Empirical Aspects of Trade, Foreign Direct Investment and Trade Policy in Times of Global Value Chains

Dissertation

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Preface - Vorbemerkungen

Die vorliegende Dissertation ist gemäß den Vorgaben der Promotionsordnung des Fachbereichs IV „Wirtschafts- und Sozialwissenschaften, Mathematik und Informatikwissenschaften“ der Universität Trier vom 28.September 2004 angefertigt worden. Kapitel 1 dient der Darstellung der Motivation und der inhaltlichen Zusammenführung der Kapitel 2 bis 5. Kapitel 6 fasst die Vorgehensweise und die wesentlichen Ergebnisse noch einmal zusammen und beschreibt künftige Forschungsmöglichkeiten. Eine deutsche Zusammenfassung der Ergebnisse gemäß §5 Abs. 4 der Promotionsordnung befindet sich am Ende der Dissertation.

Acknowledgment - Danksagung

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Chapter 1

Introduction - The Advent of Global Value Chains

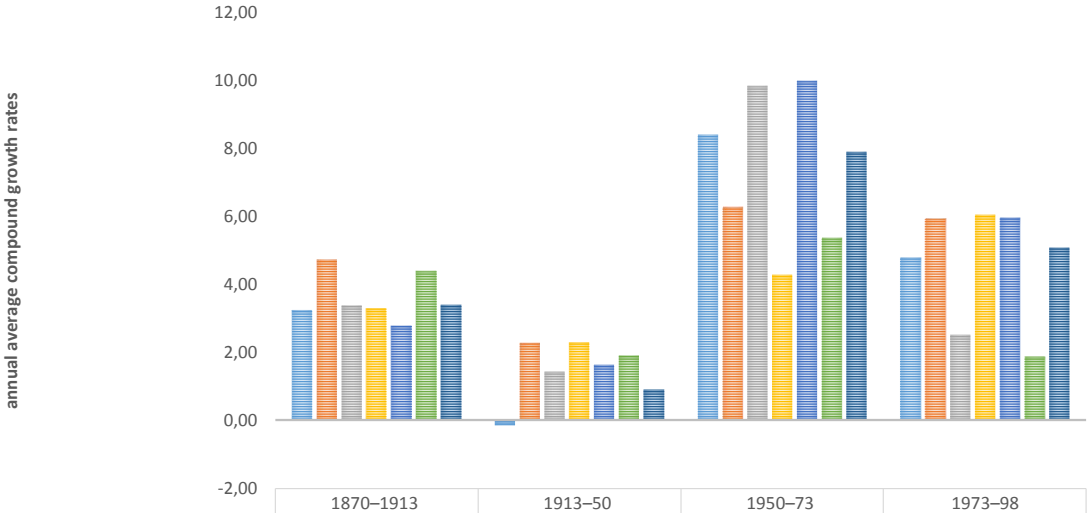
1.1 Motivation

> *In Globalization 1.0, which began around 1492, the world went from size large to size medium. In Globalization 2.0, the era that introduced us to multinational companies, it went from size medium to size small. And then around 2000 came Globalization 3.0, in which the world went from being small to tiny.*
>
> THOMAS FRIEDMAN, THE WORLD IS FLAT.

Globalization has come in waves and has had a profound impact on the world's economies. It has changed and continues to change the way people think about the world and it changes the way people live their lives. Today, it is pretty much normal that stores and supermarkets contain products from all over the world, that people spend their holidays far abroad and even live and work in not only one, but even several countries throughout their life.

This dynamic process has also changed the way economies are organized. Already today, we can observe some truly global markets, and economies, though separated by oceans and long distances, become ever more intertwined. For example, money from Germany is

Figure 1.1: Growth in Volume of Merchandise Exports for the World and Major Regions, 1870–1998



	1870–1913	1913–50	1950–73	1973–98
Western Europe	3,24	-0,14	8,38	4,79
Western Offshoots	4,71	2,27	6,26	5,92
Eastern Europe & former USSR	3,37	1,43	9,81	2,52
Latin America	3,29	2,29	4,28	6,03
Asia	2,79	1,64	9,97	5,95
Africa	4,37	1,90	5,34	1,87
World	3,40	0,90	7,88	5,07

Source: Maddison, Angus (2001): The World Economy: A Millennial Perspective.

invested in the United States within the blink of an eye. You can go to a store in Germany and buy furniture from China or Indonesia. These developments have also impacted the way economic scholars study aspects of globalization, especially how international trade has evolved.

Baldwin (2006*a*) has termed the waves of globalization the first and the second great unbundling. The first unbundling proceeded in two waves, one starting around 1850 and ending with the advent of World War I, after which an era of nationalism and protectionism followed. Globalization took up again around 1960 and has been continuing to this day. Especially in the decades after World War II, the World has experienced a great surge in international trade. Phenomena like "Factory Asia" (see e.g., Baldwin, 2008) illustrate the scope of this second wave. Southern and East Asian countries industrialized and incomes started to converge between the "North" and the industrializing South. Production inter-

nationalized and gave rise to a complex setting of cross-border flows of goods, know-how, investment, services and people, today often called Global Value Chain (GVC) (Baldwin and Lopez-Gonzalez, forthcoming). Several key drivers have been essential for this development. Generally, trade costs have been decreasing greatly.[1] The GATT/WTO rounds of trade liberalization have fostered big slashes in tariffs, and more recently, non-tariff trade barriers such as safety standards. A multitude of Regional Trade Agreements (RTA), Bilateral Investment Treaties (BIT) but also unilateral reductions in trade barriers, especially by developing and emerging countries, has led to a "Spaghetti Bowl" (Baldwin, 2006*b*) of trade relationships among countries. Furthermore, the "container revolution" (Bernhofen, El-Sahli and Kneller, 2013) has brought down shipping costs dramatically and explains in no small part the surge in trade.[2]

Political processes played an important role here, too. While already David Ricardo showed that specialization and trade is not a zero-sum game, countries still try to advance their own interests, opening up new markets and vying for competitive edges. Simultaneously, especially with respect to developing countries, a big paradigm has been that countries would develop faster if they opened up to trade (e.g., Williamson, 1993).[3] Aid for trade has been and is one of the biggest initiatives to spur development. Consequently, development assistance is one instrument to exert influence and receive something in return. This notion is taken up in chapter 2.

The second great unbundling started more recently and was greatly aided by the "'ICT-revolution'" (see e.g., Baldwin and Taglioni, 2006), i.e. reductions in transaction costs due to improvements in internet and communication technology. It has led to a further integration in production, especially North-South production sharing. Trade in intermediate

[1] Anderson and van Wincoop (2004) survey all aspects of trade costs, especially their measurement and their relative importance.
[2] The authors calculate that containerization has increased trade between developed countries by about 700%.
[3] Trade liberalization was one channel of a broader strategy called "Washington Consensus", see also Williamson (1990, 1997) for an in-depth description or Rodrik (2006) for a critical analysis.

goods has gained special importance for the global supply chain, since not only parts of the production process are outsourced, but they may also be offshored. This has also led to a surge in foreign direct investment. According to the United Nations Conference on Trade and Development, worldwide FDI flows have risen from USD 13,345 million in 1970 to about USD 1,451,965 million in 2013.[4] Today, production makes use of an ever increasing number of primary products, parts, components and intermediate services that may be produced and performed all over the world. The world has moved from trade in goods to trade in tasks (see e.g., Grossman and Rossi-Hansberg, 2008). "When Toyota makes car parts in Thailand, they do not rely on local know-how; they bring Toyota technology, Toyota management, Toyota logistics and any other bits of know-how needed since the Thai-made parts have to fit seamlessly into the company's production network." (Baldwin and Lopez-Gonzalez, forthcoming, p. 8)

These issues have also brought about profound changes in studying international economics, moving from older frameworks of country comparative advantage in producing a certain good (Ricardo, Heckscher-Ohlin) to studying the global supply chain. This includes, e.g., the question why some firms operate in more than one country, or why production is located in a specific country or even in a specific region (Antràs and Yeaple, 2014). Nevertheless, the concept of comparative advantage is still present and we have seen a recent surge of studies in its determinants establishing the fact that it remains very much important to examine who trades what and why (Nunn and Trefler, 2014). However, today these issues are more nuanced. Since the production process is split into multiple steps that are not necessarily performed at the same location, scholars are now more concerned with the question who has a comparative advantage in which steps of the production process. This warrants first a characterization of trade in intermediate and final products, which will be taken up in chapter 3.

[4] See `http://unctad.org/en/Pages/Statistics.aspx`.

In terms of studying comparative advantage, we have now also moved to deeper levels of driving forces. Today, institutions are deemed to be a key determinant of comparative advantage (Nunn and Trefler, 2014) and also for a country's development as a whole (Acemoglu and Robinson, 2012). Producers depend on functioning markets and institutions to be able to rely on contracts, to have external financing provided and to have functioning relationships with and monitoring abilities towards employees. However, since different steps of production are not necessarily performed at one location in one country anymore, an issue of measurement arises. When the whole production takes place in one country completely, gross trade is equal or at least proportionate to the value added that is created within the production process. However, if primary and intermediate goods cross borders multiple times until a final product is sold, the discrepancy between the gross value and the value added increases. To illustrate, the iPhone's final assembly takes place in China, whereas parts and components are sourced from firms in Germany, Korea, Japan and the United States (Xing and Detert, 2010). This issue has implications for studying comparative advantage, since until now, studies rely on gross trade and the assumption that value added is proportionate to gross trade. This issue is studied in chapter 4.

Splitting up and globalizing the production process has also triggered a literature on outsourcing and offshoring (Antràs and Yeaple, 2014). For this thesis, offshoring is of special interest. It refers largely to Foreign Direct Investment (FDI). There are in general two motives to transfer production to foreign locations. On the one hand, by operating a subsidiary in a large enough foreign location, firms can better serve local markets, saving on transport costs, tariffs, and possibly having a superior knowledge of local markets (Helpman, Melitz and Yeaple, 2004). On the other hand, firms exploit differences in production costs and offshore steps of production. For example, differences in taxation and other policy-induced incentives have led to large FDI inflows in Ireland (Buckley and Ruane, 2006). Furthermore, European integration and especially the 2004 enlargement

has rendered Central and Eastern European accession countries (CEECs) very attractive targets for locating parts of the production process for multinational firms. The wage differential between e.g. Germany and the Czech Republic in the manufacturing sector was approx. 20 Euro per hour on average.[5] This increases the global dimension of value chains further. Thus, when firms take the decision to offshore, the next step is to find a location. Concentrating especially on the CEEC countries, there is already a large literature on why certain countries are chosen (e.g., Cieślik and Ryan, 2004; Gorbunova, Infante and Smirnova, 2012). However, the literature is rather scarce on the subsequent step: Once a country is chosen, how does a multinational firm decide where to locate exactly? This issue is examined in chapter 5.

1.2 Contribution and Content of this Thesis

The issues raised in section 1.1 are the main subjects under study in this thesis. These issues may not only be interesting for further academic research, but also relevant for political discussion.

Chapter 2[6] deals with economic motives behind aid allocation through multinational agencies. Development funds have been shown to be allocated not solely on the basis of need and merit. In general, developed countries have exerted influence on developing countries in bilateral aid relationships to pursue their own interests (e.g., Alesina and Dollar, 2000; Younas, 2008). Thus, multilateral agencies have been set up to alleviate the pressure. The World Bank is the main actor for multilateral development lending, disbursing credits, loans and grants to support medium term reform programs. However, aid and credit extended by the World Bank comes with conditions attached that receiving countries have

[5] These numbers have been sourced from Eurostat, see `http://ec.europa.eu/eurostat/statistics-explained/index.php/Hourly_labour_costs`.

[6] This study is joint work with Maya Schmaljohann.

to fulfill to be paid the full amount of credits, or paid at all. These conditions are a hotly discussed topic. The World Bank argues that conditions are designed to help improve a country's economic situation. On the other hand, critics argue that conditions imply that the World Bank has superior knowledge and reveal paternalistic behavior. Several studies have shown that for the International Monetary Fund, similar in structure and scope to the World Bank, major shareholders exert strong influence on the specific conditions attached to a loan (e.g., Gould, 2003; Dreher and Jensen, 2007; Copelovitch, 2010). Due to a lack of publicly available data, no such studies with a large dataset have been conducted for the World Bank so far. Chapter 2 fills this gap, concentrating on a subset of conditions related to this thesis' overall topic, namely trade conditions.

Since the G5 - the United States, Japan, the United Kingdom, France and Germany - as the biggest shareholders of the World Bank are also those that effectively decide on the projects and conditions, they are the main focus of this study. It is analyzed whether they exert influence and use trade conditions to further their commercial interests. To this end, hypotheses are set up for each G5 country and subsequently tested using a newly available dataset on the conditions in each of the World Bank's projects. The dataset includes more than 870 projects ranging from 1980 to 2010.

Chapter 3[7] relates to the importance of global production processes. There is already a large literature documenting a rise in worldwide trade of manufacturing and intermediate goods connected to, among others, slicing the value chain, outsourcing, fragmentation and trade in tasks (e.g., Krugman, Cooper and Srinivasan, 1995; Feenstra and Hanson, 1996; Jones and Kierzkowski, 2001; Grossman and Rossi-Hansberg, 2008). They describe a world globalized by market liberalization, political integration and a changing production and consumption structure. However, the empirical literature has so far divided goods only into (1) primary goods, (2) parts and components, and (3) final goods. Over the

[7]This study is joint work with Stephan Huber.

period 1992 to 2004, Athukorala and Menon (2010) report an increase in the share of parts and components from 20.9% to 24.2% relative to total manufacturing.

Therefore, chapter 3 takes a step forward by further dividing (2) into parts and components. To this end, trade data from Eurostat's COMEXT database disaggregated at the 8-digit product level is matched with a scheme exclusively provided by the German Engineering Association (VDMA) that allows to label each 8-digit product in the manufacturing sector as either a part, a component or a final good. The dataset spans the years 2000 to 2014. Firstly, descriptive statistics of the EU 27 countries' development of exports and imports separated by parts, components and final goods are presented. Afterwards, the development of trade within the global value chain is examined more closely using a new indicator, labelled the "Average Relative Partner Development Level". With this indicator, it is possible to analyze who trades parts, components and final goods with whom and thus to establish directions within the value chain. The analysis is supported by "descriptive" gravity estimations introducing the difference in income between a country pair as an explanatory variable. Using exports and imports in the different categories of goods as dependent variables, linkages within the global supply chain are further scrutinized.

Chapter 4 deals with issues of institutions as determinants of comparative advantage in the light of global value chains. Several seminal studies have shown that, besides technology and endowments, different dimensions of institutions provide countries with a comparative advantage in industries that more heavily depend on the quality of institutions (Nunn and Trefler, 2014). Three larger blocks have been studied so far. The first relates to product market institutions, where Nunn (2007) and Levchenko (2007) show that countries with high-quality legal institutions and good contracting environments export more in industries that require large relationship-specific investments in the production process and in which the production process entails more complex supplier-buyer relationships. The second tackles financial markets, where countries with highly developed financial

markets enjoy a comparative advantage in industries that depend extensively on up-front financing of exports (e.g., Manova, 2008). The third relates to labor market institutions. Here, there are two issues. On the one hand, Costinot (2009) shows that countries with well-developed legal institutions export more in industries where the production process is highly task-specialized, i.e. requires better monitoring capabilities. On the other hand, Tang (2012) examines the relationship of an industry's firm-specific skill intensity and the degree of labor market protection in a country. Increasing incentives for workers to acquire such skills, countries with more protective labor markets export more in industries that more heavily depend on firm-specific skills. However, all studies use gross trade as the dependent variable.

As already argued in 1.1, today gross trade reflects less and less what countries actually export, namely the value added that is created in a country domestically. In chapter 4, it is argued that this is a superior measure for the supply side of the economy, and thus for studying comparative advantage. Therefore, in this chapter, the evidence on these institutional channels as a source of comparative advantage is re-examined. To this end, two frameworks of Chor (2010) - who covers the product market and financial market channels as well as the labor market channel of Costinot (2009) - and Tang (2012) are integrated. This yields gravity-type equations for industry level trade flows. Data is gathered from the newly available Trade in Value Added database provided by the Organization for Economic Cooperation and Development, yielding a dataset that covers 55 countries as exporters, 56 countries as importers and 18 industries. The models are then estimated once with gross exports and once with the domestic value added embodied in exports by source industry contrasting the results critically.

Lastly, chapter 5[8] takes up the issue of location decisions for multinational companies (MNCs). Through increasing integration with and also accession to the European Union,

[8]This study is joint work with Andrzej Cieślik and Xenia Matschke.

Central and Eastern European countries have become attractive regions for Foreign Direct Investment (FDI), i.e. the establishment of local subsidiaries in MNCs. The location decision has two dimensions. First, the parent company has to decide in which country to locate. Afterwards, a specific region has to be chosen. Poland has been among the most attractive countries for FDI, receiving over USD 245 million in FDI (UNCTAD, 2015). However, spatial location of multinational firms in Poland is highly concentrated in the most advanced and urbanized regions, leading to considerable divergence in regional development. Despite anecdotal and case-study evidence provided by economic geographers, this problem has been studied very little by mainstream economic scholars.

The scope of the study in chapter 5 is thus threefold. Firstly, it provides a direct link between theory and the estimating equation, deriving it directly from the New Economic Geography framework (Fujita, Krugman and Venables, 1999), in which agglomeration, infrastructure and labor market conditions may affect location decisions. Testable hypotheses are derived on the basis of this framework. Secondly and most importantly, the role of upstream and downstream industry linkages are studied, i.e. to what extent spatial location patterns are influenced by the presence of suppliers or the opportunity to better serve a market. To this end, based on Amiti and Smarzyńska Javorcik (2008), more accurate measures than in previous studies are constructed that capture the presence of potentially all upstream and downstream industries. A conditional logit-framework is then employed to validate the hypotheses, especially that the presence of upstream and downstream firms is an important regional pull factor. The study combines firm-level data on more than 1000 investment projects from the Amadeus database with regional Polish data at the NUTS II level of spatial aggregation from Eurostat and the Polish Statistical Office and provides the newest empirical evidence on this matter.

Chapter 2

Surrender Your Market! Do the G5 Countries Use World Bank Trade Conditionality to Promote Trade?[1]

2.1 Introduction

Developing countries around the world turn towards the World Bank – the main actor in terms of multilateral development lending – for financial and technical support. One of the Bank's central instruments are development policy operations.[2] These are fast disbursed credits, loans or grants intended to support a recipient's medium term reform program. A special feature of development policy operations is that they should only be disbursed after the implementation of conditions previously agreed on. According to the World Bank (2005), these conditions are meant to contribute to achieving the development objectives of the recipient country and to improve the recipient's economic situation, thereby reducing the default risk the World Bank would have to bear. However, this concept is also heavily criticized. One main issue is the implicit assumption that the Bank has superior knowledge of a country's needs compared to the country's government (Collier et al., 1997). Moreover, conditions need to be implemented to be effective (Koeberle, 2005). A third criticism is

[1] This study is joint work with Maya Schmaljohann, then University of Heidelberg.
[2] To avoid confusion, in what follows we use the terms DPO agreement, lending/loan agreement and project interchangeably.

that conditions can be interpreted as instruments of paternalism with which the Bank can enforce its ideas of an optimal policy design even against the will of the recipient country. This argument becomes even stronger when the conditions' design does not follow objective criteria but is influenced by the interest of main actors within the Bank.

As we discuss in section 2.3, many studies on the World Bank show that loan decisions are partly influenced by these particular interests, especially the interests of the United States (e.g., Fleck and Kilby, 2006; Dreher, Sturm and Vreeland, 2009; Kilby, 2009). Regarding the International Monetary Fund (IMF), which is similar to the World Bank in its organizational design, studies reveal that the number and extent of conditions are influenced by geo-strategic considerations as well (e.g., Dreher and Jensen, 2007; Copelovitch, 2010). So far, the literature has mainly focused on a preferential treatment of allies of the donors with respect to the lending decision, lending amount and the number of conditions without a direct benefit for the donor. Only Copelovitch (2010) investigates the commercial interests of the donors in the recipient country which leads to a different treatment of the recipient yielding direct benefits to the donor. We take this approach one step further and investigate to what extent the five major shareholders of the World Bank (G5) – the United States, the United Kingdom, Japan, Germany and France – use their position to extract direct trade benefits by influencing the design of conditionality. In contrast to the previous literature, we do not focus on the overall number of conditions but on the number of a specific sub-group of conditions, namely conditions on trade liberalization. As bilateral donors follow commercial interest to a certain extent in their decision to allocate aid (see, e.g., Alesina and Dollar, 2000; Younas, 2008; Hoeffler and Outram, 2011), we argue that it is very likely that they also try to use their influence in the World Bank to promote their commercial interests in terms of conditions favorable to them. Though it might be harder to influence the specific design of conditionality – and not only the extent of conditionality proxied by the number of conditions – as conditions are developed in

general by the staff in accordance with the recipient government, it is even more attractive as it offers the possibility to influence a country's policy design given that conditions are actually implemented (Koeberle, 2005). As the five main shareholders provide around 40% of the Bank's higher-level staff (World Bank, 2012*a*), their preferences can be represented already during the negotiation process. We argue that this is especially attractive with respect to trade liberalization as it has direct effects on the donors' trading sector. In section 2.4, we will discuss different possible strategies a donor might pursue with respect to trade conditions at the World Bank and develop our hypotheses for each of the five donors we study.

We use a newly available dataset on World Bank conditionality that covers more than 1100 development policy lending projects over the 1980-2011 period to analyze whether the main shareholders use their power to influence the design of conditionality, thus fostering their commercial interests. To our knowledge, this is the first study with a large dataset that analyzes the specific design of World Bank loan agreements. We find evidence (presented in section 2.6) that Germany exerts influence to support its trade links by an increased number of trade liberalization conditions attached to loans of their trading partners. On the other hand, for the United States we find a significantly negative relationship between bilateral trade and trade conditions. This suggests a strategy of protecting US traders from increased competition by preventing a liberalization of the relevant markets. For the United Kingdom, France and Japan, we cannot identify a robust relationship between their bilateral trade and the extent of trade conditionality. Our findings support the literature in that development aid disbursed by supposedly more impartial institutions such as the World Bank is also subject to special interests and even the specific design of loan agreemtents seems to be affected. We discuss the implications of these findings and possible consequences in section 2.7.

Figure 2.1: Average Number of Conditions per Year, 1980 - 2011

2.2 World Bank Conditionality

When the IMF and the World Bank were established in 1944, conditionality was not an explicit part of their lending operations (Dreher, 2004). Today, however, both the IMF and the World Bank attach conditions to their structural adjustment lending. These conditions are requirements the recipient country has to fulfill in order to receive financial assistance from the organization. In the early years, conditions attached to IMF lending were much more numerous than to World Bank lending (Dreher, 2004). With the creation of adjustment lending programs in the Bank in the early 1980s, the situation changed and conditions became more important for its interventions, exceeding the number of conditions in IMF programs on average. However, since the 1990s the number of conditions attached to the Bank's development policy lending has steadily decreased (see figure 2.1).

According to the World Bank, conditions were mainly focused on resolving short-term

economic imbalances in the 1980s and 1990s, whereas today they are mainly a means to induce medium-term institutional changes much more reflecting the interests of the recipient's governments (World Bank, 2005). Conditions apply to eleven different themes[3] and two general groups: prior actions and benchmarks. Prior actions are those conditions that have to be fulfilled before i) Board approval in the case of a single-tranche lending and ii) the release of the next tranche in case of multi-tranche operations. Regarding ii), the conditions for the next tranches are already included in the project proposal. If a country fails to comply with certain conditions, the following tranche will only be disbursed if the Board decides to waive them. On the other hand, benchmarks are literally no conditions because non-compliance does not automatically lead to a freeze in disbursements. Benchmarks can be seen as stepping-stones that reflect improvements towards a bigger institutional or policy change, e.g., conducting a study on export facilitation and setting up a plan of action accordingly.

The World Bank offers two main reasons why conditions are necessary, both for supporting development as well as due to its banking function (World Bank, 2005). First, the assistance provided by the Bank should contribute to the development objectives of the recipient country. By using conditions as criteria for the credit disbursement, positive outcomes shall be ensured. Second, conditions are meant to help ensure that the resources will be used in the intended way as the World Bank is accountable to the financiers it borrows money from. According to the *Operation Policy for Development Policy Lending*[4], the Bank provides lending only for countries that maintain an adequate macroeconomic policy framework. However it is up to the World Bank to decide whether this adequacy is achieved.

[3]Economic management; public sector governance, rule of law; financial and private sector development; trade and integration; social protection and risk management; social development, gender and inclusion; human development; urban development; rural development; environment and natural resource management (World Bank, 2012*b*).

[4]OP 8.60 Development Policy Lending, `http://go.worldbank.org/N3Y839UBH0`, accessed on 09/21/2012.

Since the beginning of its usage, conditionality has often come under attack. Some critics interpret conditions as instruments of paternalism with which the Bank can enforce its ideas of an optimal policy design against the will of the recipient country. Furthermore, conditions imply the assumption that the Bank has a superior knowledge of a country's needs than the country's government itself (Collier et al., 1997). On the other hand, if conditionality is an effective measure to foster development and reform, one can criticize that the implementation of conditions is not effectively enforced. Dreher (2004) argues that staff members do not have any incentive to strictly review whether conditions have been met as they are under pressure to hand out the allocated budget share to "their" region. Consequently, it is not in their interest to negotiate stringent criteria and few projects have ever been canceled due to non-compliance with the negotiated conditions. Svensson (2003) studies about 200 structural lending agreements and does not find evidence for a relationship between a recipient government's compliance and the disbursement of the loan. In the case of the International Development Association (IDA), lending and conditions can fall prey to the Samaritan's dilemma, too. The IDA is the organizational part of the World Bank Group that focuses its lending activities on the poorest countries (GNI p.c. $<$ 1,195 USD in 2013) and some countries above this cut-off that lack the creditworthiness to obtain money via the other borrowing institution of the World Bank, the International Bank for Reconstruction and Development (IBRD). The receiving countries of IDA lending are perceived to be in such a need that due to "moral" reasons it does not seem adequate to cancel a project even if the recipient does not comply. Still, Kilby (2009) finds evidence that poor macroeconomic performance and a lack of conditionality enforcement leads to lower loan disbursements only if a country is no political friend to the United States. Stone (2004) analyzes the performance of IMF conditionality in Africa to evaluate why there is no progress observed in the development of African countries despite the continuous engagement of the IMF. He studies whether the design of the conditions is inappropriate or

whether conditions are not sufficiently enforced and concludes that the problem lies with enforcement. Stone shows that the duration of punishment after failing to comply with conditionality rather depends on the importance of the respective country to the major donors than on the quality of economic indicators. While conditionality in World Bank operations is the main focus of our analysis, it has to be embedded into the larger theme of aid allocation in general. Therefore, the next section reviews the literature addressing political and economic factors that influence the allocation of aid.

2.3 Political Economy of Aid Allocation and Conditionality

The literature on the political economy of aid allocation suggests that development aid is not as altruistic as one might hope. Though some countries – especially the Nordic ones – seem to allocate aid primarily based on aspects of need and merit, other countries like the United States, France, Germany and Japan also consider factors such as geo-political interests, colonial pasts and commercial interests (Alesina and Dollar, 2000; Younas, 2008). Aid allocation based on commercial interests is appealing due to the possibility to intensify the commercial relationship between the donor and the recipient country. One possible way to make this work is via the allocation of tied aid where the recipient country has to consume products or services produced in the donor country. Another well-studied example is the allocation of aid towards importers of the donor's products. This should intensify the trade relationship between the two countries due to preferential behavior by the recipient country (Younas, 2008). For example, countries that import capital goods – the main export goods of donors organized within the OECD's Development Assistance Committee (DAC) – receive significantly more aid from these donors. However, there is no effect for imports of other goods on DAC aid allocation. Berthélemy (2006) obtains similar

findings when analyzing the influence of trade patterns – the sum of imports and exports as a share of the donors' GDP – on aid allocation of seventeen DAC donors. With the exception of Switzerland, he finds a significantly positive relationship for all donors. Likewise Dreher, Nunnenkamp and Schmaljohann (2015) find a significant influence of trade ties, measured as exports to the recipient country, for Germany's bilateral aid allocation.

Intuitively, aid allocation through multilateral channels – where the influence of single donors is restricted (Rodrik, 1995) – might lead to a more need-oriented allocation of aid (Maizels and Nissanke, 1984). However, several studies have shown that donors retain sufficient influence within multilateral organizations to achieve decisions favorable to their interests (e.g., Frey and Schneider, 1986; Dreher, 2004; Copelovitch, 2010). The influence of the United States is a widely studied example, especially their geo-strategic interests measured by voting behavior of recipient countries in the UN General Assembly (UNGA) or temporary membership on the UN Security Council (e.g., Andersen, Hansen and Markussen, 2006; Kuziemko and Werker, 2006; Kilby, 2009). And commercial interests play an important role, too.

Fleck and Kilby (2006) analyze US influence on the World Bank's lending decisions. According to their results, an increase in the share of US exports to a recipient country by one standard deviation leads to an increase in monetary assistance from the Bank of more than one percent. The same holds true for US bilateral aid and investment flows. Thus, both have a positive influence on World Bank decisions. Copelovitch (2010) analyzes the common interests of the G5 countries (USA, Japan, Germany, France, UK) with respect to their influence on IMF lending decisions. Countries with a high involvement of G5 banks in their financial sector receive, on average, higher loans from the IMF. However, if the commercial interests of the G5 are heterogeneous, i.e., the Bank's involvement is not equally high for all G5 countries, lending is reduced. Copelovitch (2010) argues that with heterogeneous commercial interests among the main shareholders, the role of the

IMF staff becomes more important. There is also evidence for non-permanent members of the World Bank's Executive Board exerting influence. According to Kaja and Werker (2010), the Bank's funding of developing countries doubles on average while these countries serve as members of the International Bank for Reconstruction and Development's board. Morrison (2013) studies borrowers' influence on IDA lending during their temporary membership on the Executive Board. While those countries received significantly more IDA funds than non-Board members during the Cold War, the difference is no longer significant after 1990. Morrison explains this development with the increased importance of the internal policy rating that determines the allocation of IDA funds and improves its transparency.

A second aspect, apart from the amount of aid allocated, where donors can exert influence through multilateral organizations is the design of conditionality. As information on conditions was not as easily available as on lending amounts, the number of studies on this issue is smaller. Especially for the World Bank, information on loan conditions has become available only recently. Nevertheless, the studies conducted so far on IMF conditionality, where the organization and decision structure is comparable to the World Bank, reveal that donors influence the design of conditions as well. In the existing studies, the focus has rather been on geo-strategic than on commercial interests. Dreher and Jensen (2007) provide evidence that US interests alter the extent of IMF conditionality. Allies of the United States, as measured by their voting behavior in the UNGA, receive loans with, on average, fewer conditions than other countries. Furthermore, friends of the United States face lower conditionality right before democratic elections. But, not only is the number of conditions affected by being closely aligned to the United States. Stone (2008) splits conditions into the different themes they cover. He finds that countries strongly supported by the United States, measured by US bilateral aid, are more likely to receive IMF loans and conditions in fewer sectors.

Apparently, the scope of US interest in a country affects the recipient in three ways. First, it is more likely to receive a loan. Second, fewer conditions are attached to the loan. And, third, these conditions are more narrowly focused in the sense that government action in fewer categories is required. The United States are, however, not the only country influencing IMF decisions. The other four permanent members of the Board exert influence as well. Copelovitch (2010) finds that, in addition to higher loans, a country that is of political interest to the G5 will receive fewer conditions even if interests of the G5 members are heterogeneous. To some extent, this finding indicates logrolling behavior – a tit-for-tat where benefits for allies of another G5 country are granted with the expectation of a reciprocal treatment of one's own allies in the future. With respect to commercial interests, he does not find any evidence for strategic influence to reduce the extent of conditionality. However, Gould (2003) provides evidence that private financiers are able to influence the Fund's conditionality because the IMF does to some extent depend on their money as an additional source of capital within loan agreements. These results show that, to a certain degree, loan decisions and conditionality are influenced by the geo-strategic and commercial interests of the IMF's and the World Bank's main shareholders.

