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Institutions and Offshoring

Qualitative and Quantitative Costs of Trade

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Abstract:
Discrepancies between theoretical predictions and actual trade have led scholars to broaden their view of what factors that shape global trade patterns. Previous research has shown that quality of institutions play an important role in this regard. Recent literature have suggested that strong institutions should be viewed as comparative advantage rather than just a general trade barrier due to its asymmetric effects across industries. Using a gravity model based on detailed firm-level data the present study analyzes how offshoring is affected by the institutional quality in the target country and how this effect differs across industries. Results show that industries that require (i) large relationship specific investments and are (ii) characterized by extensive backward linkages are more sensitive to inferior institutions. This is valid for both the selection of country for offshoring and the size of trade volume. This study confirms previous research on relationship-specificity, however, the significant effects of backward linkages have, to the best of my knowledge, never been shown empirically before. Thus, this study adds a quantitative dimension of trade costs by showing that trade is not only affected by the nature of the buyer-seller relationship but also by the sheer number of transactions that have to be undertaken by a firm. As world trade have become increasingly vertically integrated, these results have important implications for countries' ability to join global production chains and by doing so, attract trade and investments through offshoring.

JEL Codes: F14; F23; L14; L23; P48
Keywords: Offshoring; Institutions; Vertical specialization; Firm-level data

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1. Introduction

During recent decades global trade have experienced a fundamental transformation. Not only have trade volumes increased rapidly but the very nature of trade have changed. For centuries production was concentrated within countries and international trade mostly constituted of final goods. However, due to recent progress in communication and information technology production is now becoming increasingly geographically disintegrated. As a result a larger share of world trade is made up of intermediate goods that flow in global supply chains where different countries add bits of value. The patterns of specialization is thus moving from production in final goods to certain stages of production, see for e.g (Hummels et al, 2001; Hanson et al, 2005; Grossman & Rossi-Hansberg 2006; Grossman & Rossi-Hansberg 2008). This phenomena have become to be referred to as *vertical specialization*[1].

At the core of this transformation is the recent boom in offshoring, meaning the act in which firms outsource certain production processers to foreign locations. Offshoring has not only increased trade but also the transfer of capital, technology and knowledge of management practices across borders. Hence, by joining a global supply chain a country will not only attract trade but also a wide range of capital and knowledge intensive resources (Baldwin, 2011)[2]. This is especially attractive for poor countries that otherwise would find it difficult to accumulate such resources (Baldwin 2012).

However, while trade have become cheaper, production have become more complex as more independent supplier and buyers have to coordinate globally. This poses new challenges for international firms (Gamberoni 2010; Clark et al, 2013; Hummels & Schaur, 2013 and Harrigan & Venables, 2006). Baldwin (2012) argues that the recent transformation of trade has extended the list of potential barriers to trade. Issues such as terms of business conduct, rule of law, security of property rights and intellectual property rights (IPR) are now important aspects to consider when coordinating in highly interconnected supply chains. Hence, in the era of global supply chains these institutional aspects are taking on a crucial role, especially as developing countries have become significant players in the global economy.

An emerging strand of empirical literature provide evidence for a clear link between institutions and trade, see for e.g. (Anderson & Marcouiller, 2002; Ranjan & Lee, 2007; Turrini & van Ypersele 2010; Méon & Sekkat 2006 and Depken & Sonara, 2005). Márquez-Ramos et al (2012) even show that institutions have a larger impact on trade than tariff barriers. Nunn (2007) adds to the discussion of institutions and trade by arguing that that institutions should be viewed as a source of comparative advantage rather than only a barrier to trade. Nunn (2007) shows that countries with good contract enforcement specialize in goods that require large relationship-specific investments.

Yet, to the best of my knowledge, no literature have examined the effect of institutions through the lens of vertical specialization. This is surprising since, in addition to reshaping the nature of trade barriers, vertical specialization costs structure and risks of production. While increasing

[1] Balassa (1967) and Findlay (1978) were among the first to use this term in the academic literature. Alternative labels for this process are "slicing up the value-chain", "disintegration of production" and "intra-product specialization", see (Krugman, 1995; Feenstra, 1998 and Arndt, 1997).

[2] The movement of goods, capital and management know-how is summed up by Baldwin (2011) in the trade-investment-service-intellectual property (IPR) nexus. Among the first examples of these cross-border transfers occurred in the mid-eighties between the US and Mexico which is documented by Feenstra and Hanson (1997) and in East Asia described by Kimura and Ando (2005).

efficiency by utilizing division of labor among a broader sets of firms, it also affects the risks of doing business since more firms have to be able to coordinate. However, the structure of production differs greatly across industries. While some industries are heavily interconnected between firms and across borders others are fairly self-contained. I argue that industries that are tied to a wider set of suppliers are more vulnerable in the event of a supply chain breakdown. This is because if one suppliers fails to deliver other suppliers will. In this event, production cannot be sustained while new inputs instead have to be stored which drives inventory costs. In addition, such disruption can also cause liquidity risks since the firms that still delivers inputs have to be paid while the buying firm is not receiving any revenues from sales. Recent literature have shown that trade durations at the firm-level are significantly shorter for countries with weak institutions (Araujo et al 2012; Söderlund & Tingvall 2014). Araujo et al (2012) argues that weak institutions increases the possibility for costless contract defections among trading partners. Hence, if institutions increases the risk of supply chain breakdowns it will have an asymmetrically negative effect on industries that have to coordinate with a large set of suppliers.

While Nunn (2007) examines the cost of individual transactions through the qualitative nature of the buyer-seller relationship, this perspective adds a quantitative dimension of institutional trade costs. Put differently, lacking institutions might not just be detrimental for trade in industries where buyers and sellers are heavily dependent upon each other but also in industries where the sheer number of participants in the global supply chain are large. Thus, the quantitative dimension of trade costs could be understood as an additional source of institutional comparative advantage.

Based on Swedish firm-level data, this study empirically investigates the impact of institutions on offshoring and particularly how quantitative and qualitative dimensions of production affect industries differently. The empirical analysis both consider the effect of institutions on firms' choice of offshoring country as well as the volume offshoring. To capture asymmetric affects along the quantitative dimension of trade I develop a new index of the degree of backward-linkages across different industries based on input-output matrices.

Results of the study indicate that inferior institutions reduce the propensity for firms to select a country for offshoring and also reduces the volume of trade flows of inputs, given that a an offshoring investment is undertaken. More importantly however, results show asymmetric effects of institutions on offshoring across industries. Industries that are more interconnected and require large relationship-specific investments are more sensitive to the institutional quality. While relationship-specificity primarily influence the volume of trade, a strong industry interconnectivity seem to affect both the selection of country as well as the size of the offshoring investment. To the best of the author's knowledge, this is the first paper that show that institutions indeed drive trade costs through both a qualitative and quantitative channel. These findings could potentially have important implications for trade and in particular countries' ability to join global supply chains. For instance, lacking institutions might be a hinder for countries to cope with more complex ways of organizing production. This is something that would hinder poor countries to obtain offshoring investments of more advanced manufacturing.

The paper is organized as follows: section 2 introduces the concept of offshoring and vertical specialization in more detail. Section 3 provides a background to the institutional literature along with the hypotheses of the empirical analysis. Section 4 describes the empirical approach and particularly the gravity model which the econometric model is based upon. Section 5

describes the data and the model specification. Section 6 presents descriptive statistics. The results of the study is presented in section 7 which is followed by a conclusion and summary in section 8.

2. Offshoring and vertical specialization

The patterns of world trade have changed dramatically during recent decades. Not only have trade volumes risen dramatically but also the very nature of trade have been transformed. Perhaps the most prominent feature of this process is the ability for firms to trade intermediate goods and services. This has profoundly altered the way production is organized (Grossman and Rossi-Hansberg, 2006). Throughout the era of industrialization growth was driven by specialization in the production process through division of labor. However, more intricate ways of organizing production posed the problem of coordination as division of labor required proximity since costs of transmitting information and shipping goods were substantial. Therefore the main driver of economic efficiency was agglomeration through geographic concentration which paved the way for market expansion of labor, goods and capital. As a result international trade was constrained to final goods (Grossman and Rossi-Hansberg, 2006). With recent decade's revolutionary progress in communication and information technology, transaction costs have been significantly lowered. This has reduced the need for geographical concentration in many areas and opened the possibility to geographically disintegrate production into a global supply chain. As a result international trade has been extended to also include a significant share of intermediary goods (Grossman and Rossi-Hansberg, 2006).

