment, the number of buyers to which the seller is connected in a particular region, the distance between the seller and the customs point and the transportation mode over this distance, the distance between the customs point and the buyer and the transportation mode over the distance, and whether the shipment occurs with the use of containers. Robust standard errors appear in parentheses, with [a], [b] and [c] denoting significance at the 1%, 5% and 10% levels, respectively.

We further continue challenging previously obtained empirical evidence relying on a subsample of vertically connected firms. We replicate LPM estimations of the specification in Table 8 and report the results in Table 10. We aim to reveal how an important product characteristic – relationship specificity – influences the split of responsibilities for connected firms.

In Columns (1) and (2) we report the results for differentiated goods (Rauch (1999) classification) compared with homogeneous products. The coefficients on the dummy variable for differentiated goods are negative and significant. This result confirms conclusion of Table 10 that buyers are less likely to bear transaction-related risks and costs in the case of differentiated goods. We further explore the contract intensity à la Nunn

(2007) (see Columns (3) and (4)) and contractibility measure of Antràs and Chor (2013) (see Columns (5) and (6)). This empirical evidence suggests that the buyer is less likely to bear responsibilities throughout the shipping process for more differentiated and not easily contractible goods.

All in all, our robustness exercise on a subsample of presumably integrated buyers and sellers reveals that such firms do not behave differently than other firms. We further re-iterated the aforementioned estimations on the subsample of nonintegrated firms. The corresponding evidence (available upon request) supports this conclusion.

Table 10
Robustness: Relationship specificity and integrated trading partners

	Rauch classification		Contract intensity (Nunn, 2007)		Contractibility (Antràs and Chor, 2013)	
	B+Sh->S (1)	B->Sh+S (2)	B+Sh->S (3)	B->Sh+S (4)	B+Sh->S (5)	B->Sh+S (6)
=1 if differentiated good	-0.113[a] (0.004)	-0.123[a] (0.004)				
contract intensity			-0.072[a] (0.005)	-0.130[a] (0.007)		
contractibility					0.081[a] (0.004)	0.086[a] (0.004)
Observations	240834	240834	252782	252782	260637	260637
Adjusted R^2	0.873	0.884	0.876	0.888	0.877	0.888
Fixed effects:						
ST&BT&HS2	Yes	Yes	Yes	Yes	Yes	Yes

Note: The results are based on an LPM estimator. The three groups of responsibilities are arranged in a "ladder" with two steps and follow the progression of responsibilities from the seller to the buyer. In the first step (Columns 1, 3 and 5), the dependent variable is a dummy set to 1 for *On buyer* or *Shared* responsibilities and 0 otherwise. In the second step (Columns 2, 4 and 6), the dependent variable is a dummy variable that takes the value of 1 for *On buyer* responsibilities and 0 otherwise. The estimations include the following control variables: the value and volume of the shipment, the total value and number of transactions for a seller-buyer pair prior to the current shipment, the number of buyers that the seller is connected to in a particular region, the distance between the seller and the customs point and the transportation mode over this distance, the distance between the customs point and the buyer and the transportation mode over the distance, and whether the shipment occurs with the use of containers. Robust standard errors appear in parentheses, with [a], [b] and [c] denoting significance at the 1%, 5% and 10% levels, respectively.

5 Testable interpretations

We aim to provide in-depth interpretations of principal regression results. To do so, we proceed with a number of additional estimations inspired by microeconomic intuition and the extant research. First, we support our estimations of a product position in a global value chain (cf. Table 7) and differentiate the traded products with respect to their importance as inputs for the buyer's production. Second, we consider two-sided heterogeneity in terms of sizes between buyers and sellers. We hypothesize that discrepancies in the sizes of trading partners might interfere with the relationship specificity (cf. Table 8).

5.1 Input importance

In what follows, we analyze how the importance of a traded input for the buyer impacts the split of risks and costs between sellers and buyers. We use the variable *Input Importance* constructed by Antràs and Chor (2013), which represents "the industry's total use value as an input divided by the total input purchases made by all of its buyer industries."[19] The higher this measure is, the more important the input is for the buyer.[20]

We augment the baseline specification with an interaction term for input importance. Thus, the following equation is estimated with an LPM:

$$\begin{aligned} Choice_{sbpT} \quad = \quad & \text{Product charact.}_{pT} \times \text{Input Importance}_{p} + \\ & \text{Input Importance}_{p} + \text{Product charact.}_{pT} + \\ & \text{Controls} + \text{FE} + \varepsilon_{sbpT} \end{aligned} \tag{2}$$

The results are reported in Table 11. Note that we include with each specification the same control variables as in the baseline estimations. The coefficients on the input importance measure introduced directly are both negative and significant. The evidence of the direct impact of upstreamness is weak: the corresponding estimated coefficient has a small magnitude and is not significant for one of the two steps of the ladder.