As conditions are negotiated as part of the loan contract between the international organization and the recipient country, preferences of the recipient country play a role as well. Vreeland (2000) argues that IMF conditionality can be used as a scapegoat by the recipients' governments to implement unpopular reforms. By including these reforms in the loan conditions, the executives can blame the IMF or the World Bank for the reform and thus reduce their reelection risk. For the IMF, Caraway, Rickard and Anner (2012) show that domestic preferences have an influence on the design of labor market conditions. Countries where the labor movement is stronger and better organized will have less demanding labor conditions attached to their IMF loans. The authors argue that the government will negotiate in line with the labor organizations to prevent domestic resistance

from unsatisfied workers. Our study is somewhat similar to Caraway, Rickard and Anner (2012) as we also analyze a subset of conditions, yet we focus on the influence of the G5 on these conditions.

2.4 G5 Interests and Trade Conditions - the Hypotheses

As shown in the previous section, empirical research on conditionality is scarce. For the World Bank, to the best of our knowledge, there exists no study evaluating the political economy of conditionality based on a large dataset. Yet, it seems to be an important playground for strategic interests as it offers the possibility to impact a country's policy-making. Especially the design of prior actions, which are more likely to be implemented, should be of interest to the donors. However, conditions are negotiated before the Board approves the loan. In case of prior actions for one-tranche-only-projects, prior actions have to be fulfilled before the loan is approved. This implies that the Executive Board might only have a small influence on the conditions. Supposedly, most influence should be exerted during the negotiating process. It is not clear to what extent the Executive Directors might be able to put pressure on this process. For the IMF – most likely, this is similar for the World Bank – Copelovitch (2010) argues that the staff takes the preferences of the Executive Directors into account during the planning stage to ensure that the loan proposal will be approved by the Board. In addition, Kilby (2013) shows that the US exerts indirect influence on post-approval decisions that cannot be influenced directly by the Executive Board. The major shareholders, especially the US, have a dominant position with respect to the institution's higher staff. The share of US higher staff was 24.6 percent in 2010 (World Bank, 2012*a*). The other main shareholders are also well-represented and provide another 15 percent of the higher staff (World Bank, 2012*a*). Given this degree of representation of the G5 both in the final decision-making body, the Executive Board,

and among the staff, it is not unlikely that conditionality is influenced according to their preferences.

One thematic category of conditions appears to be especially attractive for strategic intervention: trade liberalization. Trade as a commercial motive is, in general, a decisive factor for aid allocation (e.g., Alesina and Dollar, 2000; Younas, 2008). Apart from the United States, especially Japan and France seem to allocate bilateral aid towards countries they have strong trade relations with (Canavire-Bacarreza et al., 2006; Younas, 2008) – but also Germany with its strong export sector is likely prone to promote its trade relations (Dreher, Nunnenkamp and Schmaljohann, 2015). For the United States, this relationship even appears to be a prime motive to provide foreign assistance (Tarnoff and Lawson, 2009). If trade promotion is used as an argument to justify bilateral foreign aid towards the taxpayer,[5] it seems plausible that countries try to apply this strategy for multilateral aid as well. In many countries, the export sector is a major pillar of the economy. Politicians have an interest in promoting this sector, firstly to promote economic growth and secondly, to gain support for future elections. As conditions are a crucial part of World Bank lending and recipient countries are, at least officially, obliged to implement these conditions to receive further loans, it seems probable that governments try to affect the design of trade conditions attached to World Bank loans.

There are in general three strategies a country might pursue when influencing trade conditions: trade intensification, trade creation and trade protection. The first applies to recipient countries the donor already has a trade relationship established with. To intensify this relationship, donors try to augment the trade liberalization efforts of the recipient country by negotiating for more trade liberalization conditions. In the second case, the

[5]The Republican presidential candidate Mitt Romney, when presenting his strategy for foreign policy and development cooperation in September 2012, was even more outspoken on this topic. He stated that aid should be used as a reward for countries that remove trade and investment barriers. The Washington Times, `http://www.washingtontimes.com/news/2012/sep/25/romney-takes-aim-foreign-aid/`, accessed on 9/25/2012.

donor wants to establish new trade routes. Markets that protected themselves with trade restrictions from foreign competitors are forced to liberalize to open up new trading possibilities for domestic enterprises. Donors thus push for more trade liberalization in those countries where trade relations are not established yet. The third strategy, trade protection, occurs when a country already has established trade linkages and fears the competition of other actors. In this case, the donor tries to prevent trade liberalization.

We argue that these strategies apply differently to the G5 countries, based on competitiveness, differences in development goals and institutions as well as historical ties and cultural closeness. International competitiveness should influence a country's strategy since, e.g. the more competitive a country is, the more it gains from any sort of trade liberalization. If a country is less competitive, liberalization based on WTO principles might be less desirable.[6] Market entry barriers could also affect the choice of strategy, since it is easier to intensify already established trade relationships than creating new ones. We now consider each country in turn.

First, we can divide the group of five into, generally speaking, the colonizers (France and the United Kingdom) and the non-colonizers (Germany, Japan and the United States of America) with respect to the post 1945 period.[7] The "colonizers" have well established trading routes to their former colonies. These relationships are supported by preferential customs regulations, common language and to some extent a common currency, which otherwise pose significant trade barriers.[8] In 1980, the beginning of our sample period, the share of France's trade with its former colonies was around 36.7% with respect to countries eligible for WB lending and about 19.2% for the UK.[9] Although these colonial links have

[6]For 80% of our project observations, the borrowing country was a WTO member.

[7]We are aware that the countries of the non-colonizer group have had some colonies as well. However, first, these colonies refer to a time before World War II, a time when trade was not yet so intense and second, the number of colonies and the post-colonial ties are much lower than for the two countries categorized in the colonizer group.

[8]Most of the former French colonies in Sub-Saharan Africa joined a currency union with their money pegged to the French Franc reducing transaction costs. These are now also linked to the Euro.

[9]Authors' own calculations using data from the World Integrated Trade Solution.

eroded over the last decade, they were strong before, particularly between France and its former colonies and even remaining so for some countries (Head, Mayer and Ries, 2010). Furthermore, international competitiveness may be a critical issue for a country's strategy, as explained above. Freudenberg and Ünal Kesenci (1994) as well as Cheptea et al. (2008) argue that the competitiveness of French firms has declined significantly during the period under study, especially regarding non-EU markets and compared to other major economies. Membership in the World Trade Organization might also factor in. Since more than two thirds of the countries in our sample either accessed the WTO before or during the period under study, a push for liberalization only makes sense for strong competitors in the world markets. Based on these findings, we hypothesize that France does not have an interest in stimulating trade via World Bank conditions. Therefore, we expect France to not pursue any visible strategy or a trade protection strategy.

As noted above, for the UK we also have to consider the ties to its former colonies. Though trade volumes with these countries are not as prominent as those between France and its former colonies, the same reasoning should apply in that the UK's interest in liberalizing trade of its former colonies may well be limited. While the UK's international competitiveness is favorable compared to France, evaluations on Japan and Germany have been much better. Also, these two countries have been much more diversified in terms of traded goods (Germany) or have displayed a high mobility in specialization patterns (Japan), i.e. quick adjustments to changing patterns of comparative advantages (Dalum, Laursen and Villumsen, 1998). Consequently, the above reasoning might also suggest limited UK interest in trade liberalization through World Bank conditionality.

Germany and Japan, on the other hand, are countries that base their economic growth to a large extent on their export sector. Both countries' development strategies also included an explicit focus on trade liberalization and trade return for aid. For Germany, a report of the Federal Ministry for Economic Cooperation and Development in 1980 ex-

plicitly states that Germany is an export-led economy that aims for trade liberalization and views trade as an important part of a country's development (Deutscher Bundestag, 1980). In addition, annual reports by this Ministry to the parliament include information on the positive effect of development cooperation on Germany's exports and domestic job creation (Deutscher Bundestag, 1980, 1983). This underlines the importance of trade promotion as a by-product of bilateral aid for Germany. Also, Freudenberg and Ünal Kesenci (1994) as well as Cheptea et al. (2008) show that in contrast to France, Germany retained the competitiveness it had built up after World War II in many important sectors, even strengthening it again especially during the 2000s (see also Boulhol and Sicari, 2014). Japan, on the other hand, does not have a separate Ministry for Development Cooperation. Instead, multiple ministries and agencies are responsible for the aid allocation (Nikitina and Furuoka, 2008). One of these ministries is the Ministry of International Trade and Industry (MITI). According to Hirata (1998), the MITI has intensively influenced aid allocation during the 1960s and 1970s with the aim of increasing Japanese international trade. Given this importance of exports and their high competitiveness in the world market in combination with foreign aid, we expect both countries to follow a trade intensification and/or trade creation strategy with respect to World Bank conditions.

Lastly, for the United States it is more difficult to derive expectations. After World War II, the United States' level of competitiveness has been far above that of other developed and emerging countries.[10] This fact would lead us to expect a trade intensification and/or trade creation strategy. However, there are several other aspects which we have to account for. First, Cheptea, Gaulier and Zignago (2005) describe a significant loss in competitive advantage in recent decades – especially compared to countries such as Germany and China. Second, during the period under study, US imports dominate its exports. Nevertheless, they also follow a trade-promotion strategy connected to their foreign aid strategy. One

[10] See e.g. Schnabel (1997); Cheptea, Gaulier and Zignago (2005), or the International Institute for Management Development's World Competitiveness Ranking.

institution of US development cooperation is the United States Trade and Development Agency (USTDA). The USTDA finances projects abroad with the aim to strengthen the recipient's as well as the United States' economy by providing orders for US enterprises and exporters related to these projects. The agency states that one of the project selection criteria apart from "hav[ing] the potential to generate significant exports of U.S. goods and services"[11] is competition of other foreign companies in the recipients' market (USTDA, 2005). According to the agency, two categories of projects exist where one includes the "... establishment of [...] trade agreements, market liberalization." Hence, USTDA does not only help US companies to receive orders from abroad, the agency also helps US enterprises to compete against foreign competitors by, e.g., reducing trade barriers for US products. In this sense, USTDA reports a success story for 2011 where it "[...] awarded a USD 660,000 grant to the China State Grid Electric Power Research Institute in support of opening China's market for U.S. clean energy technologies."[12] Here, the US fosters a trade promotion strategy for a narrow field in which it has identified significant market potential for their enterprises and creates US-specific market entry possibilities. Since this trade promotion strategy is applied at a bilateral level, we expect the US to follow a trade protection strategy in the multilateral sphere of the World Bank, to not endanger bilaterally negotiated advantages by opening the market to all competitors.

2.5 Data and Estimation Method

We test our hypotheses by estimating a reduced-form econometric model including our variables of interest and several control variables that we take from the literature. The unit of observation is each single lending decision.[13] The number of trade liberalization

[11] See US government's information on USTDA `http://www.allgov.com/departments/independent-agencies/united-states-trade-and-development-agency-ustda?agencyid=7282`.
[12] See footnote 5.
[13] Therefore, we do not have a panel dataset and cannot apply panel estimation methods.

conditions is our dependent variable to identify the importance and extent of trade liberalization conditions in World Bank projects. To obtain this measure, we have reviewed the conditionality descriptions available in the Policy Action Database (World Bank, 2012*b*). This database contains all prior action and benchmark conditions for 1105 projects approved between 1980 and 2011. Around 70% of the conditions are prior actions while the remaining 30% are benchmarks. We coded a condition as a trade liberalization condition if the condition's theme is grouped under "Trade and Integration"[14] and the corresponding text includes specific trade liberalization requisites. A prior action condition that we coded as trade liberalization condition reads, e.g., "Eliminate all import licensing for consumer goods, to be phased with tariff reforms" (Philippines, 1981) or "Eliminate export and import bans and licensing for agricultural products" (Romania, 1997). A benchmark condition that we coded as trade liberalization condition reads, e.g., "Implement properly trade policy reform" (Indonesia, 1991). A condition that we did not code as trade liberalization conditions reads, e.g., "Review import controls still remaining on luxury goods" (Burundi, 1986). We exclude such conditions from our dataset since they do not imply specific measures the recipient's government has to implement.

Dreher and Jensen (2007) note that it is difficult to measure the degree of intrusiveness of conditionality. Hence we follow other studies that use the number of conditions as a proxy for their stringency (Mosley, Harrigan and Toye, 1991), their causes (Gould, 2003; Dreher, 2004) and their extent (Ivanova et al., 2006). On average, a project contains approximately 34 conditions, whereas the maximum lies at a stunning 195 conditions for a loan for reforms in the agricultural sector in Morocco approved in 1988. On average, two conditions of a project are trade conditions. However, more than half of the projects do not include trade conditions (672 projects) which increases the average number of trade conditions in projects with trade conditions to five. The extent of trade conditions does

[14]This grouping includes: export development and competitiveness, international financial architecture, regional integration, technology diffusion, trade facilitation and market access or other trade and integration.

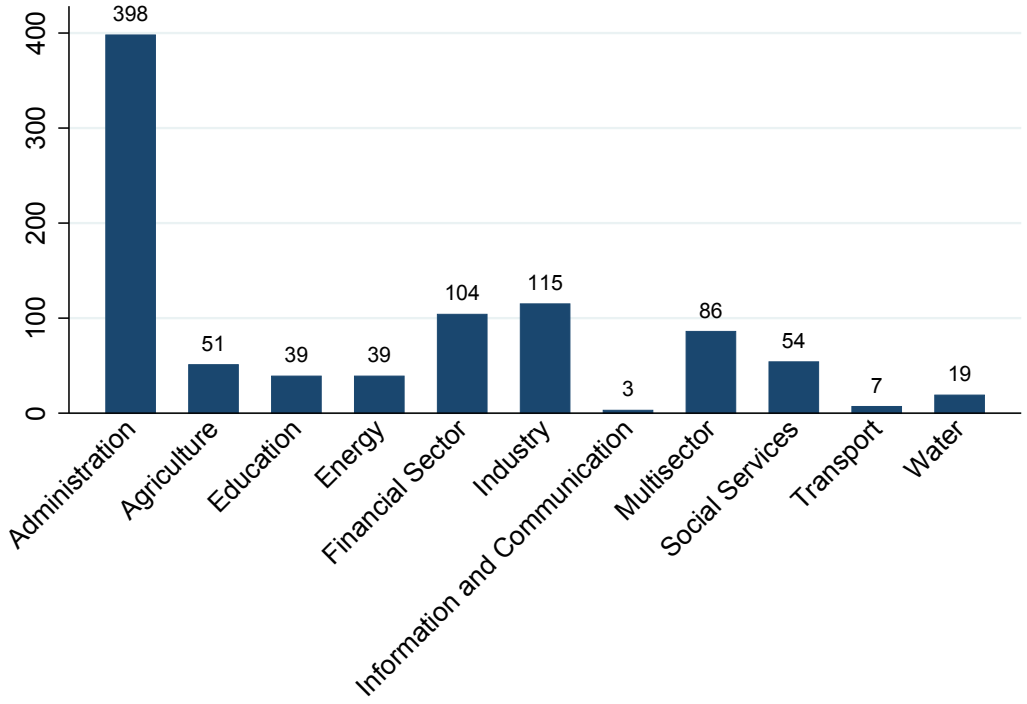
Figure 2.2: Average Number of Trade Conditions per Year, 1980 - 2011

largely depend on the project sector. Apparently, the average number of trade conditions is much lower in social service projects (0.1) than in industry projects (6.8). Furthermore, the intensity of trade conditions in the projects has experienced a sharp decrease since the mid-1990s. Figures 2.1 and 2.2 provide an overview of the average number of general conditions and trade liberalization conditions over the sample period. Figure 2.3 further visualizes the sectoral distribution of the projects analyzed.

Independent Variables

The set of independent variables is itself comprised of four subsets. The first set contains general control variables and includes GDP per capita, inflation, the current account balance, being under an IMF program and the total number of project conditions. GDP per capita has been found to have a negative or insignificant influence on IMF conditions

Figure 2.3: Number of Projects by Sector, 1980 - 2011



(Steinwand and Stone, 2008; Caraway, Rickard and Anner, 2012) and on World Bank lending decisions (Frey and Schneider, 1986; Andersen, Hansen and Markussen, 2006). In our context, we expect a negative correlation as richer countries are usually in a better bargaining situation when it comes to the negotiation of conditions. We include inflation[15] as an indicator for economic instability and thus the need for economic reforms. We expect a higher inflation rate prior to the arrangement to trigger a higher number of conditions included in an agreement. Trade liberalization might be used as a means to bring monetary policy under control. According to Romer (1993), deflation is costlier in open economies and politicians will therefore act more responsibly. Inflation is also a sign of economic instability whereas trade liberalization can be a means to increase growth and stability of the economy. Another control variable that has been found to be significantly

[15]We transform inflation to reduce the impact of outliers following Dreher, Sturm and de Haan (2008): $(ConsumerPriceIndex/100)/(1 + (ConsumerPriceIndex/100))$.

related to IMF conditionality is the ratio of current account to GDP (Dreher, Sturm and Vreeland, 2009). Since more balanced trade is usually considered to be favorable for the economic situation of a country, a higher imbalance should trigger the inclusion of more trade conditions as well. The data on GDP per capita, current account to GDP ratios and inflation are taken from the World Bank's World Development Indicators (World Bank, 2012*c*). We also include the number of total conditions excluding trade conditions, since it is more likely that a project that features more conditions also includes (more) trade conditions. Additionally, being under an IMF program should control for the fact that trade liberalization might already be demanded within the IMF agreement and thus might reduce these conditions in the World Bank program. This information is taken from Dreher (2006) and the IMF's annual reports.

The second set of control variables accounts for the recipient's trade openness. The most widely used indicator for trade openness is the ratio of total trade to GDP (e.g., Fleck and Kilby, 2006; Andersen, Hansen and Markussen, 2006; Dreher, Sturm and Vreeland, 2009). We expect fewer trade conditions to be included in the projects if a country is already relatively open to trade. We also control for specific trade openness to the G5 countries by including dummies for a regional trade agreement (RTA) with the US, Japan and the EU countries. Furthermore, a dummy indicating a recipient's membership in the GATT/WTO is included. The data for trade openness are taken from the World Bank's World Development Indicators (World Bank, 2012*c*), whereas the data on RTAs are taken from CEPII's gravity dataset (CEPII, 2013) as well as the WTOs RTA Databank (WTO, 2013*b*); data on GATT/WTO membership is from the WTO (2013*a*,*c*). We include the number of World Bank trade conditions in earlier agreements as an additional control for previous reform behavior. To create this variable, we sum up all trade conditions attached to programs until the year before the new loan is approved.

The third set of variables controls for the recipients' incentives towards the inclusion of

trade liberalization conditions. It includes the legislative competitiveness and a dummy for legislative elections. Given that trade liberalization might encounter resistance with the incumbents' domestic opposition or voters, introducing these reforms within the framework of World Bank conditionality might be preferred. The more veto players exist regarding domestic legislation, the more difficult it becomes to implement controversial reforms and the more likely it renders a country to use the World Bank as a scapegoat for the implementation (Vreeland, 2004). The second measure, legislative elections, controls for the government's willingness to reform. Costly reforms are more likely to be implemented shortly after an election as the reelection risk is smaller due to the long time period until the next elections take place. The control variables for recipient interests are provided by the Database of Political Institutions (Beck et al., 2001).

In terms of geopolitics, our fourth set of variables, we use a country's voting behavior in the United Nations General Assembly (UNGA) to measure how closely it is allied with the G5 countries. Closer allies to these countries have been found to be rewarded with fewer conditions attached to IMF loans (e.g., Andersen, Hansen and Markussen, 2006). Since however, this is the effect on total conditionality, it may not apply in the context of trade liberalization holding the total number of conditions constant. In addition, we control for temporary membership on the UN Security Council (UNSC) as this has been found to be a relevant geo-strategic interest variable as well (Dreher, Sturm and Vreeland, 2009, 2015).

Lastly, our main variables of interest that measure the commercial interests of the G5 countries are the total bilateral trade flows (constant USD in logs) between the recipient and the respective donor countries. These data have been taken from the World Integrated Trade System's (WITS) database which itself comes from the United Nation's Comtrade database (World Bank, 2013).

Estimation Strategy

Our basic econometric model reads as follows:

$$\begin{aligned} tradeconditions_{l,i,t} &= \alpha + \beta_1 \ln trade_{j,i,t-1} + \beta_2 tradeopenness_{i,t-1} + \gamma controls_{i,t-1} \\ &+ \delta recipient_{i,t-1} + \xi geostrategic_{i,t-1} + \kappa_t + \omega_k \\ &+ \phi_i + \epsilon_{i,t} \end{aligned} \tag{2.1}$$

where $tradeconditions_{l,i,t}$ is the number of trade conditions attached to a loan l country i received in year t, and $\ln trade_{j,i,t-1}$ is the logarithm of ex- and imports of G5 country j with i. $controls_{i,t-1}$, $tradeopenness_{i,t-1}$, $recipient_{i,t-1}$, $geostrategic_{i,t-1}$ represent the vectors of control variables described in the previous section. All control variables with exception of the total number of conditions of the project and UNSC[16] are lagged by one year to account for the fact that the negotiations probably take some time. We add a time trend (κ_t) to catch the overall development of trade conditionality over time. We include a fixed effect ω_k for the sector[17] the project is embedded in and for the recipient country (ϕ_i). Finally, $\epsilon_{i,t}$ is an error term that we cluster by recipient countries, assuming that within-country errors are not independent of each other.

We perform OLS regressions as a benchmark, fully aware that the mass point at zero (as well as other violations of the Gauss-Markov assumptions) renders the estimates inconsistent and inefficient. Though the count nature of our dependent variable gives rise to a Poisson estimator, our data do not fulfill its very strong assumptions of a conditional mean that is equal to the conditional variance (Cameron and Trivedi, 2009). Hence, to correct for the apparent overdispersion, we perform Negative Binomial regression as suggested in Hilbe (2007) and used, e.g., in Caraway, Rickard and Anner (2012). As we present in

[16] UNSC membership is not lagged as the election of the new members on the UNSC already takes place in the year before entering the council, thus the information is already available.

[17] A project may be embedded in different sectors, see figure 2.3. We assigned the agreement to the sector that was identified as the major sector within the project information.

our results section, the zero-inflation of the data still leads to a slight discrepancy between the number of observed zero counts and the number of zeros predicted.[18] Therefore we will further use the Poisson Pseudo Maximum Likelihood (PPML) estimator as robustness check (Santos Silva and Tenreyro, 2006). The PPML estimator is widely used in the trade literature due to its good performance even if a high portion of zeros is observed in the dependent variable.[19]

2.6 Results

We begin our analysis by a step-wise inclusion of our different sets of control variables. Table 2.1 presents the respective results for the OLS and Negative Binomial estimations. Due to the previously described shortcomings of the OLS estimator, our interpretation will focus on the Negative Binomial results in the following. The first model only includes the set of general economic and trade openness control variables. None of the economic control variables has a significant and robust effect on the number of trade conditions. As we argued before, these economic conditions might matter only for the overall number of conditions attached to a loan and not specifically for trade conditions. However, the trade openness measures also appear to be less relevant than expected. Though it is surprising that trade openness has no significant effect as it proxies a country's general trade openness well, it might be a too general measure for the very sector specific liberalization conditions.

[18] A comparison of the deviation between the predicted and observed values for Poisson and Negative Binomial estimations shows that the Negative Binomial prediction is better for very small values (<4) compared to the Poisson predictions and that the predictions of both models become very similar afterwards. Plotting the counts predicted by the model against the observed counts reveals that the zero-inflation apparent in the Poisson model vanishes when using Negative Binomial regression. Therefore, we stick to the Negative Binomial model for further estimations and also decided not to use a zero inflated model.

[19] Martin and Pham (2008) argue that the PPML is less accurate if the zeros are generated by a two-step Heckman selection or a Tobit truncation process. However we believe that the zeros in our dataset are true ones, in the sense that they do not result from a process that is different to the one that generates the count. The PPML is therefore adequate for the nature of our data. Nevertheless, we also tested a two-step sample selection approach assuming that the process generating a count > 0 was independent from the process generating the number of counts. The second stage, using only positive counts, confirmed our findings.

Regional trade agreements turn out to be relevant only if partnered by the US and then significantly reduce the number of liberalization conditions. If a country had a free trade agreement one year prior to the loan, the expected number of trade conditions decreases by approximately 60%. For an average of two trade conditions, this implies a decrease of more than one condition. In addition, a loan's total number of conditions and the number of prior trade conditions turn out to have a significant effect on the dependent variable. On average, for a one unit increase in the number of total conditions the expected number of trade conditions increases by approximately 1%. This effect is statistically significant at the one percent level. Furthermore, countries that had to fulfill more trade liberalization conditions in the past have less new trade conditions attached to their loan. A one unit increase in the number of prior trade liberalization conditions decreases the expected number of trade conditions by approximately 2.5%.

In the second model, we include the index of legislative constraints and the dummy for legislative elections to control for the recipients' interests in implementing trade liberalization reforms. None of the controls for the recipient's interest is statistically significant at conventional levels and their inclusion has no effect on the economic variables. In the next step, we include the bilateral trade variables which are our main variables of interest. By including the bilateral trade of all five main shareholders simultaneously, we ensure that we capture only the effect of each donor and not implicitly the effect of another donor with a similar trade pattern. The bilateral trade patterns of the United States and Germany seem to have a significant effect on the number of trade conditions. While the coefficient is significantly positive for Germany, it is negative for the US. This implies that countries that trade a lot with Germany face on average more trade liberalization conditions. Specifically, an increase of German bilateral trade by one log point is correlated with an increase in the number of trade conditions by 126% on average ($\exp(0.818) - 1$). Accordingly, an increase of German bilateral trade by 50% would increase the number of trade liberalization condi-

Table 2.1: Baseline Regression OLS and Negative Binomial

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS				Negative Binomial			
Log GDPpc$_{t-1}$	-0.429 [0.694]	-0.303 [0.788]	-1.512 [0.192]	-1.338 [0.287]	0.169 [0.758]	0.148 [0.786]	-0.391 [0.455]	-0.080 [0.900]
Inflation$_{t-1}$	0.794 [0.511]	0.654 [0.587]	0.331 [0.761]	-0.075 [0.952]	0.633 [0.260]	0.652 [0.255]	0.705 [0.172]	0.680 [0.238]
Current Account$_{t-1}$	0.000 [0.986]	0.008 [0.763]	0.008 [0.754]	0.010 [0.709]	0.017 [0.175]	0.019 [0.149]	0.018 [0.154]	0.023* [0.090]
Trade Openness$_{t-1}$	-0.000 [1.000]	0.000 [0.998]	0.004 [0.643]	0.004 [0.636]	-0.001 [0.835]	-0.002 [0.733]	0.001 [0.843]	-0.001 [0.926]
RTA with USA	-0.119 [0.854]	0.277 [0.667]	0.243 [0.656]	0.103 [0.850]	-0.922** [0.034]	-0.831* [0.063]	-0.906** [0.029]	-0.952** [0.027]
RTA with Japan	0.664 [0.273]	0.873* [0.094]	0.940* [0.068]	0.714 [0.168]	0.320 [0.670]	0.570 [0.400]	0.580 [0.353]	0.598 [0.324]
RTA with EU	-0.082 [0.893]	-0.066 [0.915]	-0.364 [0.569]	-0.202 [0.763]	-0.499 [0.336]	-0.532 [0.304]	-0.529 [0.335]	-0.586 [0.319]
GATT/WTO	-0.544 [0.316]	-0.427 [0.434]	-0.333 [0.531]	-0.343 [0.542]	-0.085 [0.756]	0.061 [0.829]	-0.046 [0.863]	-0.067 [0.814]
Under IMF Program$_{t-1}$	-0.254 [0.314]	-0.228 [0.369]	-0.278 [0.265]	-0.233 [0.391]	-0.193 [0.176]	-0.144 [0.299]	-0.159 [0.270]	-0.147 [0.330]
Total No. of Conditions (without trade conditions)	0.007 [0.382]	0.008 [0.359]	0.008 [0.342]	0.009 [0.317]	0.010*** [0.001]	0.010*** [0.001]	0.010*** [0.001]	0.011*** [0.001]
Number of Prior Trade Conditions	-0.137*** [0.000]	-0.138*** [0.000]	-0.142*** [0.000]	-0.141*** [0.000]	-0.022** [0.029]	-0.024** [0.020]	-0.024** [0.012]	-0.026** [0.010]
Legislative Constraints$_{t-1}$		0.172** [0.047]	0.152* [0.055]	0.178** [0.041]		0.043 [0.333]	0.031 [0.469]	0.016 [0.713]
Election$_{t-1}$		0.449* [0.084]	0.415 [0.124]	0.440 [0.101]		0.158 [0.271]	0.167 [0.239]	0.182 [0.212]
Log Trade US$_{t-1}$			-1.112*** [0.003]	-1.103*** [0.004]			-0.566*** [0.004]	-0.571*** [0.004]
Log Trade Japan$_{t-1}$			-0.135 [0.603]	-0.183 [0.471]			0.267 [0.165]	0.245 [0.186]
Log Trade UK$_{t-1}$			-0.722** [0.025]	-0.627** [0.034]			-0.241 [0.172]	-0.248 [0.156]
Log Trade France$_{t-1}$			0.010 [0.976]	0.017 [0.956]			-0.223 [0.188]	-0.209 [0.221]
Log Trade Germany$_{t-1}$			1.974*** [0.000]	1.915*** [0.000]			0.818*** [0.001]	0.843*** [0.000]
UNGA Voting USA$_{t-1}$				1.612 [0.371]				0.356 [0.813]
UNGA Voting Japan$_{t-1}$				5.030 [0.428]				0.477 [0.855]
UNGA Voting UK$_{t-1}$				-4.284 [0.605]				3.241 [0.445]
UNGA Voting France$_{t-1}$				-4.474 [0.385]				-3.614 [0.142]
UNGA Voting Germany$_{t-1}$				0.985 [0.839]				1.001 [0.499]
UNSC				0.128 [0.693]				0.003 [0.984]
Constant	16.880* [0.075]	6.521 [0.287]	11.058* [0.061]	27.347** [0.021]	1.401 [0.684]	1.128 [0.742]	2.961 [0.352]	0.126 [0.977]
Observations	915	878	878	865	915	878	878	865
R^2	0.520	0.520	0.539	0.539				
McFadden R^2					0.121	0.117	0.123	0.121
BIC					2608	2552	2518	2487

Notes: Dependent variables: total number of trade conditions in project i. Standard errors are clustered at the country level. All estimations include a time trend, sector and country dummies. P-values are in brackets where *p<0.1 **p<0.05 ***p<0.01.