Global disintegration of production essentially means that specialization of production can occur at different stages of production rather than in final goods. This "slicing of the value chain" have become to be referred to as *vertical specialization*, see for e.g. Krugman (1995). However, the nature in which firms integrate globally can take different forms. Ekholm (2006) describes four ways of sourcing business processes by dividing the organization of production into two major decisions presented in a two by two matrix. The first decision concerns the organization of production, meaning if the firm produces a good or a service by itself or to buy it from an external company. The second decision concerns the location of the production; that is, if the production is carried out in the home country or abroad. If the firm decides to use an external company, this is called outsourcing and if the firm decides to locate production abroad it is called offshoring according to present terminology (Ekholm, 2006). When a firm decides to both outsource a business process abroad to an external firm it is called outsourced offshoring which is simply referred to as offshoring in the present study. The alternative is to only outsource and maintain ownership within the firm which is referred to as foreign direct investment (FDI).

Organization/Localization	**Domestically**	**Abroad**
Internal	Insourcing	FDI
External	Outsourcing	Outsourced offshoring

The global disintegration of production processes and the rise of trade in intermediate goods have been documented by several scholars. Using US firm-level data Hanson et al (2005) analyzes the driving forces behind trade in intermediate goods between parent firms and their foreign affiliates. Hummels et al (2001) uses input-output matrices to study patterns of vertical specialization, meaning the amount of imported intermediate inputs that makes of a countries exports[3]. The authors show that vertical specialization has grown by around 40 percent in the last 25 years and that it accounts for approximately 30 percent of world exports. In a similar study also based on input-output matrices Hummels et al (1998) examine four case studies of vertical specialization. The authors find evidence that vertical specialization has increased sharply during recent years and that this development have contributed strongly to the rise in global trade volumes. Finally, Campa and Goldberg (1997) show that external orientation among manufacturing firms, defined as the share of imports in production and exports of total output, in Canada, US, UK and Japan have increased rapidly during the last two decades.

Theoretical contributions to explain the recent rise of trade in intermediate goods have been made by Grossman and Rossi-Hansberg (2008). Grossman and Rossi-Hansberg (2008) models the occurrence of offshoring as trade in tasks, meaning that production constitutes of a continuum of tasks that each factor of production has to perform throughout the production chain. A firm can choose to perform all tasks that are necessary to produce a certain product in close proximity to the headquarter or it can choose to locate some of the tasks to an offshore location. A firm's propensity to offshore a task is determined by the total benefits and disadvantages with regard to the production process. For example, some factors of production might be cheaper at the offshore location, but moving production might also entail some costs in terms of loss of control of the production process. Since the gains and disadvantages of offshoring tasks is not likely to be uniform the authors introduce heterogeneous offshoring costs for various tasks. Depending on the costs of offshoring different tasks, firms organize the production chain geographically to minimize costs. Based on this theoretical framework the authors analyze the effect of declining costs of offshoring different tasks. Similar theoretical contributions have been provided by Yi (2003).

Another important aspect of the recent rise in global offshoring is its geographic composition. While a great share of academic literature on offshoring have focused on trade between countries that differ in factor endowments and technology, most offshoring actually occurs between high income countries, see for e.g. (Hummels et al 2001; Barefoot & Mateloni 2010 and World Trade Organization & IDE-JETRO 2011). Grossman and Rossi-Hansberg (2012) provide a theoretical explanation for this type of offshoring. The authors model offshoring as trade in intermediate goods where each good involve a continuum of tasks to be carried out. Each task requires certain competences and generate spillovers that are not bound to a specific firm but to a certain geographic location. These spillovers generate external economies of scale when a certain task become clustered at a specific geographic location. Hence, the location of offshoring becomes a tradeoff between utilizing such economies of scale and the cost of organizing and monitoring performance of production at offshore locations.[4]

[3] For a closer description of input-output matrices and its use in empirical work see Mell et al (2011)

[4] To illustrate their point Grossman and Rossi-Hansberg (2012) cite Newhouse (2007) which provide an anecdotal account of North-North offshoring in the production of the Boeing 787 Dreamliner, an American mid-size jet. While the headquarter of Boeing is located in the US the production relies on 43 offshore suppliers located over 135 sites around the world. Some of which are owned by the Boeing Corporation and some which

3. The link between institutions and trade

Stable rules and well-functioning institutions are known to be an important factors in facilitating trade.[5] To retain the conceptual framework of quantitative and qualitative dimensions of trade costs, presented in the introduction, I divide previous empirical and theoretical contributions into two subsections which deals with each of these aspects. These dimension can be understood as two distinct channels through which institutions affect costs of offshoring. The qualitative dimensions captures the nature of the buyer-seller relationship which determines the cost of individual transactions. The quantitative dimensions, on the other hand, relates to total trade costs based on the number of transactions that have to be undertaken by a certain firm to attain all necessary inputs for production.

3.1 Qualitative dimensions

In the context of trade, institutions is often thought of as affecting cross-border transaction costs between buyers and sellers. The theoretical foundation of this analysis is linked to the make-or-buy decision, meaning the decision whether a transaction should be conducted through market exchange or within the firm. This decision ultimately determines the boundaries of the firm. The concept of make-or-buy was first introduced by Coase (1937) and developed by several scholars including Williamson (1979) and Grossman and Hart (1986)[6]. The key obstacle in a market transaction between two firms is that it usually requires relationship-specific investments while at the same time it is difficult to formulate complete contracts. Hence, there is an underlying risk of a breakdown of the contract. Due to the relationship-specific nature of the input good, a breakdown will cause a welfare losses for both partners. The supplier will find that the good is less valuable to other potential buyers on the market and the buyer will not obtain the input needed in production. As a consequence the contracting partners tend to underinvest, something usually referred to as the hold-up problem. Better contracting institutions that reduce the risk of such breakdowns will mitigate the problem of underinvestment.

An emerging strand of empirical literature have also been able to provide evidence for a link between institutions and trade. Based on various gravity models, Andersson and Marcollier (2002) and Ranjan and Lee (2007) suggests that a dysfunctional institutional environment have a negative impact on bilateral trade flows. Méon and Sekkat (2006) shows that rule of law, corruption, political violence and government effectiveness affect exports of manufactured goods. Awokuse and Yin (2010) provide evidence, based on Chinese data, which suggests that strengthened intellectual property rights is coupled with increased imports in knowledge-

are outsourced to external suppliers. Production is organized in an intricate web which heavily relies on local expertise. For example, the wings are produced in Japan, the engines in the UK and the US, the flaps in Canada and Australia and the fuselage in the US, Italy and Japan. This example confirms the findings of Grossman and Rossi-Hansberg (2012) in the sense that no country display a general technological advantage over another, instead similar tasks are clustered around the same geographical area.

[5] There exists several definitions of the concept of institutions. In this study I stick to a frequently used definition provided by North (1991), who states that "Institutions are the humanly devised constraints that structure political, economic and social interaction".

intensive goods. Finally, Turrini and van Ypersele (2010) show that differences in legal systems reduces bilateral trade flows.

Nunn (2007) highlights that the degree of relationship-specific investments that contracting parties have to undertake differs across industries. Based on Rauch's (1999) commodity classification Nunn constructs an index of relationship-specificity on the industry level and examines how this influences trade patterns. The study provides evidence that countries with developed contracting institutions seem to specialize in goods that require extensive relationship specific investments.

The concept of relationship-specificity in cross-border transaction has spurred on a new strand of literature which focuses on heterogeneous effects of institutions on trade across firms and industries. For instance, based in Italian firm-level data Casaburi and Gattai (2009) study relationship-specificity and loss of intangible assets. Using Swedish firm-level data, Söderlund and Tingvall (2014) show that weak institutions in recipient countries make exports to these countries less likely and that exports to countries with weak institutions are characterized by relatively short duration and small volume. The authors also identify a learning process in which firms learn about their contracting partners as well as the local business climate which reduces the sensitivity to institutions as trade relations mature. Ferguson and Formai (2013) provide evidence, based on US data, that the propensity to vertically integrate on the industry level diminishes the detrimental effect of relationship-specificity on trade. Bartel et al (2005) examines how the degree of industry innovation affects the cost of relationship-specific investments and how this influence the decision to outsource. Finally Kukenova and Strieborny (2009) show that financial institutions can alleviate the problem of hold-up in industries that require extensive relationship-specific investments.