The estimated coefficients on the interaction between input importance and the upstreamness measure are positive and significant. Thus, the results suggest that, for

[19] In similar research, Fally (2012) developed two simple measures of vertical fragmentation of production chains across plants based on input-output tables.

[20] The *Input Importance* has been computed using the 2002 I-O Tables as a benchmark. The correspondence between the 2002 I-O Tables and the 2002 HS Classification has been achieved based on the tables available at: https://are.berkeley.edu/~fally/data.html. Furthermore, the correspondence between the 2002 and 2012 HS Classifications has been assured by relying on the tables developed by Reference And Management Of Nomenclatures (RAMON).

more upstream goods, the probability of the buyer bearing risks and costs rises with the importance of the traded input for the buyer. Overall, we conclude that the upstreamness of a traded good matters to the split of risks and costs between sellers and buyers when the good is an important input in the production of buyers.

Table 11
Input importance and position in a global value chain

	Upstreamness (Antràs et al., 2012)	
	B+Sh->S	B->Sh+S
	(1)	(2)
input importance	-0.557[a]	-0.848[a]
	(0.033)	(0.055)
input importance x upstreamness	0.292[a]	0.388[a]
	(0.008)	(0.013)
upstreamness	-0.005[a]	-0.000
	(0.000)	(0.000)
Observations	4824113	4824113
Adjusted R^2	0.906	0.898
Fixed effects:		
ST&BT&HS2	Yes	Yes

Note: The results are based on an LPM estimator. The three groups of responsibilities are arranged in a "ladder" with two steps and follow the progression of responsibilities from the seller to the buyer. In the first step (Column 1), the dependent variable is a dummy set to 1 for *On buyer* or *Shared* responsibilities and 0 otherwise. In the second step (Column 2), the dependent variable is a dummy variable that takes the value of 1 for *On buyer* responsibilities and 0 otherwise. The estimations include the following control variables: the value and volume of the shipment, the total value and number of transactions for a seller-buyer pair prior to the current shipment, the number of buyers that the seller is connected to in a particular region, the distance between the seller and the customs point and the transportation mode over this distance, the distance between the customs point and the buyer and the transportation mode over the distance, and whether the shipment occurs with the use of containers. Robust standard errors appear in parentheses, with [a], [b] and [c] denoting significance at the 1%, 5% and 10% levels, respectively.

We further aim to test whether the input importance shapes the role of relationship specificity for the risk and cost sharing. We strongly expect that more important inputs should be treated by buyers differently. The extant research on GVCs reveals the important role of intermediate inputs for functioning of the importers.[21]

In Table 12, we interact the input importance measure with a dummy for differentiated goods, the contract intensity measure developed by Nunn (2007) and the contractibility measure developed by Antràs and Chor (2013). In Columns (1) and (2), the interaction terms are negative and significant, suggesting that the higher the input importance is, the lower the probability is that a buyer takes on responsibilities if the good is differentiated. In Columns (3) and (4), the interaction terms are also negative and significant, suggesting that the more important an input is and the more relation-

[21] For instance, Feng et al. (2016) showed that increased imports of intermediate inputs largely impact both the extensive and intensive margins of buyers' exports.

ship specific it is, the lower the probability is for the buyer to bear responsibilities. Finally, in Columns (5) and (6), the interaction terms are positive and significant, implying that the higher the input importance is and the less specific the relationship is, the higher the probability is that the buyer takes on responsibilities. Note that the term input importance isolated is positive and significant across all specifications, suggesting that the buyer tends to take on responsibilities for more important goods. However, in specific circumstances, as described above, the buyer might be deterred from doing so.

Table 12
Input importance and relationship specificity

	Rauch classification		Contract intensity (Nunn, 2007)		Contractibility (Antràs and Chor, 2013)	
	B+Sh->S	B->Sh+S	B+Sh->S	B->Sh+S	B+Sh->S	B->Sh+S
	(1)	(2)	(3)	(4)	(5)	(6)
input importance	0.652^a	0.777^a	1.418^a	3.810^a	0.034^b	-0.014
	(0.006)	(0.006)	(0.052)	(0.073)	(0.017)	(0.028)
input importance x =1 if differentiated good	-0.331^a	-0.503^a				
	(0.021)	(0.025)				
=1 if differentiated good	-0.004^a	-0.010^a				
	(0.000)	(0.001)				
input importance x contract intensity			-1.559^a	-6.190^a		
			(0.106)	(0.149)		
contract intensity			-0.003^a	0.019^a		
			(0.001)	(0.001)		
input importance x contractibility					0.640^a	0.808^a
					(0.018)	(0.029)
contractibility					0.000	0.008^a
					(0.001)	(0.001)
Observations	4634625	4634625	4518424	4518424	4824113	4824113
Adjusted R^2	0.905	0.896	0.907	0.897	0.906	0.898
Fixed effects:						
ST&BT&HS2	Yes	Yes	Yes	Yes	Yes	Yes