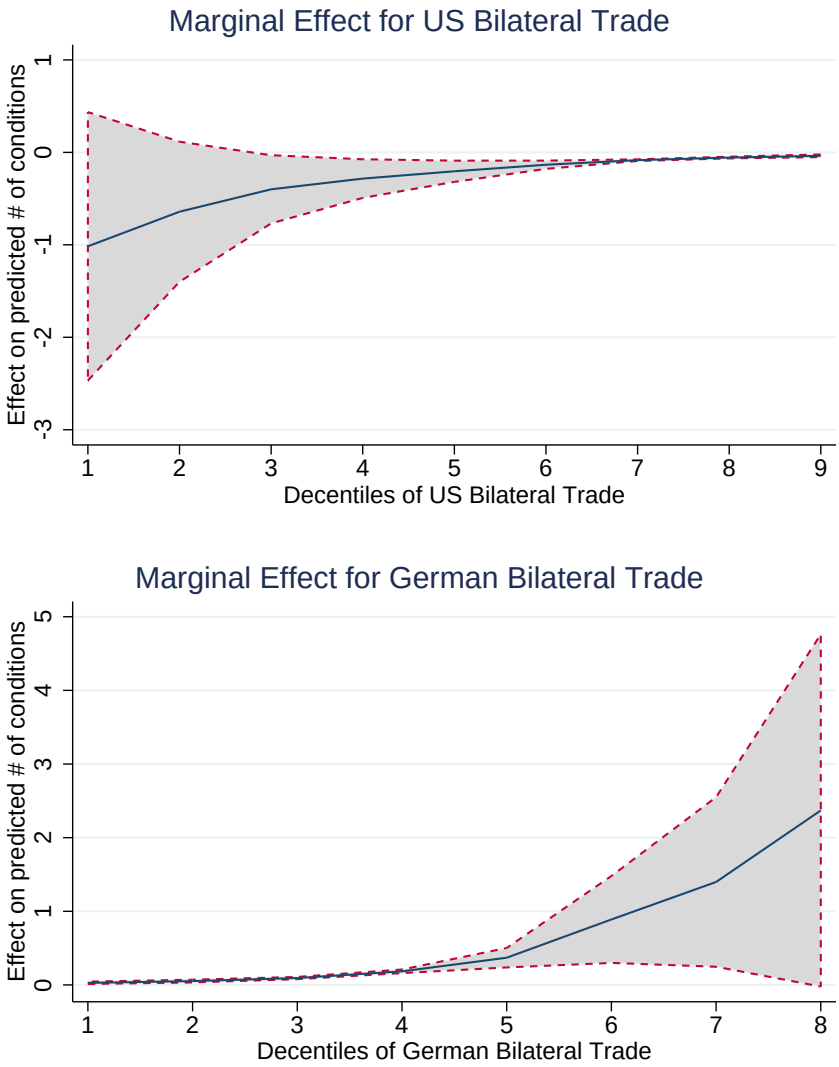
tions by one. This suggests a German trade intensification strategy. A look at the marginal effect of German trade on the number of conditions over the decentiles of German trade (figure 2.4) shows that the effect is most pronounced around the median where trade is already established, but can still be intensified. For the United States and the United Kingdom[20] on the other hand, the negative coefficient indicates that recipients who trade more with these countries face, on average, a smaller number of trade liberalization conditions attached to their loans. For the US, the effect of a one log point increase of trade on the number of trade conditions is -43%, i.e. an increase in trade by 50% would decrease the average number of liberalization conditions by 0.63. When analyzing the effect over the different trade decentiles of the US (figure 2.4), the marginal effect is not positive at the lower end of the trade distribution.[21] Thus, the negative effect does not reflect the intent to open up new markets, as one might have expected. Two interpretations are possible for the significantly negative coefficient in the medium to higher trade intensity area. First, it is possible that the need for further trade liberalization is lower as an already profound level of trade can be observed. However this interpretation seems to be weak as we control for the general level of trade openness. The second possible explanation is protection of the own trading routes and thus prevention of additional trade competition in the recipient country due to liberalization. To see whether this result can indeed be attributed to the bilateral relationship and is not driven by a similarity of trade flows with geo-strategic interests, we include UNGA voting behavior and a dummy for UNSC membership in the final specification of table 2.1. Our results are robust to the inclusion of these additional variables. Furthermore, geo-strategic interests do not seem to play a role for the extent of trade liberalization attached to a loan.

In the previous model, we have analyzed all conditions independently of their character

[20] In our preferred Negative Binomial specification, the coefficients for UK trade are not significantly different from zero at conventional levels. However, in the OLS, Poisson and PPML estimations they are.

[21] The pattern is similar for the UK, but not shown as the coefficient is not significant at conventional levels in the negative binomial regression.

Figure 2.4: Marginal Effects of German and US Bilateral Trade on Trade Conditions



Notes: Plots based on results (Table 1, column 7) from article. Solid lines show average marginal effects of US (German) bilateral trade on number of trade conditions over US (German) trade decentiles. Dashed lines indicate 90% confidence intervals.

(prior action or benchmark) and the financier (IBRD or IDA). Yet, loan agreements between a country and either IDA or IBRD might not be equally prone to being influenced by industrialized countries, first as stricter allocation rules apply to IDA projects which might also affect the freedom of conditionality design and second as IBRD countries might be of higher interest due to their higher economic importance compared to IDA countries. To account for this possible discrepancy, we interact our trade interest variables with an IBRD dummy. Similarly a difference between prior actions and benchmarks is likely as prior actions are binding conditions that in general have an influence on the disbursement of the loan. We expect a stronger effect with respect to prior actions compared to the softer benchmark conditions.

Table 2.2 shows the results for separating between these categories. With respect to the difference between IDA and IBRD (where we include blend lending[22]), the results support our hypotheses in general. Given that we find a significant effect for all donors except Japan, this underlines the assumption that a difference between IBRD and pure IDA lending exists. For the UK, France and Germany, there is only an effect of trade on the number of trade liberalization conditions observable if the lending is not provided by the IDA whereas for the United States, the effect is present only for IDA lending. In a second step, we divide the sample between prior actions and benchmark conditions (Table 2.2, columns 3 to 6). Though the former should be more attractive for donors to influence as their implementation is related to the loan disbursement, the coefficient for the United States differs only marginally between the two groups. For Germany, the difference is more pronounced as the effect of a log point change in trade on the number of trade conditions is 152% for prior actions, while it is 88% for benchmark conditions. In addition, when splitting the

[22]Blend countries are countries that are IDA eligible due to their low per capita income, but are to some extent creditworthy and therefore qualify for IBRD lending as well. Blend lending therefore consists of both lending categories, IBRD and IDA lending. We observe 34 cases of blend lending of which 19 have a higher share of IBRD lending, 7 a higher IDA lending share and 8 an equal share of IBRD and IDA lending. We therefore decided to attribute blend lending to IBRD lending. However our results are robust to excluding blend lending and to counting those projects with a higher share of IDA lending as IDA projects.

Table 2.2: Negative Binomial for IBRD Interaction, Prior Actions and Benchmarks Separately

	(1)	(2)	(3)	(4)	(5)	(6)
			Prior Action		Benchmark	
Log GDPpc$_{t-1}$	-0.323 [0.545]	0.021 [0.974]	-0.488 [0.419]	-0.298 [0.682]	-0.760 [0.406]	-0.148 [0.887]
Inflation$_{t-1}$	0.677 [0.178]	0.639 [0.246]	0.863 [0.109]	0.865 [0.139]	0.509 [0.504]	0.916 [0.267]
Current Account$_{t-1}$	0.015 [0.265]	0.020 [0.160]	0.032** [0.034]	0.036** [0.021]	0.003 [0.861]	0.007 [0.648]
Trade Openness$_{t-1}$	-0.000 [0.937]	-0.002 [0.696]	0.002 [0.757]	0.000 [0.952]	0.001 [0.859]	-0.001 [0.863]
RTA with USA	-1.082** [0.021]	-1.097** [0.020]	-0.700* [0.054]	-0.811*** [0.009]	-15.131*** [0.000]	-14.689*** [0.000]
RTA with Japan	0.409 [0.526]	0.418 [0.506]	0.682 [0.366]	0.646 [0.395]	0.708 [0.477]	0.848 [0.382]
RTA with EU	-0.488 [0.381]	-0.546 [0.350]	-1.014* [0.064]	-0.950 [0.104]	-0.208 [0.803]	-0.341 [0.703]
GATT/WTO	0.042 [0.884]	0.017 [0.954]	-0.162 [0.485]	-0.170 [0.488]	-0.225 [0.583]	-0.307 [0.475]
Under IMF Program$_{t-1}$	-0.120 [0.388]	-0.107 [0.473]	-0.001 [0.996]	-0.014 [0.943]	-0.429** [0.022]	-0.375* [0.068]
Total No. of Conditions (without trade conditions)	0.010*** [0.002]	0.011*** [0.001]	0.002 [0.593]	0.002 [0.523]	0.020*** [0.000]	0.021*** [0.000]
Number of Prior Trade Conditions	-0.025*** [0.010]	-0.027*** [0.009]	-0.005 [0.684]	-0.007 [0.531]	-0.052*** [0.000]	-0.052*** [0.000]
Legislative Constraints$_{t-1}$	0.030 [0.462]	0.014 [0.744]	-0.057 [0.224]	-0.065 [0.195]	0.013 [0.841]	0.005 [0.933]
Election$_{t-1}$	0.169 [0.222]	0.183 [0.196]	0.293 [0.100]	0.300* [0.088]	0.107 [0.572]	0.167 [0.390]
Log Trade US$_{t-1}$	-0.515** [0.013]	-0.503** [0.016]	-0.612** [0.020]	-0.569** [0.025]	-0.511** [0.024]	-0.532** [0.021]
Log Trade Japan$_{t-1}$	0.153 [0.504]	0.108 [0.622]	0.441** [0.027]	0.418** [0.028]	0.105 [0.661]	0.074 [0.749]
Log Trade UK$_{t-1}$	0.022 [0.929]	0.026 [0.915]	-0.610*** [0.006]	-0.615*** [0.002]	0.236 [0.305]	0.255 [0.252]
Log Trade France$_{t-1}$	-0.076 [0.651]	-0.067 [0.704]	-0.092 [0.702]	-0.108 [0.658]	-0.230 [0.321]	-0.269 [0.237]
Log Trade Germany$_{t-1}$	0.485* [0.072]	0.507* [0.067]	0.925*** [0.000]	0.921*** [0.000]	0.632* [0.074]	0.704* [0.051]
IBRD	-1.095 [0.838]	-0.935 [0.863]				
Log Trade US$_{t-1}$ * IBRD	0.076 [0.809]	-0.024 [0.938]				
Log Trade Japan$_{t-1}$ *IBRD	0.130 [0.659]	0.191 [0.504]				
Log Trade UK$_{t-1}$ * IBRD	-0.547* [0.085]	-0.544* [0.092]				
Log Trade France$_{t-1}$ * IBRD	-0.407** [0.032]	-0.386* [0.053]				
Log Trade Germany$_{t-1}$ * IBRD	0.804* [0.076]	0.817* [0.074]				
UNGA Voting USA$_{t-1}$		0.614 [0.669]		1.853 [0.271]		-1.771 [0.353]
UNGA Voting Japan$_{t-1}$		0.625 [0.812]		4.727* [0.100]		-1.356 [0.686]
UNGA Voting UK$_{t-1}$		2.949 [0.498]		-7.288 [0.131]		12.025** [0.039]
UNGA Voting France$_{t-1}$		-3.509 [0.154]		2.166 [0.399]		-7.541* [0.055]
UNGA Voting Germany$_{t-1}$		0.954 [0.490]		2.462 [0.125]		-1.903 [0.161]
UNSC		-0.024 [0.894]		0.109 [0.568]		-0.113 [0.700]
Constant	2.223 [0.498]	-0.922 [0.832]	4.273 [0.219]	1.356 [0.787]	0.865 [0.875]	-3.312 [0.612]
Observations	878	865	878	865	878	865
McFadden R^2	0.123	0.120	0.154	0.152	0.0882	0.0858
BIC	2484	2447	1933	1855	1536	1521

Notes: Dependent variables: total number of trade conditions (columns 1 and 2), total number of trade prior actions (columns 3 and 4) and total number of trade benchmark conditions (columns 5 and 6) in project i. Standard errors are clustered at the country level. All estimations include a time trend, sector and country dummies. P-values are in brackets where *p<0.1 **p<0.05 ***p<0.01.

Table 2.3: Marginal Effects of Bilateral Trade for IBRD and Non-IBRD Lending

		(1)	(2)
Log Trade US_{t-1}	IBRD=0	-0.068** [0.043]	-0.070** [0.044]
	IBRD=1	-0.097 [0.266]	-0.125 [0.201]
Log Trade $Japan_{t-1}$	IBRD=0	0.020 [0.506]	0.015 [0.623]
	IBRD=1	0.062 [0.349]	0.071 [0.314]
Log Trade UK_{t-1}	IBRD=0	0.003 [0.929]	0.004 [0.915]
	IBRD=1	-0.116** [0.048]	-0.123* [0.054]
Log Trade $France_{t-1}$	IBRD=0	-0.010 [0.656]	-0.009 [0.708]
	IBRD=1	-0.107** [0.050]	-0.107* [0.067]
Log Trade $Germany_{t-1}$	IBRD=0	0.064 [0.118]	0.071 [0.117]
	IBRD=1	0.284*** [0.001]	0.314*** [0.001]

Notes: Marginal effects for the interactions derived from table 2, columns 1 and 2. P-values are in brackets where *p<0.1 **p<0.05 ***p<0.01.

sample into subgroups, some of the UNGA voting controls become statistically significant. Interestingly, political alliances seem to matter more for the less binding benchmark conditions. However, the change in significance of the UNGA variables does not affect our trade variables.

Given that our previous results suggest conflicting strategies among the G5 countries, the question arises how these conflicting strategies affect the design of conditionality when interests are mixed. E.g., when both the US and Germany have a high trade interest in a given recipient country, which country is able to pursue its strategy? To answer this question, we use two different approaches. First, we follow Copelovitch (2010) and evaluate whether heterogeneity among the G5's commercial interests has an effect on the conditionality design. To do so, we construct two additional measures. The first one reflects the G5's combined interest in a country, measured as total bilateral trade of all five countries with the recipient. The second one is a ratio that reflects the heterogeneity of trade interests among the G5 countries towards each recipient country. It is constructed in the following way: the numerator contains the combined variance of G5 trade, i.e. the

sum of the squared differences between each country's trade value and the G5 trade mean. The denominator is just the mean of G5 trade. In addition to these two measures, the share of each G5 country's trade with the recipient relative to the G5's total trade with the country is included. Second, we interact US and German trade interests to evaluate their impact exclusively.

Table 2.4 presents the results for the heterogeneity analysis. Model 1 includes G5 trade intensity and heterogeneity. To clarify the interpretation, note that if the heterogeneity measure takes on a low value, all G5 countries have an equally strong (weak) trade interest in a given recipient country. Our previous results would suggest that in this case, the G5 countries possibly pursue conflicting strategies. If the heterogeneity measure takes on a high value, some of the G5 countries have a much stronger interest in the recipient country than the others. The results from table 2.4 show that while the intensity of combined G5 trade interest does not have a significant influence on the dependent variable, stronger heterogeneity among G5 interests leads to a lower number of trade conditions. This can be interpreted in two ways. From the previous regressions, we conclude that loans for countries the US have a stronger interest in include a lower number of trade conditions. Thus, it is possible that, on average, the US manage to achieve their preferred outcome if interests are heterogeneous. On the other hand, this negative relation between heterogeneous interests and the number of trade conditions can be interpreted such that the "targeted" number of trade conditions is low and thus, if trade interests in a given recipient country among the G5 are not homogeneous, this target level prevails. This interpretation would be in line with the previous finding (a lower number of trade conditions in case of a stronger interest of the United States). As a large share of the World Bank staff consists of US citizens, we might conclude that what we observe as "objective" behavior is in fact the special interest of the US pushed through by the staff.

In model 2, we interact G5 interest intensity with interest heterogeneity to analyze whether

Table 2.4: Heterogeneity of G5 Interests

	(1)	(2)	(3)	(4)
Log GDPpc$_{t-1}$	-0.533 [0.362]	-0.542 [0.351]	-0.677 [0.247]	-0.734 [0.265]
Inflation$_{t-1}$	0.696 [0.196]	0.664 [0.224]	0.727 [0.171]	0.703 [0.169]
Current Account$_{t-1}$	0.020 [0.117]	0.021 [0.115]	0.023* [0.071]	0.022* [0.099]
Trade Openness$_{t-1}$	-0.001 [0.914]	-0.000 [0.926]	-0.001 [0.841]	-0.000 [0.994]
RTA with USA	-0.832** [0.046]	-0.778* [0.075]	-1.038** [0.024]	-0.920** [0.033]
RTA with Japan	0.602 [0.347]	0.618 [0.350]	0.448 [0.467]	0.593 [0.338]
RTA with EU	-0.573 [0.279]	-0.572 [0.284]	-0.608 [0.245]	-0.651 [0.242]
GATT/WTO	0.027 [0.919]	0.037 [0.892]	0.002 [0.993]	-0.014 [0.959]
Under IMF Program$_{t-1}$	-0.134 [0.314]	-0.131 [0.331]	-0.160 [0.246]	-0.140 [0.314]
Total No. of Conditions	0.010*** [0.002]	0.010*** [0.002]	0.010*** [0.002]	0.010*** [0.002]
Number of Prior Trade Conditions	-0.024** [0.015]	-0.024** [0.015]	-0.025*** [0.005]	-0.025*** [0.008]
Legislative Constraints$_{t-1}$	0.007 [0.867]	0.005 [0.904]	0.029 [0.508]	0.034 [0.429]
Election$_{t-1}$	0.167 [0.246]	0.164 [0.255]	0.161 [0.253]	0.177 [0.207]
Share Trade USA/G5$_{t-1}$	-1.251 [0.441]	-1.211 [0.466]		
Share Trade Japan/G5$_{t-1}$	0.993 [0.676]	1.057 [0.668]		
Share Trade UK/G5$_{t-1}$	-1.748 [0.424]	-1.692 [0.451]		
Share Trade France/G5$_{t-1}$	1.126 [0.547]	1.142 [0.547]		
Share Trade Germany/G5$_{t-1}$	3.290* [0.077]	3.304* [0.079]		
G5 Trade Heterogeneity$_{t-1}$	-1.112** [0.029]	0.412 [0.943]	-0.974 [0.846]	
Log Trade G5$_{t-1}$	0.182 [0.425]	0.239 [0.448]		
Log Trade G5$_{t-1}$ * G5 Trade Heterogeneityt-1		-0.073 [0.791]		
Log Trade US$_{t-1}$			-0.663* [0.065]	-0.775*** [0.002]
Log Trade US$_{t-1}$ * G5 Trade Heterogeneityt-1			0.198 [0.514]	
Log Trade Japan$_{t-1}$			0.792** [0.026]	0.269 [0.162]
Log Trade Japan$_{t-1}$ * G5 Trade Heterogeneityt-1			-0.513* [0.091]	
Log Trade UK$_{t-1}$			0.143 [0.731]	-0.238 [0.187]
Log Trade UK$_{t-1}$ * G5 Trade Heterogeneityt-1			-0.377 [0.390]	
Log Trade France$_{t-1}$			-0.266 [0.369]	
Log Trade France$_{t-1}$ * G5 Trade Heterogeneityt-1			0.075 [0.791]	
Log Trade Germany$_{t-1}$			0.345 [0.444]	0.591** [0.020]
Log Trade Germany$_{t-1}$ * G5 Trade Heterogeneityt-1			0.582 [0.234]	
Log Trade Germany$_{t-1}$ * G5 TradeUSA$_{t-1}$				0.011 [0.360]
Constant	1.766 [0.714]	0.566 [0.934]	-0.201 [0.973]	5.145 [0.196]
Observations	877	877	877	878
McFadden R^2	0.121	0.120	0.123	0.123
BIC	2438	2446	2448	2464

Notes: Dependent variables: total number of trade conditions in project i. Standard errors are clustered at the country level. All estimations include a time trend, sector and country dummies. P-values are in brackets where *p<0.1 **p<0.05 ***p<0.01.

heterogeneity is not equally important over the range of G5 interests. Since we cannot observe a statistically significant difference, we conclude that the negative effect of G5 heterogeneity on the number of trade conditions does not depend on the intensity of interests. Since we observed a conflicting relationship between US and German strategies, we also interact each G5 state's bilateral trade with the heterogeneity variable in model 3. In doing so, we may be able to determine whose strategy dominates. Surprisingly, both the US and the German trade strategy hold when interacting with G5 heterogeneity. When looking at the marginal effects at different levels of heterogeneity (not shown here), one can see that both can pursue their strategies only at a medium level of heterogeneity. Yet the German effect is stronger and statistically significant over a broader range of heterogeneity. However, for both countries the interaction is not significant at a low level of interest heterogeneity. This implies that for those recipient countries in which both are interested, neither the US nor Germany succeed in pursuing their strategy. As the assumed strategies of the US and Germany are conflicting, it seems logical that if both have an interest in a certain country they cannot both be successful in achieving their aim at the same time. Yet, if a certain level of heterogeneity exists, the data show that both are successful in pursuing their strategies. Since heterogeneity indicates that not all countries have the same trade interest in a recipient, it is not surprising that it becomes easier to fulfill one's own aim. Heterogeneous interests between the G5 thus seem to open up some leeway to pursue donor-specific trade strategies. Our results differ from those of Copelovitch (2010) who finds that G5 interest heterogeneity does not significantly affect the number of conditions attached to an IMF loan, except when overall G5 interests in a country are low. His interpretation is more in line with ours when considering countries where both, the US and Germany have a high interest in. Still, compared to his results for the IMF, the G5 countries seem to have significantly more influence over conditionality with respect to World Bank loans.

Table 2.5: Marginal Effect German and US Trade Interaction

Log German $Trade_{t-1}$	Decentiles of Log US $Trade_{t-1}$	
	1	0.862 [0.199]
	2	0.558 [0.106]
	3	0.360** [0.032]
	4	0.253*** [0.006]
	5	0.179*** [0.001]
	6	0.113*** [0.001]
	7	0.075*** [0.008]
	8	0.052** [0.041]
	9	0.035 [0.108]
Log US $Trade_{t-1}$	Decentiles of Log German $Trade_{t-1}$	
	1	-0.015 [0.133]
	2	-0.024* [0.074]
	3	-0.040** [0.030]
	4	-0.066** [0.012]
	5	-0.109** [0.011]
	6	-0.227** [0.040]
	7	-0.321* [0.073]
	8	-0.465 [0.121]
	9	-0.867 [0.215]

Notes: Marginal effects of German trade (US trade) on the number of trade conditions at different decentiles of US trade (German trade). Coefficients are based on the results of Table 4, column 4. P-values are in brackets where *p<0.1 **p<0.05 ***p<0.01.

With Germany and the US being our two main cases of interest, we interact their trade in column 4. The marginal effects at different decentiles of trade of the respective other G5 member (table 2.5) show that the effect of Germany's trade interest is most pronounced in the lower part of the US trade distribution. As our results suggested in the beginning, the US rather pursues a trade protection than a trade creation strategy. Therefore, it apparently has little interest in influencing conditions regarding countries it does not trade extensively with. Hence, it is easier for Germany to follow its strategy when US trade intensity is low. For the United States, it is the other way around. It is more successful in pursuing its strategy when German trade intensity is high. This result is in line with our findings in the baseline regression where we show that Germany follows a trade creation and promotion strategy and therefore is less interested in countries it already trades very intensely with. Consequently, the leeway for the US to succeed in its strategy is higher at the upper end of Germany's trade intensity distribution. The results so far show a consistent pattern for

Germany's and the United States' interests reflected in World Bank conditionality.[23] We test for the robustness of our results in the next section.

Robustness and Sensitivity Analysis

As described in section 2.6, the number of trade conditions declined sharply since the mid-1990s. This implies that the share of zeros in our observations increases dramatically for the later years. To ensure that our results are not driven by this trend, we restrict the sample to projects approved before 2001. Another reason to split the sample in this way is related to the nature of the included trade conditions. In the 1980s and 1990s, trade liberalization conditions were mostly about limiting or abolishing quantitative restrictions and reducing tariffs. In contrast, trade conditions were increasingly targeted at implementing trade facilitation measures in the 2000s. This reduces our sample to 419 observations without any further distinctions, and to 183 IDA and 236 IBRD projects respectively when additionally differentiating by the source of financing. As table 2.6 shows, our results are robust to this restriction of our dataset. Furthermore, the results hold for the interaction with the IBRD dummy. Only with respect to IDA lending, the overall results are not confirmed. Also, distinguishing between prior actions and benchmarks does not change our findings in the reduced sample. Additionally, we re-run our model separately for each region as the interests of the G5 might differ between regions (table 2.7).[24] For Germany, the results hold with respect to each different region, whereas concerning the US, we only find our results confirmed for Latin America and the Caribbean and East Asia

[23] While we are able to establish a relationship in terms of overall interests in line with the G5 country strategies, it would have been very interesting to delve further into the "suspicious" conditions, such as countries being obliged to reduce or abolish trade barriers for sectors/products of specific interest to G5 countries. However, due to a lack of specificity in the conditions' description and a lack of adequate trade data, we were confined to an analysis on a more general level.

[24] Middle East and North Africa as well as South Asia have too few observations to run a separate regression. The regions analyzed separately are: Latin America and the Caribbean, Sub-Saharan Africa, East Asia and Pacific as well as Europe and Central Asia.

and Pacific. It is well-known that Latin America is the most important trading region for the US. Therefore, it is not surprising that we find the strongest effect here.

In addition, we test the sensitivity of our analysis using formal alliances as an alternative measure for geo-strategic interests. We extracted data on formal alliances from the Correlates of War Dataset (COW, 2013; Gibler, 2009).[25] Firstly, including formal alliances does not change the overall results and secondly, we do not find a significant effect of formal alliances on the number of trade conditions. We also test for the robustness of our results by including economic sanctions on the recipient by the G5 countries (Hufbauer et al., 2008). The results for the US and Germany are robust to both additional tests. The sanctions themselves show a negative and significant impact, but only when the dataset is confined to the pre-2000 observations.[26,27]

With respect to robustness checks, we address some issues that might influence our results. Firstly, we were concerned that while the negative binomial estimator performed quite well in light of the many zeros in the dependent variable, the influence of these zeros may still not be sufficiently controlled for. Therefore, we re-estimate our specifications using the Poisson Pseudo Maximum Likelihood (PPML) method (Santos Silva and Tenreyro, 2006). The PPML estimator in the version of Santos Silva and Tenreyro (2006) has been developed in the context of gravity estimations. Firstly, it performs well in the presence of a large number of zeroes in the dependent variable. Secondly, it is also robust to heteroskedasticity processes in the data.[28] Our main results are robust to changing the estimation method

[25] This measure has also been used by Berger et al. (2013) who analyzed the effect of CIA interventions on US trade. While we do not see a relation between CIA interventions and trade conditions as it is a very special measure, formal alliances are more general and reflect broad geo-strategic interests.

[26] Export or import sanctions may be interpreted as extreme forms of political trade barriers. Consequently, it seems logical that countries against whom sanctions are installed are not pushed towards liberalization through a different channel.

[27] In addition, we also included governments' political orientation in our model, assuming that left-wing governments would be more reluctant to push other countries towards trade liberalization. However, we do not find a significant effect in any specification.

[28] For the PPML estimator to be consistent, only the conditional mean has to be correctly specified. Since it does not make any specific assumptions about dispersion, it is not affected by a violation of equidispersion.

Table 2.6: Sample Limited to Projects Approved Between 1980 - 2000

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Prior Action		Benchmark	
Log GDPpc$_{t-1}$	-0.192 [0.817]	-0.372 [0.678]	-0.009 [0.993]	0.230 [0.797]	0.325 [0.752]	-0.929 [0.430]	-0.110 [0.945]
Inflation$_{t-1}$	1.579** [0.013]	1.598*** [0.009]	1.559** [0.018]	1.720** [0.011]	1.434* [0.061]	0.986 [0.243]	1.304 [0.157]
Current Account$_{t-1}$	0.006 [0.730]	-0.001 [0.937]	-0.002 [0.910]	0.013 [0.528]	0.012 [0.534]	-0.007 [0.768]	0.000 [1.000]
Trade Openness$_{t-1}$	-0.007 [0.284]	-0.007 [0.281]	-0.009 [0.199]	-0.008 [0.250]	-0.007 [0.325]	-0.001 [0.915]	-0.004 [0.742]
RTA with USA	-18.227*** [0.000]	-16.982*** [0.000]	-17.315*** [0.000]	-16.482*** [0.000]	-16.837*** [0.000]	-15.891*** [0.000]	-15.552*** [0.000]
RTA with EU	-1.103 [0.140]	-1.062 [0.178]	-0.918 [0.241]	-1.602 [0.187]	-1.406 [0.236]	-0.386 [0.618]	-0.470 [0.507]
GATT/WTO	-0.027 [0.911]	-0.062 [0.809]	-0.047 [0.861]	-0.003 [0.989]	0.080 [0.732]	-0.393 [0.399]	-0.536 [0.271]
Under IMF Program$_{t-1}$	-0.133 [0.393]	-0.077 [0.627]	0.008 [0.962]	0.000 [0.999]	0.133 [0.491]	-0.353* [0.074]	-0.380* [0.082]
Total No. of Conditions	0.003 [0.345]	0.003 [0.398]	0.003 [0.414]	0.000 [0.961]	0.000 [0.973]	0.011** [0.029]	0.011** [0.048]
Number of Prior Trade Conditions	-0.015 [0.270]	-0.014 [0.291]	-0.016 [0.202]	-0.004 [0.800]	-0.008 [0.586]	-0.039** [0.012]	-0.038** [0.017]
Legislative Constraints$_{t-1}$	-0.000 [0.993]	-0.008 [0.870]	-0.010 [0.855]	-0.075 [0.182]	-0.048 [0.416]	-0.007 [0.931]	-0.035 [0.671]
Election$_{t-1}$	0.232 [0.192]	0.237 [0.188]	0.227 [0.211]	0.237 [0.209]	0.224 [0.224]	0.197 [0.393]	0.254 [0.294]
Log Trade US$_{t-1}$	-0.635*** [0.003]	-0.578** [0.012]	-0.624*** [0.008]	-0.566* [0.059]	-0.630** [0.023]	-0.634** [0.018]	-0.674** [0.025]
Log Trade Japan$_{t-1}$	0.012 [0.963]	-0.118 [0.742]	-0.189 [0.609]	0.025 [0.929]	0.015 [0.960]	-0.093 [0.807]	-0.162 [0.681]
Log Trade UK$_{t-1}$	-0.380** [0.013]	0.046 [0.877]	0.092 [0.767]	-0.547*** [0.007]	-0.448*** [0.007]	0.003 [0.991]	-0.026 [0.909]
Log Trade France$_{t-1}$	-0.422* [0.078]	-0.340 [0.133]	-0.276 [0.208]	-0.227 [0.436]	-0.135 [0.606]	-0.564 [0.117]	-0.598 [0.117]
Log Trade Germany$_{t-1}$	1.044*** [0.001]	0.660* [0.073]	0.633* [0.100]	1.209*** [0.000]	1.110*** [0.001]	0.669 [0.116]	0.634 [0.168]
IBRD		-1.426 [0.862]	-1.983 [0.809]				
Log Trade US$_{t-1}$ * IBRD		0.034 [0.922]	-0.022 [0.951]				
Log Trade Japan$_{t-1}$ *IBRD		0.246 [0.583]	0.357 [0.435]				
Log Trade UK$_{t-1}$ * IBRD		-0.656* [0.067]	-0.620* [0.091]				
Log Trade France$_{t-1}$ * IBRD		-0.403 [0.100]	-0.441* [0.091]				
Log Trade Germany$_{t-1}$ * IBRD		0.879 [0.144]	0.860 [0.162]				
UNGA Voting USA$_{t-1}$			-0.515 [0.782]		-0.750 [0.705]		-0.092 [0.972]
UNGA Voting Japan$_{t-1}$			1.932 [0.549]		0.989 [0.768]		5.063 [0.214]
UNGA Voting UK$_{t-1}$			-1.221 [0.779]		-7.781 [0.108]		7.590 [0.151]
UNGA Voting France$_{t-1}$			-2.359 [0.345]		0.854 [0.758]		-6.192 [0.141]
UNGA Voting Germany$_{t-1}$			0.863 [0.423]		1.789 [0.179]		-1.518 [0.159]
UNSC			0.021 [0.931]		0.105 [0.622]		0.131 [0.728]
Constant	10.365** [0.023]	9.934 [0.111]	8.520 [0.245]	2.401 [0.674]	3.285 [0.609]	18.691** [0.011]	14.741* [0.096]
Observations	419	419	408	419	408	419	408
McFadden R^2	0.0702	0.0695	0.0628	0.0836	0.0799	0.0367	0.0290
BIC	1667	1669	1647	1394	1360	1046	1039

Notes: Dependent variables: total number of trade conditions (columns 1 - 3), total number of trade prior actions (columns 4 and 5) and total number of trade benchmark conditions (columns 6 and 7) in project i. The sample is restricted to observations before the year 2001. Standard errors are clustered at the country level. All estimations include a time trend, sector and country dummies. P-values are in brackets where *p<0.1 **p<0.05 ***p<0.01.