A number of scholars have raised some critical points with regard to the use of institutional indices in the empirical literature and the difficulty to capture institutional quality. The most relevant critique in the context of this study primarily concerns the weighing of individual components and what types of measurements to use.[7]

[7] Chang (2011a) argues that it does not make theoretical sense to add minor measures in to aggregate indexes since the construction of such measures often become arbitrary. Heckelman and Stroup (2005) focuses on similar problems but from an econometric perspective. The authors generally approve of the empirical literature but question individual methods for aggregating broader institutional indices. Chang (2011a) also claims that many institutional indices are based on incompatible variables by including both measures of institutional form, such as democracy or independent judiciary, with institutional function, such as rule of law, respect for private property or government effectiveness. While acknowledging this distinction Heckelman and Stroup (2005) argues that this is not an argument for rejecting the findings of previous literature but rather a reason to question some of its policy implications. The authors uses the dichotomy of de Haan et al (2006) which distinguishes between intuitional measures that reflect "the rules of the game" and those that reflect "outcomes of the game". Heckelman and Stroup (2005) conclude that inferences between outcome variables and for example growth provide little guidance on necessary reforms to undertake. Instead they claim that one need to examine institutions that shape "the rules of the game" of economic actors. Furthermore, Chang (2011a) claims that many of the qualitative indices are biased since they often rely on survey data of businessmen and experts that received training in the US. An additional critique to such indices is their propensity to reflect the general state of business rather than institutional quality. For instance, Rodrik (2009) points to the reassessment of the institutional development in Southeast Asia after the Asian crisis in 1997 as an example of when good institutions rather reflect a booming economy. Along with the discussion on these narrow topics there is a more fundamental debate concerning what insights could be gained from the empirical literature with regard to various economic outcomes, see for e.g. (Chang 2011b; Acemoglu & Robinson 2006; Andrews 2008; Keefer 2011;

3.2 Quantitative dimensions

While the literature of the previous section analyzes trade costs for individual transactions it neglects the macro level view of the industry structure that each firm has to cope with. Therefore, the goal of this section is to complement the qualitative dimension of asymmetric trade costs with a quantitative one. The quantitative dimension aims to capture the risks involved when a large set of actors have to coordinate production. To be more precise, this dimension emphasizes the risks involved among firms that are linked to a large set of different suppliers, something often referred to as strong backward linkages.

Clague (1991) show that if production is organized sequentially, the productivity of a firms relies on its ability obtain timely and high-quality input from suppliers as well as reliable government services. If this is not the case and inputs cannot be substituted a supply chain disruption occur. I argue that the costs of such a disruption is not uniform due to the varying degree of backward linkages across different types of industries. Central to this argument is that disruptions in one part of a supply chain can have spill over costs in other parts of the production. A supply chain breakdown from an individual supplier simply means that an adequate input does not reach the producer which leads to a situation where production cannot be sustained. However, inputs from parts of the supply chain that is not disrupted are still arriving. This leads to accumulation of inputs which translates into rising inventory costs. In addition to this a disruption also risks to put a firm in financial distress since the stream of revenue is cut-off while inputs still have to be paid. Depending in the degree of backward linkage this affects the amount of inputs that have to be stored and the amount of inputs that still have to be paid while production is down.

Recent literature shows that the strength of a country's institutions affects business risk and the likelihood of disruptions in cross-border trade, (Araujo et al 2012; Söderlund & Tingvall 2014 and Kokko et al 2013). Araujo (2012) explains this finding by arguing that weak institutions increases the profitability of defecting from signed contracts. There is a wide body of empirical literature that show negative effect of supply chain uncertainty on trade. On the empirical side there are a number of studies that examine the effect of supply chain uncertainty on trade and particularly the effect of delays. Clark et al (2013) find significant negative effects of supply chain uncertainty measured by shipping delays and ordering costs on bilateral trade flows. Harrigan and Venables (2006) show a link between supply uncertainty and agglomeration of production. Using a gravity equation based on trade data from 98 countries Djankov et al (2010) find that each additional day of expected delivery time reduces trade by 1 percent. Blonigen and Wilson (2008) find a significant link between port efficiency and trade. Hummels and Shaur (2013) examine the speed-cost tradeoff between air and ocean transport. The authors find that each day in transit is equivalent to an ad-valorem tariff of 0.6 to 2.3 percent and that the most time-sensitive trade flows are those that involve input goods. Finally, Clague (1991) show that uncertain supply of high quality inputs and government services are should increase the prevalence of firms within self-contained industries, meaning industries that relies less on other firms or a government.

Maseland 2011). However, much of the academic discussion are concerned with economic growth which falls outside of the scope of this study.

Thus, while industries that have strong backward linkages to suppliers incur larger costs in the event of a supply chain disruption, weak institutions seems to magnify this risk. These observations suggests that weak institutions should have an asymmetric negative effect on trade in industries with strong backward linkages. The inability to cope with intricate supply chains is increasingly problematic as production becomes more complex. In an era where supply chains are more vertically specialized weak institutions risk to exclude certain countries from integrating with the global economy. Empirically examining this issue could thus shed light on how institutions both hinder and distort trade.

3.3 Hypotheses

Based on previous literature and the concept of qualitative and quantitative channels through which institutions affect costs of offshoring, three distinct hypothesis are formulated:

1) Weak institutions in the exporting country have a negative effect on offshoring, both with regard to firms' choice of country and the volume of offshoring.

2) The negative effect of weak institutions on offshoring should be more pronounced in industries that require a higher degree of relationship-specific investments.

3) The negative effects of weak institutions should be larger in highly interconnected industries with strong backward linkages.

By testing these hypotheses this study extends the knowledge of asymmetric effects of institutions on offshoring. This contribution is especially important in the light of the ever more increasing role of vertical specialization. Hence, the results of the study could shed light on how institutions affect trade patterns of vertically disintegrated production chains. It could also bring insights on countries' abilities to join global production chains by attracting certain types of trade. This is particularly relevant for developing economies which often lack capital, technology and managerial skills. If joining a global production chain represents a viable strategy to accumulate such resources the understanding of the link between institutions and the formation of global production chains hold important policy implications.

4. Empirical approach

4.1 The Gravity model of trade

The gravity model of trade is the underlying framework to analyze the flow of inputs to the Swedish firms in the data set. Since its introduction by Tinbergen (1962), it has emerged as a one of the main models to analyze trade flows. It have also been applied frequently in studies similar to this, see for e.g. (De Mello-Sampayo; 2007; De Mello-Sampayo 2009; Hejazi 2009; and Ferguson & Formai 2013). In its most basic specification the model predicts bilateral trade flows between two countries based on its' joint economic size, often measured by GDP, and the geographic distance between them. While the model had strong empirical support its theoretical foundation was initially weak. However, since its introduction several theoretical contributions have showed that the concept of economic gravity is consistent with most

common trade theories[8]. The purpose of using the gravity model in this study is simply to control other aspects that influence the size of trade flows besides institutions. Hence, by extending the standard model with an institutional variable, I am able to tell if institutions carry any explanatory power with regard to offshoring[9].

Despite its wide success, recent literature have shown some weaknesses of the model. Anderson and van Wincoop (2003) points out that the original specification only control for bilateral trade resistance but not for multilateral trade resistance (MTR). The authors argue that this leads to omitted variable bias. The logic of this claim is that bilateral trade flows are not only affected by barriers to trade between pairs of countries but also by the barriers that each country faces with all its trading partners, i.e. the MTR. Consider the effect of bilateral trade flows between France and Germany. Imagine if all of a sudden trade barriers between France and the UK would drop dramatically. Predictions would be that a share of France´s trade would be shifted from Germany to the UK, despite the fact that the trading relations between France and Germany are unchanged. While France's bilateral trade resistance towards Germany is unchanged, its multilateral trade resistance with the rest of the world is reduced which in turn affect the French-German trading relations.[10] The source of MTR is affected by a wide range of circumstances in other countries such as distances, free trade agreements, common language etc. One could think of MTR as a residual term that captures all factors that affect bilateral trade flows not related to the country pair but to third parties (Adam & Cobham 2007). When using panel data Baldwin and Taglioni (2006) suggests that the original gravity model should be extended by including both country and period dummies to control for MTR.

Another aspect that is not controlled for in the original gravity model is firm heterogeneity. Since the study does not examine bilateral trade flows, but trade flows between firm-country pairs, aspects related to the importing firm have to be considered. Melitz (2003) shows that firms need to cross a certain level of productivity to afford the fixed costs associated with internationalization. Helpman et al (2008) develop a generalized gravity equation that accounts for self-selection into trade and its effect on volume of trade based on firm productivity. The authors show that traditional estimates that does not account firm heterogeneity generate biased results.