Note: The results are based on an LPM estimator. The three groups of responsibilities are arranged in a "ladder" with two steps, and they follow the progression of responsibilities from the seller to the buyer. In the first step (Columns 1, 3 and 5), the dependent variable is a dummy set to 1 for *On buyer* or *Shared* responsibilities and 0 otherwise. In the second step (Columns 2, 4 and 6), the dependent variable is a dummy variable that takes the value of 1 for *On buyer* responsibilities and 0 otherwise. The estimations include the following control variables: value and volume of the shipment, the total value and number of transactions for a seller-buyer pair prior to the current shipment, the number of buyers that the seller is connected to in a particular region, the distance between the seller and the customs point and the transportation mode over this distance, the distance between the customs point and the buyer and the transportation mode over the distance, and whether the shipment takes place with the use of containers. Robust standard errors appear in parentheses, with ^{a}, ^{b} and ^{c} denoting significance at the 1%, 5% and 10% levels, respectively.

5.2 Firm sizes

In what follows, we explore how product characteristics interfere with firm characteristics in shaping the split of responsibilities between sellers and buyers throughout the shipping process. We match Russian customs data with the Orbis dataset and subsequently run regression analysis on the obtained subsample. The key firm characteristic that might affect the sharing of risks and costs is the firm size. We consider the total assets (reported in Orbis) as a proxy for the seller's and buyer's sizes. In what follows, we differentiate the transactions in which buyers are larger than sellers.

Therefore, we estimate the following equation with an LPM estimator:

$$\begin{aligned} Choice_{sbpT} \quad = \quad & \text{Product charact.}_{pT} \times \text{dummy =1 if buyer > seller size}_{sbt} + \\ & \text{dummy =1 if buyer > seller size}_{sbt} + \text{Product charact.}_{pT} + \\ & \text{Controls} + \text{FE} + \varepsilon_{sbpT} \end{aligned} \tag{3}$$

Our main explanatory variable is the interaction between the vector **Product charact.**$_{pT}$ and a dummy variable set to 1 if the buyer is larger than the seller. The separate terms of the interaction are also included in the estimations, along with all control variables from the baseline estimations. We control for seller-year and HS2-sector fixed effects.[22]

We advance a number of hypotheses regarding the role of size heterogeneity. First, we hypothesize that larger size means greater bargaining power. A larger partner is better able to impose its position in the course of negotiations over split of risks and costs. If the difference in sizes is substantially large, "take-it-or-leave-it" offers might occur. Second, larger firms are more efficient and better able to cover additional costs due to economies of scale.[23]

Third, larger importers might enjoy lower freight rates due to scale effects (Holmes and Singer, 2018; Ardelean and Lugovskyy, 2020). Finally, Dickstein and Morales (2018) found that larger firms tend to have more information about the market conditions in foreign countries, even when they have never exported to these countries.

In Table 13, we analyze how the upstreamness of a good shapes the decision to split risks and costs throughout the shipping process when the buyer is larger than the seller. We note that the coefficient of the direct upstreamness term is positive and significant, in line with the baseline results (cf. Table 7).

The direct coefficients for the dummy set to 1 if the buyer is larger than the seller are positive and significant. This result suggests that, in general, larger buyers tend to

[22]Note that, compared to the baseline estimations ,we do not consider buyer-year fixed effects. This aspect is motivated by, on average, a buyer importing from 1.7 Russian sellers. Thus, very little variation for a buyer across sellers would be exploited. However, we include controls for the size and the number of Russian selling partners of a buyer.

[23]For instance, this message is promoted by the literature on one-sided heterogeneity (Melitz, 2003; Antras et al., 2017) and two-sided heterogeneity (Bernard and Moxnes, 2018).

take on more responsibilities throughout the shipping process. The coefficients on the interaction terms between this dummy and upstreamness are negative. Thus, the more upstream a good is, the less probable it is that a larger buyer bears responsibilities over shipping. One could interpret this result such that larger buyers might employ their bargaining power to avoid additional costs.

Table 13
Firm sizes and position in a global value chain

	Upstreamness (Antràs et al., 2012)	
	B+Sh->S	B->Sh+S
	(1)	(2)
= 1 if buyer > seller	0.142[a]	0.052[a]
	(0.002)	(0.003)
= 1 if buyer > seller × upstreamness	-0.037[a]	-0.017[a]
	(0.001)	(0.001)
upstreamness	0.024[a]	0.035[a]
	(0.001)	(0.001)
Observations	2275870	2275870
Adjusted R^2	0.601	0.623
Fixed effects:		
ST&*HS*2	Yes	Yes

Note: The results are based on an LPM estimator. The three groups of responsibilities are arranged in a "ladder" with two steps and follow the progression of responsibilities from the seller to the buyer. In the first step (Column 1), the dependent variable is a dummy set to 1 for *On buyer* or *Shared* responsibilities and 0 otherwise. In the second step (Column 2), the dependent variable is a dummy variable that takes the value of 1 for *On buyer* responsibilities and 0 otherwise. The estimations include the following control variables: the value and volume of the shipment, the total value and number of transactions for a seller-buyer pair prior to the current shipment, the number of buyers that the seller is connected to in a particular region, the distance between the seller and the customs point and the transportation mode over this distance, the distance between the customs point and the buyer and the transportation mode over the distance, and whether the shipment occurs with the use of containers. Robust standard errors in parentheses, with [a], [b] and [c] denoting significance at the 1%, 5% and 10% levels, respectively.