Table 2.7: Projects by Region

	(1) Latin America & Caribbean	(2) Sub-Sahara Africa	(3) Europe & Central Asia	(4) East Asia & Pacific
Log GDPpc$_{t-1}$	0.283 [0.910]	-1.012 [0.198]	0.325 [0.880]	-0.009 [0.997]
Inflation$_{t-1}$	-0.714 [0.531]	1.436 [0.160]	1.574 [0.320]	0.193 [0.955]
Current Account$_{t-1}$	0.091*** [0.001]	0.028** [0.031]	-0.029 [0.450]	0.010 [0.797]
Trade Openness$_{t-1}$	0.000 [0.978]	-0.008 [0.287]	0.002 [0.949]	0.004 [0.875]
RTA with USA	-1.786** [0.030]			
RTA with Japan	14.557*** [0.000]			0.755 [0.323]
RTA with EU	-13.376*** [0.000]	-22.325*** [0.000]	-2.690*** [0.002]	
GATT/WTO	0.599 [0.161]	0.013 [0.965]	0.895 [0.197]	-0.941** [0.037]
Under IMF Program$_{t-1}$	-0.314 [0.397]	-0.213 [0.246]	-0.270 [0.517]	0.568 [0.483]
Total No. of Conditions	-0.004 [0.608]	0.016*** [0.000]	0.012* [0.068]	0.000 [0.985]
Number of Prior Trade Conditions	0.007 [0.672]	-0.034*** [0.000]	-0.176* [0.060]	-0.013 [0.623]
Legislative Constraints$_{t-1}$	-0.082 [0.523]	0.009 [0.877]	-0.210* [0.089]	-0.221 [0.729]
Election$_{t-1}$	0.978*** [0.010]	-0.114 [0.493]	0.958** [0.018]	0.121 [0.758]
Log Trade US$_{t-1}$	-1.681* [0.060]	-0.373 [0.136]	0.549 [0.444]	-1.210** [0.013]
Log Trade Japan$_{t-1}$	0.257 [0.614]	0.237 [0.240]	-0.547** [0.022]	-0.235 [0.682]
Log Trade UK$_{t-1}$	-0.725*** [0.003]	-0.655*** [0.000]	0.108 [0.719]	0.185 [0.886]
Log Trade France$_{t-1}$	-0.308 [0.550]	0.305** [0.038]	-0.741 [0.164]	-1.103* [0.067]
Log Trade Germany$_{t-1}$	2.577*** [0.000]	0.532** [0.012]	1.205* [0.071]	2.325** [0.016]
Constant	1.054 [0.963]	7.800* [0.093]	-15.178 [0.302]	5.638 [0.666]
Observations	240	273	156	80
McFadden R^2	0.172	0.0952	0.0984	0.0384
BIC	572.2	884.9	306.2	240.8

Notes: Dependent variables: total number of trade conditions in project i. Samples are restricted by region of the recipient: Latin America & Caribbean (column 1), Sub-Sahara Africa (column 2), Europe & Central Asia (column 3), East Asia & Pacific (column 4). Standard errors are clustered at the country level. All estimations include a time trend, sector and country dummies. P-values are in brackets where *p<0.1 **p<0.05 ***p<0.01.

to PPML. We find the same sign and significance as well as similar sizes of coefficients for the US and Germany.

We address three further issues, multicollinearity, outliers, and the overall development of trade conditionality. Naturally, there is correlation between the trade flows of the different G5 countries with the recipient countries, leaving some concern about whether this affects the identification of coefficients in extreme cases.[29] To address these concerns, we exclude the upper 30% (and 40% respectively) of the German trade distribution and re-estimate all specifications. For the US, we exclude the lower 30% (and 40% respectively) of its trade distribution.[30] In doing so, the correlation between trade flows of the G5 countries drops substantially, most notably between German and US trade flows. Still, our main results remain unchanged. The size of the coefficients varies to some degree, but qualitatively the results hold, including the margins over the different trade decentiles. In addition, we were also concerned with possible outliers, especially at high numbers of trade conditions. Therefore, we dropped the upper 10% and 20% of the trade conditions distribution, respectively. The overall coefficients for German trade remain positive and significant, while the coefficients for US trade are negative, but insignificant, now. However, when looking at the marginal effects over the decentiles of the US trade distribution, we again find the results of our main specifications confirmed. With respect to the overall development of trade conditionality[31], we test the robustness of our results by further including quadratic and cubic trends. This procedure also leaves our main results unaffected.[32]

[29] Correlation of the G5 trade flows is between 0.7 and 0.8.
[30] This procedure implicitly yields an additional check for the overall robustness of our results, since we exclude the parts of the US and German trade distributions for which our results are strongest.
[31] See figure 2.2.
[32] The details for all results described in this section are available from the authors upon request.

2.7 Conclusion

In order to alleviate poverty and foster economic and social development, the ability of international organizations to function as impartial providers of aid is vital to limiting the strategic behavior that has been found to accompany bilateral aid relationships. As the main institutions to turn to in situations of need and economic turmoil, the World Bank and the IMF both use conditionality attached to loans and projects to streamline the use of the provided funds to the intended means. Yet, numerous studies suggest that we can observe strategic behavior of the most important shareholders within these organizations. The number of conditions attached to an agreement has been found to depend on various factors that reflect a major shareholder's behavior, e.g., measures of geopolitical interests.

In this chapter, we take the analysis one step further, exploiting a newly available dataset which features the conditions attached to World Bank development policy loans approved during the last decades. Specifically, we focus on trade liberalization conditions. On the one hand, developing countries' economies typically depend on trade in a few selected products, while restrictions are seen as helpful in developing sectors where their potential competitiveness is high. On the other hand, the major industrialized countries also rely on trade extensively to sustain economic growth, rendering liberalized markets more desirable. We analyze the trade interests of the five main shareholders of the World Bank and find different and robust patterns for Germany and the United States. While trading partners of Germany on average face a significantly higher number of trade conditions attached to their loans, those of the United States have a lower number of trade conditions included in their agreements.

For Germany, we interpret this result as a trade intensification strategy. The effect is most pronounced close to the median of trade, which is the area where trade has already been established, but can still be intensified. Trade liberalization could be one instrument to

achieve this objective. For the United States, we conclude that their behavior reflects a trade protection strategy. Those countries the US trades intensively with should not further liberalize their markets to maintain entry barriers for competitors to US firms. Interestingly, we find a stronger effect for prior actions which are binding conditions that influence the loan disbursement decision. The results confirm our expectation that it is more beneficial to influence this kind of conditions as they are more likely to be implemented. Furthermore, our results are also in line with the general hypothesis that IDA lending is less prone to be exploited strategically.

Summing up, our estimations show that in addition to the probability of a loan being issued and the amount of money the loan contains, major actors within the multilateral aid agencies also influence the design of lending agreements. As conditionality is supposed to ensure necessary reforms to improve the economic performance of the recipient country, strategic influence by the main shareholders undermines this aim. Furthermore, recipient countries might question the World Bank's advice and its legitimacy when commercial interests affect conditionality. This might, for example, lead recipient countries to turn to other sources for development aid. Within the new donor landscape, there are countries such as China providing unconditional loans or loans that are tied to conditions that suit the recipient countries better more readily. Our finding thus contributes to the discussion on enhancing transparency of decisions by the World Bank's Executive Board and on the distribution of power within the Bank.

2.A Appendix

Table A1: Variables and Data Sources

Variable	Description	Source
Openness	Sum of imports and exports as share of GDP.	World Development Indicators, World Bank (2012c)
GDP p.c.	GDP per capita in constant 2000 USD.	World Development Indicators, World Bank (2012c)
Inflation	Inflation as annual % increase in consumer prices (CPI), transformed in the following: (CPI/100)/(1+(CPI/100))	World Development Indicators, World Bank (2012c)
Current Account	The sum of net exports of goods, services, net income, and net current transfers as share of GDP.	World Development Indicators, World Bank (2012c)
Under IMF Program	Dummy coded 1 if country is under IMF program.	Dreher (2006); IMF annual reports
GATT/WTO Dummy	Coded as 1 beginning the year of joining the GATT/WTO, 0 otherwise.	WTO (2013)
RTA Dummy	Coded bilaterally for agreement partnering the USA, Japan and the EU. Coded as 1 if a regional trade agreement is in place and 0 otherwise.	WTO (2013)
Total Number of Conditions	Number of conditions in project *i* excluding trade conditions.	Development Action Database, World Bank (2012b)
Total Number of Trade Conditions	Number of conditions in project *i* grouped under "Trade and Integration" that include trade specific conditions.	Development Action Database, World Bank (2012b)
Number of Prior Trade Conditions	Sum of trade conditions in projects of country i until t-1.	Development Action Database, World Bank (2012b)
Legislative Constraints	Measure for political competitiveness in the legislature, ranges from 1 (no legislature) to 7 (largest party has less than 75% of seats).	Database of Political Institutions, Beck et al. (2001)
Legislative Elections	Dummy coded 1 in years of legislative elections.	Database of Political Institutions, Beck et al. (2001)
Bilateral Trade	Log of total trade of donor *i* with recipient *j*	World Integrated Trade System, World Bank (2013)
UNGA voting	Share of recipient *i* voting in line with country *j* in the UN General Assembly.	Dreher and Sturm (2012)
UNSC	Dummy for being temporary member on the UN Security Council.	Dreher *et al.* (2009b); www.un.org

Table A2: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Dependent Variables					
Trade Conditions	915	2.07	4.20	0	35
Trade Conditions (Prior Actions)	915	1.30	3.07	0	31
Trade Conditions (Benchmarks)	915	0.76	1.97	0	25
General Controls					
GDPpc	915	1853.08	1982.06	102.20	10491.08
Inflation	915	0.12	0.15	-0.09	0.99
Current Account	915	-4.47	6.07	-42.05	14.89
Under IMF Program	915	0.30	0.46	0	1
Total Conditions in Project	915	32.37	24.82	1	190
Trade Openness					
Trade Openness	915	64.86	34.60	6.32	256.36
RTA with USA	915	0.06	0.24	0	1
RTA with Japan	915	0.03	0.18	0	1
RTA with EU	915	0.13	0.34	0	1
GATT/WTO	915	0.83	0.38	0	1
Sum of Prior Trade Conditions	915	24.09	22.04	0	92
Recipient Interest					
Legislative Constraints	878	6.17	1.58	1	7
Legislative Election	878	0.22	0.41	0	1
Commercial Interest					
Trade with US	908	11,700,000,000	41,000,000,000	0	316,000,000,000
Trade with Japan	908	2,500,000,000	6,230,000,000	0	56,200,000,000
Trade with UK	908	1,090,000,000	2,010,000,000	0	14,000,000,000
Trade with France	908	1,440,000,000	2,410,000,000	0	17,600,000,000
Trade with Germany	908	2,890,000,000	7,010,000,000	0	87,400,000,000
Geo-Strategc Interest					
UNGA voting with US	912	0.30	0.11	0.10	0.63
UNGA voting with Japan	912	0.73	0.06	0.49	0.88
UNGA voting with France	912	0.64	0.08	0.45	0.87
UNGA voting with UK	912	0.61	0.09	0.42	0.87
UNGA voting with Germany	912	0.69	0.09	0.47	0.92
UNSC Membership	905	0.10	0.30	0	1
Project Sectors					
Agriculture	915	0.06	0.23	0	1
Administration	915	0.43	0.50	0	1
Information&Communication	915	0.00	0.06	0	1
Education	915	0.04	0.20	0	1
Finance	915	0.11	0.32	0	1
Industry	915	0.13	0.33	0	1
Energy	915	0.04	0.20	0	1
Multisector	915	0.01	0.09	0	1
Transport	919	0.01	0.09	0	1
Social Services	915	0.06	0.24	0	1
Water	915	0.02	0.14	0	1

Chapter 3

International Vertical Specialization: Who Trades What With Whom?[1]

3.1 Introduction

International vertical integration is an essential characteristic of modern world trade. When people talk about the undergoing change in international trade, they usually refer to the fact that production of a final good follows a sequential process, which is ever more broken down into different stages. When people refer to increasing 'vertical trade', they mean that countries more and more trade and specialize at certain stages of production. The reasons and consequences of the change in the nature of trade are discussed intensively in the literature by using different buzzwords, such as *Slicing the value chain* (Krugman, Cooper and Srinivasan, 1995), *outsourcing* (Feenstra and Hanson, 1996), *disintegration of production* (Feenstra, 1998), *vertical specialization* (Hummels, Rapoport and Yi, 1998; Hummels, Ishii and Yi, 2001), *fragmentation* (Jones and Kierzkowski, 2001; Arndt and Kierzkowski, 2001), *production sharing* (Yeats, 2001), *it's not wine for cloth anymore*, *trading tasks* (Grossman and Rossi-Hansberg, 2008, 2006), *new global division of labor* (Marin, 2006), *offshoring* (Blinder, 2006), *the intensive and extensive margins*

[1]This study is joint work with Stephan Huber, University of Regensburg.

of international trade (Helpman, Melitz and Rubinstein, 2008; Chaney, 2008), or *global value chains* (Gereffi, Humphrey and Sturgeon, 2005).

These studies differ in several aspects, but, as a common denominator, they describe a globalizing world in terms of market liberalization, political integration, and less trade impediments. Furthermore, they emphasize changing production and consumption structures throughout the world in which trade does not solely take place in final, but also in intermediate goods. Although a large empirical literature accompanies these mostly theoretical studies by documenting a rise in worldwide trade of manufacturing and intermediate goods, there has not been empirical research that further subdivides trade of intermediate goods into parts and components and thus allows a closer look at global value chains. So far, the rise in international vertical fragmentation of the production process is usually documented by considering a trisection of goods: (1) primary goods, (2) manufactured parts and components (P&C), and (3) final manufactured goods. For instance, Athukorala and Menon (2010) report nearly a triplication of worldwide trade in P&C from $527 billion in 1992/3 to $1652 billion in 2004/5. This corresponds to an increase of trade in P&C as a share of total manufacturing trade from 20.9% to 24.2%. In this chapter. we take a step forward by further subdividing trade of P&C into (2a) trade in parts and (2b) trade in components. We use highly disaggregated bilateral trade flow data at the HS97-based CN 8-digit level from Eurostat's COMEXT database for the 2000 to 2014 period and match these data with a scheme–exclusively provided to us by experts from the German Engineering Association (VDMA)–that allows us to assign a good uniquely to be a part, a component or a final good in the manufacturing sector. We then go on to analyze in a descriptive fashion trade patterns of the European Union member countries at different stages of the value chain.

Hummels, Rapoport and Yi (1998) provide the following definition: There is vertical specialization of trade (or vertical trade, for short) as soon as - the production of a good

follows a sequential process that can be broken down into several stages; - at least two countries take part in this production process; - at least one country imports inputs to produce the goods, at least some of which are exported in turn.

Given the nature of our data, we cannot fully analyze this pattern for the EU countries. However, we are able to provide descriptive evidence for directions of trade within the value chain and for several predictions and stylized facts that have emerged from the literature. The underlying question is: with whom do countries trade different kinds of goods? Costinot, Vogel and Wang (2013) as well as Fieler (2011) and Fajgelbaum, Grossman and Helpman (2009) develop theoretical models in which rich countries specialize in later stages of the supply chain. Furthermore, they are based on premises also documented empirically by Hallak (2006), Hallak (2010) and Hallak and Schott (2011) that richer countries provide higher-quality goods and that rich and poor countries mostly trade among themselves.

After characterizing the development of trade in parts, components, and final goods for the EU member countries, we examine these features in two ways: Firstly, we apply a simple measure to the data which relates the average gross domestic product per capita of a country's trading partners to its own GDP per capita, which we call Average Relative Trading Partner Development Level (TPD). Calculating this measure for different kinds of products allows us to examine with whom countries trade at different stages of the supply chain. Secondly, introducing the income difference as an explanatory variable into gravity estimations, we provide further evidence on the directions of trade flows.

We find the following results: Firstly, intermediate products are an important part of manufacturing trade. Making use of the VDMA classification, we show that a much more nuanced picture can be gained when looking at parts and components separately. Secondly, we document that all EU member countries are active at all stages of the supply chain, and thus can be characterized as bazar-like economies. Thirdly, we find that while rich EU

countries do trade mostly with similarly developed countries, poorer EU countries trade with countries considerably richer than they are. Furthermore, these patterns also differ at different stages of the supply chain. We acknowledge that much more research has to be done to gain a comprehensive picture of processes within the global supply chain. Still, we find that this is an important first step to gain insights at a more detailed level.

The rest of the chapter is structured as follows. In section 3.2, we describe the novelty of the dataset and the development of the EU countries' trade in parts, components and final goods. Section 3.3 introduces the measure to capture the level of development of a country's trading partners as well as the hypotheses examined. Section 3.4 shows the results from the TPD calculations as well as from the gravity estimations. Section 3.5 concludes.

3.2 Trade Composition and its Development

Classify trade into parts, components, and final goods In order to classify international trade flows into a trisection of parts, components, and final goods, we use a novel classification scheme provided exclusively by experts from the German Engineering Association (VDMA). This scheme allows to distinguish manufacturing goods at the Combined Nomenclature (CN) 8-digit level. We identify 225 parts, 301 components, and 965 final goods. All 14055 goods not classified according to this scheme are labeled as "other goods". The class of goods classified as parts contains, for example, electronic instruments, mechanical seals, sewing machine needles, or spinning rings. Goods that belong to the class of components are, for example, engines and motors, air conditioning machines, temperature regulators, or articulated shafts. Goods that are classified as final goods are, for example, gas turbines, diggers, lifts, or mobile cranes.

The classification into a trisection of goods requires a high level of disaggregation. The only

trade data set that records (European) trade at the CN 8-digit level is Eurostat's COMEXT database from the year 2000 forward[2]. It is important to note that not all countries export and import the same share of their total exports and imports in parts, components, and final goods. Exports of parts, components, and final goods, as a share total exports, range from under three percent in Greece to almost 20 percent in Italy in the year 2014. The import share of parts, components, and final goods ranges from about four percent in Greece to about 13 percent in Hungary. Changes in import and export shares of parts, components, and final goods in total trade are rather small, although, for example, the share of exports of parts, components, and final goods in total trade has increased by more than six percent in Finland and Lithuania from 2000 to 2014. In contrast, the share of imports of parts, components, and final goods in total imports decreased by about four percent in Greece, Cyprus and Malta. Interestingly, only five countries have recorded a decrease in exports of parts, components, and final goods as a share of total exports - and only for Cyprus the decrease exceeded 1.5% - while 14 countries display a decrease of imports of parts, components, and final goods as a share of total imports.[3]

To start our descriptive exercise, we first sketch some facts about the development of overall trade for the EU-27 countries. Afterwards, we look more closely at trade in parts, components and final goods according to the VDMA scheme.

Trade has been growing at healthy rates for most of the EU member countries over the period covered here, with only Malta displaying a negative growth rate for exports.[4] Overall, total exports of the EU 27 countries have been growing at just above 4%, while imports have been growing at 3.74%. There are large discrepancies with respect to growth rates between the "old" and the "new" member states. In absolute values, exports as well as

[2]Note that due to a lack of data early on, we are not able to include Croatia in our analysis.
[3]A table displaying the share of exports and imports of parts, components, and final goods as a share of total exports and imports in 2014, as well as the respective changes from 2000 to 2014 can be found in the appendix.
[4]Table A3 of the appendix shows export and import values for the years 2000, 2014 and average annual growth rates.

imports of the EU 15 countries have increased more than those of the CEECs. However, relative growth of CEEC trade has exceeded growth of EU 15 trade considerably. Generally, exports have increased slightly more than imports. The difference in growth rates is much more pronounced for the CEECs, while it is almost negligible for the EU 15. Interestingly, no CEEC has seen imports grow at rates higher than exports, while this has been the case for 6 states of the EU 15. Most of the CEECs have experienced average growth rates in exports above 10%, with only Hungary (7.45%) and Slovenia (7.89%) showing growth rates significantly below 10%. Lithuania, Latvia and Slovakia have had the highest growth rates with more than 12%. For the EU 15, the picture is more uneven. While the Netherlands, Spain, Germany and Austria have seen their imports grow at rates above 4%, Finland and Ireland have hardly had any growth in exports at all. With respect to imports, Lithuania, Slovakia, Romania and Bulgaria have experienced the highest growth rates of the CEECs at over 10%, while again, Hungary and Slovenia display the lowest rates at around 6%. The Netherlands, Belgium and Austria have had the highest import growth rates of the EU 15 at around 4%, while only Ireland has not had a growth rate of more than 2%.

Figure 3.1 depicts the export and import composition and its development for the EU-27 countries. The share of trade for country i in parts, components, and final goods is defined as follows:

$$S_i^g = \left(\frac{T_i^g}{(T_i^\bullet - T_i^o)} \cdot 100 \right) \forall g \in \{p, c, f\},$$

where T_i^g denotes either the exports, X_i^g, or the imports, M_i^g, of country i in the good category g. $T_i^\bullet$ denotes the total sum of trade, $\sum_g T_i^g$. The change from the year 2000 to 2014 is marked by an arrow.[5]

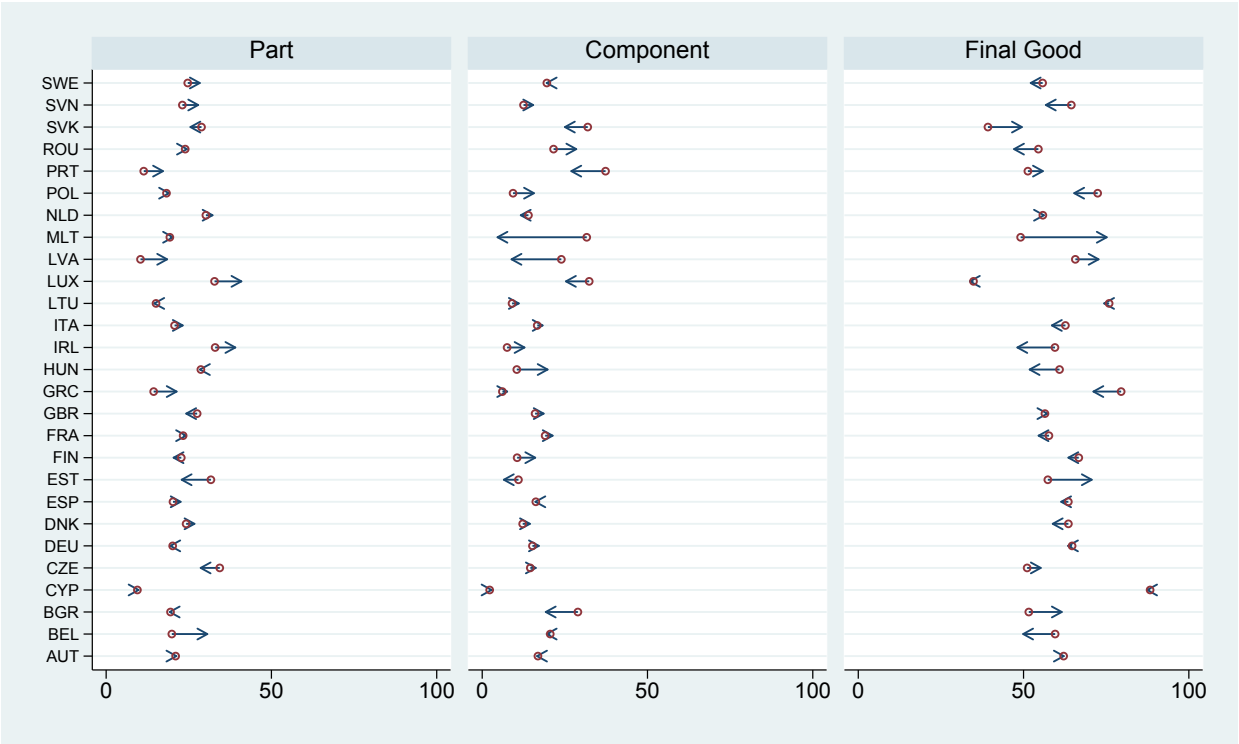
Here, a more nuanced picture emerges.[6] Overall, the share of final goods in exports as

[5]The corresponding numbers can be found in table A5 in the appendix.

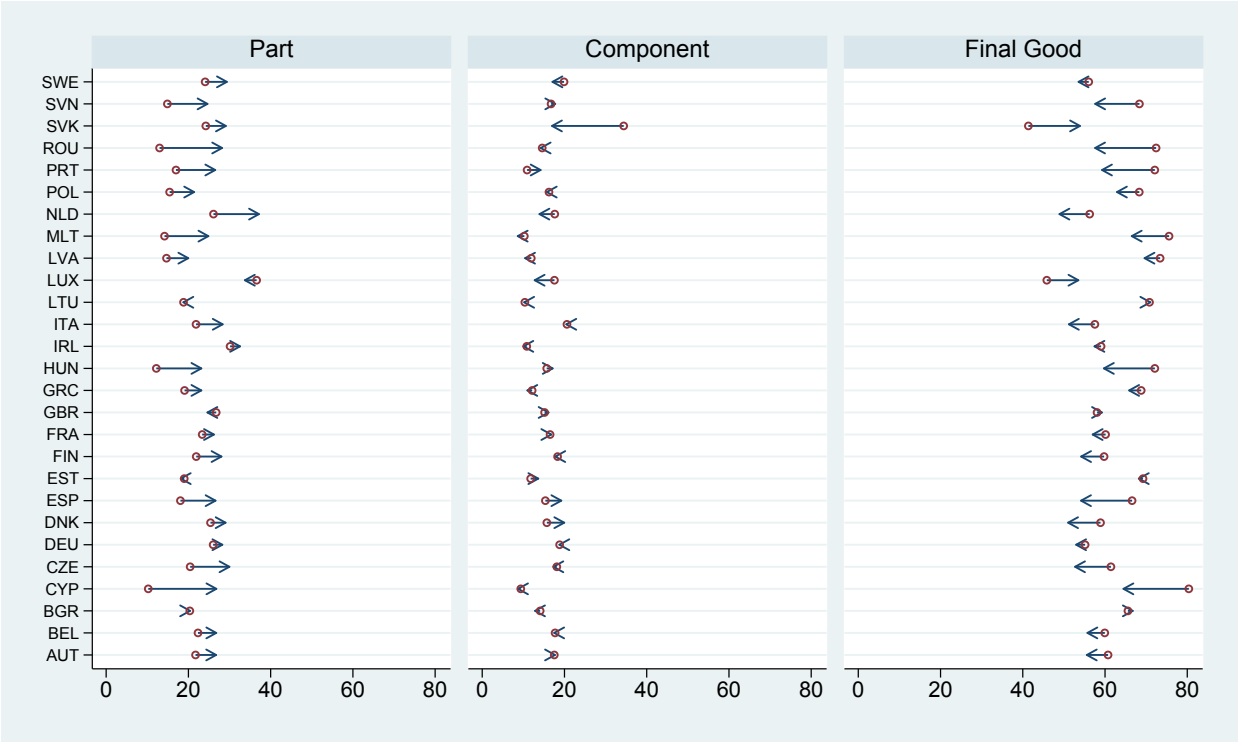
[6]We neglect Cyprus and Malta in the analysis to a certain degree, since they are quite small in terms of importance for EU trade and the global value chain and changes are disproportionately pronounced.

Figure 3.1: Shares of Exports and Imports in Parts, Components and Final Goods

(a) Exports



(b) Imports



Share of parts, components, and final goods is defined for each country i as follows: $\left(\frac{X_i^g}{(X_i^\bullet - X_i^o)} \cdot 100\right) \forall g \in \{p, c, f\}$. *The change from the year 2000 to 2014 is marked by the arrow.*

well as imports is considerably larger for all EU countries than the shares of parts and components. The shares have not changed much over the 15 years of data for the EU 27 aggregates, with changes below 2% in either direction. However, the aggregate values seem to be largely driven by the EU 15, and there are some interesting differences when looking at individual countries. For example, parts made up only 10% of Cyprus' exports, whereas they made up 35% of Czech Republic's exports in 2000. Components made up only 2% of Cyprus' exports and 6% of Greece's exports, whereas they made up 37% of Portugal's exports and 32% of Slovakia's exports in 2000. Furthermore, the share of parts was only 15% in Slovenia's imports, while it was 30% in Slovakia's imports.

When looking at the changes in relative importance, we can also observe large differences between the countries. For example, whereas for countries such as Bulgaria, Poland or France, there was no change in the importance of exports in parts, exports in parts made up 9 percentage points less for the Czech Republic and the Netherlands in 2014 than in 2000. In contrast, the share of parts in exports increased by 8 percentage points in Latvia and by 7 percentage points in Belgium. When looking at components, the changes are even larger. Only for Belgium there has been almost no change in the share of components in exports, whereas the share decreased by 14 percentage points in Latvia and by 9 percentage points in Bulgaria, while it increased by 9 percentage points in Romania and Finland. There have also been equally large changes with respect to the shares of final goods in exports.

Looking at imports, a picture of similar differences emerges. In contrast to exports, the share of parts in imports increased for most EU countries. While it has hardly changed for France and Bulgaria, it decreased considerably only for the UK and Lithuania, while increasing hugely for Romania, Hungary and Slovenia, and also quite robustly for Portugal, Finland and Poland. Changes in the share of components in imports were much less pronounced at mostly below 2 percentage points in either direction. There have only been considerable increases for Portugal, Spain, Denmark and Slovenia and significant

decreases for Slovakia, the Netherlands and Luxembourg.

Overall, these figures show that, while no clear pattern emerges, separating intermediate goods into parts and components allows for a much more nuanced description of international trade which might allow for a better analysis of the global value chain. We observe considerable differences in the relative importance of different product groups for the different EU member countries. One key feature of the data is that all countries appear to be active at all stages of value chains, exporting and importing intermediate and final products to a large degree. In the next section, we will have a closer look at the degree of development of the countries' trading partners.

3.3 Fragmentation of Bazar-like Economies - Who Trades With Whom Which Kinds of Goods?

Apart from sketching how trade in parts, components and final goods developed in the EU, we aim to answer a more interesting question: With whom do countries trade different types of goods? As outlined in section 3.1, our analysis is based on the premise that parts, components and final goods are traded within fragmented global supply chains (Hummels, Rapoport and Yi, 1998). The literature also documents the importance of vertical specialization and, consequently, that the extent of fragmentation has been growing (see e.g., Hummels, Ishii and Yi, 2001; Feenstra and Hanson, 1996; Hanson, Mataloni and Slaughter, 2005). Several facts of the theoretical and empirical literature on fragmentation are worth noting. Firstly, rich countries tend to specialize in later stages of the supply chain. Costinot, Vogel and Wang (2013) imply that consequently, rich countries also trade more among themselves, importing inputs from and exporting outputs to other rich countries. Accordingly, poor countries also trade more with each other (Hallak, 2010). Secondly, rich countries have preferences for higher-quality goods. This is the basic starting point of sev-

eral models on fragmented international production such as Fieler (2011) or Fajgelbaum, Grossman and Helpman (2009). They also assume that rich countries are better at producing high-quality goods, rationalized for example by a "home-market" effect (Fajgelbaum, Grossman and Helpman, 2009). These assumptions are based on empirical findings, e.g. by Hallak (2006). However, the question remains how the different stages within the supply chain and thus countries' trade links come together. With our novel classified trade data, we can examine these patterns for the EU member countries and answer several related questions.

However, we need a measure to capture the stage of development of a countries' trading partners. We thus develop a simple measure that combines trade flows categorized into parts, components and final goods with GDP per capita to reveal the average level of development of a country i's trade partners (j) relative to a country's own level of development. We call this measure the Average Relative Trading Partner Development Level (TPD):

$$TPD_i^{T,g} = \sum_{j=1}^{J} \frac{T_{ij}^g}{T_{i\bullet}^g} \frac{Y_j}{Y_i}, \tag{3.1}$$

where Y_i and Y_j denote the real GDP per capita of exporting country i and importing country j. T_{ij}^g denotes either the exports of country i to country j in good category g, X_{ij}^g, or the imports of country i from country j in good category g, M_{ij}^g. $T_{i\bullet}^g$ abbreviates, either the total exports of country i, $\sum_j X_{ij}$, or the total imports of country i, $\sum_j M_{ij}$. The trade category, g, represents trade in parts (p), components (c), final goods (f), other goods (o), or total trade ($pcfo$).

By construction, the ratio increases with the average level of development of a country's trading partners, given a certain level of one's own development.[7] A value smaller than

[7] Unfortunately, we were not able to find a suitable normalization. Given a certain level of GDP per capita of country i and its trading partners, the ratio decreases if all countries experience an increase in GDP per capita.

one means that, on average, the country trades more with countries less developed than itself, while a value higher than one means that, on average, a country trades more with countries more developed than itself.

Armed with this measure, we aim to explore descriptive evidence on how countries are positioned within the global supply chain. As already indicated, there are several hypotheses that can be investigated. Firstly, if countries tend to trade mostly with other countries at a similar stage of development, we should observe TPD values close to one for each category of goods.