In addition to MTR and firm heterogeneity, the original gravity model is usually extended in other dimensions that is not derived theoretically but rather based on empirical observations (Head 2003). In this study two common variables are included, per-capita income and tariff

[8] See Deardorff (1998) for a comprehensive overview of the theoretical contributions to the gravity model.
[9] It is important to note that the study does not use bilateral trade flows, but import flows from the rest of the world to individual Swedish firms. Consequently gravity is defined on a firm-country basis rather than gravity between countries as in the original specification. This give rise to one important difference with the original specification as the joint size of the trading partners is determined by the size of the exporting country and the size of the importing firm.
[10] Head (2003) uses another example to clarify the effect of MTR by comparing bilateral trade flows between Austria and Portugal to trade flows between Australia and New Zealand. While the distance between the two country pair's capitals and their joint size in terms of GDP are about the same, the Australia-New Zealand trade is about nine times larger, measured in 1993. This is at odds with the predictions of the gravity model in its original specification which would predict bilateral trade flows of similar magnitude. The reason for this prediction error is the remoteness of Oceania. Austria have a wide range of close potential trading partners which will reduce the trade with Portugal. Australia, on the other hand, have few alternative trading partners which instead will increase the trade with New Zealand. Stated in theoretical terms, the MTR with respect to geographic distance is low in Austria and Portugal which reduces bilateral trade flows and high in Australia and New Zealand which increases bilateral trade flows.

levels[11]. The general idea behind including per-capita income is that rich countries trade more in general compared to poor countries. Also, since offshoring in many cases is driven by factor price differences, per-capita income is a way of controlling for type of offshoring[12]. The reason for using tariffs is that it is an important source of bilateral trade frictions.

4.2 Choosing an estimator

While the literature gives good guidance with regard to the specification of gravity model there is less consensus on suitable estimators to use in applied work. The main issue that have to be dealt with is the large amount of zero observations in the data and firm selection into trade. In this section I present this issue in more detail and suggest two recognized estimators that handle this problem in two different ways.

The source of the problem has to do with the composition of the offshoring data. All observations are organized in firm-country pair. This means that for each firm in the data set, observations of import flows are registered for every country and every year between 1997 and 2009. Thus, most of the observations contain zero trade since most firms only offshore production to a few countries. In this dataset almost 97 % of the observations record no trade.[13] The large amount of zeros becomes an issue since the gravity model has previously been defined in a log-normal specification. Because the logarithm of zero is undefined this leads to omission of all zero-trade observations when estimating the model. This raises an issue of sample selection bias since the distribution of zero trade flows are not likely to be equally distributed over all firm-country-pairs. Instead, some firms should be more likely to engage in offshoring and some countries be more likely to be targeted for such offshoring. (Söderlund & Tingvall 2014).

Helpman et al (2008) suggests that the problem of zero-trade flows can be overcome by estimating the gravity model in a two-step Heckman procedure. In the Heckman estimation the choice of offshoring is decomposed in two sequential decisions. First, the firm chooses whether to offshore or not and to which country. Second, given that a firm has chosen a country, the firm chooses the volume of offshoring. The first decision is estimated by probit model where the probability for a firm to choose a certain country is estimated. Consequently, this estimation manages to incorporate both the distribution of zeros as well as the offshoring volumes for all observations where positive trade flows are recorded.

When estimating the selection part of the model it is suggested to include additional exclusion restrictions to obtain reliable estimates. The reason for the additional restrictions is to include variables that specifically affect firms' selection into trade. I follow Bernard and Jensen (2004)

[11] Since GDP already is a part of the original specification of the gravity model, income per-capita is controlled for by adding a variable for population size, in accordance with (Bergstrand 1989). This is because for a given GDP, a larger population implies a lower per capita income.

[12] A common distinction in the offshoring literature is that between business process outsourcing (BPO) which constitutes low and medium-skilled task and knowledge process outsourcing (KPO) which comprise of high-skilled task. BPO is primarily driven by factor price differences while KPO is driven by other aspects related to technology and human capital (Sen & Shiel 2006).

[13] The original dataset obtained from Statistics Sweden contain both trading and non-trading firm. In order to reduce the extreme size of the dataset in a manner that does not distort sample selection firms that do not record any cross border trade during the entire period of observation are dropped. This procedure is in line with Koenig et al (2010).

and include a variable for skill intensity at the firm level measured as the share of workers with tertiary education.

While the Heckman model has obtained a good reputation in the empirical literature, recent studies have pointed out some drawbacks linked to this estimator. The critique mostly stem from its sensitivity to the use of multiple dummies which becomes an issue when including the country dummies to control for multilateral trade resistance. Another issue has to do with its vulnerability when the homoscedasticity assumption is violated (Shepherd 2012). Various count data models have been suggested as suitable alternatives to overcome these drawbacks. These models are estimated in linear form and hence circumvent the problems of sample selection due to the elimination of zero-observations. Moreover, these estimators have shown more stable properties when using large sets of dummy variables. However, by naturally including zeros in the estimation it is assumed that all observations, both zero and non-zero ones, are drawn from the same distribution (Cook et al 2008). This is a questionable assumptions since the decision to trade with a certain country is likely to be an outcome of a different process as opposed to the decision of how much to trade when a country is already selected for offshoring. In the light of these drawbacks a recent strand of literature have suggested using a zero one inflated beta distribution estimator (ZOIB) (Kokko et al 2014). The ZOIB model is a count data model that estimates the selection part separately, similar to the two-step Heckman procedure. Hence, while keeping the upside of being more robust in the presence of dummy variables and heteroskedasticity, it generates separate estimates for the selection of country and the volume of offshoring. Another advantage with the ZOIB model is that it treats selection into trade and trade volume as two strictly different stochastic processes, as opposed to the Heckman model which explicitly assumes that the choice to trade precedes positive trade flows. The consequence of this is that the ZOIB model is not reliant on extra exclusion restrictions to properly control for firm selection into trade. This is important since difficulty to control for firm selection into trade have been another source of criticism towards the Heckman model (Hardin & Hilbe 2007).

It is important to note that the ZOIB model estimates value between zero and one. To allow for this the dependent variable is transformed into a ratio of import of intermediate inputs through total sales. Consequently, coefficients of the model represents semi-elasticities rather than pure elasticities. It should also be noted that the coefficients of the selection part of ZOIB estimator is expected to be of opposite sign as to those of a logit model. (Ferrari & Cribari-Neto 2004; Paolino 2001; Smithson & Verkuilen 2006).

5. Data

The study is based on firm level data of imported intermediate goods to Sweden from the rest of the world between 1997 and 2009 divided up on the national origin of the supplier. The trade data is then matched with data covering other firm characteristics as well as with country level data of the exporting country, including institutional quality. In addition to this, industry level data of relationship-specificity and interconnectivity are added to capture asymmetric effects of institutions across industries.

5.1 Trade and other firm level data

The trade data are obtained from the Swedish Foreign Trade Statistics and contain information on firm-level imports of goods, classified by product and country. Trade statistics are compulsorily reported to Swedish customs. Import data cover all transactions to countries outside of the EU while imports from other EU countries are available for all firms with yearly imports above 1.5 million SEK (approximately 165,000 EUR). According to figures from Statistics Sweden, the data cover 92 percent of all trade with EU countries. I follow Feenstra and Hanson (1996) and define offshoring as imports of intermediate inputs.[14] To distinguish material offshoring from total import flows, imports are classified according to the MIG code classification.[15] This classification defines six categories of manufactured goods: durable consumption goods, non-durable consumption goods, investment goods, energy goods, and other intermediary goods. In this study imports of non-durable consumption goods and other intermediate goods are used as proxies for offshoring. Firms also receive a sector classification according to SNI92 which is used to match firm level variables with industry level variables.[16] To make the sample of firms consistent across time and to reduce the impact of non-registered, within EU-transactions, I restrict the analysis to firms in the manufacturing sector with at least 30 employees. Remaining firm level data are gathered from Statistics Sweden. This includes information on sales, educational level of employees and whether the firm is foreign owned or not. In addition to this firm level data on capital stock, value added and revenues are used to calculate a firm level productivity measure in accordance with Levinsohn and Petrin (2003).

5.2 Country level data (except institutional data)

The country level data include GDP, population, geographic distance to the exporting country and tariffs. Data on population and GDP are collected from the World Bank. GDP data are measured in constant 2000 USD prices. Figures on geographic distance is based on the CEPII population weighted measure and tariff data are taken from the UNCTAD/TRAINS database[17].

5.3 Institutional data

The institutional data used in the study is made up of two country-level indices compiled by the Fraser Institute. The first index represents *Legal structure and property rights* and second index describes *Freedom to trade internationally*. The variables ranges from 0 to 10, where higher

[14] Imports of intermediate inputs have become a standard definition of offshoring in the empirical literature (Hijzen 2005). It is important to note that this definition does not distinguish between imports from foreign affiliated or independent firms. Hence, recorded trade could both be outsourced offshoring or FDI. To deal with this issue I include a dummy in the model specification that takes the value one if the importing firm is foreign owned. Foreign ownership indicates that the importer is a multinational firm which increases the likelihood that recorded trade flows are FDI rather than outsourced offshoring.

[15] MIG (Major Industrial Groupings) is a European Community classification of products.