We continue the analysis of the role of two-sided heterogeneity with an interaction term between size differences and relationship specificity. We report the results in Table 14. In Columns (1) and (2), the interaction terms are positive and significant, emphasizing that, in the case of differentiated goods, buyers tend to take on responsibilities if they are larger than the sellers. The interaction terms in Columns (3) and (4) suggest that the higher the relationship specificity between sellers and buyers is, the greater the probability is that the buyer bears the risks and costs in the shipping process if it is bigger than the seller. Finally, in Columns (5) and (6), the coefficients are both negative and significant, suggesting that the higher the contractibility of a good is, the lower the probability is that the buyer takes on responsibilities if it is larger than the seller.

Table 14
Firm sizes and relationship specificity

	Rauch classification		Contract intensity (Nunn, 2007)		Contractibility (Antràs and Chor, 2013)	
	B+Sh->S	B->Sh+S	B+Sh->S	B->Sh+S	B+Sh->S	B->Sh+S
	(1)	(2)	(3)	(4)	(5)	(6)
= 1 if buyer > seller	0.021[a]	-0.004[a]	0.005[a]	-0.011[a]	0.080[a]	0.030[a]
	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
= 1 if buyer > seller × =1 if differentiated good	0.044[a]	0.020[a]				
	(0.001)	(0.002)				
=1 if differentiated good	-0.027[a]	-0.047[a]				
	(0.001)	(0.001)				
= 1 if buyer > seller × contract intensity			0.092[a]	0.046[a]		
			(0.003)	(0.004)		
contract intensity			-0.047[a]	-0.064[a]		
			(0.003)	(0.004)		
= 1 if buyer > seller × contractibility					-0.078[a]	-0.051[a]
					(0.002)	(0.002)
contractibility					-0.007[a]	0.017[a]
					(0.002)	(0.002)
Observations	2203853	2203853	2125206	2125206	2290348	2290348
Adjusted R^2	0.600	0.622	0.602	0.622	0.603	0.624
Fixed effects:						
ST&HS2	Yes	Yes	Yes	Yes	Yes	Yes

Note: The results are based on an LPM estimator. The three groups of responsibilities are arranged in a "ladder" with two steps and follow the progression of responsibilities from the seller to the buyer. In the first step (Columns 1, 3 and 5), the dependent variable is a dummy set to 1 for *On buyer* or *Shared* responsibilities and 0 otherwise. In the second step (Columns 2, 4 and 6), the dependent variable is a dummy variable that takes the value of 1 for *On buyer* responsibilities and 0 otherwise. The estimations include the following control variables: the value and volume of the shipment, the total value and number of transactions for a seller-buyer pair prior to the current shipment, the number of buyers that the seller is connected to in a particular region, the distance between the seller and the customs point and the transportation mode over this distance, the distance between the customs point and the buyer and the transportation mode over the distance, and whether the shipment occurs with the use of containers. Robust standard errors appear in parentheses, with [a], [b] and [c] denoting significance at the 1%, 5% and 10% levels, respectively.

6 Concluding Remarks

International commercial terms (Incoterms) are a powerful tool at the disposal of trading firms that facilitate negotiations and delimit responsibilities. However, Incoterms have been overlooked by international economics literature, and this study attempts to close this gap. It is also one of the first efforts to address the division of risks and costs between trading firms. In this regard, our empirical analysis focuses on the role of the characteristics of the exchanged products.

We deem this question to be important for several reasons. First, contracting frictions associated with input trade could be an important obstacle to the smooth functioning and further development of value chains (Conconi et al., 2020). The position of the exchanged product in the value chain might therefore cause trading partners to design contracts that alleviate risks and reduce costs to ensure a smooth production process. Second, it has been argued that contracting frictions are particularly serious when inputs are differentiated or tailored to the needs of the user (Nunn, 2007; Antràs and Chor, 2013; Conconi et al., 2020; Martin et al., 2020), which might induce trading partners to be trapped in sticky relationships.

This paper investigates how both the position of a product in the value chain and the specificity of a product influence the split of risks and costs between trading partners throughout the shipping process. To do so, we rely on a highly detailed firm-to-firm dataset involving all Russian exporters and their international partners over 2012-2015. We show that the more upstream a good is, the higher the probability that trading partners design contracts that place the responsibilities associated with the shipping process on the buyer. Finally, we investigate how the relationship specificity influences the choice of a class of risk and cost. We find that the more specific that a good is to a seller-buyer pair, the lower that the probability is that the trading partners engage in a transaction in which responsibilities are borne by the buyer. These results are reinforced when the product exchanged is particularly important to the production process and reversed when the transaction involves buyers with larger size than the sellers.