However, there is more that we can examine with the data and measure at hand. Every country produces goods with a certain quality level. The theoretical models mentioned above imply that richer countries produce at higher quality levels than poorer countries. In order to produce high-quality goods, they need inputs of a certain quality level, combined with a certain production technology. This, in turn, implies that the number of possible input providers is limited and TPD values for imports are expected to be high. However, although if rich countries' preferences are skewed towards high-quality goods, we should observe similarly high TPD values for exports, higher-quality goods might also be sold to poorer countries - since there also is a part of the population with the income to demand them. This would imply a bigger variety of export destinations in terms of income from which our first proposition follows:

- Proposition:

$$TPD^{x,g} < TPD^{m,g} \quad \forall g \in \{p, c, f\}$$

At every stage of production, a country imports from richer countries compared to those it exports to. Again, while a country needs inputs of a certain quality level that matches its production technology to attain a certain quality level of output, there is no such limit

with respect to the destinations where the goods are demanded.

Further assuming that parts are used to produce components and final goods, while components are only used to produce final goods, this line of argument implies the following further propositions:

- Proposition:

$$TPD^{x,p} > TPD^{x,c} > TPD^{x,f}$$

- Proposition:

$$TPD^{m,p} > TPD^{m,c} > TPD^{m,f}$$

.

The further the stage of the production process, the less rich a country's trading partners are, on average. High-quality parts have to be sourced from countries able to produce them. Goods at a subsequent stage of the production process are then exported to a larger variety of countries. We expect the difference between parts and final goods as well as components and final goods to be more clear-cut than between parts and components. For imports, the picture should be similar. Final goods are sourced from a greater variety of trading partners at a greater variety of quality levels than imported parts and components used to assemble final goods of a certain quality level. However, since parts are also used to produce components, there should also be a difference between the level of development of a country's sources for parts and components, respectively. These propositions are in line with Hallak (2010) and Costinot, Vogel and Wang (2013), but add a layer due to the more nuanced classification of goods at hand.

Table 3.1: Trade Partner Development (Mean Over 2000-2014)

i	(1) $TPD_i^{pcfo,\bullet}$	(2) $TPD_i^{p,x}$	(3) $TPD_i^{p,m}$	(4) $TPD_i^{c,x}$	(5) $TPD_i^{c,m}$	(6) $TPD_i^{f,x}$	(7) $TPD_i^{f,m}$	(8) $TPD_i^{o,x}$	(9) $TPD_i^{o,m}$
AUT	.824	.735	.813	.76	.871	.717	.858	.762	.796
BEL	.984	.804	.919	.849	.901	.834	.896	.896	.893
BGR	6.58	6.304	7.326	7.245	7.034	5.38	7.231	6.396	5.394
CYP	1.159	.645	1.271	.982	1.207	.929	1.155	1.006	1.082
CZE	2.196	2.264	2.428	2.097	2.332	2.045	2.319	2.071	1.937
DEU	.841	.79	.881	.8	.898	.765	.892	.855	.819
DNK	.727	.638	.708	.665	.666	.667	.704	.711	.687
ESP	1.328	1.09	1.314	1.157	1.251	1.014	1.222	1.169	1.093
EST	2.928	3.135	3.144	2.101	3.035	2.415	3.028	2.8	2.454
FIN	.864	.694	.846	.7	.895	.638	.882	.751	.743
FRA	.928	.774	.928	.809	.922	.772	.906	.836	.839
GBR	1.004	.846	.947	.865	.892	.833	.89	.93	.868
GRC	1.583	1.046	1.606	1.05	1.461	1.016	1.451	1.329	1.239
HUN	2.694	3.204	3.272	2.798	3.06	2.968	3.135	2.753	2.482
IRL	.756	.741	.781	.737	.768	.712	.769	.777	.752
ITA	1.053	.871	1.047	.945	1.037	.861	1.033	.991	.888
LTU	3.238	2.164	3.838	2.032	3.273	2.429	3.512	2.806	2.41
LUX	.355	.338	.413	.351	.402	.372	.425	.407	.377
LVA	3.107	2.738	3.618	2.419	3.321	2.774	3.521	2.982	2.648
MLT	1.99	1.881	1.961	2.214	1.909	1.797	1.785	1.868	1.825
NLD	.818	.701	.816	.746	.805	.71	.746	.766	.664
POL	3.582	3.598	3.781	3.428	3.524	3.257	3.666	3.231	3.063
PRT	1.758	1.595	1.7	1.66	1.64	1.446	1.617	1.628	1.489
ROU	5.918	6.148	6.694	6.229	6.413	5.994	6.703	5.88	5.223
SVK	2.551	3.203	2.942	3.004	2.856	2.563	2.843	2.603	2.238
SVN	1.213	1.609	1.469	1.503	1.678	1.258	1.684	1.352	1.514
SWE	.818	.707	.774	.748	.764	.724	.768	.777	.766

Trade Partner Development is defined as described in equation 3.1 on page 63. The dot ($\bullet$) in $TPD_i^{pcfo,\bullet}$ indicates that the TPD is calculated for the sum of trade, which is exports plus imports.

GDP Data Data on GDP per capita as well as the appropriate deflators are sourced from the IMF's World Economic Outlook database.

3.4 Results

Our propositions are largely confirmed by the results displayed in tables 3.1 and 3.2, with a slight exception when comparing TPD values for the exports of parts and components. Table 3.1 shows the actual values for our TPD measure. It is interesting to note that the notion of countries with similar levels of development trading more among each other can only be partially confirmed by the data. Looking at EU15 countries, they indeed mostly display TPD values close to one except for Luxembourg. However, a lot of the CEECs

Table 3.2: Truth Table

	(1) $TPD^{p,x} > TPD^{c,x}$	(2) $TPD^{p,x} > TPD^{f,x}$	(3) $TPD^{c,x} > TPD^{f,x}$	(4) $TPD^{p,m} > TPD^{c,m}$	(5) $TPD^{p,m} > TPD^{f,m}$	(6) $TPD^{c,m} > TPD^{f,m}$	(7) $TPD^{p,x} < TPD^{p,m}$	(8) $TPD^{c,x} < TPD^{c,m}$	(9) $TPD^{f,x} < TPD^{f,m}$
AUT	0	1	1	0	0	1	1	1	1
BEL	0	0	1	1	1	1	1	1	1
BGR	0	1	1	1	1	0	1	0	1
CYP	0	0	1	1	1	1	1	1	1
CZE	1	1	1	1	1	1	1	1	1
DEU	0	1	1	0	0	1	1	1	1
DNK	0	0	0	1	1	0	1	1	1
ESP	0	1	1	1	1	1	1	1	1
EST	1	1	0	1	1	1	1	1	1
FIN	0	1	1	0	0	1	1	1	1
FRA	0	1	1	1	1	1	1	1	1
GBR	0	1	1	1	1	1	1	1	1
GRC	0	1	1	1	1	1	1	1	1
HUN	1	1	0	1	1	0	1	1	1
IRL	1	1	1	1	1	0	1	1	1
ITA	0	1	1	1	1	1	1	1	1
LTU	1	0	0	1	1	0	1	1	1
LUX	0	0	0	1	0	0	1	1	1
LVA	1	0	0	1	1	0	1	1	1
MLT	0	1	1	1	1	1	1	0	0
NLD	0	0	1	1	1	1	1	1	1
POL	1	1	1	1	1	0	1	1	1
PRT	0	1	1	1	1	1	1	0	1
ROU	0	1	1	1	0	0	1	1	1
SVK	1	1	1	1	1	1	0	0	1
SVN	1	1	1	0	0	0	0	1	1
SWE	0	0	1	1	1	0	1	1	1

display TPD values considerably higher than one (and none of them values below one). These values indicate that, on average, the CEECs trade with countries considerably richer than they are, which holds for both exports and imports. On the one hand, this finding might speak against earlier findings and the theoretical model of Costinot, Vogel and Wang (2013). On the other hand, and possibly more likely, it documents the degree of integration among EU member countries and may suggest that within highly integrated regions, the notion might not hold per se.[8] However, due to a lack of data for non-EU countries, we cannot explore this issue further.

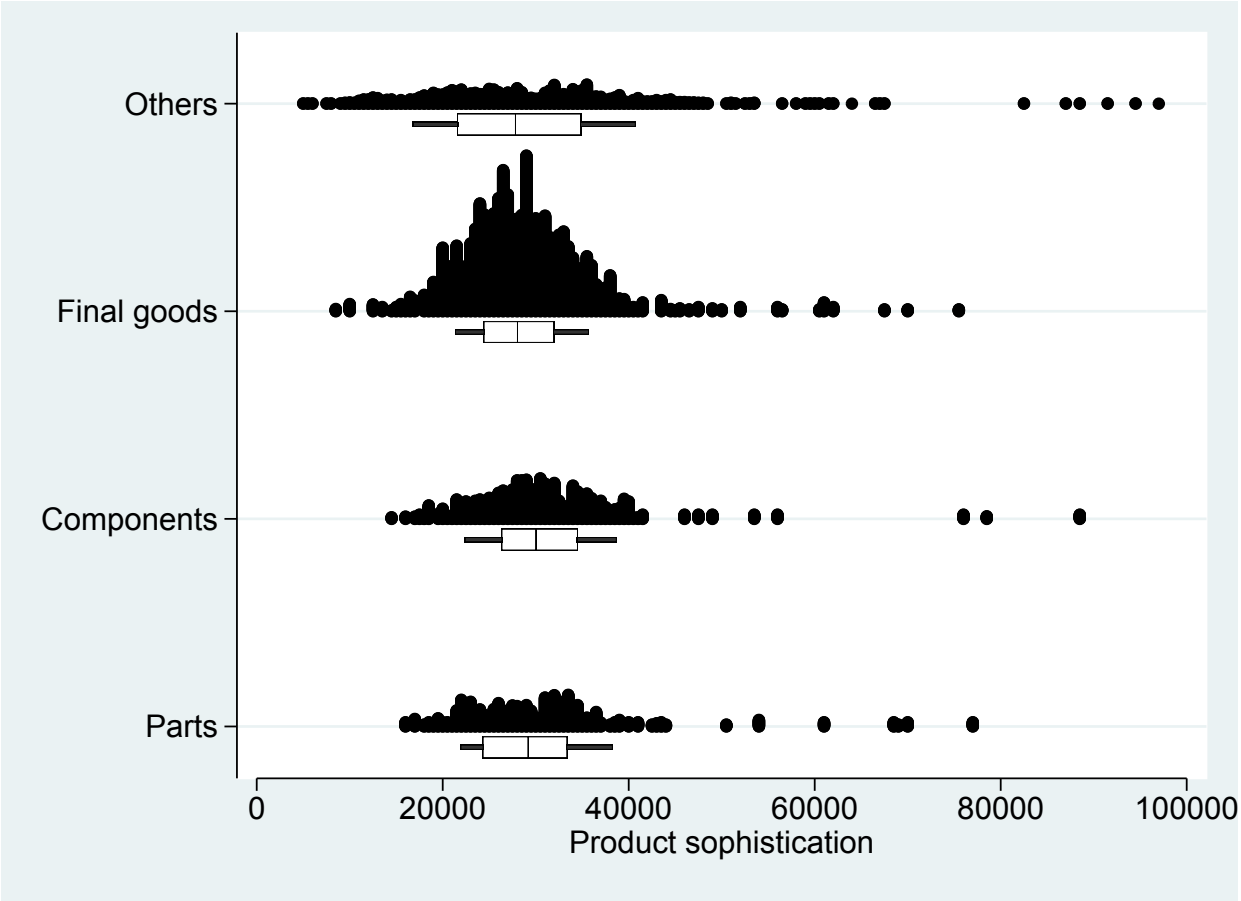
To facilitate relating the TPD values to our propositions, table 3.2 displays whether the conditions from the propositions are fulfilled. Columns (7)-(9) refer to proposition (1),

[8]The latter interpretation is supported by results displayed in table A6, which shows TPD values calculated for intra-EU trade only.

columns (1)-(3) to proposition (2) and columns (4)-(6) to proposition (3). A value of one in a certain cell means that the TPD values in table 3.1 fulfill the conditions, a value of zero means that the condition is not fulfilled. Overall, the results are quite encouraging. Support for proposition (1), that at every stage of production, import suppliers are, on average, richer than export destinations, is especially strong. 22 countries fulfill the condition at every production stage, while the other five countries do not fulfill the conditions only partially. These findings indeed suggest that countries need a certain quality of inputs to produce goods of an associated quality level, while also producing and exporting goods of the same stage that are sold to poorer countries - of either the same or a lower level of quality.

Looking at the results for conditions implied by propositions (2) and (3), the evidence is a bit more mixed. However, for most countries the conditions hold that, on average, export destinations as well as import sources are richer for production stages further up the value chain. This certainly supports the view that there seems to be a step-wise relationship within the value chain between countries of different income levels. Rich countries need high-quality inputs to produce final goods (but also components) of a certain quality level, thus trading inputs mostly among themselves. In contrast, final goods also appear to be demanded by less-developed countries. A similar pattern, only at a lower level, can then be observed for less developed countries. The Czech Republic is a prime example where every condition from our propositions is fulfilled, while only one condition is not fulfilled for a further 8 countries and only two conditions are not fulfilled for 6 countries. For Poland, our propositions also hold almost completely. This is especially interesting, since Poland and the Czech Republic are prime recipient countries of foreign direct investment, and our results would confirm a story that companies from richer source countries produce inputs there, e.g. for cost-saving reasons. There are also examples where our suggested patterns do not hold. For example, Latvia and Lithuania seem to export final goods to richer

Figure 3.2: Distributional Strip Plots of Product Sophistication by Category of Goods



In the distributional strip-plots, each • denotes one good and a boxplot is shown below each distribution. Two goods are stacked within a band of 1000 in the product sophistication indicator.

countries than they export parts and components to. As expected, this finding suggests that there is not one clear-cut story and that the picture is much more complex. The only part of our propositions that does not seem to hold well is that countries to which parts are exported are, on average, richer than those countries to which components are exported. For some countries such as Germany of Finland, the differences are rather small and thus within a margin of error, but for others they are not. However, since both, parts and components, can be seen as inputs for final goods, this is not such a surprising result and we explore this issue further below.

As described in section 3.3, one of the basic premises from the theoretical literature also is

that richer countries tend to specialize at later stages of the supply chain. If this is indeed the case, it should be visible in the data. In order to examine this feature, we calculate product sophistication ($PRODY$) indices for all goods (see Hausmann, Hwang and Rodrik, 2007). This procedure assigns an income/productivity level to each traded good. If more advanced countries specialize at later stages of the supply chain, the distribution of $PRODY$ values for final goods should be centered at a visibly higher level than the distribution of $PRODY$ values for parts and components. As figure 3.2 reveals, the picture is rather blurred. There is no clear pattern, which leads us to conclude that most countries participate at all stages of the global supply chain providing various levels of sophistication.

We can now go a step further in our analysis of fragmentation and global supply chains. In the preceding part, we were able to establish that average trading partners of a country are richer the further up the supply chain goods are traded. We were also able to establish that at a certain level of the supply chain, the average import sources are richer than the average export destinations. However, we are also interested in examining the directions of trade within the supply chain more closely. To this end, we estimate a simple gravity model akin to Kimura, Takahashi and Hayakawa (2007) introducing the difference between exporter- and importer-GDP per capita as an explanatory variable:

$$\begin{aligned} x_{ij}^{g} &= FE_i + FE_j + \gamma_1 ldist_{ij} + \gamma_2 Adj_{ij} + \gamma_3 ComLang_{ij} \\ &+ \beta_1 (Y_i - Y_j) * D_{(=1 \text{ if } (Y_i - Y_j) > 0)} + \beta_2 (Y_i - Y_j) * D_{(=1 \text{ if } (Y_i - Y_j) < 0)} + \epsilon \end{aligned} \tag{3.2}$$

$$\begin{aligned} m_{ij}^{g} &= FE_i + FE_j + \delta_1 ldist_{ij} + \delta_2 Adj_{ij} + \delta_3 ComLang_{ij} \\ &+ \eta_1 (Y_i - Y_j) * D_{(=1 \text{ if } (Y_i - Y_j) > 0)} + \eta_2 (Y_i - Y_j) * D_{(=1 \text{ if } (Y_i - Y_j) < 0)} + \epsilon \end{aligned} \tag{3.3}$$

x_{ij}^g (m_{ij}^g) denotes country i's exports to (imports from) country j in each category of goods g. FE_i (FE_j) are exporter (importer) fixed effects to capture all country-specific factors influencing bilateral trade. Trade costs are captured by bilateral distance ($ldist_{ij}$), a dummy variable indicating if two countries share a border (Adj_{ij}) and a dummy variable indicating if two countries share a common language ($ComLang_{ij}$).[9] The difference between the degree of development of a country pair, is modeled as an interaction, once with a dummy variable indicating a positive difference, $(Y_i - Y_j) * D_{(=1 \text{ if } (Y_i - Y_j) > 0)}$, and once with a dummy indicating a negative difference, $(Y_i - Y_j) * D_{(=1 \text{ if } (Y_i - Y_j) < 0)}$. We use exports (imports) in each category of goods g (parts, components, final goods and other goods) as well as total exports (imports) as the dependent variable in turn. We also perform the same estimations using only the absolute income difference $|Y_i - Y_j|$ as an explanatory variable instead of the two interactions.

To start with, these estimations allow us to further examine the assertion that countries at similar stages of development mostly trade among themselves. If this is the case, we should not observe any significant impact of the interaction terms. In contrast, if production processes are indeed fragmented internationally as, e.g., the literature on vertical FDI suggests, we expect to observe significant impacts. If we only used the absolute income difference as Kimura, Takahashi and Hayakawa (2007) do, we would not be able to conclude the direction of trade. However, since this is a very interesting aspect of global production chains, our method appears to be better-suited to catch these directions. There are also other testable hypotheses: Firstly, there is ample evidence for the presence of production chains and vertically motivated foreign direct investment in the EU and globally, not least related also to "factory Asia" (see e.g., Baldwin and Lopez-Gonzalez, forthcoming). Combined with the notion that richer countries tend to specialize at later stages of the supply chain, we would expect that final goods are traded disproportionately from higher-

[9] Data for all three variables are sourced from CEPII.

Table 3.3: Influence of Differences in the Level of Development on Exports

Variable	(1) Coefficient/p-value	(2) Parts	(3) Components	(4) Final Goods	(5) Other Goods	(6) Total Exports
$(Y_i - Y_j) * D^-$	estimate	.821***	-.457***	.193	-.612	-.358
$(Y_i - Y_j) * D^-$	p-value	0	.007	.265	.126	.372
$(Y_i - Y_j) * D^+$	estimate	1.073***	-.297*	.376**	-.608	-.247
$(Y_i - Y_j) * D^+$	p-value	0	.056	.023	.124	.534
$\|(Y_i - Y_j)\|$	estimate	.156***	.062	.099***	-.001	.054*
$\|(Y_i - Y_j)\|$	p-value	0	.137	.002	.97	.07

The coefficients are obtained from simple gravity estimations for exports averaged over the 2000 to 2014 period as detailed in the text. Estimations are performed separately for exports of parts, components, final goods and other goods as well as for total exports.

income countries to lower-income countries, and thus a positive and significant coefficient for the positive income difference between exporter and importer for final good exports. If, in addition, we do not find significant differences for the imports of final goods, this would support proposition (1) as well. Secondly, if lower-income countries are specialized as suppliers of parts and/or components within the global supply chain, we would also expect reverse signs for exports in this category.[10]

Note that estimation results from Kimura, Takahashi and Hayakawa (2007) would suggest that in contrast to East Asia, we should not expect significant results for Europe.

Results displayed in tables 3.3 and 3.4 support the view of production fragmentation.[11] It is interesting to note that we do find a significant influence of income differences on exports of parts, components, and final goods, while the same is not true for exports of other goods and total trade. Furthermore, when estimating the gravity model for imports, we only find a significant coefficient for the positive interaction for imports of final goods. These results support the view that inputs of a certain quality level are needed that can only be sourced from countries at similar stages of development, while exports are sold to a wider array of countries at different levels of development.

Concerning the exports of parts, we find positive and significant coefficients for both,

[10] Note that, since there is no theoretical model from which our estimation equation is derived and we only partially control for multilateral resistance and other issues, we only claim to present descriptive evidence.
[11] Full estimation results can be found in tables A7 and A8 in the appendix.

Table 3.4: Influence of Differences in the Level of Development on Imports

Variable	(1) Coefficient/p-value	(2) Parts	(3) Components	(4) Final Goods	(5) Other Goods	(6) Total Imports
$(Y_i - Y_j) * D^-$	estimate	.176	.137	.241	.388	.383
$(Y_i - Y_j) * D^-$	p-value	.516	.621	.394	.505	.53
$(Y_i - Y_j) * D^+$	estimate	.485*	.284	.616**	.562	.626
$(Y_i - Y_j) * D^+$	p-value	.061	.285	.025	.328	.298
$\|(Y_i - Y_j)\|$	estimate	.162***	.078	.193***	.09**	.125***
$\|(Y_i - Y_j)\|$	p-value	.001	.124	0	.039	.006

The coefficients are obtained from simple gravity estimations for imports averaged over the 2000 to 2014 period as detailed in the text. Estimations are performed separately for imports of parts, components, final goods and other goods as well as for total imports.

positive as well as negative income differences between exporter and importer. These coefficients imply that parts are exported much more to countries at lower stages of development and similar stages of development, but much less to countries at higher stages of development.[12] The results are different with respect to components. Here, the coefficients for both interactions are negative and significant, meaning that components are traded significantly more with countries at the same stage of development and with countries at higher stages of development. In terms of final goods, we find that these are exported significantly more to countries at lower stages of development.

Overall, the results from these descriptive gravity estimations support the literature and and our results from the TPD calculations that imports seem to be sourced from countries at similar stages of development. While final goods appear to be also imported to a significant degree from countries at lower stages of development, this would suggest that there is also demand for cheaper or lower-quality goods among final consumers in richer countries. The picture is more complex with respect to exports. It is interesting to note that components appear to be exported significantly more to countries at higher stages of development, which would certainly support the literature on vertical FDI. However,

[12]To clarify, by using the positive and negative difference in the level of development between two countries, we can assess if there is more (less) trade with countries that are more developed or less developed than country i. If we only included the absolute income difference, we would only be able to conclude if country i trades disproportionately with countries at different levels of development, but not if these are more developed or less developed than country i.

in our view, the most important findings are that results for trade in parts and trade in components are quite different and that we do not find significant coefficients for differences in income when using other goods and total trade as dependent variables. We conclude that our novel classification of trade data is an important step towards a better understanding of production fragmentation and global value chains. Indeed, while there is a lot of scope for further analysis, we have already obtained a much more nuanced picture of trade within value chains of EU countries, differentiating intermediate inputs into parts and components, than if we had not been able to separate these categories.

3.5 Concluding Remarks

The purpose of this descriptive study was to obtain a more nuanced view on trade of the European Union member countries in the light of fragmentation of production and global value chains. As trade theory is often preceded by empirical findings, we present some new stylized facts on international trade by EU countries. Using a novel data set over the period 2000 to 2014 based on a classification provided by the German Engineering Association (VDMA) which classifies manufacturing products from the 8-digit Combined Nomenclature according to their nature as either part, component or final good, we provide two contributions.

Firstly, we describe the development of trade in parts, components, final goods and other goods for the EU 27 which presents a step forward as intermediate goods are subdivided into parts and components. We show that these subcategories develop quite differently over time and are not equally important to individual countries. Therefore, this further division of intermediate goods should be an important part of subsequent research on fragmentation of production. Secondly, we develop a simple measure that captures the average relative level of development of a country's trading partners in order to shed some

light on the direction of trade within the global value chain. Here, we present descriptive evidence that countries act as bazar-like economies within the global value chain. We find that, at every stage of production, import sources are richer than export destinations. Furthermore, for exports as well as for imports, trade partners are richer at earlier stages of the value chain. These findings suggest that while inputs of a certain quality are necessary in order to produce, a country sells its exports to a larger array of partners in terms of income levels. Interestingly, especially for poorer EU countries, we do not find convincing evidence that these countries trade largely with other countries at similar levels of income. We support these findings by simple gravity estimations introducing the difference in income as explanatory variables. The results suggest that imports are sourced mostly from countries at similar income levels, while exports are sold significantly more to countries at different, and mostly lower levels of income. Overall, our findings show the importance of differentiating by the nature of traded goods in order to analyze global value chains. Firstly, we are able to test more nuanced hypotheses. Secondly, we obtain quite different results for trade in parts versus trade in components. Thirdly, we find significant influences of income differences for trade in parts, components, and final goods, while income differences do not play a role when looking at trade in other goods or overall trade, highlighting the importance of a more finely-grained analysis.

While we are confident that our results present a significant improvement in analyzing fragmentation of production, there is a lot of scope for future research. Firstly, since the novel classification only applies to parts of goods that are traded internationally, further work on the classification would enhance data quality and the possibilities for generalization of analysis. Secondly, a further refinement of the classification in terms of sophistication of the products (akin to the PRODY indicator) would allow for a much more nuanced analysis of trade links for different kinds of products within the global production networks. Thirdly, as more years of data become available, it should become possible to analyze medium- to

long-term developments. It would also be interesting to be able to conduct this exercise for more than just the EU member countries. On the one hand, even the CEECs are relatively developed compared to a lot of other countries in the world. On the other hand, we miss a large part of the global supply chain by not being able to include "factory Asia". These additions would allow for a much more thorough and complete picture.

3.A Appendix

Table A1: Number of CN08 Products Classified

Product Category	(1) Number of Products
Parts	225
Components	301
Final Goods	965
Other Goods	14055
Total	15546

Classification based on 8-digit data according to the Combined Nomenclature.

Table A2: Development of Real GDP per Capita and Real GDP of EU 27

	(1) GDPpc 2000	(2) GDPpc 2014	(3) Growth Rate	(4) GDP 2000	(5) GDP 2014	(6) Growth Rate
AUT	24024	45045	4.59	192629.6	385275.8	5.08
BEL	22164.6	42372	4.74	227541.3	473185.8	5.37
BGR	1339.6	8520.2	14.13	11059.66	61713.43	13.07
CYP	12255.1	23575	4.78	8526.293	20132.24	6.33
CZE	4619	17992.8	10.2	47499.19	189400.2	10.38
DEU	23605.2	39789.6	3.8	1941030	3277191	3.81
DNK	28957.5	54611.5	4.64	154675.6	308015	5.04
ESP	12682.8	25239.6	5.04	512114.4	1171725	6.09
EST	3496.5	23195.2	14.47	4791.759	30463.08	14.12
FIN	24378	45270.4	4.52	126378.4	247034.3	4.9
FRA	21495.9	36160.6	3.78	1305721	2394740	4.43
GBR	27610	35914.5	1.9	1626120	2314052	2.55
GRC	10974.6	18027.8	3.61	120136.6	198063.1	3.64
HUN	3405.5	11497.5	9.08	34982.62	113022.1	8.74
IRL	22879.4	39975	4.07	86944.68	184319.8	5.51
ITA	18396	30590	3.7	1049704	1858692	4.17
LTU	3110.4	17260.8	13.02	10756.2	50541.99	11.69
LUX	43559.8	115935	7.24	19050.62	64751.07	9.13
LVA	3484.8	18246.8	12.55	8163.725	36282.03	11.24
MLT	10595.2	23361.6	5.81	4141.399	9974.272	6.48
NLD	22854.7	44330.4	4.85	363207.3	747604.6	5.29
POL	4331.6	12786.5	8.04	164171	493695	8.18
PRT	10750	18774.6	4.06	109492.5	195714.5	4.24
ROU	1211.4	11242.5	17.25	27358.32	224877.7	16.24
SVK	2984.8	19543.4	14.36	16050.14	105752.1	14.42
SVN	9666	21231.3	5.78	19272.39	43756.65	6.03
SWE	31015.4	53191.2	3.93	275495.4	515900.3	4.58

Data sourced from Eurostat, base year = 2005. GDP in million Euro, GDP per capita in Euro.

Table A3: Development of Exports and Imports of EU 27 (in Mio Euro)

	(1) Exports 2000	(2) Exports 2014	(3) Growth Rate	(4) Imports 2000	(5) Imports 2014	(6) Growth Rate
AUT	70831	130127	4.44	76671	132469	3.98
BEL	202614	348650	3.95	192022	340326	4.17
BGR	4622	21411	11.57	6802	26046	10.07
CYP	431	1110	6.99	3386	4887	2.66
CZE	31340	129942	10.69	34555	113252	8.85
DEU	583885	1117794	4.75	524385	879681	3.76
DNK	49616	81320	3.59	48078	74082	3.14
ESP	119766	232285	4.85	168396	268643	3.39
EST	3443	11988	9.32	4601	13612	8.06
FIN	49522	51745	.31	36368	54732	2.96
FRA	346837	428650	1.52	362591	507154	2.43
GBR	303733	366353	1.35	359855	497948	2.35
GRC	12359	24915	5.13	36072	47736	2.02
HUN	30317	82944	7.45	34766	78106	5.95
IRL	80838	87656	.58	51958	52017	.01
ITA	254904	389281	3.07	248026	352302	2.54
LTU	3849	24320	14.07	5587	26443	11.74
LUX	8959	14083	3.28	11796	19436	3.63
LVA	2016	10895	12.81	3448	13258	10.1
MLT	2513	2035	-1.5	3695	4680	1.7
NLD	233808	469613	5.11	218834	420838	4.78
POL	34241	162469	11.76	52980	164682	8.44
PRT	26132	46660	4.23	43206	58498	2.19
ROU	11020	52053	11.73	13634	58357	10.94
SVK	12769	65079	12.34	13734	61742	11.33
SVN	9328	27008	7.89	10931	25158	6.13
SWE	89609	119491	2.08	74972	122116	3.55

Data sourced from Eurostat.