[16] SNI92 is a Swedish classification system to distinguish activities of firms and work places. SNI92 is based on NACE Rev. 1 (Nomenclature statistique des activités économiques dans la Communauté européenne) which is a European industry classification system.

[17] CEPII stand for Centre d'Etudes Prospectives et d'Informations Internationales. A closer description of the geographic distance measure can be found in in Mayer and Zignago (2006). TRAINS (Trade Analysis and Information System) is a comprehensive database at the most disaggregated level of Harmonized System (HS), covering tariff and non-tariff measures as well as import flows by origin for more than 150 countries.

values reflect better institutional quality. These indices are well recognized and used in a wide set of empirical work related to trade and economic development, see for e.g. (Ferguson & Formai 2013; Berggren 2003; Doucouliagos & Ulubasoglu 2006; and de Haan et al 2006).

The Freedom to trade internationally index is a broad measure of how well-integrated a country is with the global economy. The index is based on taxes on international trade, regulatory trade barriers, actual size of trade sector compared to expected size, difference between official exchange rate and black market rate and international capital market controls. The Legal structure and property rights index relates to the quality of a countries legal system and the ability to secure property rights. The key elements of this index are judicial independence, impartiality of courts, protection of property rights and legal enforcement of contracts.[18]

5.4 Industry level data

Along with firm- and country level data, industry level data have to be collected in order to examine asymmetric effects across industries with regard to relationship-specificity and interconnectivity.

5.4.1 Relationship-specificity

As previously mentioned the degree of relationship-specific investments have a great influence on problems related to hold-up and the costs for writing contracts. To examine asymmetric effects of offshoring across industries with regard to relationship specific investments I follow previous empirical literature and apply Nunn's (2007) relationship-specificity-index (RS-index) based on Rauch's (1999) commodity classification. The RS-index essentially captures the amount of investments buyer and sellers have to undertake in order for a transaction to occur on the industry level. Common to all such investments is that they only carry value in specific firm to firm relationship. Hence, in an event of termination of the trading relationship these investments will be lost and a new investment have to be undertaken to find a new partner.

Rauch's (1999) commodity classification measures to which degree prices of goods are standardized. Nunn (2007) then uses this as a proxy for the amount of relationship-specific investments the buyer and seller have to undertake.[19] The index distinguishes between three categories of goods: goods that are sold on exchanges, goods that are referenced priced and goods that are neither sold on exchange or are referenced priced. If an input is sold on an organized exchange it indicates a low degree of customization. Hence if a contract breaks down between a buyer and a seller, the good that the seller produces is still valuable to other buyers in the market. It also implies that the buyer easily can find alternative sellers to provide a similar

[18] The indices used in the study are subcomponents of a broader index compiled by the Fraser Institute called the Economic Freedom of the World-index (EFW). The EFW-index is based on an unweighted average of five sub-indices: (i) Size of Government: Expenditure, Taxes and Enterprises, (ii) Legal Structure and Property Rights, (iii) Access to Sound Money, (iv) Freedom to Trade Internationally and (v) Regulation of Credit, Labor and Business. In total the index uses 42 distinct variables to construct the sub-indices. The reason for not using the aggregate EFW-index is that some of its subcomponents are difficult to theoretically link to firms' offshoring decisions. Instead I wish to focus on institutional aspects specifically related to the cost of writing contacts and freedom to trade.

[19] Rauch (1999) uses the commodity classification index in a similar context but focuses more on search-costs and buyer-seller matching.

good. Thus, this type of good is by definition not relationship specific and the costs due to a breakdown of the buyer-seller relationship are limited (Klein et al 1978; Williamson 1979, 1985). If a good is not sold in an organized exchange but is referenced priced in a trade publication the good is considered to be relationship specific at an intermediate level. The logic of the intermediate level is that it is that the good is not generic enough to be sold in a standard exchange but basic enough that its value can be approximately standardized. Hence, it is concluded that there still is a reasonable amount of alternative buyers and sellers if contract break down. If a good is neither sold through and exchange or price referenced it is considered to be customized and thus fully relationship specific.

Based on these three levels of relationship-specificity, Rauch classifies 1189 goods using the SITC (rev 2) classification at the 4-digit level.[20] Nunn (2007) subsequently links these goods to 342 industries defined by the NAICS classification system using input-output matrices based in US trade data[21]. I convert the NAICS classification to SNI92-codes to fit with the Swedish trade data. The least relationship specific industries uses predominantly inputs from the primary industries and includes among others poultry processing, flour milling, petroleum refineries, corn milling and oilseed processing. While industries related to the production of automobiles, aircrafts, computers and other electronic equipment manufacturing adhere to the most relationship-specific industries (Nunn 2007).

Including the RS-index in the gravity model I am able to analyze the direct impact of relationship-specificity on the firms' propensity to offshore production as well as the size of such offshoring investments. However, the primary interest of this study is to examine the interaction between institutions and relationship-specificity. Hence I also include an interaction term between the RS-index and the institutional index. This interaction term thus reveals if the impact of institutions is larger or smaller in certain industries depending on the degree of relationship specific investments buyers and sellers have to undertake in order for trade to occur.

5.4.2 Vertical specialization and backward linkages

While relationship-specificity can indicate costs of individual buyer-seller interactions it reveals little about the total trade costs that a firm faces when engaged in international trade. Hence, to fully understand asymmetric impact of institutions across industries both the qualitative and quantitative side have to be accounted for. To the best of my knowledge no previous study have distinguished these sides when examining the impact of institutions on trade. Thus, this is a key contribution of the present study.

To measure the quantitative side I create an index in the spirit of Nunn (2007) that captures the degree of backward linkages (BL) for various industries. The BL-index essentially measures the amount of cross-border transactions that have to be undertaken by a firm in order to obtain all necessary inputs to production. If a firm has a high degree of backward linkages, this

[20] SITC (Standard International Trade Classification) is a widely used system to classification system for goods used to classify countries imports and exports. Rev 2 indicates the version of the classification and the 4-digit level indicates the aggregation of goods.

[21] NAICS (North American Industry Classification System) is used by business and government to classify business establishments according to type of economic activity in Canada, Mexico, and the United States of America.

indicates that it is heavily interconnected to other industries and that a wide range of contracts have to be written with suppliers.

To construct this index I follow an extensive literature that uses input-output tables (IO-tables) to analyze the degree of vertical specialization on the industry level, see for e.g. (Hummels et al 2001; Dean et al 2007; Koopman et al 2008 and Johnson & Noguera 2012). An IO-table is a quantitative technique to illustrate economic dependencies between different branches of an economy within a country or internationally. The model relies on the notion that the output of one industry becomes inputs for other industries. These dependencies can be illustrated in a matrix form where the axis represent input and output of all industries the economy. To understand the logic of an input-output model, consider the following 3x3 matrix which represents an economy made up of three industries, k =1, 2, 3.

Table 1. Input-Output matrix.

Industry output (j)

Industry input (i)	k	1	2	3	
	1	a_{11}	a_{12}	a_{13}	O_1
	2	a_{21}	a_{22}	a_{23}	O_2
	3	a_{31}	a_{32}	a_{33}	O_3
		I_1	I_2	I_3	

Each value, a_{ij}, represents all firm transactions of inputs within or across industries. In this case, *i* indicate which industry that produces inputs and *j* indicate which industry that purchases inputs. For example, a_{12} represents the value of all output that industry 1 sells to industry 2 and a_{31} represents the total value of all input industry 1 purchases from industry 3. Consequently, the sum of each column constitutes the aggregate value of all inputs used in each industry k and the sum of each row constitutes the aggregate value of output produced by each industry k. Since the economy represents a closed system, the value of total input and output is equal. The total value of inputs is denoted by I_k and the total value of output is denoted by O_k.

It is important to note that out O_k captures the value of output in terms of the total cost of inputs and hence excludes value added produced by each industry. This is a consequence of the fact that the economy is described as a closed loop. If value added were to be incorporated in O_k, total output would be larger than total input which violates the structure of the loop. Based on this IO-matrix I_k and O_k can be expressed as follows:

$$\sum_{i=1}^{3} a_{ik} = I_k$$

$$\sum_{j=1}^{3} a_{kj} = O_k$$

The IO-tables that are used to construct the BL-index is obtained from Statistics Sweden and covers cross-border flows of goods that is purchased and sold by Swedish firms. The trade flows are divided into 22 industries according to SNI92 classification system at the 2-digit level. Since inter-industry dependences are likely to change over the observed period I use IO-tables from 1995, 2000 and 2005[22]. To fill out the missing values for years where no IO-table exist I use linear interpolation. This is a suitable method since trade flows recorded in the IO-tables represent stable stock variables (Hazewinkel 2001).[23]

I proceed by summing each column for every industry and every year excluding the value of inputs that is purchased from the same industry, $a_{i=k}$. By doing this I obtain the total value of inputs of an industry that is purchased from other industries. This value is then divided by the total sales of each industry, Y_k. This value represents total output, O_k, and the value added of that industry. This procedure generates a ratio between the value of imported inputs from abroad from other industries and the size of the industry, se below.

$$BLimp_k = \frac{\sum_{i=1}^{n} a_{ik} - a_{kk}}{Y_k}$$

Thus, the degree of industry-level backward linkages is defined as the value of imports of inputs from other industries as a share of the output of that industry. If a firm is active within an industry that heavily relies on other industries for inputs it is likely to need to write a greater amount of contracts with suppliers as opposed to an industry that is more self-contained and relies on less inputs from other industries.