Further research is required to perceive the nuance in the micro-level evidence of the split of costs and risks between trading partners. We would emphasize two prospective directions. First, panel data with longer time span would allow for exploring the durability and stickiness of relationships between partners. Second, the empirical research should distinguish firms that are simultaneously importers and exporters and thus are involved in multiple global value chains.

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References

Alfaro, Laura, Davin Chor, Pol Antras, and Paola Conconi, "Internalizing global value chains: A firm-level analysis," *Journal of Political Economy*, 2019, *127* (2), 508–559.

Antràs, Pol, *Global production: Firms, contracts, and trade structure*, Princeton University Press, 2015.

_ **and C. Fritz Foley**, "Poultry in Motion: A Study of International Trade Finance Practices," *Journal of Political Economy*, 2015, *123* (4), 809–852.

_ **and Davin Chor**, "Organizing the global value chain," *Econometrica*, 2013, *81* (6), 2127–2204.

_ **and Stephen R Yeaple**, "Multinational firms and the structure of international trade," in "Handbook of international economics," Vol. 4, Elsevier, 2014, pp. 55–130.

_ **, Davin Chor, Thibault Fally, and Russell Hillberry**, "Measuring the upstreamness of production and trade flows," *American Economic Review*, 2012, *102* (3), 412–16.

Antras, Pol, Teresa C Fort, and Felix Tintelnot, "The margins of global sourcing: Theory and evidence from us firms," *American Economic Review*, 2017, *107* (9), 2514–64.

Ardelean, Adina and Volodymyr Lugovskyy, "Do Larger Importing Firms Face Lower Freight Rates?," CAEPR Working Paper 2020-002 2020.

Baniya, S., *Effects of Timeliness on the Trade Pattern between Primary and Processed Goods*, International Monetary Fund, 2017.

Barrot, Jean-Noël and Julien Sauvagnat, "Input specificity and the propagation of idiosyncratic shocks in production networks," *The Quarterly Journal of Economics*, 2016, *131* (3), 1543–1592.

Berkowitz, Daniel, Johannes Moenius, and Katharina Pistor, "Trade, law, and product complexity," *the Review of Economics and Statistics*, 2006, *88* (2), 363–373.

Bernard, Andrew B and Andreas Moxnes, "Networks and Trade," *Annual Review of Economics*, 2018, *10*, 65–85.

_ **,** _ **, and Yukiko U Saito**, "Production networks, geography, and firm performance," *Journal of Political Economy*, 2019, *127* (2), 639–688.

_ **, J Bradford Jensen, and Peter K Schott**, "Importers, exporters and multinationals: a portrait of firms in the US that trade goods," in "Producer dynamics: New evidence from micro data," University of Chicago Press, 2009, pp. 513–552.

Besedeš, Tibor, "A search cost perspective on formation and duration of trade," *Review of International Economics*, 2008, *16* (5), 835–849.

_ **and Thomas J Prusa**, "Product differentiation and duration of US import trade," *Journal of international Economics*, 2006, *70* (2), 339–358.

Boehm, Johannes and Ezra Oberfield, "Misallocation in the Market for Inputs: En-

forcement and the Organization of Production," *The Quarterly Journal of Economics*, 2020, *135* (4), 2007–2058.

Castellani, Davide, Francesco Serti, and Chiara Tomasi, "Firms in international trade: Importers' and exporters' heterogeneity in Italian manufacturing industry," *World Economy*, 2010, *33* (3), 424–457.

Chor, Davin, "Modelling Global Value Chains: Approaches and Insights from Economics," *Research Handbook on Global Value Chains*, 2018.

Coase, Ronald H, "The nature of the firm," *economica*, 1937, *4* (16), 386–405.

Conconi, Paola, Glenn Magerman, and Afrola Plaku, "The gravity of intermediate goods," *Review of Industrial Organization*, 2020, pp. 1–21.

Coşar, A Kerem and Banu Demir, "Shipping inside the box: Containerization and trade," *Journal of International Economics*, 2018, *114*, 331–345.

Costinot, Arnaud, Jonathan Vogel, and Su Wang, "An elementary theory of global supply chains," *Review of Economic studies*, 2013, *80* (1), 109–144.

Defever, Fabrice, Christian Fischer, and Jens Suedekum, "Relational contracts and supplier turnover in the global economy," *Journal of International Economics*, 2016, *103*, 147–165.

Demir, Banu and Beata Javorcik, "Don't throw in the towel, throw in trade credit!," *Journal of International Economics*, 2018, *111*, 177 – 189.

Dickstein, Michael J and Eduardo Morales, "What do exporters know?," *The Quarterly Journal of Economics*, 2018, *133* (4), 1753–1801.