Table A4: Development of Exports and Imports of Parts, Components and Final Goods as a Share of Total Exports/Imports

	(1) Exports share of PCF in t=2014	(2) Change from 2000 to 2014	(3) Import share of PCF in t=2014	(4) Change from 2000 to 2014
AUT	17.13	2.34	13.78	1.03
BEL	6.98	-.26	7.08	-.87
BGR	8.85	1.62	9.47	.54
CYP	4.07	-2.57	4.83	-4.13
CZE	14.11	1.11	12.49	-.01
DEU	18.23	1.58	10.08	1.6
DNK	17.72	3.61	11.01	.41
ESP	7.75	.43	6.96	-2.54
EST	9.71	5.09	8.56	.76
FIN	18.28	6.01	10.32	.18
FRA	9.61	1.06	8.84	-.13
GBR	10.52	.52	8.16	.29
GRC	3.02	-.57	4.49	-4.48
HUN	11.05	4.31	15.2	1.2
IRL	3.36	.91	8.53	2.33
ITA	21.79	2.38	8.49	-.44
LTU	9.88	6.52	9.11	1.86
LUX	8.18	-1.02	6.56	-.68
LVA	6.52	1.53	7.79	-2.67
MLT	7.31	4.54	5.23	-3.86
NLD	8.28	2.99	6.78	1.4
POL	10.01	-1.38	10.86	-1.59
PRT	8.19	2.52	7.46	-1.65
ROU	10.49	3.69	12.14	2.32
SVK	10.07	2.28	10.73	-.91
SVN	12.95	.62	9.46	-.97
SWE	15.47	1.79	10.9	-.42

The export and import share of PCF, which abbreviates parts, components, and final goods, is defined by $\left(1 - \frac{T_i^o}{T_i^\bullet}\right) \cdot 100$, *where* T_i^o *denotes the total exports or the total imports of country* i, *and* $T_i^\bullet$ *is the sum of all exports or imports over all goods* g: $\sum_g T_i^g$. *The change from the year 2000 to 2014 is the difference of the share in 2000 and 2014.*

Table A5: Export Composition and Its Development

	(1) Share of parts in t=2014	(2) Change from 2000 to 2014	(3) Share of components in t=2014	(4) Change from 2000 to 2014	(5) Share of final goodsin t=2014	(6) Change from 2000 to 2014	(7) Share of exports PCF in t=2104	(8) Change from 2000 to 2014
AUT	21.24	.22	16.59	-.26	62.17	.05	17.13	2.34
BEL	30.61	10.74	19.51	-1.07	49.88	-9.68	6.98	-.26
BGR	19.23	-.25	19.22	-9.72	61.56	9.97	8.85	1.62
CYP	9.8	.35	2.81	.56	87.39	-.91	4.07	-2.57
CZE	28.59	-5.77	16.2	1.65	55.21	4.13	14.11	1.11
DEU	19.41	-.72	17.14	1.95	63.45	-1.23	18.23	1.58
DNK	26.72	2.53	14.44	2.2	58.83	-4.74	17.72	3.61
ESP	22.54	2.32	16.09	-.13	61.37	-2.19	7.75	.43
EST	22.83	-8.86	6.54	-4.42	70.62	13.28	9.71	5.09
FIN	20.4	-2.33	16.03	5.47	63.56	-3.14	18.28	6.01
FRA	24.16	.87	21.31	2.27	54.53	-3.14	9.61	1.06
GBR	24.22	-3.31	18.59	2.6	57.19	.71	10.52	.52
GRC	21.32	6.95	7.55	1.44	71.13	-8.39	3.02	-.57
HUN	28.38	-.28	19.78	9.32	51.84	-9.05	11.05	4.31
IRL	39.08	6.1	12.8	5.27	48.13	-11.37	3.36	.91
ITA	23.16	2.47	18.27	1.63	58.57	-4.1	21.79	2.38
LTU	14.55	-.53	11.07	2.04	74.38	-1.51	9.88	6.52
LUX	40.91	8.13	25.33	-7.04	33.76	-1.09	8.18	-1.02
LVA	18.44	8.06	8.86	-15.08	72.69	7.02	6.52	1.53
MLT	20.22	.94	4.63	-26.99	75.16	26.05	7.31	4.54
NLD	32.18	2.01	11.66	-2.33	56.16	.32	8.28	2.99
POL	19.01	.76	15.66	6.34	65.33	-7.1	10.01	-1.38
PRT	17.2	5.83	26.95	-10.36	55.85	4.54	8.19	2.52
ROU	24.42	.5	28.46	6.87	47.12	-7.37	10.49	3.69
SVK	25.49	-3.36	25.02	-6.91	49.49	10.27	10.07	2.28
SVN	27.85	4.78	15.42	2.93	56.73	-7.72	12.95	.62
SWE	28.33	3.65	19.51	-.03	52.16	-3.62	15.47	1.79

Share of parts, components, and final goods is defined for each country i as follows: $\left(\frac{X_i^g}{(X_i^\bullet - X_i^o)} \cdot 100\right) \forall g \in \{p, c, f\}$. *Share of PCF, which abbreviates parts, components, and final goods, is defined by* $\left(1 - \frac{X_i^o}{X_i^\bullet}\right) \cdot 100$ *. The Change from the year 2000 to 2014 is the difference of the share in 2000 and 2014. The countries are sorted by the real GDP per capita in 2013.*

Table A6: Trade Partner Development, Intra-EU Trade Only (Mean Over 2000-2014)

	(1) $TPD_i^{p,x}$	(2) $TPD_i^{c,x}$	(3) $TPD_i^{f,x}$	(4) $TPD_i^{o,x}$	(5) $TPD_i^{p,m}$	(6) $TPD_i^{c,m}$	(7) $TPD_i^{f,m}$	(8) $TPD_i^{o,m}$
AUT	.769	.782	.75	.743	.778	.84	.83	.794
BEL	.877	.89	.893	.939	.897	.918	.912	.964
BGR	7.14	7.675	6.154	6.299	7.384	7.312	7.208	6.304
CYP	.912	1.144	1.105	1.14	1.277	1.234	1.254	1.183
CZE	2.343	2.205	2.133	2.089	2.426	2.329	2.311	2.135
DEU	.819	.843	.812	.852	.765	.832	.839	.869
DNK	.663	.665	.675	.698	.686	.678	.708	.699
ESP	1.185	1.203	1.14	1.204	1.303	1.281	1.284	1.285
EST	3.231	2.684	2.823	2.925	3.185	3.082	3.068	2.767
FIN	.81	.806	.79	.824	.838	.885	.89	.874
FRA	.851	.869	.841	.872	.894	.905	.911	.905
GBR	.899	.925	.904	.938	.914	.895	.914	.919
GRC	1.036	1.099	1.089	1.288	1.568	1.512	1.532	1.496
HUN	3.228	2.893	3.073	2.846	3.238	3.073	3.199	2.889
IRL	.707	.736	.775	.737	.747	.747	.744	.751
ITA	.964	1.003	.937	.977	1.046	1.081	1.062	1.034
LTU	3.211	2.866	3.151	3.02	3.929	3.585	3.609	3.197
LUX	.38	.375	.392	.398	.405	.396	.421	.411
LVA	3.53	2.956	3.225	3.155	3.67	3.478	3.605	2.929
MLT	1.907	1.987	1.913	1.896	1.868	1.915	1.846	1.85
NLD	.763	.766	.763	.783	.788	.808	.806	.789
POL	3.725	3.687	3.404	3.412	3.733	3.585	3.667	3.553
PRT	1.737	1.687	1.593	1.659	1.68	1.642	1.636	1.613
ROU	6.647	6.274	6.354	6.007	6.555	6.519	6.427	5.853
SVK	3.229	3.011	2.66	2.6	2.917	2.952	2.851	2.564
SVN	1.722	1.782	1.614	1.575	1.728	1.76	1.751	1.629
SWE	.733	.771	.745	.758	.748	.753	.762	.773

Trade Partner Development is defined as described in equation 3.1 on page 64.

Table A7: Gravity Estimations for Exports

	(1) Parts	(2) Components	(3) Final Goods	(4) Other Goods	(5) Total Exports	(6) Parts	(7) Components	(8) Final Goods	(9) Other Goods	(10) Total Exports
Distance	-1.741***	-1.578***	-1.687***	-1.782***	-1.783***	-1.754***	-1.574***	-1.691***	-1.780***	-1.782***
	(0.085)	(0.091)	(0.072)	(0.065)	(0.065)	(0.085)	(0.091)	(0.072)	(0.065)	(0.065)
Contiguity	0.060	0.183	0.121	0.128	0.111	0.060	0.181	0.119	0.127	0.110
	(0.175)	(0.185)	(0.149)	(0.137)	(0.136)	(0.175)	(0.185)	(0.149)	(0.137)	(0.136)
Common Language	0.859***	0.880***	0.836***	0.810***	0.800***	0.861***	0.884***	0.838***	0.810***	0.800***
	(0.098)	(0.106)	(0.082)	(0.074)	(0.074)	(0.098)	(0.106)	(0.082)	(0.074)	(0.074)
(Y(i)-Y(j))*D^(+)	1.073***	-0.297*	0.376**	-0.608	-0.247					
	(0.192)	(0.156)	(0.165)	(0.396)	(0.398)					
(Y(i)-Y(j))*D^(-)	0.821***	-0.457***	0.193	-0.612	-0.358					
	(0.204)	(0.171)	(0.173)	(0.400)	(0.402)					
|Y(i)-Y(j)|						0.156***	0.062	0.099***	-0.001	0.054*
						(0.039)	(0.041)	(0.033)	(0.030)	(0.030)
Constant	20.230***	20.286***	21.719***	26.485***	26.027***	22.063***	19.585***	22.288***	25.275***	25.427***
	(0.815)	(0.824)	(0.695)	(0.965)	(0.967)	(0.725)	(0.771)	(0.612)	(0.560)	(0.558)
Observations	4,381	4,194	4,597	4,843	4,851	4,381	4,194	4,597	4,843	4,851
R-squared	0.853	0.833	0.880	0.908	0.911	0.852	0.832	0.880	0.908	0.911

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; estimations performed as detailed in the text.

Table A8: Gravity Estimations for Imports

	(1) Parts	(2) Components	(3) Final Goods	(4) Other Goods	(5) Total Imports	(6) Parts	(7) Components	(8) Final Goods	(9) Other Goods	(10) Total Imports
Distance	-1.467***	-1.463***	-1.593***	-1.802***	-1.826***	-1.471***	-1.465***	-1.597***	-1.802***	-1.826***
	(0.100)	(0.101)	(0.094)	(0.095)	(0.099)	(0.100)	(0.101)	(0.094)	(0.095)	(0.099)
Contiguity	0.416**	0.416**	0.342*	0.011	-0.063	0.418**	0.415**	0.341*	0.012	-0.062
	(0.202)	(0.200)	(0.192)	(0.200)	(0.209)	(0.202)	(0.200)	(0.192)	(0.200)	(0.209)
Common Language	0.519***	0.412***	0.591***	0.807***	0.869***	0.516***	0.411***	0.594***	0.807***	0.869***
	(0.119)	(0.126)	(0.112)	(0.108)	(0.113)	(0.119)	(0.126)	(0.112)	(0.108)	(0.113)
(Y(i)-Y(j))*D^(+)	0.485*	0.284	0.616**	0.562	0.626					
	(0.259)	(0.266)	(0.275)	(0.575)	(0.602)					
(Y(i)-Y(j))*D^(-)	0.176	0.137	0.241	0.388	0.383					
	(0.271)	(0.277)	(0.283)	(0.582)	(0.610)					
|Y(i)-Y(j)|						0.162***	0.078	0.193***	0.090**	0.125***
						(0.049)	(0.051)	(0.044)	(0.043)	(0.045)
Constant	16.887***	16.357***	17.608***	22.995***	23.102***	17.479***	16.715***	18.398***	23.928***	24.092***
	(0.965)	(0.960)	(0.944)	(1.395)	(1.460)	(0.845)	(0.846)	(0.795)	(0.814)	(0.852)
Observations	3,752	3,407	4,037	4,813	4,817	3,752	3,407	4,037	4,813	4,817
R-squared	0.854	0.847	0.874	0.871	0.871	0.854	0.847	0.874	0.871	0.871

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; estimations performed as detailed in the text.

Chapter 4

Trade in Value Added and the Role of Institutions

4.1 Introduction

Institutions matter for international trade. As noted by Nunn and Trefler (2014), there has been a strong revival in studies on the determinants of comparative advantage and thus also on institutional determinants. These include formal institutions such as legal and contracting institutions, financial institutions, labor market institutions as well as informal institutions such as networks or trust. Well-developed institutions provide countries with a comparative advantage in industries that depend heavily on, e.g., a functioning legal system to enforce contractual relationships. At the same time, there is a growing understanding that with the emergence of global value chains, gross trade flows reflect only imperfectly the underlying processes, i.e., where the value that is subsequently traded is actually created. Hence, if gross trade is not proportionate anymore to the embodied value added, one might draw different conclusions on comparative advantage and its institutional determinants via the observed trade patterns.

In this study, I re-examine the evidence on the institutional determinants of comparative advantage by employing data from OECD's new Trade in Value Added (TiVA) database. Estimations are based on two frameworks of international trade models by Chor (2010)

and Tang (2012) to obtain a comprehensive picture on the role of formal institutions when it comes to comparative advantage. Both frameworks yield gravity-type equations for industry-level trade flows which are estimated contrasting gross trade and the domestic value added embodied in gross trade. Furthermore, I employ Poisson Pseudo Maximum Likelihood, established as a consistent and very robust estimator in the gravity literature.

I find that, overall, the predictions of the frameworks hold, both for gross exports and also for value added exports. Institutional settings do indeed influence the volume of exports in industries that depend more heavily on, among others, high-quality legal institutions or well-developed financial markets. These channels are also economically significant. However, I also find substantial differences in terms of economic and statistical significance. There are institutional channels such as the quality of legal institutions that appear to be significant determinants of comparative advantage when using value added exports, but they are not when using gross exports. Despite the limitations of my dataset, this finding has a potentially large implication when trying to derive policy conclusions from studies on comparative advantage. For example, apart from determining in which industries a country has a comparative advantage, results from studies on institutional factors might also influence politicians in terms of implementing policies to foster trade. If factors are then targeted that do not play a role, resources might be wasted. Thus, in times of global value chains, it seems important to have adequate measures for trade which reflect more adequately what countries actually export than gross trade flows do.

The rest of the chapter is structured as follows. In section 4.2, I briefly review the related literature, both on institutional determinants of comparative advantage and on trade in value added. Section 4.3 lays out the frameworks of Chor (2010) and Tang (2012). Section 4.4 describes the empirical approach, the estimation strategy and the dataset. In section 4.5, I present the main results, followed by section 4.6 in which I explore the robustness of my results. Section 4.7 concludes.

4.2 Related Literature

Chapter 4 is related to two different strands of literature. The first strand analyzes the institutional determinants of comparative advantage, nicely summarized in Nunn and Trefler (2014). The second strand deals with the concept of trade in value added. Since the aim of this chapter is to revisit the evidence on institutional determinants of comparative advantage in light of the value added content of trade, it seems instructive to review both strands in turn.

Institutional Determinants and Comparative Advantage

Traditional research on comparative advantage has largely concentrated on the link between technology and factor endowment and what countries produce and export. More recently, a growing literature on the importance of institutions for economic growth and development has lent its hand also to new ways of thinking about the determinants of comparative advantage, and hence, "... deeper social, political, and economic processes..." (Nunn and Trefler, 2014). Not least the empirical applications of the two frameworks this chapter is based on show that institutions matter besides technology and endowments (Chor, 2010; Tang, 2012). However, there is no clear-cut definition of what the concept of institutions entails. Even Acemoglu and Robinson (2012), who elaborate extensively on their hypothesis about which kinds of institutions lead to a sustainable economic system within a society and thus inclusive development, provide only a rough definition. This chapter will stick to what is laid out in Nunn and Trefler (2014). They distinguish between formal and informal institutions. Formal institutions include contracting and property-right institutions (Nunn, 2007; Levchenko, 2007; Ma, Qu and Zhang, 2010; Feenstra et al., 2013), the development of financial markets (Beck, 2003; Becker, Chen and Greenberg, 2013; Manova, 2013; Manova, Wei and Zhang, 2015) as well as labor market institutions

(Costinot, 2009; Tang, 2012; Cuñat and Melitz, 2012). Informal institutions include repeated interactions (Bigsten et al., 2000; Johnson, McMillan and Woodruff, 2002; Araujo, Mion and Ornelas, 2012), networks (Kolasa, 2012), as well as cultural beliefs (Guiso, Sapienza and Zingales, 2009; Tabellini, 2008). Empirically, tests for the importance of such institutional factors are generally implemented by including an interaction term between a variable reflecting the dependence of a certain industry on functioning institutions and a variable reflecting the quality of the institutions in question in a certain country. Due to difficulties in measuring informal institutions and all the more so an industry's dependence on them, this chapter concentrates on formal institutions.

In their seminal studies, both Nunn (2007) and Levchenko (2007) offer evidence at the country-industry level on the importance of well-developed property-right and contracting institutions, due to the well-known hold-up problem. Input suppliers make relationship-specific investments to provide customized inputs to certain final good producers. Due to the specificity, the input cannot be sold easily to other final good producers or has less value to them. Thus, there is an incentive for the final good producers to renegotiate terms once specific investments have been made. Assuming input suppliers anticipate the potential hold-up, they may provide lower than optimal amounts of such specific investments leading to higher production costs. Well-developed contracting institutions effectively reduce the risk of running into a hold-up problem and should thus provide countries that offer better contract enforcement with a comparative advantage. The difference between the two studies lies in the specification of the measure of contractual dependence. Here, Levchenko (2007) offers a broader view in that he also takes into account the complexity of a good, measured by the number of inputs needed. The more inputs a production process relies on, the more producers would be hurt by low-quality institutions. Ma, Qu and Zhang (2010) confirm these findings at the firm level, while Feenstra et al. (2013) offer intra-national evidence on these issues.

Financial markets also play an important role, and there are various possibilities how their development might influence comparative advantage. The general argument is that credit market imperfections affect different industries differently. Exports require up-front payments, mostly in the form of fixed costs. These are argued to be higher in countries in which financial markets are less developed and in industries that are more differentiated according to the well-known Rauch (1999) classification (Becker, Chen and Greenberg, 2013). Much of the empirical literature is based on the seminal work of Rajan and Zingales (1998), who show that output in industries that heavily depend on the availability of external finance is higher in countries in which financial markets are well-developed. Again, the measure of interest is an interaction between an industry's dependence of external finance and the degree of development of financial markets in a country. Further evidence can be found in Manova (2008). There is also a more recent strand of literature based on heterogeneous firm models, including different modes of entry into a foreign country (e.g., Manova, 2013; Manova, Wei and Zhang, 2015). However, due to the aggregate nature of the data used in this chapter, these issues are not explored further. Finally, there is also a considerable number of studies tackling the importance of labor market institutions for comparative advantage. One basic argument is laid out in Costinot (2009), describing the inherent trade-off in task specialization in production. To produce a good, there are a number of tasks to be performed that require fixed training costs for the workers, implying scale returns. Thus, the more workers can specialize, the higher the benefits are. In turn, workers have to bring non-contractible effort into work, and goods can only be produced if all tasks are performed. Therefore, firms have to incur monitoring costs. This also means that the more tasks there are in the production process of one good, the higher are the monitoring costs and the lower the probability that the production process is successful. Higher-quality institutions improve firms' abilities to monitor their workers and possibly reduce monitoring costs. Thus, countries have a comparative advantage in

the production of more task-specialized, complex goods if workers can be monitored to a higher degree than elsewhere. The empirical implementation features an interaction term between the complexity of a good aggregated to the industry level and the rule of law as a proxy for effective monitoring capabilities. The difference between Costinot's (2009) complexity measure and the ones used by Nunn (2007) and Levchenko (2007) will be further described in section 4.4. Another dimension of how labor market institutions can affect comparative advantage is studied by Tang (2012). Workers acquire firm-specific skills while performing a specific job in a specific company. More protective labor laws, implying a lower probability to be fired, increase the incentives for a worker to acquire more firm-specific skills compared to general skills. Thus, a country with more protective labor laws has a comparative advantage in industries that require more firm-specific skills.

Yet another dimension, i.e. how the flexibility of labor laws affects comparative advantage, is explored in Cuñat and Melitz (2012). Their argument is based on firm-specific shocks. The more flexible the labor laws in a certain country are, the better firms in this country can react to firm-specific shocks by hiring or firing. Thus, a country with greater flexibility in its labor law has a comparative advantage in industries more prone to shocks.

Chor (2010) puts these various dimensions of how institutions affect comparative advantage together. He finds that all of them matter. However, he misses the channel explored in Tang (2012). Thus, one of the contributions of this chapter is to include this channel into a broader model. The next section links comparative advantage to the issue of gross trade versus trade in value added.

Comparative Advantage and Trade in Value Added

All models and studies mentioned above seek to explain observed patterns of international trade. More specifically, in the context of this chapter, trade patterns are determined by

institutional factors that influence comparative advantage. Hence, if the theoretical models are correct, observed trade patterns should give an adequate view on which countries have a comparative advantage in producing and exporting certain goods based on institutional factors. However, all of these papers use gross trade flows as the dependent variable. In times of globalized supply chains, gross trade flows provide only a very rough proxy as to what is actually exported by a country. As Johnson (2014) notes: "... gross trade is an increasingly misleading guide to how value added is exchanged between countries." This has key implications for the analysis of international trade, certainly with respect to the role of comparative advantage in trade and trade policy.

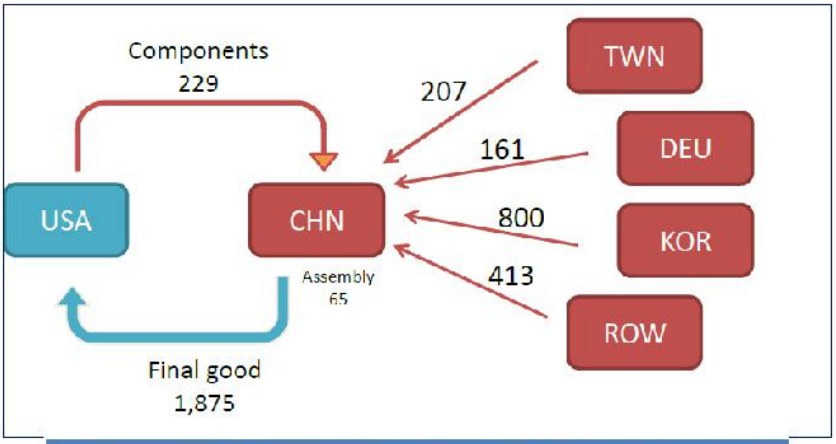
Early attempts to formalize the globalization of production can be found in Leontief (1963), while Sanyal and Jones (1982) noted already in the 1980's that a large part of international trade flows contained intermediate products that already contained value-added, and were thus not raw materials and primary inputs. De Backer and Miroudot (2013) observe that nowadays trade in intermediate goods and services makes up 56% and 70%, respectively. The key concept is that of a global value chain (GVC) and it falls in line with the more recently termed "Globalisation's second unbundling" (Baldwin, 2006*a*). Production is not organized any longer purely within a certain industry, but a mixture of primary and intermediate goods as well as services is used to obtain a final product. The process of the development of true GVC has in large part been driven by a significant decrease in trade costs. Most notable among the factors that have greatly increased trade in goods were concerted efforts to reduce tariff and non-tariff barriers via the WTO and bilateral and regional trade agreements as well as decreasing transport costs mainly due to the container revolution.[1] These developments have fostered an increasing international fragmentation in production. More recently, especially relevant to services, the so-called ICT revolution, a large drop in information and communications technology cost, has

[1]For a recent analysis, see Bernhofen, El-Sahli and Kneller (2013).

further increased the possibilities to organize and facilitate production across borders. A nice summary of this process can be found in Baldwin and Lopez-Gonzalez (forthcoming).

To illustrate the relevance for the analysis conducted here, consider the now famous example of the production of the iPhone (see, e.g., Xing and Detert, 2010).[2] The final assembly takes place in China from where iPhones are subsequently exported.

Figure 4.1: Value Added in iPhone Production and Balance of Trade



US trade balance in iPhones with:	CHN	TWN	DEU	KOR	ROW	World
Gross	-1,646	0	0	0	0	-1,646
Value added	-65	-207	-161	-800	-413	-1,646

Source: OECD (2012)

Figure 4.1 displays the situation with a numerical example. Intermediate parts and components are sourced from companies based in Japan, Korea, Germany and the US. According to the authors' calculations, only about 3 to 4% of the total value in the production process is actually added in China. This does not only have sizable effects on the trade balance,[3,4] but also for studying comparative advantage, especially since these studies are mostly based on aggregated data. The OECD (2012) notes three main problems with gross trade

[2]Other such examples can be found in Linden, Kraemer and Dedrick (2009) and Kraemer, Linden and Dedrick (2011) concerning the iPod and iPad, respectively.

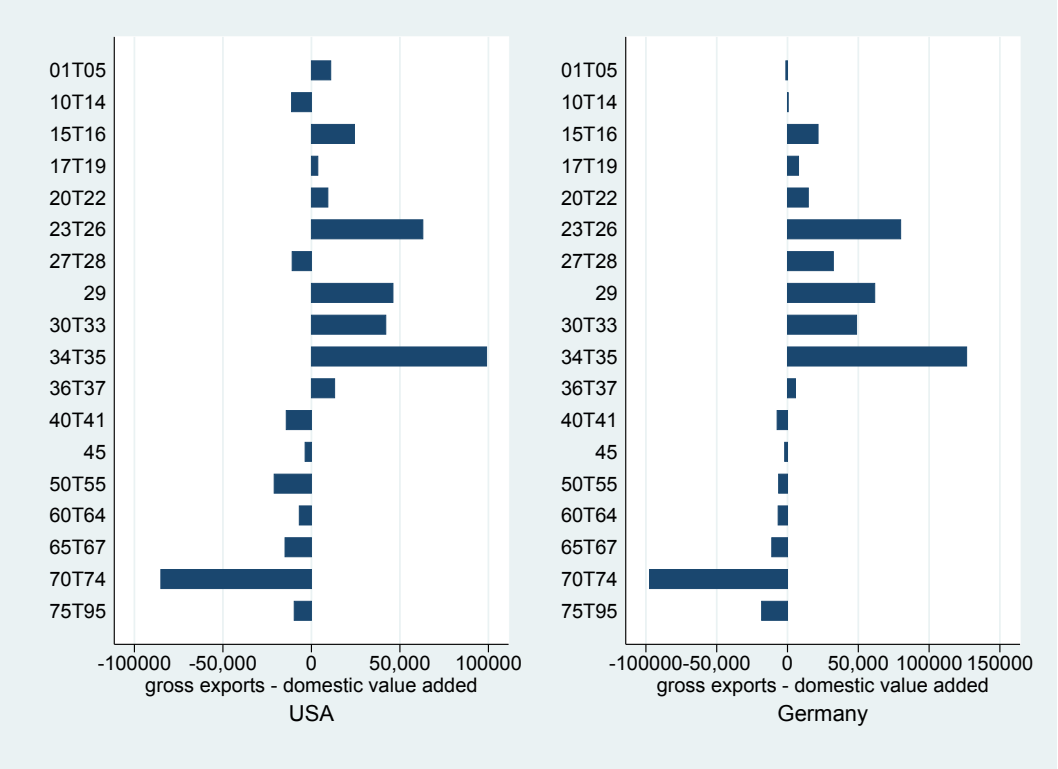
[3]Xing and Detert (2010) calculate that China's trade surplus with the US in iPhones would have been reduced from US$ 1,901.2 million in gross terms to US$ 73.45 million when considering value added.

[4]According to the OECD (2012), this is not even the full story, since though the companies providing the intermediate inputs might be headquartered in Germany or Korea, they also have production facilities in China or other countries. Thus, the picture is even more complicated.

flows. Firstly, intermediate goods and services are implicitly counted multiple times, i.e., every time a good or a service further down the supply chain crosses a border. Thus, the importance of trade is overstated. Secondly, it is difficult to identify the real contribution to an economy's well-being. Moreover, gross trade statistics do not necessarily reveal the sectors in which value added originates. Thirdly, even value added might not provide the full picture of the importance of trade to an economy when it is part of multinational firm activities, where profits might be repatriated, etc. The second problem is most relevant in the context of studying comparative advantage. If gross trade flows do not reveal where value added originates, it is difficult to draw conclusions on competitiveness, which lies at the heart of the concept of comparative advantage. For example, Koopman et al. (2010) calculate revealed comparative advantage for the business service sector in India. When using official gross trade flow data, their result indicates that this is a comparative advantage sector. However, when using value added data, the same sector becomes a disadvantage sector. This example illustrates that empirical studies on comparative advantage might actually be problematic when using gross trade flows. In the context of this chapter, it is not clear a priori whether the results on the importance of institutional factors in determining comparative advantage from Chor (2010) and Tang (2012) hold when considering the exported value added instead of gross exports. If China exports a lot of iPhones, it records huge positive exports in industry 26 of the International Standard Industrial Classification (ISIC). Employing a gravity model, one tries to establish a relationship between institutional factors causing these observed flows, and thus draw conclusions on how these factors shape comparative advantage. However, if the value added by China is actually rather small, importance might be given to factors that in value added terms do not play such a role.

Figure 4.2 shows the difference between gross exports and the domestic value added as embodied in gross exports by industry for Germany and the US in 2005. It is noteworthy

Figure 4.2: Differences Between Gross Exports and Value Added for Germany and the US in Different Industries in 2005 (Mio US$).



Source: Own calculations based on data from OECD's TiVA database.

that the differences are quite large and can go either way - although in the manufacturing industries, the differences are mostly positive. This figure highlights the discrepancy between what is recorded as trade by a country and what is actually traded.

All in all, the above described issues suggest that the evidence on institutional determinants of comparative advantage should be re-evaluated. Specifically, instead of gross exports, the value added content of exports should be employed to capture more adequately what countries really export. The caveat comes with how to measure the value added that is actually exported. In general, a truly global input-output table is needed to completely decompose gross trade flows and trace all value added on the way back to its sources (Koopman et al., 2010). There have been several approaches to achieve this feat. Early attempts were based on Asian input-output tables (Koopman, Wang and Wei, 2009; Pula

and Peltonen, 2011; Wang, Wei and Yi, 2009), but could not keep track of value added flows to and from non-Asian countries. Global inter-country input-output tables based on the GTAP database improved upon these early attempts. However, since the GTAP database does not distinguish between imported intermediates and final goods in bilateral trade flows, the applicability was limited. Still, authors such as Daudin, Rifflart and Schweisguth (2011) and Johnson and Noguera (2012) used these tables, allocating proportionally gross trade flows to intermediate and final goods.

At the moment, there are four major sources for truly global input-output tables and value added trade flows: the AISHA project[5], the EXIOPOL project[6], the World Input-Output Database[7], and the OECD's Trade in Value Added (TiVA) Database (OECD, 2012)[8]. The analysis in this chapter is based on the TiVA database, since it most readily provides the necessary value added bilateral export flows for the widest number of countries. Other databases may be superior in terms of industries and products covered. However, due to aggregation necessary to match the institutional variables used in the analysis, the advantage in the number of countries outweighs the lower number of industries.

4.3 The Frameworks of Chor (2010) and the Addition of Tang (2012)

In this section, the models set up by Chor (2010) and Tang (2012) are briefly reviewed with a focus on the derivation of the estimation equations.

[5]Based at University of Sydney; see Geschke et al. (2011).
[6]It is conducted by several universities and research centers from various continents, see `http://www.feem-project.net/exiopol/index.php`.
[7]See Timmer et al. (2015).
[8]See also `http://www.oecd.org/sti/ind/measuringtradeinvalue-addedanoecd-wtojointinitiative.htm`.

The Chor (2010) framework

Chor (2010) extends the well-known Eaton and Kortum (2002) Ricardian model to the industry-level, set in a world with $j = 1, ..., J$ countries, each in which $s = 0, 1, ..., S$ industries operate. Non-tradable goods are combined in the homogeneous good industry 0, whereas the tradable industries feature differentiated products with varieties over the continuum $n^s \in [0, 1]$. A representative consumer is assumed to have the following utility function:

$$U_j = \Big(Q_{j0}\Big)^{1-\eta}\left(\sum_{s\geq 1}\Big(\int_0^1 \Big(Q_{js}\Big(n_s\Big)\Big)^{\alpha} dn_s\Big)^{\frac{\beta}{\alpha}}\right)^{\frac{\eta}{\beta}}, \quad \alpha, \beta, \eta \in (0, 1) \tag{4.1}$$

$Q_{js}(n_s)$ represents the consumption quantity of variety n_s from industry s in country j. From now on, the index s is suppressed for varieties n to simplify notation. A nested constant elasticity of substitution function is used to aggregate the utility derived from tradable goods. $\epsilon = 1/(1-\alpha) > 1$ denotes the elasticity of substitution between varieties from the same industry and $\phi = 1/(1-\beta) > 1$ the elasticity of substitution between varieties from different industries. Assuming that ϵ is greater than ϕ, varieties within the same industry are closer substitutes than varieties from different industries. A Cobb-Douglas function is used to aggregate consumption over tradable and non-tradable goods where η represents the income share spent on tradable goods. The representative consumer faces the following budget constraint:

$$Y_j = p_{j0}Q_{j0} + \sum_{s\geq 1}\Big(\int_0^1 p_{js}(n)Q_{js}(n)dj\Big) \tag{4.2}$$

with p_{j0} denoting the price of j's non-tradable good, $p_{js}(n)$ j's price for variety n from industry s and Y_j j's total income. Maximizing (4.1) subject to (4.2) yields:

$$Q_{js}(n) = \frac{\eta Y_j \big(P_{js}\big)^{\epsilon-\phi}}{\sum_{s\geq 1}\big(P_{js}\big)^{1-\phi}} p_{js}(n)^{-\epsilon} \tag{4.3}$$

as the demand for any tradable variety, where $P_{js} = \int_0^1 \big(p_{js}(n)\big)^{1-\epsilon} dj$ represents the ideal price index consumers in j face in industry s. Furthermore, the maximization yields $Q_{j0} =$

$(1-\eta)Y_j/p_{j0}$ as the demand for the non-tradable good.