Based on the theoretical framework presented in section 3.2, backward linkages can be expected to cause asymmetric effects of weak institutions across industries. As argued previously strong backward linkages make firms more vulnerable when a supply chain breakdown occur. Partly due to a buildup of costly inventory as well as for financial reasons since other suppliers still have to be paid. If this would be the case, countries with weak institutions is expected to be less likely to attract trade from industries that have extensive backward linkages. To examine this effect I interact the institutional index with the BLimp-index.

In addition to this I construct a similar index as the BL-index but for domestic backward linkages and include this as an additional control variable[24]. The reason for this is that the degree of inter-industry imports is not only dependent on industry structure but also the ability for firms to purchase inputs from domestic suppliers. An industry might have very limited exposure to other industries in foreign markets but still be vertically specialized due to many backward

[22] Statistics Sweden have also compiled IO-matrices for the years 2008 and 2010, however due to major changes in the SNI-classification system data for these years are difficult to append to the original dataset which uses the SNI-classification system of 1992.

[23] Poldahl (2012) investigates Swedish trade patterns using input-output matrices between 1995, 2000, 2005 and 2008. The study concludes that international dependency of Swedish firms have increased in terms of imports, exports and offshoring, domestic manufacturing processes are shifted towards developed countries and offshoring of manufacturing activities towards growth economies have seen dramatic increases but from initially low levels.

[24] The domestic BL-index also relies on IO-matrices compiled by Statistics Sweden and covers the same years as the BL-index of cross-border transactions.

linkages to domestic firms. Thus I control for this by including a separate variable for the degree of domestic backward linkages, se below.

$$BLdom_k = \frac{\sum_{i=1}^{n} a_{ik} - a_{kk}}{Y_k}$$

5.5 Model specification

In order to analyze the effects of institutions on offshoring of Swedish firms the following log-linear gravity model is formulated:

$$\ln(\text{Offshoring})_{ikct} = \alpha + \beta_1(Y)_{ct} + \beta_2(q)_{ikt} + \beta_3\ln(\text{Dist})_c + \beta_4(\text{Inst})_{ct} + \beta_5(\text{RS})_k + \beta_6(\text{BLimp})_{kt} + \beta_7(\text{BLdom})_{kt} + \beta_8[(\text{Inst})_{ct}*(\text{RS})_k] + \beta_9[(\text{Inst})_{ct}*(\text{BLimp})_{kt}] + \beta_{10}(\text{Tariff})_{ct} + \beta_{11}(\text{TFP})_{it} + \beta_{12}(\text{FOF})_{it} + \beta_{12}\Omega + \beta_{13}(\text{Skill})_{it} + D_c + \gamma_t + \varepsilon_{ikct}$$

Subscripts: i = firm, k = industry, c = country, t = time

where offshoring is imports of input goods to firm i from country c. Since this study does not analyze bilateral trade flows but unilateral flows of input goods to Sweden from the rest of the world on the firm-level, I estimate a one-sided model that captures gravity between firm-country pairs. Hence, I need to include variables that affect gravity at both the firm level and the country level. *Y* is GDP of the exporting country, which captures country level gravity while *q* is firm sales which captures gravity on the firm level. *Dist* is geographical distance to the exporting country, *Inst* is the institutional quality of the exporting country, *RS* is the relationship-specificity of the industry, *BLimp* is the degree of cross-border backward linkages of the industry, *BLdom* is the degree of domestic backward-linkages of the industry, *Tariff* is the trade-weighted average tariff of the exporting country, *TFP* is a firm productivity measure calculated in accordance with Levinsohn & Petrin (2003) and *FOF* is a dummy that takes the value one if the importing firm is foreign-owned. *D* is a vector of country dummies, γ is a vector of period dummies and ε is the error term[25]. *Skill* is used as an extra exclusion restriction to control for firm choice to engage in cross-border trade when estimating the selection part of the equation, see Koenig et al (2010). Skill is measures as the share of employees that possess tertiary (post-secondary) education at the firm level. Lastly, for the Heckman estimation, Ω represents the inverse Mills ratio which is obtained when estimating the selection part of the regression in the probit model. This variable tackles the issue of sample selection that arises from the vast amount of zeros in the data. As consequence of this model specification, each variable will generate two beta estimates. One that captures the effect of the probability that a country will selected for offshoring and one that captures the effect of the size of the offshoring investment in the event that a country is actually selected.

[25] Including country dummies in the model will cause the geographic distance term to be dropped in all estimations since this variable is constant over time.

6. Descriptive statistics

Before presenting the main results of the study some basic descriptive statistics of the data are provided. In Table 1, I analyze the composition of offshoring between countries with institutional quality above and below average. The group of countries that have an institutional quality above average attracts approximately 95 percent of all positive offshoring flows and 96 percent of its total volume.[26] Table 1 also show that the average size of firm-country trade flows differs greatly. Countries with above mean institutions record about 48 times larger trade flows on average.

Table 2 display a clear geographic concentration for Swedish offshoring where EU15 attracts around 69 percent of the offshoring volume, while the corresponding number for the OECD is 88 percent and only 0.08 percent for the least developed countries[27]. The dominance of North-North offshoring is line with previous empirical findings and the theoretical predictions of Grossman and Rossi-Hansberg (2012) mentioned in section 2.

Table 1 – Offshoring flows and offshoring volume to countries above and below institutional mean

	Below average inst. quality	Above average inst. quality
Share of non-zero offshoring flows	0.047	0.953
Share of offshoring volume	0.041	0.959
Average firm-country offshoring volume (millions, sek)	79.90	3838.57

Table 2 – Geographic dispersion of offshoring volume.

	Share [%]
EU15	0.6876
OECD	0.8804
Least Developed	0.0008

The data also reveal some distinct time trends over the period of observation. Table 3 show a fairly rapid rise in the volume of offshoring from 1997 until the financial crisis, where a sharp drop is observed. The number of positive firm-country trade flows on the other hand seem more stable and does not show to be particularly affected by the crisis. These trade patterns, especially the effect of the crisis on the extensive and intensive margin of trade, are in line with previous

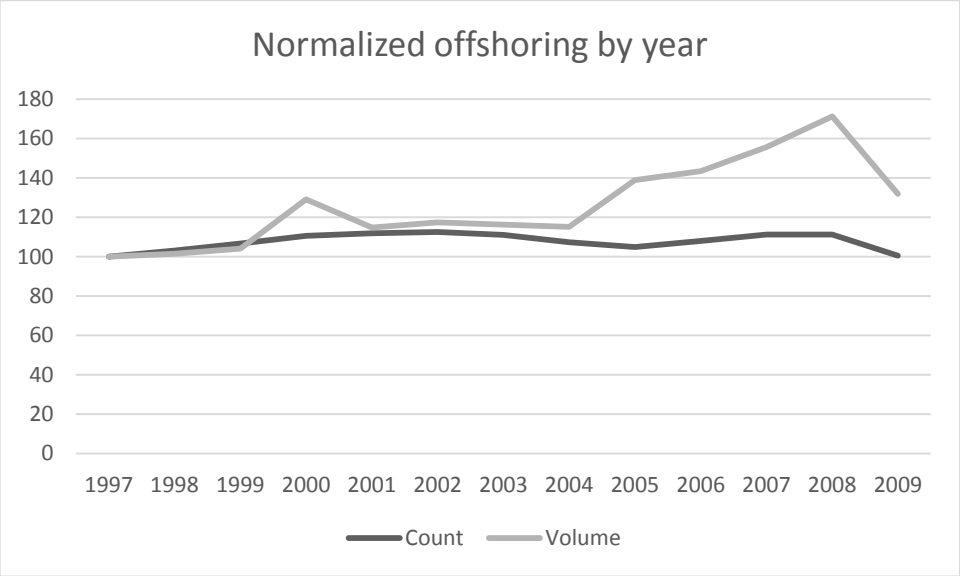
[26] In order to compare trade between countries below and above average quality of institutions I construct an unweighted mean of the two institutional indices that is used in the study. Based on this aggregated index, I divide countries into above and below average countries.