Dragusanu, Raluca, "Firm-to-Firm Matching Along the Global Supply Chain. Evidence from US - India Trade," 2016. Mimeo.

Eaton, Jonathan, Francis Kramarz, and Samuel Kortum, "Firm-to-firm trade: Exports, imports, and the labor market," Meeting Papers 702, Society for Economic Dynamics 2019.

Fally, Thibault, "Production staging: measurement and facts," 2012. Mimeo.

_ **and Russell Hillberry**, *A coasian model of international production chains*, The World Bank, 2015.

Feng, Ling, Zhiyuan Li, and Deborah L Swenson, "The connection between imported intermediate inputs and exports: Evidence from Chinese firms," *Journal of International Economics*, 2016, *101*, 86–101.

Gamberoni, Elisa, Rainer Lanz, and Roberta Piermartini, *Timeliness and contract enforceability in intermediate goods trade*, The World Bank, 2010.

Grossman, Sanford J and Oliver D Hart, "The costs and benefits of ownership: A theory of vertical and lateral integration," *Journal of political economy*, 1986, *94* (4), 691–719.

Hahn, Jinyong and Whitney Newey, "Jackknife and analytical bias reduction for non-

linear panel models," *Econometrica*, 2004, *72* (4), 1295–1319.

Hart, Oliver and John Moore, "Property Rights and the Nature of the Firm," *Journal of political economy*, 1990, *98* (6), 1119–1158.

Holmes, Thomas J and Ethan Singer, "Indivisibilities in distribution," "Working Paper 24525", National Bureau of Economic Research 2018.

International Chamber of Commerce, *Incoterms® 2010: ICC Rules for the Use of Domestic and International Trade Terms* ICC publication, International Chamber of Commerce, 2010.

Javorcik, Beata S and Gaia Narciso, "Differentiated products and evasion of import tariffs," *Journal of International Economics*, 2008, *76* (2), 208–222.

Kikuchi, Tomoo, Kazuo Nishimura, and John Stachurski, "Span of control, transaction costs, and the structure of production chains," *Theoretical Economics*, 2018, *13* (2), 729–760.

Li, Yue and John S. Wilson, "Time as a Determinant of Comparative Advantage," World Bank Policy Research Working Paper Series 2009.

Malfliet, Jonas, "Incoterms 2010 and the mode of transport: how to choose the right term," in "Management challenges in the 21st century : transport and logistics : opportunity for Slovakia in the era of knowledge economy, Proceedings" City University of Seattle Bratislava 2011, pp. 163–179.

Martin, Julien, Isabelle Mejean, and Mathieu Parenti, "Relationship stickiness and economic uncertainty," *Mimeo*, 2020.

Melitz, Marc J., "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, 2003, *71* (6), 1695–1725.

Miroudot, Sébastien, Rainer Lanz, and Alexandros Ragoussis, "Trade in intermediate goods and services," *OECD Trade Policy Papers*, 2009.

Muûls, Mirabelle and Mauro Pisu, "Imports and Exports at the Level of the Firm: Evidence from Belgium," *World Economy*, 2009, *32* (5), 692–734.

Niepmann, Friederike and Tim Schmidt-Eisenlohr, "International trade, risk and the role of banks," *Journal of International Economics*, 2017, *107*, 111 – 126.

Nunn, Nathan, "Relationship-Specificity, Incomplete Contracts and the Pattern of Trade," *Quarterly Journal of Economics*, 2007, *122* (2), 569–600. Reprinted in D. Bernhofen (ed.), Empirical International Trade, Edward Elgar Publishing, 2010.

_ **and Daniel Trefler**, "The Boundaries of the Multinational Firm: An Empirical Analysis," in Elhanan Helpman, Dalia Marin, and Thierry Verdier, eds., *The Organization of Firms in a Global Economy*, Harvard University Press, 2008, pp. 55–83.

O'Meara, A., *Making Money with Incoterms 2010: Strategic Use of Incoterms Rules in Purchases and Sales*, O'Meara & Associates, 2017.

Rauch, James, "Networks versus markets in international trade," *Journal of Interna-*

tional Economics, 1999, *48* (1), 7–35.

Schmidt-Eisenlohr, Tim, "Towards a theory of trade finance," *Journal of International Economics*, 2013, *91* (1), 96 – 112.

Stammann, Amrei, Florian Heiss, and Daniel McFadden, "Estimating fixed effects logit models with large panel data," Working Paper, Kiel und Hamburg: ZBW-Deutsche Zentralbibliothek 2016.

Tang, Linghui, "Communication costs and trade of differentiated goods," *Review of International Economics*, 2006, *14* (1), 54–68.

Teshome, Abiy, "Property rights and hold-up in international shipping," Working Paper, University of Virginia 2018.

Zhang, Hongsong, "Static and dynamic gains from costly importing of intermediate inputs: Evidence from Colombia," *European Economic Review*, 2017, *91*, 118–145.