Chor (2010) assumes that markets for each variety are perfectly competitive and production technology features constant returns to scale with no fixed costs such that prices are equal to average costs of production. All countries can potentially supply a variety n in a specific industry s. An exporter from a specific country i supplying a variety to country j would then charge:

$$p_{jis}(n) = \frac{c_{is}d_{jis}}{z_{is}(n)} \tag{4.4}$$

c_{is} represents the cost of producing one unit of variety n from industry s in exporting country i, $d_{jis} \geq 1$ represents iceberg trade costs while $z_{is}(n)$ represents a Ricardian productivity indicating how productive producers in i are with respect to variety n from industry s. Let $f = 0, 1, ..., F$ index production factors, w_{if} be remuneration of factor f in i and $s_{fs} \in (0, 1)$ be the share in total payments of factor f in industry s. Then, $c_{is} = \prod_{f=0}^{F}(w_{if})^{s_{fs}}$ defines unit production costs as a Cobb-Douglas aggregate over prices of all factors used in the production of variety n from industry s in country i. The assumption of constant returns to scale implies that the factor shares in each industry sum to 1. With markets being perfectly competitive, each producer is a price taker with respect to factor prices. Due to transport costs, there is generally no factor price equalization. Since factor prices are a result of endowment and therefore vary by country, the factor price terms represent Heckscher-Ohlin forces with respect to trade patterns. Furthermore, transport costs can potentially vary by industry, and it is assumed to be cheaper to ship a good directly to an importing country than shipping via a third country.

To later derive an equation that can be estimated, Chor (2010) specifies productivity for a variety n in country i and industry s as a log-linear function of observables:

$$\ln z_{is}(n) = \lambda_i + \mu_s + \sum_{(l,m)} \beta_{lm} L_{il} M_{sm} + \beta_0 \epsilon_{is}(n) \tag{4.5}$$

This function consists of two parts. The more important part for this chapter is the system-

atic one which relates productivity to industry (μ_s) and country (λ_i) fixed effects as well as to an interaction between country characteristics, L_{il} indexed by l, and industry characteristics, M_{sm} indexed by m. While the scope of this specification is not limited to the interplay of an industry's institutional dependence and a country's quality of institutions, it is especially this issue which is the main focus of the estimation. For example, countries in which financial markets are more developed have a higher productivity in industries that feature a higher dependence on external credits (e.g., Beck, 2003; Manova, 2013; Manova, Wei and Zhang, 2015), or countries where contract enforcement is insecure have a lower productivity in industries that are subject to a hold-up problem (e.g., Levchenko, 2007; Nunn, 2007). β_{lm} reflects the importance of this institutional interplay. The stochastic part $\beta_0 \epsilon_{is}(n)$ allows for possible shocks with respect to specific varieties. It reflects independent draws from a Type I extreme-value distribution with cumulative distribution function $F(\epsilon) = \exp(-\exp(-\epsilon))$. Chor's (2010) use is motivated on the one hand by a direct relation to Eaton and Kortum (2002) and on the other hand by the convenience of yielding a closed-form solution for trade flows.

The equation for the price that country j faces when buying a variety n of industry s from country i is obtained by substituting (4.5) into (4.4):

$$\ln p_{jis}(n) \;=\; \ln\Big(c_{is} d_{jis}\Big) - \lambda_i - \mu_s - \sum_{(l,m)} \beta_{lm} L_{il} M_{sm} - \beta_0 \epsilon_{is}(n) \tag{4.6}$$

Thus, the variety price increases with unit costs and trade costs. Depending on the country's productivity position with respect to the variety, the price may be increased further or may also be decreased. The stochastic term of the productivity function and its distribution along with the Type I extreme-value distribution CDF produces a distribution of prices that consumers in j face for variety n of industry s from country i:

$$G_{jis}(p) \;=\; \Pr\Big\{p_{jis}(n) < p\Big\} = 1 - \exp\Big\{-\big(c_{is} d_{jis}\big)^{-\theta} p^{\theta} \phi_{is}\Big\} \tag{4.7}$$

with $\theta = 1/\beta_0$ being an inverse productivity spread parameter and $\phi_{is} = \exp\{\theta\lambda_i + \theta\mu_s +$

$\theta \sum_{(l,m)} \beta_{lm} L_{il} M_{sm}\}$ increasing in a country's institutional interactions and the fixed effects. Now, akin to Eaton and Kortum (2002), Chor (2010) derives an expression for trade flows. Trade follows from the fact that consumers in each country buy their varieties from the producers offering the lowest prices. If $p_{js}(n) = \min\{p_{jis}(n) : i = 1, ..., J\}$ denotes the price that is paid by consumers in j for industry s's variety n, the price distribution faced by j's consumers for industry s follows as:

$$G_{js}(p) = 1 - \prod_{i=1}^{N} \Big[1 - G_{jis}(p)\Big] = 1 - \exp\Big\{ - \big(\sum_{i=1}^{N} (c_{is} d_{jis})\big)^{-\theta} \phi_{is} \Big) p^{\theta} \Big\} \tag{4.8}$$

Furthermore,

$$\pi_{jis} = \int_0^{\infty} \prod_{k \neq i} \Big[1 - G_{jis}(p)\Big] dG_{jis}(p) = \frac{\big(c_{is} d_{jis}\big)^{-\theta} \phi_{is}}{\sum_{k=1}^{N} (c_{ks} d_{jks})^{-\theta} \phi_{ks}} \tag{4.9}$$

is the probability that country i supplies variety n of industry s at the lowest price. Trade flows can now be aggregated over industries. If X_{jis} represents country i's export value to country j in industry s and $X_{js} = \sum_{i=1}^{N} X_{jis}$ represents the value of j's total consumption in industry s, then

$$\frac{X_{jis}}{X_{js}} = \frac{\pi_{jis} \int_0^{\infty} \int_0^1 p_{js}(n) Q_{js}(n) dn \; dG_{js}\big(p_{js}\big)}{\sum_{i=1}^{N} \pi_{jis} \int_0^{\infty} \int_0^1 p_{js}(n) Q_{js}(n) dn \; dG_{js}\big(p_{js}\big)} = \pi_{jis} \tag{4.10}$$

As Chor (2010) notes, one has to integrate over varieties n and the minimum price distribution G_{js} in order to evaluate country j's total consumption of industry s products. Based on Eaton and Kortum (2002), Chor (2010) shows that π_{jis} corresponds exactly to the market share of country i in country j's market for industry s products. (4.9) provides the closed-form expression, which relates this market share, and thus the exports, to country and industry characteristics as well as trade costs. Expressing (4.10) against a reference exporting country u yields:

$$\frac{X_{jis}}{X_{jus}} = \frac{\big(c_{is} d_{jis}\big)^{-\theta} \phi_{is}}{\big(c_{us} d_{jus}\big)^{-\theta} \phi_{us}} \tag{4.11}$$

Thus, country i's market share relative to that of the reference country u decreases with increasing relative costs of production and increasing relative trade barriers. In contrast,

it increases with an increasing relative productivity, as defined by the interplay of country and industry characteristics, especially with respect to institutions. A larger spread in the productivity shocks (a low θ) can still make country i the lowest cost provider of some industry s varieties. The model is closed by imposing factor market clearing with factors assumed to be perfectly mobile between domestic industries, but perfectly immobile across international borders. To do so, Chor (2010) sets factor payments across all industries equal to factor income for each factor f and country i:

$$w_{if}V_{if} \quad = \quad s_{f0}(1-\eta)Y_i + \sum_{s=1}^{S}\sum_{j=1}^{J} s_{fs}X_{jis} \tag{4.12}$$

$Y_i = \sum_{f=0}^{F} w_{if}V_{if}$, while V_{if} represents i's endowment in terms of the respective factor $f = (0, ..., F)$. Chor (2010) notes that the system of equations given by (4.12) cannot be solved analytically. However, by summing both sides of (4.12) over all factors and making use of $\sum_{f=0}^{F} s_{fs} = 1$, he obtains $\sum_{s=1}^{S}\sum_{j=1}^{J} X_{jis} = \eta Y_i$, which also implies balanced trade after some further rearrangements.

To transform this model into an estimable equation, Chor (2010) specifies (4.10) in terms of observables. Firstly, the trade cost term is parameterized by $d_{jis} = \exp\{\beta_d D_{ji} + \delta_s + \xi_{ji} + \epsilon_{jis}\}$ as a log-linear function of observable trade barriers, as well as industry fixed effects which allow trade costs to vary by industry. The error term is made up of a country-pair specific and an idiosycratic shock component, both assumed to be identically and independently distributed. Treating factor prices as an inverse function of endowments, using $s_{0s} = 1 - \sum_{f=1}^{F} s_{fs}$ and substituting both the trade cost expression and the productivity expression into (4.10) yields:

$$\begin{aligned} \ln\left(X_{jis}\right) \quad &= \quad \sum_{f=1}^{F} \theta\beta_f \left(\ln \frac{V_{if}}{V_{i0}}\right) s_{fs} + \theta \sum_{l,m} \beta_{lm} L_{il} M_{sm} - \theta\beta_d D_{ji} \\ &+ \quad I_i + I_{jk} - \theta\xi_{ji} - \theta\epsilon_{jis} \end{aligned} \tag{4.13}$$

This expression is akin to a gravity model, while the hypotheses implied by the model are straightforward. Trade costs inhibit trade between any country pair. Multilateral resistance

is explicitly taken care of by the inclusion of fixed effects. Comparative advantage is influenced through several channels. On the one hand, it is influenced by Heckscher-Ohlin forces. Countries with a higher relative endowment of a factor have a comparative advantage in industries that use this factor intensively ($(\ln V_{if}/V_{i0})s_{fs}$). Chor (2010) uses three factors: physical capital, skilled labor, and unskilled labor as the denominator V_{i0}. Countries with high-quality institutions have a comparative advantage in industries that are more dependent on these institutions ($\sum_{l,m} \beta_{lm} L_{il} M_{sm}$). Here, the importance of product market, labor market and financial market institutions is tested. The construction of the proxy measures as well as the estimation strategy are discussed in section 4.4.

The addition of Tang (2012)

The mechanism determining comparative advantage - the interplay of institutional intensity and institutional settings - can be augmented by a channel introduced in Tang (2012). Set in a multi-country open-economy model similar to Helpman, Melitz and Yeaple (2004), workers derive utility from consumption and disutility from acquiring skills. In order to be able to produce, workers in firms need to acquire general as well as firm-specific skills.[9] Labor regulation, i.e. the degree of protection, plays a crucial role. This idea is based on Blanchard and Giavazzi (2003). Labor market protection can refer to the degree of extension agreements or to rules on the right to strike. Generally, it is assumed that a higher degree of protection grants workers increased powers to bargain with owners or management over a firm's surplus, affecting the incentives of workers to acquire firm-specific skills. Since firms' productivity depends on these skills, the model thus produces an upward-sloping productivity schedule in the degree to which an industry depends on firm-specific skills. This in turn influences comparative advantage. The basic estimation equation is specified as follows:

[9] Tang (2012) abstains from including industry-specific skills, but controls for them in the empirical analysis.

$$\begin{aligned} \ln X_{ijs} &= \alpha + \beta Labor_i \times FSpec_s + \ln D_{ij} + \delta_n \ln N_{is} + \delta_p ln P_{js} \\ &+ \left(F_s + F_i + F_j\right) + u_{ijs} \end{aligned} \tag{4.14}$$

X_{ijs} denotes exports from country i to country j in industry s. $\beta Labor_i \times FSpec_s$ represents the primary variable of interest as an interaction term between industry s's dependence on firm-specific skills and the degree of labor-market protection in a country i. D_{ij} captures bilateral trade costs between countries i and j. N_{is} is the number of firms in country i and sector s, while P_{js} is the price index of industry s in importing country j. F_s, F_i, and F_j are industry, exporter, and importer dummies, respectively. Note that the price index is captured by country dummies interacted with a full set of industry dummies. All other variables are described in section 4.4.

Comparing both models, there are quite a few similarities. Both models yield estimation equations akin to gravity models which are estimated using OLS. Both also account for Heckscher-Ohlin forces, although they are only explicitly modelled by Chor (2010). He also models institutional forces more generally, while Tang (2012) concentrates on firm-specific skill intensity and labor protection. Furthermore, both explicitly derive a two-stage approach differentiating between the extensive and intensive margins of trade. However, whereas Tang (2012) bases his approach on Helpman, Melitz and Rubinstein (2008) in which fixed costs generate zero-trade flows and accordingly estimates the model using a Heckman selection procedure, Chor (2010) makes use of the productivity shocks to generate zero-trade flows. He then uses the simulated method of moments, simulating zero flows whose moments are then matched to moments of the actual data to re-estimate the underlying parameters. Due to the strong assumptions necessary for both two-stage estimations, I will concentrate on the intensive margin of trade. This issue will be further discussed in section 4.4. Another difference can be found in the dimensions of fixed effects.

Tang (2012) employs exporter, importer and sector fixed effects, while in Chor (2010), I find exporter fixed effects and importer-sector fixed effects. Although Tang's (2012) estimation equation is derived from his theoretical model, he uses importer-fixed effects and sector-fixed effects separately. In doing so, unobserved factors with an importer-sector dimension end up in the error term.[10] Thus, for the combined model, I use importer-sector fixed effects. This has the additional advantage of controlling for the average sectoral prices in the importing country modelled in Tang (2012).

Note that for both frameworks (and also the combined model), gross trade and also the domestic value added embodied in gross exports by source industry are only proxies for model-consistent trade flows, since both Chor (2010) and Tang (2012) assume market clearing and balanced trade. Still, as I argue here, value added should be the more adequate proxy when studying determinants of comparative advantage.

4.4 Data and Estimation Strategy

The preceding section yields two gravity-type equations for industry-level data. In this section, I discuss the variables proxying each part of the respective equations. Afterwards, I describe my estimation strategy in section 4.4. As already noted, the main interest lies in the interplay of institutional requirements and the quality of institutions, which determine a country's productivity position in a certain industry. Thus, the variables of interest are interactions between country and industry attributes. Additionally, both models feature Heckscher-Ohlin forces and bilateral trade cost variables.

[10] See Baldwin and Taglioni (2006) for a discussion on which kind of fixed effects should be employed in gravity models.

Domestic Value Added Embodied in Gross Exports by Source Industry

One of the main contributions of this chapter comes from introducing the *domestic value added embodied in gross exports by source industry* as the dependent variable. In principle, as argued in 4.2, this should be a superior measure for what countries actually export, i.e. in which industries they have a comparative advantage. The data is culled from the OECD's TiVA database. This database is the result of a joint OECD-WTO project launched in 2013 and contains TiVA indicators for 57 OECD and non-OECD countries for the years 1995, 2000, 2005, 2008, and 2009 for 18 industries. So how are value added exports measured? In theory, the value of any product with a value V can be decomposed into the value that is added in each country i where steps of assembly or the production of parts and components are performed: $V = \sum_i ValueAdded_i$. However, in practice it becomes much more complicated. Firstly, not only do goods crossing international borders within global supply chains overstate the importance of gross trade, but circular trade might even overstate the significance of trade in value added. Secondly, data at the level of detail necessary to decompose individual products into value added components is almost impossible to obtain (OECD, 2012). Thus, researchers have reverted to input-output tables (albeit at a much more aggregate level) in order to construct global input-output frameworks (e.g., Johnson and Noguera, 2012; Koopman, Wang and Wei, 2014; Timmer et al., 2015). Since the OECD's data is used for the present analysis, the approach is briefly described here.

National I-O tables are prepared for reference years exploiting sources such as supply and use tables, national accounts and trade statistics. Afterwards, bilateral merchandise trade data is assembled by end-use categories, also for reference years. These are adjusted for issues such as confidential flows, re-exports, waste and scrap products and valuables. Trade coefficients for services are estimated or based on OECD and UN service trade statistics. A major caveat in this step is the estimation of missing trade flows using econometric models.

Since in an international framework, mirror trade flows should match perfectly, c.i.f. based imports are converted into f.o.b. figures. Afterwards, import matrices are created using the assumption that the share of imports in any product consumed directly as intermediate consumption or final demand is the same for all users. While widely used by national statistical offices, this assumption is not trivial for developing countries, where discrepancies between the import content of exports and the import contents of products for domestic consumption are in general much higher than in developed countries, where differences are negligible. In a final step, these matrices are once more adjusted for missing sectors and trade with the rest of the world, while at the same time, remaining discrepancies are minimized. A detailed discussion can be found in OECD (2012).

This procedure yields the above described version of the TiVA database, of which the relevant indicator for the present analysis is the *domestic value added as embodied in gross exports*. I use data for the year 2005 in order to obtain results not affected by the global financial crisis. The data are based on the International Standard Industrial Classification (ISIC), Revision 3. Due to differences in recording and construction procedures of national I-O tables, some industries are aggregated. A table detailing the industries can be found in the appendix. All other industry-level variables are concorded into this classification. Naturally, due to the assumptions made and the estimations performed to arrive at these values, the analysis should be taken with a grain of salt. While the data may be less reliable than officially recorded gross trade flows, they nevertheless measure much more accurately the supply side of international trade, identifying the sources of competitiveness. Since this is at the heart of studies on comparative advantage, again, I argue that it should be preferred over the use of gross trade. Note that while this does not change the predictions of the models considered, it might still lead to different conclusions.

Independent Variables

As independent variables, the model includes standard gravity-type trade cost variables, "Heckscher-Ohlin" forces and the institutional interactions as the variables of primary interest. I adopt a common set of trade cost variables for both frameworks considered here to make results more comparable. These include bilateral distance, dummies for past colonial relationships, common language, adjacency, common legal origin, the presence of a landlocked country in a country pair, the presence of an island in a country pair, a common currency as well as membership in the same regional trade agreement. These variables are all sourced from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII).[11]

Heckscher-Ohlin Forces

As mentioned in 4.3, due to data availability issues, factor prices are treated as an inverse function of factor endowments following Romalis (2004). Thus, to capture the Heckscher-Ohlin forces, relative factor endowments are interacted with factor intensities. Physical capital intensity ($CapInt$) in an industry is measured as the log of the ratio of real capital stock to total employment. Skill intensity ($SkillInt$) is measured as the log of the ratio of non-production workers to total employment. Following the approach in Tang (2012), I also include material resource intensity ($MatInt$), measured as the log of the ratio of the value of material costs to the sum of value added and material costs. Data for these three variables come from the National Bureau of Economic Research's (NBER) and Center for Economic Studies' (CES) Manufacturing Industry Database. Note that this assumes a common factor intensity ranking for all countries. I have values for the years 1996 to 2005 at hand. Physical capital endowment ($CapEnd$) is measured as a country's log of capital stock to total employment and data for the years 1996 to 2005 is taken from the

[11] See `http://www.cepii.fr/cepii/en/bdd_modele/bdd.asp`.

Penn World Tables (PWT), version 8.0 (Feenstra, Inklaar and Timmer, forthcoming).[12] I have two different measures for relative human capital endowment ($SkillEnd$). The first is the human capital index from PWT 8.0, which is based on average years of schooling from Barro and Lee (2013) and an assumed rate of return. Data are obtained for the years 1996 to 2005. The second set of measures comes from Barro and Lee (2013) itself and represents the percentage of secondary and tertiary schooling, respectively, available for the year 2005. These two measures have been used e.g. in Kowalski (2011). Material resource endowment ($MatEnd$) is measured as the log of the estimated dollar value of the natural resources stock per worker. In this context, natural resources include crop land, pasture land, timber, non-timber forest resources, protected areas and subsoil assets. Data are culled from the World Bank's Changing Wealth of Nations database and are available for the year 2005 (World Bank, 2010).[13]

Institutional Interactions

The main variables of interest are the "institutional interactions". They are constructed as described in the original articles, albeit with data to fit the time frame for 2005 when possible. For product markets, I consider the measures from Levchenko (2007) and Nunn (2007). From Levchenko (2007), I have that countries with good contracting institutions will export relatively more in industries where production costs depend to a higher degree on the quality of these institutions. To proxy the quality of contracting institutions ($Legal$), I use the "Quality of Legal System and Property Rights Index" from the Economic Freedom of the World project (Gwartney and Lawson, 2007). It ranges from 0 - very low - to 10 - very high. The proxy for the dependence on well-developed contracting institutions ($ProdCompl$) is a Herfindahl Index of input use based on detailed United States I-O tables

[12] See `http://www.rug.nl/research/ggdc/data/pwt/pwt-8.0`.
[13] See `http://data.worldbank.org/data-catalog/wealth-of-nations`.

from 2002[14] provided by the United States Bureau of Economic Analysis (US BEA).[15] It has also been used to proxy for product complexity and institutional dependence by Blanchard and Kremer (1997) and Cowan and Neut (2007). Its use is preferable to just counting the number of intermediates to account for possible concentration, since the scope for hold-up is arguably much lower when a producer only purchases small amounts of inputs from some suppliers. To obtain a measure that increases with the dependence on institutions, the index is multiplied by -1. Since US I-O tables are provided in their own classification, the data has to be converted first to ISIC Rev. 3 before the calculation of the Herfindahl Index. Two steps were necessary. First, a concordance table from the US BEA (see the link above) is applied to convert it to the North American Industry Classification System (version of 2002). Afterwards, a concordance table between NAICS 2002 and the 4-digit version of ISIC Rev. 3 provided by the United Nations Statistics Division (UNStats) is used.[16] If categories do not map cleanly, they are assumed to split evenly. Finally, the data is aggregated to the 2-digit level, applying the number of 4-digit categories as weights if necessary. It is important to note that this procedure imposes the same complexity ranking on all countries in the sample. While not being a trivial assumption, I-O tables accessible for other countries are not detailed enough to allow meaningful calculations. The same drawback also applies to the other industry-level indicators.

From Nunn (2007), there is a similar argument with a different measure of contract intensity. As described in 4.2, the scope for hold-up and thus the dependence on well-developed contracting institutions is higher for more relationship-specific investments. The proxy for relationship specificity ($RelSpec$) is based on the Rauch (1999) classification.[17] Goods are classified into three categories according to their degree of differentiation.[18] Due

[14] Since the next version of I-O tables covers the year 2007, this is the most appropriate version available.
[15] See `http://www.bea.gov/industry/io_benchmark.htm#2002data`.
[16] See `http://unstats.un.org/unsd/cr/registry/regot.asp?Lg=1`.
[17] See `http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/TradeData.html`.
[18] Category 1: Goods that are sold on an organized exchange; category 2: Goods that have a reference price;

to ambiguity issues, Rauch (1999) provides a "conservative" and a "liberal" classification. In the former, the number of goods that are classified as either being sold on an organized exchange or reference priced are minimized, while in the latter the number is maximized. Nunn (2007) argues that investments for differentiated goods are relationship-specific, as other goods are possibly traded in markets with many buyers and sellers. Thus, to obtain the degree of relationship specificity, I follow Nunn's (2007) procedure in calculating for each output the share of differentiated inputs based on 2002 US I-O tables and the Rauch (1999) classification. Afterwards, the same steps as described above are applied to convert the measure to ISIC Rev. 3. The default variable in the analysis is based on the "liberal" Rauch (1999) classification and it is assumed that only differentiated goods are relationship-specific. Furthermore, I take the mean to aggregate from 4-digit to 2-digit ISIC Rev. 3. This measure is also interacted with the quality of the legal system index described above.

To test the importance of well-developed financial markets, an interaction between the industry dependence on external finance ($FinDep$) and the quality of financial markets ($FinDev$) in a country is included. Rajan and Zingales (1998) measure a firm's dependence on external finance as the fraction of total capital expenditures not financed by internal cash flows. These firm-level data are usually culled from the Compustat database and then aggregated to the desired industry level. Unfortunately, I do not have access to Compustat. Thus, I employ data from three different sources, Hattendorff (2012), Aizenman and Sushko (2011), and Kroszner, Laeven and Klingebiel (2007). Hattendorff (2012) provides average data for the original version of Rajan and Zingales (1998) for the years 1980 to 1989 as well as two slightly modified versions for the years 1990 to 2009. Aizenman and Sushko (2011) present average data for the original measure as well as a slight modification for the years 1990 to 2007. In Kroszner, Laeven and Klingebiel (2007), aver-

category 3: Differentiated goods, i.e. those that do not fall under 1 or 2.

age data for the original measure are available for the years 1980 to 1999. The measures from all three sources are originally presented at the 3-digit/4-digit ISIC Rev. 2 level. They are converted to ISIC Rev. 3 using the same concordance tables provided by UNStats mentioned above. If ISIC Rev. 2 categories do not map cleanly into ISIC Rev. 3, the values are considered for all potential ISIC Rev. 3 categories. All values are then aggregated to the 2-digit level. Data on the development of financial markets are taken from Beck, Demirgüç-Kunt and Levine (2010) for the years 1996 to 2005. There are three potential measures, private credit by deposit money banks as a percentage of GDP, private credit by deposit money banks and other financial institutions as a percentage of GDP, and the ratio of bank credit to bank deposits. I use private credit by deposit money banks and other financial institutions as a percentage of GDP as the default.

Next in line are labor market institutions. Firstly, I consider the job complexity measure ($JobCompl$) from Costinot (2009). Here, the argument is that well-developed institutions are necessary in order to guarantee effective monitoring of workers in highly task-specialized production processes. The measure is constructed to reflect the training costs necessary for a particular job. These are proxied by using response data from the 1985 and 1993 waves of the Panel Study of Income Dynamics (PSID).[19] In these waves, participants were asked the question "Suppose someone had the experience and education needed to start working at a job like yours. From that point, how long would it take them to become fully trained and qualified (to do a job like yours)?" Based on these data, an index normalized to a maximum value of 1 is calculated at the 3-digit Standard Industrial Classification (SIC) 1972 level. Again, this warrants a conversion procedure. Firstly, the data is mapped into 4-digit SIC 1987 categories using a concordance table provided by the National Bureau of Economic Research.[20] Afterwards, the resulting dataset is mapped into

[19] See `https://psidonline.isr.umich.edu/`.
[20] See `http://www.nber.org/nberces/`.

2-digit ISIC Rev. 3 categories using a concordance table provided by Eurostat.[21] As before, if no clean mapping is possible, index values are considered for all potential categories. Subsequent aggregation is performed using either the mean or the median. To explore the argument that a good contracting environment provides a comparative advantage in industries with a greater division of labor, this index is also interacted with the legal quality index. To test the further implication that countries with a more highly skilled workforce are also more able to export more complex products, the job complexity measure is also interacted with countries' relative endowment with high-skilled workers.

Lastly, to also test for the argument made in Tang (2012), I include the interaction between the industry-specific requirements of firm-specific skills ($FSpec$) and the degree of labor market protection in a country ($Labor$). The firm-specific skill intensity is proxied by returns to firm tenure. To this end, Tang (2012) estimates a Mincer wage equation based on PSID data from 1974 to 1993. To ensure comparability, only males aged 21 to 60 working a minimum of 500 hours per year and earning a real hourly wage rate (in 1990 USD) of at least USD 2 are included. The estimates are then normalized to a maximum value of 1. Again, the data are classified according to the SIC 1987 classification. Therefore, the same concordance table and procedure as described above is used to convert the data into ISIC Rev. 3. Furthermore, the same aggregation procedure based on either the mean or the median is applied. Data on the degree of protection in the labor market come from Campos and Nugent (2012). Their index of labor market rigidity (LAMRIG) ranges from 0 to 3.5, where higher values indicate more protective labor laws.

In total, I have data for 31 OECD and 24 non-OECD countries as exporters, 56 countries as importers and 18 industries, potentially yielding 55,440 observations. However, some of the industry-level measures are only available for manufacturing and a subset of service industries, some are available purely for manufacturing industries.[22] Additionally, some

[21] See `http://ec.europa.eu/eurostat/ramon/relations/index.cfm?TargetUrl=LST_REL`.
[22] Tables listing the countries included and displaying the availability of indicators are shown in the appendix.

country-level variables are missing completely for certain countries.[23] Therefore, the sample is restricted to those observations where there are no missing values, the number varying depending on the specification. For the combined model, this leaves me with a total of 25,800 observations.

Finally, it is important to note that since the data are only for OECD countries and some non-OECD emerging countries, odds are stacked much more against finding significant impacts of institutions than if I had a full sample also containing most developing countries. Of course, this issue applies to gross trade flows as well as value added, so it does not matter that much in terms of comparability. Still, it should be borne in mind when interpreting the results.

Estimation Strategy

As the restrictions on data for value added embodied in gross exports leaves us with a sample much smaller than in Chor (2010) and Tang (2012), the first step in my analysis is to re-estimate both equations using gross trade flows as the dependent variable to obtain a benchmark. Afterwards, I repeat the estimations, this time with value added as the dependent variable. Following this procedure, I can compare the direction, significance as well as the magnitude of the estimated coefficients. In a final step, I combine both models to scrutinize all institutional channels simultaneously.

Regarding the choice of estimator, there is a huge literature on the estimation of gravity models with a multitude of estimators to choose from. An extensive overview of most estimation methods and their advantages and disadvantages can be found in Head and Mayer (2014). I start out using OLS, as is standard in the gravity literature. While allowing for an easy interpretation of most coefficients as elasticities, it does not come without its costs.

[23] Countries for which variables are missing include Brunei, Chile, Israel, Cambodia, Lithuania, Luxembourg, Latvia, Romania, and Saudi Arabia.

Firstly, it requires an extensive set of dummy variables to consistently capture multilateral resistance (see e.g., Baldwin and Taglioni, 2006), though this is also true for most other estimators. Fortunately, these are already warranted due to the theoretical derivations in this case. Furthermore, the OLS estimator suffers from heteroskedasticity bias with a log-linear estimation equation as is also the case here. This issue has been brought up by Santos Silva and Tenreyro (2006). Lastly, due to log-linearization, zero-trade flows are omitted. Zeroes may appear in the dataset for two reasons. On the one hand, small trade flows could have been rounded to zero or they may not have been reported. On the other hand, zeroes may be real in the sense that there was just no trade in a certain industry between a country pair. Since trade data comes from the OECD and is mostly recorded by developed and emerging countries, it is more likely that the zeroes in my dataset are true. This also implies that ad-hoc fixes like adding 1 to the trade flows or applying a simple Tobit estimator will probably not alleviate the problem much. In this case, the share of zeroes ranges from 10% to 14% for gross exports and from 8% to 10% for value added exports. Therefore, I will use the Poisson Pseudo Maximum Likelihood (PPML) estimator developed by Santos Silva and Tenreyro (2006) which has been established in the literature as one of the most consistent and also most widely employed estimators for gravity models (Santos Silva and Tenreyro, 2011; Head and Mayer, 2014). It has the additional advantage of also being immune to the heteroskedasticity problem, while only requiring weak distributional assumptions. Of course, relying on the PPML estimator does not allow me to distinguish between the extensive and the intensive margin of trade. However, dealing with both simultaneously is still a controversial issue and two-stage procedures a la Helpman, Melitz and Rubinstein (2008) rely heavily on strong distributional assumptions, especially homoskedasticity. Since these are very seldom fulfilled and results are very sensitive to departures (Santos Silva and Tenreyro, 2015), I only use a Heckman selection similar to Tang's (2012) as a robustness check. An additional advantage the

PPML estimator has over, e.g. Probit, Tobit or Heckman selection estimators stems from the fact that the Poisson estimator is one of only a few non-linear maximum likelihood estimators that does not suffer from an incidental parameters problem when including unconditional fixed effects (Greene, 2004). Random-effects estimation would alleviate this problem, but at the cost of suffering again from strong assumptions that are hardly ever met with country- and sector-specific unobserved heterogeneity. The drawback of the PPML estimator is that I depart from estimating the models structurally, since it assumes a non-standard distribution of the regression error terms.