[27] The EU15 constitutes the first 15 members of the EU which includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. The group of least developed countries is based on a UN classification from 2009 and includes a list of 49 countries mostly located in Sub-Saharan Africa.

empirical results, see for e.g. (Behrens et al 2013). For a more extensive analysis of the effect of crisis on Swedish exports and offshoring see Kokko et al (2014).

Comparing offshoring firms with non-offshorers, Table 4 show that offshorers are almost four times larger than non-offshores in terms of sales and also more skill-intensive[28]. Lastly, a simple correlation between the institutional indices used in this study, *freedom to trade internationally* and *legal structure and property rights*, is run. Results show a correlation of 0.55.

Table 3 – Time trends



The number of positive trade flows and the average volume are normalized with 1997 as a base year.

Table 4 – Offshorers/ Non-offshoreres

	Non-offshoring firms	Offshoring firm
Sales (millions, sek)	132856	512416
Skill-intensity (share)	0.066	0.076

7. Analysis

In the following section the main results of the study are presented. However, before presenting the actual estimates some issues related to the interpretation of the results are discussed. Partly what results that are to be expected and how the results could be interpreted. The variables of primary interest is the institutional variables as well as its interactions with both the relationship-specificity (RS) index and the backward linkage (BS) index. A positive sign of the institutional index in the Heckman regression means that better institutions increases trade. To

[28] It is important to note that all firms in the data set engage in offshoring at some point in time during the period of observation. Hence, a non-offshorer is defined as a firm that does not engage in offshoring a certain year. Skill is measured as the share of employees with at least three years of post-secondary education.

be more precise, for the selection part of the regression, a positive sign means that a higher score of the institutional index increases the likelihood of a country being targeted for offshoring. For the ZOIB-estimation opposite signs are expected in the selection part of the regression. The reason is that this part estimates the probability of zero trade-flows and not positive trade flows as in the Heckman estimation. A positive sign in the volume part of the regression, for both the Heckman and ZOIB-estimations, means that, given that a country is selected for offshoring better institutions increases the value of goods that the firm in Sweden imports. A positive signs for any of the interaction terms means that the effect of good institutions has an even larger effect on trade for firms in industries that requires extensive relationship specific investments or that have strong backward linkages to suppliers.

It is also important to note that while weak institutions creates frictions in cross-border trade, it also generates additional costs for domestic transactions as well. Thus, lacking institutions could generate a negative productivity effect for foreign exporters which reduces trade. For instance, consider a firm in a country with a very weak legal system. If that firm would have to devote large resources to supervise the performance of its suppliers, this firm would have a comparative disadvantage compared to a firm that operated in an environment where such efforts were not needed. However, I argue that it is reasonable to assume that most of this effect will be captured by the Inverse Mills ratio in the selection part of the regression. The reason for this is simply that firms should only engage in trade with foreign suppliers that can provide competitive input goods. Also, *Freedom to trade internationally* index should be less affected with domestic circumstances as it focuses on cross-border transaction exclusively.

Another aspect is input quality, which have become target for an emerging branch of both theoretical and empirical literature. If a country exports low quality goods at a cheaper price, this translate into lower observed trade volume while exported quantity is the same. Schott (2004) shows that export quality is tightly linked to a countries GDP per capita. Since, income per capita as part of the model specification I argue that this variable captures much of the variation with regard to quality. A related issue to quality is the question whether firms buys different types of products depending on the institutional quality of a country. For instance, if firms buys cheaper types of products from countries certain countries this would generate a negative effect in the volume part of the regression. Sutton and Trefler (2011) models the export basket of countries. In this model firms gradually move to higher mark-up products as the country develops. Similar to Schott (2004), Sutton and Trefler (2011) tightly links a countries' export basket to its level of economic development. Hence, I argue similarly that controlling for per capita income would also capture variation in countries export basket.

Turning to the empirical analysis, the institutional indices are examined one at a time. First, the effect of *freedom to trade internationally* is analyzed to see if this country characteristic affects firms' choice and volume of offshoring. Using the basic model specification presented in section 5.5 I examine both the direct effects of this variable as well as its asymmetric effects across different industries depending on the degree of backward linkages and relationship-specificity. I first estimate the model using a simple OLS as a benchmark and then apply a Heckman model and a Zero-One Inflated Beta estimator (ZOIB) model which both tackle the issue of zeros in the dataset. The results are presented in Table 5. This procedure is then repeated for the second institutional variable, *legal structure and property rights* which is presented in Table 6.

It is important to note that both the Heckman and the ZOIB model disentangle observed offshoring flows into two sequential steps. First, both models estimate the likelihood of a firm to select a certain country. Second, given that positive trade flows are observed, the models analyze what determines the size of the offshoring investment. Hence, for each variable included in the model specification two coefficients are obtained. The first coefficient indicates the effect of the variable on firms' likelihood to select a country. This is the effect of the variables on the extensive margin of trade. The second coefficient indicate the effect of the variable on the volume of inputs a firm imports from a certain country. This is the effect on the intensive margin of trade. The OLS model, on the other hand, does not take any measures to control for selection into trade. Instead the log-linear OLS model simply drops all zero observations. Hence, the OLS estimations are only able to provide results with regard to the intensive margin of trade. The first three columns of each table presents the effect on the intensive margin of offshoring using OLS, Heckman and ZOIB. The last two columns present the effects of the extensive margin of trade using only Heckman and ZOIB, since the OLS is unable to provide such results.

Looking at the intensive margin of trade in the first three columns of Table 5, results show that *freedom to trade internationally*, (from now on FTI), have a positive significant effect on offshoring flows which is to be expected. The asymmetric effects, in column 1 to 3, also show expected results with the exception of the interaction between the FTI and RS-index in the ZOIB estimation. Thus, the impact of institutions is significantly larger in industries which are characterized by strong backward linkages and large relationship-specific investments.

Table 5 - Trade Freedom

	Intensive margin				**Extensive margin P(T>0)**	
	1. OLS	2. Heckm.	3. ZOIB		4. Heckm.	5. ZOIB
		Target	Proportion		Selection	Inflate
$Inst_{ct}$	0.2166	0.2189	0.0685		-0.0013	-0.2772
	(0.000)***	(0.000)***	(0.000)***		(0.929)	(0.007)***
RS_k	-1.3428	-1.2742	-0.3161		0.0878	-0.2021
	(0.000)***	(0.000)***	(0.000)***		(0.000)***	(0.436)
$BLimp_{kt}$	-1.4783	-1.0593	-0.3371		0.7807	-1.6486
	(0.000)***	(0.000)***	(0.000)***		(0.000)***	(0.000)***
$BLdom_{kt}$	-1.0804	-2.3264	-0.6643		-1.9067	2.7227
	(0.000)***	(0.000)***	(0.000)***		(0.000)***	(0.000)***
RS_k*$Inst_{ct}$	0.4229	0.4200	-0.0058		0.0038	0.0655
	(0.000)***	(0.000)***	(0.797)		(0.893)	(0.698)
$BLimp_{kt}$*$Inst_{ct}$	0.7984	1.0646	0.2926		0.4934	-0.5782
	(0.000)***	(0.000)***	(0.000)***		(0.000)***	(0.000)***
TFP_{it}	1.58e-05	1.74e-05	-5.39e-06		3.25e-06	-4.51e-05
	(0.000)***	(0.000)***	(0.000)***		(0.000)***	(0.063)*
q_{it}	0.5165	0.7325	-0.0085		0.3348	-0.0122
	(0.000)***	(0.000)***	(0.137)		(0.000)***	(0.839)
FOF_{it}	0.1940	0.3087	-0.0195		0.1667	-0.7748
	(0.000)***	(0.000)***	(0.003)***		(0.000)***	(0.000)***
$Tariff_{ct}$	0.0214	0.0358	0.0021		0.0215	0.0185
	(0.087)*	(0.073)*	(0.699)		(0.068)*	(0.759)
Y_{ct}	1.0036	1.5897	0.0017		0.7989	0.0133
	(0.000)***	(0.000)***	(0.977)		(0.000)***	(0.993)
$Skill_{it}$					0.0473	-0.9449
					(0.244)	(0.000)***
Obs.	184666	5216544	5216544		5216544	5216544
Country dum.	yes	yes	yes		yes	yes

Notes: Sample restriction, firm-country pairs with zero trade for the whole period excluded.
Robust standard errors clustered by country-year, p-value within parenthesis (.)

Turning to the extensive margin of trade, the direct effect of institutions show expected results in the ZOIB-estimations while this coefficient become insignificant in the Heckman estimation. The effect of backward linkages also show to significantly increase the impact of institutions on firms' choice of selecting a country for offshoring. Hence, industries with strong backward-linkages seem to be especially sensitive to infringements of the freedom to trade. The interaction term between the FTI- and the RS-index does not produce significant results. Thus, firms in industries that requires large relationship-specific investments do not seem extra sensitive to intuitional quality when selecting a country for offshoring.