Appendix

Appendix A. Data preparation

Construction of Buyer IDs

The steps used to clean the buyer names to create unique IDs are detailed below.

1. We replace all nonalphanumeric characters in the name of a buyer (i.e., commas, dots, hyphens, etc.) with a single space.

2. Buyer names appear in the dataset either in Cyrillic or Latin characters. Moreover, both uppercase and lowercase letters are used. Stata treats all of these characters differently, although they might be the same. First, we convert all Cyrillic characters into Latin characters. Then, we transform them to capital letters.

3. The type of business entity might enter the name of a firm in an extended form or as an abbreviation. We use only abbreviations, considering all possible misspellings. For instance, consider a buyer that we will refer to as firm X. Firm X, located in Azerbaijan, might appear in our dataset under different forms. It may be introduced as "OBSHESTVO S OGRANICHENNOI OTVETSTVENNOSTYU FIRM X" or simply as "OOO FIRM X." Without performing any modification of the names, these observations would be considered two different firms, although they have the same name and are located at the exact same address. To correct these errors, we replace "OBSHESTVO S OGRANICHENNOJ OTVETSTVENNOSTYU," which is the Russian equivalent for "Limited Liability Company," with "OOO." Since the type of business entity might also be partially abbreviated, as in "KOMPANIYA S OGR OTVETSTV FIRM X," we replace all of these possible cases with "OOO." As another example, a German buyer, called firm Z, might appear as "FIRM Z GESELLSCHAFT MBH" or as "FIRM Z GMBH." For consistency, we replace "GESELLSCHAFT MBH" with "GMBH," which stands for GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG and is the German equiva-

lent for "Limited Liability Company." We repeat this exercise for all types of legal entities specific to the different destinations in our dataset.

4. After correcting these errors, we focus on the names of the importing firms in the remaining long strings. Some interesting patterns emerge. Some firms might import on behalf of another firm: we might have cases such as "FIRM A *ON BEHALF OF* FIRM B." For all possible synonyms of "ON BEHALF OF," including the Russian ones (i.e., "IN THE NAME OF," "FOR THE ACCOUNT OF," "FOR FURTHER DELIVERY TO," "PO PORUCHENIYU," "PO KONTRAKTU," "TRANZITOM CHEREZ," etc.), we retain the first importer (i.e., FIRM A) and remove the second one (i.e., FIRM B) because the same firm A might import for itself and on behalf of another firm. We keep track of these cases by creating a dummy variable for intermediary firms.

5. We eventually create a unique ID for buyers based on their name, their country of origin, and the matchit command in Stata. Indeed, despite these extensive cleaning operations, some errors might still occur. The matchit command overcomes this problem by applying different string-based matching techniques and allowing for a fuzzy similarity between two firm names. To create the buyer ID, we match firm names with a degree of similarity greater than 85%.

Although this method might still be subject to errors, we are confident that the number of buyers is approximately correctly determined. A firm with several plants in different cities within a country is considered to be a single firm.

Construction of Distances

The Russian Federation is geographically a large country with long borders. We consider the geographical dimension by computing the following distances: seller-buyer, seller-customs point, and customs point-buyer. We proceed as follows.

1. ***Seller-Buyer distance***. The dataset includes information about the location of a seller within Russia and of a buyer abroad, enabling us to compute the distance

between them. We write a script that searches through Google and returns the Global Positioning System (GPS) coordinates of the seller and buyer. We further compute the distance between them as the shortest distance between two points on an ellipsoid.[24] However, certain shortcomings arise due to potential misspellings in the addresses provided in the declarations. We discuss the potential problems and how we address them in the following.

For the address of a sender, we observe only the city where the firm is located: misspellings can easily be addressed. The script returned the GPS coordinates for almost all Russian exporters. In contrast, in the case of buyers, we have the detailed address, which is more problematic because misspellings in several words might return no result at all or could lead to some errors. To overcome this issue, after obtaining all of the possible results via Google, we proceed to a further check, relying on the geosphere package in R software. First, we develop an algorithm to identify the city in the detailed address and then directly obtain GPS coordinates existing in the package. Then, we compare the coordinates found by Google with those found by R whenever possible. In the vast majority of cases, the results obtained from R are highly similar to those obtained from Google. In very few cases, the distance between the coordinates found through the two methods is important, and we set these values to missing. These two approaches allow us to obtain coordinates for more than 95% of the senders and for almost 70% of the buyers. Since the share of missing coordinates for international buyers is still important, we aim to recover the missing values. Relying on R, we obtain the coordinates of the capital cities of each destination in our database and replace the missing coordinates for buyers with these coordinates. This method does not appear to be problematic, as indicated by various robustness tests.

2. ***Seller-Customs Point & Customs Point-Buyer distances***. Customs points have a unique ID, enabling us to write another script to obtain their exact addresses and GPS coordinates. We manage to do so for more than 90% of all of the cus-

[24] The ellipsoid is defined by World Geodetic System 1984.

toms points. With these coordinates, we are able to compute the distance from a seller to the customs point through which the export transaction is processed and from the customs point to the buyer, using the same method as for the distance between a seller and a buyer.