Results are slightly more mixed when estimating the effect of *Legal structure and property rights*, (LSPR from now on), shown in Table 6. In the volume equation the direct effects of LSPR- index show expected signs but the results are only significant in the ZOIB-estimation. The between the LSPR- and the RS-index show expected significant signs. The interaction with the BL-index, on the other hand, show a significant negative sign which is a bit puzzling.

Table 6 – Legal Structure and Property Rights

	Intensive margin				**Extensive margin P(T>0)**	
	1. OLS	2. Heckm.	3. ZOIB		4. Heckm.	5. ZOIB
		Target	Proportion		Selection	Inflate
$Inst_{ct}$	0.0429	0.0366	0.0411		-0.0087	-0.1795
	(0.154)	(0.239)	(0.000)***		(0.391)	(0.940)
RS_k	-1.5238	-1.4043	-0.3676		0.1599	-0.4298
	(0.000)***	(0.000)***	(0.000)***		(0.000)***	(0.905)
$BLimp_{kt}$	0.6244	1.1037	0.3027		0.7189	-2.0043
	(0.035)**	(0.000)***	(0.001)***		(0.000)***	(0.712)
$BLdom_{kt}$	-1.0146	-2.2544	-0.6733		-1.8877	2.7974
	(0.000)***	(0.000)***	(0.000)***		(0.000)***	(0.702)
RS_k*$Inst_{ct}$	0.2494	0.2235	0.0178		-0.0391	0.1407
	(0.000)***	(0.000)***	(0.111)		(0.001)***	(0.891)
$BLimp_{kt}$*$Inst_{ct}$	-0.5146	-0.4065	-0.1575		0.3093	-0.2101
	(0.000)***	(0.001)***	(0.000)***		(0.000)***	(0.917)
TFP_{it}	1.62e-05	1.79e-05	-3.86e-06		3.31e-06	-5.81e-05
	(0.000)***	(0.000)***	(0.000)***		(0.000)***	(0.866)
q_{it}	0.5181	0.7347	-0.0204		0.3346	-0.0690
	(0.000)***	(0.000)***	(0.000)***		(0.000)***	(0.866)
FOF_{it}	0.1970	0.3123	-0.0070		0.1675	-0.7073
	(0.000)***	(0.000)***	(0.262)		(0.000)***	(0.224)
$Tariff_{ct}$	0.0207	0.0354	0.0039		0.0217	-0.0132
	(0.104)	(0.078)***	(0.468)		(0.064)*	(0.935)
Y_{ct}	1.1120	1.7318	0.0029		0.8308	0.0212
	(0.000)***	(0.000)***	(0.958)		(0.000)***	(0.999)
$Skill_{it}$					0.0500	-0.9195
					(0.215)	(0.040)**
Obs	184666	5216544	5216544		5216544	5216544
Country dum.	yes	yes	yes		yes	yes

Notes: Sample restriction, firm-country pairs with zero trade for the whole period excluded.
Robust standard errors clustered by country-year, p-value within parenthesis (.)

For firms' choice of country the interaction between the LSPR- and the BL-index generate expected results. However, the remaining coefficients of interest in the selection equation show insignificant results except for the interaction between the LSPR- and the RS-index in the Heckman model, which show a positive significant results. The ZOIB estimation does not produce any significant results when estimating the extensive margin of trade.

Taken together, results clearly indicate that institutions matter for countries to attract offshoring. However, institutions do not just have a direct impact on firms' choice of offshoring destination as well as the size of the offshoring investment but that this effect differs across industries. Industries that have strong backward linkages or requires large relationship specific investments are especially deterred by weak institutions. Results show to be somewhat more distinct for trade freedom as opposed to legal structure and property rights. However, aggregating the two generate equally strong results as when only using the trade freedom index alone. Results also show to be generally stable with regard to the choice of estimator since both the Heckman and the ZOIB model produce similar output. This is reassuring since both models tackles the issue of selection into trade in different ways.

A more important finding is that the RS- and the BL-index is compatible together in a gravity model. This suggests that there indeed seems to be both a qualitative and quantitative side to consider when it comes to trade costs. Hence, this paper does not only confirm previous findings between institutions and trade but also add to the empirical literature by showing that the number of cross-border interactions a firm has to undertake will affect the decision when sourcing production abroad.

The quantitative dimension of trade costs could have great implications for the predictions of which industries countries may attract and how this might affect the ability of certain economies to join global production chains. Baldwin (2006) argues that vertical integration of production causes global competition to shift from the level of sectors to the stages of production. Thus, joining global production chains becomes increasingly important for countries that seek to industrialize since this represents a way to attract capital, technology and management know-how through offshoring investments undertaken by foreign firms. Baldwin (2006) contrasts this form of transfer-industrialization to previous growth miracles, such as Japan or South Korea which had to accumulate such resources internally.

More importantly, with regards to the findings of this study, is that recent research have provided evidence that the transition from low to high income passes a period where the domestic industry is highly interconnected globally. Lopez-Gonzales and Holmes (2011) studies the import content of exports across countries, meaning the share of value of exports that is not added domestically. The authors find an inverted U-shaped relationship between the share of import content in exports and per-capita income. An interpretation of this finding is that poor countries engage in fairly self-contained industries which does not rely heavily on imports. This includes for example primary production or low-skilled manufacturing such as textile production. However, as countries moves to more advanced manufacturing the ability to import a large set of inputs become crucial. Take for example medium-skilled manufacturing of electronics which involves assembly of a vast amount of components from a wide range of suppliers. The increase of import-content is then reversed when countries transition from medium to high income, due to a shift away from manufacturing to services. Hence, the share of domestic value in exports increases and the importance of imports declines.

The large share of import content in exports at the medium-level of income could indicate that transaction costs could play a crucial role in the industrialization of low income countries. If institutions have a major impact on countries ability to join global production chains, institutional reform could be an important strategy for economic development through trade. Thus, by for example strengthen property rights and increasing freedom to trade countries could be able to better cope with more complex organization of production and consequently attract production of more skill-intensive forms of manufacturing. While this proposition clearly needs further testing, the general message is intuitive. Industrialization increases the complexity of production. However, institutions could prevent such transformation by making this way of organizing production very costly. Thus, further research with regard to the quantitative side of trade costs could enhance the understanding of aspects related to trade and economic development.

8. Summary and conclusions

Since the mid-1980s world trade have experienced a radical transformation. Due to the recent advancement in communication and information technology production is now becoming increasingly vertically specialized. As a result supply chains stretches across borders in a web where different countries ad bits of value. This have contributed to a rapid increase of global trade volumes. It has also increased the complexity of production as wider range of buyers and suppliers have coordinate across borders. As a result, when multinational firms offshore certain stages of production institutions are becoming important factors when deciding where to locate production. Aspects such as business freedom, rule of law and property rights all affects the cost of cross-border transactions. Trade frictions due to lacking institutions can potentially have a large impact of total trade costs as intermediate goods cross borders multiple times.

Based on Swedish firm-level data, this study provide evidence that institutions indeed shape trade patterns. Results show that inferior institutions reduce the propensity for firms to select a country for offshoring and also reduces the volume of trade flows of inputs, given that an offshoring investment is undertaken. Results also display significant asymmetric effects of institutions across industries. The study is able confirm the findings of Nunn (2007), that industries that are characterized by large relationship-specific investments are more sensitive to lacking institutions. More importantly however, the study also provide new evidence that more interconnected industries are more sensitive to the institutional environment. While relationship-specificity primarily influence the volume of trade, a strong backward linkages seem to affect both the selection of country as well as the size of the offshoring investment. To the best of my knowledge, this is the first paper that show that institutions affect trade costs through both a qualitative and quantitative channel.

These findings have potentially important implications for trade and countries' ability to join global supply chains. Lacking institutions might be a hinder for countries to cope with more complex ways of organizing production. Especially since breakdown of intricate production chains can be very expensive due to high inventory costs. For poor countries this means that more advanced manufacturing that require extensive coordination between buyers and sellers might be too costly. As a consequence, these countries risk to miss out on certain trade that could generate significant transfers of capital, technology and management know-how crucial for economic development. While these results are promising more research is needed to better

uncover asymmetric effects of institutions across industries. Future research should aim to extend the knowledge of which types of institutional trade barriers that affect the qualitative and quantitative dimension of trade. This could include barriers such as corruption, lacking infrastructure or inefficient customs procedure. Other areas of interest would be to analyze asymmetric affects across firms. For instance, with respect to size as small and medium size firm are less well-equipped to deal large trade barriers. Thus, much remain to be done within this area of research.

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