Appendix B. Incoterms

The different categories of Incoterms are described below.

1. **EXW (Ex-Works)** can be used regardless of the mode of transport. It represents the minimum obligation for the seller. The seller delivers when it places the goods at the disposal of the buyer at the seller's premises or another named location (i.e., works, factory, warehouse, etc.). The seller does not load the goods or clear them for export. Once the delivery occurs, all risks and costs are borne by the buyer.

2. **FCA (Free Carrier)** can also be used irrespective of the mode of transport. Under FCA, the seller can deliver the goods at its premises or at another location agreed upon by the parties by loading them onto the collecting vehicle provided by the buyer. In both cases, the seller is in charge of clearing the goods for export and is responsible for paying all of the costs for this activity. The buyer bears all of the risks and costs associated with the subsequent stages of the shipping process.

3. **FAS (Free Alongside Ship)** is recommended for sea or inland waterway transportation. It stipulates that the seller delivers when the goods are placed alongside the ship designated by the buyer at the named port of shipment. As in the previous case, the buyer incurs all of the risks and costs from this moment onward.

4. **FOB (Free On Board)** is also recommended for sea or inland waterway transportation. In the case of FOB, the seller delivers the goods at the named port of shipment by placing the goods on board the vessel after clearing the goods for export. The risk of loss of or damage to the goods passes when the goods are on board the vessel. The buyer bears all of the costs from this moment onward.

5. **CPT (Carriage Paid To)** is appropriate for any mode of transport. For this term, risks and costs are transferred at different locations. Delivery, and implicitly passing of risk, occurs upon departure, when the seller transfers the goods to the main

carrier after clearing the goods for export. However, the seller pays the costs of transportation up to the arrival at the agreed destination. In other words, the carriage is paid for by the seller but occurs at the buyer's risk.

6. **CIP (Carriage and Insurance Paid)** is very similar to CPT but adds an additional obligation for the seller, which must provide cargo insurance covering the goods to the agreed destination. The seller obtains insurance for the benefit of the buyer (who bears all risks for the main transportation).

7. **CFR (Cost and Freight)** is appropriate for sea and inland waterway transportation. It has two critical points. Delivery (i.e., passing of risk) occurs at the port of departure when the seller places the goods on board the vessel. In contrast, the seller pays the freight until the destination port. Sea carriage is paid by the seller but occurs at the buyer's risk.

8. **CIF (Cost, Insurance and Freight)** is very similar to CFR but places an additional obligation on the seller to procure cargo insurance in the buyer's interest (similar to the CIP rule).

9. For **DAT (Delivered At Terminal)**, which can be used regardless of the transportation mode, the seller delivers the goods when it places them at the disposal of the buyer, unloaded from the arriving vehicle in a terminal at the agreed port or destination. The buyer has the obligation to clear the goods for import.

10. **DAP (Delivered At Place)**, which can be used irrespective of the mode of transport, indicates that the seller delivers when the goods are placed at the disposal of the buyer on the arriving vehicle, ready for unloading, at the agreed destination. Import duties and formalities are handled by the buyer.

11. **DDP (Delivered Duty Paid)** is essentially the same as DAP. The only difference is the additional obligation on the seller to obtain all official authorizations, carry out all customs formalities and pay all duties, taxes and other charges payable

upon import. The term represents the maximum obligation for the seller (as opposed to EXW).

Appendix C. Additional Tables

Table C1
Share of transactions and export value (%) for each Incoterms rule

Incoterms	2012		2013		2014		2015	
	Trans.	Exp. Val.	Trans.	Exp. Val.	Trans.	Exp. Val.	Trans.	Exp. Val.
EXW	1.9	0.5	1.9	0.9	1.8	0.7	2.2	0.5
FCA	47.8	34.4	48.1	32.2	46.7	28.3	49.3	30.6
FAS	0.2	1.5	0.2	1.5	0.2	1.7	0.2	2.1
FOB	3.5	21.0	3.4	19.3	3.3	21.8	3.2	20.8
CFR	1.6	2.9	1.7	3.2	1.9	3.3	2.2	4.0
CIF	0.9	1.3	0.9	1.4	0.9	1.6	1.1	2.0
CPT	15.1	10.0	15.6	10.5	16.7	13.7	15.6	15.6
CIP	4.4	9.9	4.6	12.9	4.6	8.7	3.6	4.7
DAT	0.6	0.3	0.3	1.4	0.5	4.6	0.5	4.0
DAP	23.7	18.0	23.0	16.6	23.2	15.6	21.7	15.6
DDP	0.3	0.3	0.3	0.2	0.3	0.2	0.3	0.2

Note: For each year, the first and second columns present the share of transactions and the share of export value, respectively, occurring on a given Incoterms rule.