Summing up, the following equations are estimated:

$$\begin{aligned} \ln X_{ijs} &= \alpha + \beta_p D_{ij} + \delta_t FactorEndowment_i \times FactorIntensity_s \\ &+ \xi_v Institution_i \times Dependence_s + \left(F_i + F_{js}\right) + u_{ijs} \end{aligned} \tag{4.15}$$

which comes from the framework of Chor (2010). D_{ij} is specified as:

$$\begin{aligned} D_{ij} &= \beta_1 \ln Distance_{ij} + \beta_2 Colony_{ij} + \beta_3 CommonLanguage_{ij} \\ &+ \beta_4 CommonBorder_{ij} + \beta_5 CommonLegalOrigin_{ij} + \beta_6 CommonCurrency_{ij} \\ &+ \beta_7 RTAmembers_{ij} + \beta_8 AnyLandlocked_{ij} + \beta_8 AnyIsland_{ij}; \end{aligned} \tag{4.16}$$

$FactorEndowment_i \times FactorIntensity_s$ as:

$$\begin{aligned} FactorEndowment_i \times FactorIntensity_s &= \delta_1 SkillInt_s \times SkillEnd_i \\ &+ \delta_2 CapInt_s \times CapEnd_i; \end{aligned} \tag{4.17}$$

and $Institution_i \times Dependence_s$ as:

$$\begin{aligned} Institution_i \times Dependence_s &= \xi_1 ProdCompl_s \times Legal_i + \xi_2 RelSpec_s \times Legal_i \\ &+ \xi_3 JobCompl_s \times Legal_i + \xi_4 JobCompl_s \times SkillEnd_i \\ &+ \xi_5 FinDep_s \times FinDev_i. \end{aligned} \tag{4.18}$$

$$\begin{aligned} \ln X_{ijs} &= \alpha + \beta Labor_i \times FSpec_s + \ln D_{ij} + \delta FactorEndowment_i \times FactorIntensity_s \\ &+ \gamma_p lnP_{js} + \left(F_s + F_i + F_j\right) + u_{ijs} \end{aligned} \tag{4.19}$$

which comes from the framework of Tang (2012).[24] Trade costs (D_{ij}) are specified as in equation 4.16, and Heckscher-Ohlin forces include an interaction between material resource intensity and material resource endowment.

Finally, the combined estimation equation is similar to equation 4.15, but now includes the interactions of $Labor_i \times FSpec_s$ and $MatEnd_i \times MatInd_s$. Each equation is estimated with X_{ijs} as gross exports and afterwards with X_{ijs} as value added exports.

4.5 Estimation Results

As already noted, I start out by estimating both the model of Chor (2010) and Tang (2012) separately, once using gross exports and once using value added exports as the dependent variable, and combining them afterwards. OLS results for the model of Chor (2010) are displayed in table 4.1. Columns (1) and (2) show results for a model which only includes trade cost variables. In columns (3) and (4), Heckscher-Ohlin forces are added. Afterwards, each institutional channel is examined in turn, while columns (13) and (14) show results for the full model.

Overall, the models yield an encouraging fit, with R^2 values ranging from 0.645 to 0.783. Differences between the fit of gross exports and that of value added exports are small, but on average, the fit for value added exports appears to be better, especially for the combined model. The trade cost variables show the expected signs and are of reasonable magnitude compared to a meta study of gravity estimations conducted in Head and Mayer (2014).

[24] Note that due to a lack of data, the number of firms in exporting country i and industry s could not be included.

Table 4.1: OLS Results for Chor Framework

	(1) Gross Trade	(2) Value Added	(3) Gross Trade	(4) Value Added	(5) Gross Trade	(6) Value Added	(7) Gross Trade	(8) Value Added	(9) Gross Trade	(10) Value Added	(11) Gross Trade	(12) Value Added	(13) Gross Trade	(14) Value Added
Distance	-0.8930***	-0.8795***	-0.9568***	-0.9077***	-0.9888***	-0.9387***	-0.9895***	-0.9389***	-1.0159***	-0.9310***	-0.9779***	-0.9175***	-1.0278***	-0.9448***
	(0.029)	(0.030)	(0.032)	(0.031)	(0.032)	(0.032)	(0.032)	(0.032)	(0.035)	(0.033)	(0.033)	(0.032)	(0.036)	(0.034)
Colony	0.4153***	0.3676***	0.4261***	0.3794***	0.4292***	0.3708***	0.4315***	0.3711***	0.4507***	0.3886***	0.4413***	0.3951***	0.4603***	0.3942***
	(0.079)	(0.089)	(0.085)	(0.091)	(0.087)	(0.093)	(0.088)	(0.093)	(0.096)	(0.094)	(0.088)	(0.092)	(0.097)	(0.095)
Common Language	0.0738	0.0881	0.0661	0.0901	0.0682	0.0901	0.0704	0.0910	0.0571	0.0816	0.0552	0.0676	0.0468	0.0681
	(0.062)	(0.065)	(0.070)	(0.069)	(0.070)	(0.069)	(0.070)	(0.069)	(0.077)	(0.072)	(0.072)	(0.070)	(0.078)	(0.073)
Common Border	0.5203***	0.4845***	0.5017***	0.4828***	0.4955***	0.4899***	0.4957***	0.4889***	0.4802***	0.4808***	0.5050***	0.4788***	0.4731***	0.4743***
	(0.080)	(0.086)	(0.083)	(0.087)	(0.083)	(0.085)	(0.083)	(0.085)	(0.091)	(0.087)	(0.086)	(0.088)	(0.092)	(0.087)
Common Legal Origin	0.3006***	0.3091***	0.3240***	0.3058***	0.3139***	0.3046***	0.3143***	0.3048***	0.3241***	0.3079***	0.3241***	0.3143***	0.3213***	0.3071***
	(0.034)	(0.034)	(0.037)	(0.036)	(0.038)	(0.037)	(0.038)	(0.037)	(0.040)	(0.037)	(0.038)	(0.036)	(0.041)	(0.038)
Common Currency	-0.0285	-0.1437**	-0.0556	-0.1203*	-0.0660	-0.1401**	-0.0683	-0.1389**	-0.0338	-0.0865	-0.0562	-0.1205*	-0.0340	-0.0862
	(0.060)	(0.060)	(0.063)	(0.062)	(0.064)	(0.062)	(0.064)	(0.062)	(0.069)	(0.064)	(0.065)	(0.062)	(0.070)	(0.065)
RTA members	0.1545***	0.1598***	0.2723***	0.2396***	0.2894***	0.2501***	0.2899***	0.2507***	0.3502***	0.3069***	0.2614***	0.2297***	0.3262***	0.2758***
	(0.052)	(0.054)	(0.056)	(0.056)	(0.057)	(0.057)	(0.057)	(0.057)	(0.062)	(0.059)	(0.057)	(0.057)	(0.063)	(0.059)
Any Landlocked	-0.3176**	-0.3522***	-0.2325*	-0.3470***	-0.2128	-0.3167***	-0.2125	-0.3175***	-0.2199*	-0.3066**	-0.2225*	-0.3190***	-0.2218*	-0.2954**
	(0.130)	(0.122)	(0.130)	(0.122)	(0.129)	(0.121)	(0.129)	(0.121)	(0.131)	(0.121)	(0.130)	(0.123)	(0.131)	(0.121)
Any Island	-0.4831***	-0.4382***	-0.4854***	-0.4391***	-0.4588***	-0.4223***	-0.4578***	-0.4235***	-0.4498***	-0.3918***	-0.4691***	-0.4203***	-0.4424***	-0.3932***
	(0.110)	(0.124)	(0.125)	(0.130)	(0.126)	(0.131)	(0.126)	(0.131)	(0.140)	(0.135)	(0.127)	(0.130)	(0.140)	(0.135)
SkillInt x SkillEnd			0.0449***	0.0401***	0.0434***	0.0391***	0.0319***	0.0294***	0.0078*	-0.0028	0.0416***	0.0445***	0.0049	-0.0045
			(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.005)	(0.003)	(0.004)	(0.003)	(0.005)	(0.003)
CapInt x CapEnd			0.1862***	0.0157	0.1392***	-0.0220	0.3620***	0.1265***	0.3377***	0.2207***	0.2757***	0.0738***	0.3429***	0.2332***
			(0.022)	(0.016)	(0.025)	(0.018)	(0.027)	(0.019)	(0.020)	(0.017)	(0.023)	(0.017)	(0.026)	(0.021)
ProdCompl x Legal					0.6071***	1.3560***							-1.3677***	-0.4472**
					(0.229)	(0.146)							(0.351)	(0.225)
RelSpec x Legal							0.8217***	0.5805***					-0.0150	-0.0256
							(0.048)	(0.034)					(0.072)	(0.052)
JobCompl x Legal									0.0226***	0.0229***			0.0150***	0.0194***
									(0.002)	(0.002)			(0.003)	(0.002)
JobCompl x SkillEnd									0.0015***	0.0023***			0.0020***	0.0025***
									(0.000)	(0.000)			(0.000)	(0.000)
FinDep x FinDev											0.0224***	0.0162***	0.0142***	0.0060***
											(0.001)	(0.001)	(0.002)	(0.001)
Constant	9.5871***	9.8201***	1.6631	9.4945***	4.6126***	12.4889***	-9.7060***	2.1455**	-8.3439***	-3.8353***	-2.9374**	6.4713***	-8.7715***	-4.2444***
	(0.288)	(0.303)	(1.098)	(0.807)	(1.210)	(0.898)	(1.407)	(1.046)	(1.021)	(0.856)	(1.177)	(0.881)	(1.334)	(1.072)
Observations	42,935	48,394	31,544	34,422	30,375	32,852	30,375	32,852	24,625	25,201	29,314	31,173	24,272	24,760
R-squared	0.650	0.764	0.645	0.747	0.662	0.761	0.666	0.763	0.701	0.779	0.658	0.751	0.709	0.782
# of clusters	2691	2691	2691	2691	2691	2691	2691	2691	2691	2691	2691	2691	2691	2691

Standard errors clustered at the country-pair level in parentheses, estimation using exporter and importer-industry fixed effects; *** p<0.01, ** p<0.05, * p<0.1

They are also remarkably robust when adding the other variables. The Heckscher-Ohlin forces turn out mostly positive and highly significant. However, they do not maintain significance throughout all estimations. Especially in the full model, only capital endowment appears to be a significant driver of comparative advantage for capital-intensive industries. The institutional interactions are all positive and highly significant when examined individually. This holds for gross exports as well as value added. When estimating the combined model, the labor market interactions as well as the interaction capturing the dependence on external finance turn out positive and highly significant. The relationship-specificity interaction does not seem to play a role, while Levchenko's (2007) product complexity interaction is negative and significant. However, this should not be surprising since, when putting all indicators together, there may be multiple issues of multicollinearity, leading to changes in significance and even inducing sign changes. In addition, as already mentioned, one has to bear in mind that the sample only includes developed and emerging countries and the industries are quite aggregated, so the results should also be seen in light of this fact. Furthermore, by log-linearization, I have neglected zero-trade flows as well as the potential bias induced by heteroskedasticity. There are approx. 10% zeroes in the dataset, both for gross exports and for value added. Thus, I now turn to estimation by PPML.

Results are displayed in table 4.2. Overall, again, the models appear to fit the data remarkably well. A similar pattern compared to the OLS results emerges with respect to the trade cost variables. All of them display the expected sign and are of a reasonable magnitude. Most notably, the dummy for a past colonial relationship is not significant anymore, the coefficients for distance, common border and common legal origin are smaller and the coefficients for RTA membership as well as landlocked and island status are bigger.

More interesting differences arise when examining the Heckscher-Ohlin and institutional interactions. Again, only the capital interaction is positive and highly significant, while the skilled labor interaction is insignificant for value added and slightly negatively significant

Table 4.2: PPML Results for Chor Framework

	(1) Gross Trade	(2) Value Added	(3) Gross Trade	(4) Value Added	(5) Gross Trade	(6) Value Added	(7) Gross Trade	(8) Value Added	(9) Gross Trade	(10) Value Added	(11) Gross Trade	(12) Value Added	(13) Gross Trade	(14) Value Added
Distance	-0.6920***	-0.6714***	-0.7240***	-0.6877***	-0.7514***	-0.7281***	-0.7499***	-0.7268***	-0.7354***	-0.6935***	-0.7282***	-0.6948***	-0.7360***	-0.6940***
	(0.040)	(0.041)	(0.042)	(0.046)	(0.040)	(0.041)	(0.040)	(0.041)	(0.039)	(0.039)	(0.043)	(0.047)	(0.039)	(0.039)
Colony	-0.1161	-0.0928	-0.1305	-0.1033	-0.1376	-0.1195	-0.1396	-0.1226	-0.1206	-0.0992	-0.1320	-0.1039	-0.1203	-0.0988
	(0.089)	(0.088)	(0.092)	(0.090)	(0.090)	(0.088)	(0.090)	(0.089)	(0.092)	(0.090)	(0.092)	(0.091)	(0.091)	(0.090)
Common Language	0.0834	0.0877	0.0988	0.1120	0.0647	0.0689	0.0598	0.0657	0.0569	0.0674	0.0834	0.1039	0.0516	0.0630
	(0.070)	(0.073)	(0.075)	(0.080)	(0.073)	(0.075)	(0.073)	(0.075)	(0.073)	(0.074)	(0.076)	(0.081)	(0.073)	(0.074)
Common Border	0.3352***	0.3622***	0.3447***	0.3852***	0.3266***	0.3569***	0.3303***	0.3590***	0.3240***	0.3639***	0.3428***	0.3750***	0.3275***	0.3642***
	(0.060)	(0.062)	(0.063)	(0.066)	(0.061)	(0.063)	(0.061)	(0.063)	(0.062)	(0.063)	(0.062)	(0.066)	(0.062)	(0.063)
Common Legal Origin	0.1949***	0.1832***	0.2057***	0.1853***	0.2435***	0.2344***	0.2417***	0.2341***	0.2321***	0.2172***	0.2124***	0.1916***	0.2356***	0.2190***
	(0.046)	(0.048)	(0.050)	(0.055)	(0.047)	(0.048)	(0.047)	(0.048)	(0.047)	(0.048)	(0.050)	(0.056)	(0.047)	(0.048)
Common Currency	-0.0088	-0.0087	-0.0249	-0.0246	-0.0360	-0.0363	-0.0358	-0.0380	-0.0038	0.0027	-0.0344	-0.0363	-0.0067	0.0016
	(0.067)	(0.070)	(0.070)	(0.075)	(0.070)	(0.074)	(0.070)	(0.074)	(0.070)	(0.071)	(0.070)	(0.075)	(0.070)	(0.071)
RTA members	0.2690***	0.2657***	0.3751***	0.3697***	0.3174***	0.2837***	0.3198***	0.2831***	0.4536***	0.4783***	0.3807***	0.3711***	0.4522***	0.4786***
	(0.090)	(0.095)	(0.098)	(0.108)	(0.096)	(0.101)	(0.096)	(0.101)	(0.087)	(0.087)	(0.100)	(0.110)	(0.087)	(0.088)
Any Landlocked	-0.3553***	-0.3491**	-0.2942**	-0.3246**	-0.2657**	-0.2883**	-0.2655**	-0.2875**	-0.2773**	-0.3154**	-0.2845**	-0.3118**	-0.2735**	-0.3134**
	(0.137)	(0.145)	(0.136)	(0.138)	(0.134)	(0.136)	(0.135)	(0.136)	(0.135)	(0.136)	(0.136)	(0.138)	(0.134)	(0.136)
Any Island	-0.3947**	-0.4241**	-0.3879	-0.4314*	-0.4415*	-0.4907*	-0.4415*	-0.4882*	-0.2934*	-0.3149*	-0.3703	-0.4042	-0.2826*	-0.3065*
	(0.193)	(0.196)	(0.239)	(0.253)	(0.239)	(0.257)	(0.244)	(0.261)	(0.165)	(0.161)	(0.244)	(0.263)	(0.165)	(0.162)
SkillInt x SkillEnd			0.0054	0.0245***	0.0032	0.0218***	-0.0023	0.0133**	-0.0254**	-0.0051	0.0088	0.0367***	-0.0232*	-0.0036
			(0.009)	(0.006)	(0.009)	(0.006)	(0.009)	(0.006)	(0.012)	(0.009)	(0.010)	(0.008)	(0.012)	(0.009)
CapInt x CapEnd			0.3440***	0.0365	0.3197***	-0.0101	0.4439***	0.2044***	0.4060***	0.1747***	0.3668***	0.0481	0.3888***	0.2076***
			(0.062)	(0.061)	(0.063)	(0.058)	(0.065)	(0.062)	(0.045)	(0.032)	(0.058)	(0.055)	(0.053)	(0.040)
ProdCompl x Legal					0.5060	1.4191***							-0.4160	-0.5752
					(0.510)	(0.409)							(0.615)	(0.523)
RelSpec x Legal							0.5130***	0.7620***					-0.0607	0.1823*
							(0.098)	(0.095)					(0.110)	(0.105)
JobCompl x Legal									0.0127***	0.0231***			0.0050	0.0157***
									(0.004)	(0.004)			(0.004)	(0.004)
JobCompl x SkillEnd									0.0024***	0.0024***			0.0031***	0.0027***
									(0.000)	(0.000)			(0.001)	(0.000)
FinDep x FinDev											0.0156***	0.0156***	0.0116***	0.0060**
											(0.003)	(0.002)	(0.003)	(0.003)
Constant	7.5478***	8.3954***	-6.0122**	8.5238***	-4.2844	11.9941***	-12.8578***	-2.5365	-9.6346***	-2.3117*	-7.7869***	7.3121***	-8.1885***	-3.8792*
	(0.559)	(0.515)	(2.867)	(2.888)	(2.882)	(2.691)	(3.241)	(3.195)	(1.865)	(1.384)	(2.731)	(2.651)	(2.483)	(2.074)
Observations	53,055	54,234	38,900	39,169	36,137	36,387	36,137	36,387	27,990	27,990	35,508	35,508	27,450	27,450
R-squared	0.624	0.660	0.644	0.630	0.666	0.678	0.668	0.681	0.762	0.816	0.643	0.631	0.761	0.818
# of clusters	3013	3013	3013	3013	2799	2799	2799	2799	2799	2799	2959	2959	2745	2745

Standard errors clustered at the country-pair level in parentheses, estimation using exporter and importer-industry fixed effects; *** p<0.01, ** p<0.05, * p<0.1

for gross exports, which is a bit puzzling, but it should not be given too much weight. Again, individually, all institutional interactions are positive and highly significant except for the product complexity interaction for gross trade. However, there are striking differences in the combined model results between gross trade and value added compared to OLS estimation. The financial institutions interaction and the interaction of job complexity with skill endowment are positive and highly significant for gross trade and trade in value added. But now, using a consistent estimator, I obtain a positive and significant coefficient for the interactions of job complexity with the quality of the legal system as well as a positive and significant coefficient for the interaction of relationship specificity with the quality of the legal system (albeit only at the 10% level in this case) for trade in value added. These effects are insignificant when using gross trade flows. Overall, this confirms the belief that institutions do matter for the determination of comparative advantage.

Turning to the estimation of Tang's (2012) model, I also find some interesting patterns when comparing OLS (table 4.3) and PPML (table 4.4) results. For both estimators, the model fit is similarly high compared to the other models. Also, the trade cost variables display the expected signs and are of reasonable magnitude, except for the coefficient for common currency which is negative and significant when using OLS. This puzzle vanishes when using the consistent PPML estimator. Heckscher-Ohlin forces are positive and highly significant throughout. However, when using PPML, the interaction of skilled labor endowment and skill intensity is only significant for trade in value added. Furthermore, material resource endowment interacted with material resource intensity, which was not part of Chor's (2010) framework, is also positive and highly significant. Therefore, it is included in the combined model, too.

The most interesting part is of course the coefficient for the institutional interaction of firm-specific skill intensity and the degree of labor market protection. Using OLS, it is positive and significant throughout all specifications for gross trade and value added, even when

Table 4.3: OLS Results for Tang Framework

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Gross Trade	Value Added	Gross Trade	Value Added	Gross Trade	Value Added	Gross Trade	Value Added	Gross Trade	Value Added
FSpec x Labor	0.7272***	0.2359***	0.6797***	0.1920**	0.5857***	0.0780	1.0638***	0.5169**	1.0305***	0.5214**
	(0.105)	(0.077)	(0.107)	(0.079)	(0.109)	(0.079)	(0.326)	(0.247)	(0.320)	(0.244)
ISpec x Labor							-0.4066	-0.3743	-0.3944	-0.3840
							(0.287)	(0.238)	(0.282)	(0.236)
Distance	-0.9925***	-0.9174***	-0.9948***	-0.9182***	-0.9999***	-0.9165***	-0.9998***	-0.9165***	-1.0140***	-0.9207***
	(0.033)	(0.032)	(0.033)	(0.032)	(0.034)	(0.032)	(0.034)	(0.032)	(0.034)	(0.032)
Colony	0.4568***	0.3957***	0.4577***	0.3956***	0.4645***	0.4023***	0.4645***	0.4023***	0.4666***	0.4010***
	(0.091)	(0.092)	(0.092)	(0.092)	(0.095)	(0.095)	(0.095)	(0.095)	(0.096)	(0.096)
Common Language	0.0537	0.0625	0.0512	0.0619	0.0457	0.0619	0.0457	0.0620	0.0424	0.0659
	(0.074)	(0.071)	(0.075)	(0.071)	(0.075)	(0.072)	(0.075)	(0.072)	(0.076)	(0.072)
Common Border	0.5201***	0.4860***	0.5194***	0.4857***	0.5103***	0.4882***	0.5103***	0.4882***	0.5023***	0.4851***
	(0.087)	(0.086)	(0.087)	(0.086)	(0.088)	(0.086)	(0.088)	(0.086)	(0.090)	(0.087)
Common Legal Origin	0.3427***	0.3337***	0.3425***	0.3338***	0.3442***	0.3268***	0.3440***	0.3267***	0.3490***	0.3260***
	(0.039)	(0.036)	(0.039)	(0.036)	(0.040)	(0.037)	(0.040)	(0.037)	(0.040)	(0.037)
Common Currency	-0.0844	-0.1269**	-0.0874	-0.1275**	-0.1124*	-0.1436**	-0.1122*	-0.1435**	-0.1300*	-0.1469**
	(0.065)	(0.062)	(0.065)	(0.062)	(0.066)	(0.063)	(0.066)	(0.063)	(0.067)	(0.063)
RTA members	0.3268***	0.2983***	0.3305***	0.2991***	0.3659***	0.3400***	0.3660***	0.3399***	0.3640***	0.3395***
	(0.060)	(0.057)	(0.060)	(0.057)	(0.060)	(0.057)	(0.060)	(0.057)	(0.060)	(0.057)
Any Landlocked	-0.2389*	-0.3396***	-0.2378*	-0.3384***	-0.2210*	-0.3330***	-0.2209*	-0.3329***	-0.2141	-0.3325***
	(0.131)	(0.125)	(0.131)	(0.125)	(0.132)	(0.126)	(0.132)	(0.126)	(0.136)	(0.128)
Any Island	-0.4986***	-0.3945***	-0.4956***	-0.3930***	-0.4823***	-0.3815***	-0.4821***	-0.3815***	-0.4729***	-0.3779***
	(0.143)	(0.140)	(0.143)	(0.140)	(0.143)	(0.139)	(0.143)	(0.139)	(0.142)	(0.140)
SkillInt x SkillEnd			0.0419***	0.0390***	0.0446***	0.0423***	0.0441***	0.0418***	0.0435***	0.0414***
			(0.004)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)
CapInt x CapEnd			0.2918***	0.1248***	0.2708***	0.0941***	0.2718***	0.0950***	0.2818***	0.0973***
			(0.024)	(0.019)	(0.025)	(0.019)	(0.025)	(0.019)	(0.023)	(0.018)
MatInt x MatEnd					0.0000***	0.0001***	0.0000***	0.0001***	0.0000***	0.0001***
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	9.6710***	10.1354***	-5.3383***	3.9571***	-4.4432***	5.2876***	-4.5039***	5.2354***	-4.5278***	4.9526***
	(0.331)	(0.318)	(1.298)	(1.032)	(1.359)	(1.057)	(1.356)	(1.054)	(1.322)	(1.038)
Observations	26,980	28,418	26,980	28,418	25,980	27,301	25,980	27,301	25,980	27,301
R-squared	0.620	0.721	0.625	0.723	0.626	0.723	0.627	0.723	0.652	0.739
# of clusters	2700	2700	2700	2700	2700	2700	2700	2700	2700	2700

Standard errors clustered at the country-pair level in parentheses, estimation using exporter, importer, and industry fixed effects; *** p<0.01, ** p<0.05, * p<0.1

Table 4.4: PPML Results for Tang Framework

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Gross Trade	Value Added	Gross Trade	Value Added	Gross Trade	Value Added	Gross Trade	Value Added	Gross Trade	Value Added
FSpec x Labor	0.2241	0.0568	0.1985	0.0006	0.1596	-0.0592	1.7260***	1.7484***	1.4957**	1.5146***
	(0.217)	(0.233)	(0.221)	(0.238)	(0.208)	(0.198)	(0.552)	(0.423)	(0.583)	(0.452)
ISpec x Labor							-1.4343***	-1.6275***	-1.2677***	-1.4795***
							(0.460)	(0.394)	(0.479)	(0.419)
Distance	-0.7293***	-0.6929***	-0.7293***	-0.6929***	-0.7267***	-0.6914***	-0.7267***	-0.6914***	-0.7302***	-0.6964***
	(0.045)	(0.052)	(0.045)	(0.052)	(0.045)	(0.052)	(0.045)	(0.052)	(0.044)	(0.050)
Colony	-0.1143	-0.0917	-0.1143	-0.0917	-0.1151	-0.0924	-0.1151	-0.0924	-0.1239	-0.0949
	(0.097)	(0.099)	(0.097)	(0.099)	(0.098)	(0.100)	(0.098)	(0.100)	(0.097)	(0.099)
Common Language	0.0787	0.0969	0.0787	0.0969	0.0791	0.0975	0.0791	0.0975	0.0861	0.1068
	(0.078)	(0.087)	(0.078)	(0.087)	(0.078)	(0.087)	(0.078)	(0.087)	(0.078)	(0.086)
Common Border	0.3656***	0.4197***	0.3656***	0.4197***	0.3676***	0.4209***	0.3676***	0.4209***	0.3633***	0.4150***
	(0.066)	(0.073)	(0.066)	(0.073)	(0.066)	(0.073)	(0.066)	(0.073)	(0.066)	(0.073)
Common Legal Origin	0.1924***	0.1627***	0.1924***	0.1627***	0.1921***	0.1622***	0.1921***	0.1622***	0.1914***	0.1617***
	(0.052)	(0.061)	(0.052)	(0.061)	(0.052)	(0.062)	(0.052)	(0.062)	(0.053)	(0.061)
Common Currency	-0.0154	-0.0232	-0.0154	-0.0232	-0.0142	-0.0226	-0.0142	-0.0226	-0.0207	-0.0276
	(0.073)	(0.080)	(0.073)	(0.080)	(0.073)	(0.080)	(0.073)	(0.080)	(0.072)	(0.079)
RTA members	0.4328***	0.4592***	0.4328***	0.4592***	0.4357***	0.4611***	0.4357***	0.4611***	0.4343***	0.4585***
	(0.103)	(0.117)	(0.103)	(0.117)	(0.103)	(0.117)	(0.103)	(0.117)	(0.102)	(0.116)
Any Landlocked	-0.3095**	-0.3663**	-0.3095**	-0.3663**	-0.3108**	-0.3675**	-0.3108**	-0.3675**	-0.3109**	-0.3621**
	(0.139)	(0.145)	(0.139)	(0.145)	(0.140)	(0.145)	(0.140)	(0.145)	(0.140)	(0.145)
Any Island	-0.4206*	-0.4724*	-0.4206*	-0.4724*	-0.4198*	-0.4717*	-0.4198*	-0.4717*	-0.4100	-0.4618*
	(0.249)	(0.265)	(0.249)	(0.265)	(0.250)	(0.265)	(0.250)	(0.265)	(0.250)	(0.263)
SkillInt x SkillEnd			0.0001	0.0196**	0.0046	0.0256***	0.0030	0.0239***	0.0020	0.0254***
			(0.010)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)	(0.009)	(0.007)
CapInt x CapEnd			0.4199***	0.2101***	0.3974***	0.1686***	0.4096***	0.1862***	0.4373***	0.2122***
			(0.073)	(0.065)	(0.071)	(0.061)	(0.069)	(0.059)	(0.061)	(0.059)
MatInt x MatEnd					0.0002***	0.0003***	0.0002***	0.0003***	0.0002***	0.0003***
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	9.2916***	8.3825***	-7.1837**	0.4471	-6.6673**	1.5659	-7.1540**	0.8572	-8.9412***	-0.5904
	(0.551)	(0.628)	(3.100)	(2.830)	(2.993)	(2.648)	(2.932)	(2.563)	(2.686)	(2.659)
Observations	31,966	31,966	31,966	31,966	30,173	30,173	30,173	30,173	30,173	30,173
R-squared	0.594	0.551	0.606	0.544	0.630	0.586	0.637	0.593	0.691	0.656
# of clusters	2906	2906	2906	2906	2743	2743	2743	2743	2743	2743

Standard errors clustered at the country-pair level in parentheses, estimation using exporter, importer, and industry fixed effects; *** p<0.01, ** p<0.05, * p<0.1

controlling for industry-specific skill intensity (columns 7 to 10). However, the coefficients for gross trade are much bigger than those for value added, in particular twice as large when controlling for industry-specific skill intensity. The picture changes dramatically when using PPML. Here, the effect of firm-specific skill intensity is insignificant for all specifications in which I do not control for industry-specific skill intensity (columns 1 to 6). When including this control, coefficients for firm-specific skill intensity are positive and highly significant, while coefficients for industry-specific skill intensity are negative and highly significant, appearing to moderate the firm-specific skill channel. Furthermore, the coefficients are very similar in size when comparing results for gross trade and value added. Since the estimation sample includes almost 14% zeroes for gross trade and almost 10% for value added in this case and OLS possibly suffers from heteroskedasticity-induced bias, PPML results should be more reliable. However, both measures are highly correlated, shedding some doubt on the robustness. After all, large coefficients and standard errors could be a symptom of a multicollinearity problem.

Finally, table 4.5 displays results for the combined estimation of both frameworks. Coefficients in columns (1) and (2) are obtained by OLS while those in the other columns are obtained using PPML. Due to consistency, PPML results should be preferred, in this case even aided by the fact that it also yields superior model fit.

Overall, the picture already painted by the separate estimations is reinforced. Looking at the potentially most adequate specifications in columns (3) and (4), I first examine the Heckscher-Ohlin forces. The results indicate that countries with a higher relative capital endowment have a comparative advantage in capital-intensive industries, both when using gross trade flows and value added flows. It is slightly puzzling that for gross trade, the coefficient for the skilled labor interaction is negative and significant. For value-added trade exports, there is no such problem, which might strengthen this chapter's main hypothesis that it is the more adequate measure for studying comparative advantage. While being

Table 4.5: OLS and PPML Results for Combined Model

	(1)	(2)	(3)	(4)	(7)	(8)	(9)	(10)
Dep. Var.	Gross Trade	Value Added	Gross Trade	Value Added	Gross Trade	Value Added	Gross Trade	Value Added
FSpec x Labor	0.9551***	0.1883	1.5128***	1.6226***	0.9363***	0.1960	1.2610**	1.3468***
	(0.311)	(0.238)	(0.497)	(0.398)	(0.304)	(0.234)	(0.547)	(0.447)
ISpec x Labor	-0.0712	0.1022	-0.9753**	-1.1733***	-0.0460	0.0986	-0.7123*	-0.9318**
	(0.265)	(0.216)	(0.379)	(0.334)	(0.258)	(0.213)	(0.426)	(0.379)
SkillInt x SkillEnd	-0.0012	-0.0073**	-0.0239*	-0.0063	-0.0012	-0.0073**	-0.0281**	-0.0069
	(0.005)	(0.004)	(0.013)	(0.011)	(0.005)	(0.003)	(0.011)	(0.009)
CapInt x CapEnd	0.3258***	0.2205***	0.3810***	0.2088***	0.3281***	0.2210***	0.3879***	0.2114***
	(0.027)	(0.022)	(0.066)	(0.048)	(0.026)	(0.021)	(0.054)	(0.039)
MatInt x MatEnd	-0.0001***	-0.0001***	-0.0000	-0.0000	-0.0001***	-0.0001***	-0.0000*	-0.0000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ProdCompl x Legal	-1.9985***	-0.7483***	-1.4081**	-1.5369***	-1.9638***	-0.7409***	-1.0332*	-1.2007**
	(0.353)	(0.230)	(0.566)	(0.464)	(0.348)	(0.226)	(0.614)	(0.514)
RelSpec x Legal	0.0641	0.0259	0.0552	0.2665**	0.0694	0.0262	0.0009	0.2418**
	(0.074)	(0.053)	(0.116)	(0.115)	(0.072)	(0.051)	(0.105)	(0.103)
JobCompl x Legal	0.0170***	0.0205***	0.0037	0.0144***	0.0171***	0.0206***	0.0065	0.0166***
	(0.003)	(0.002)	(0.004)	(0.003)	(0.003)	(0.002)	(0.004)	(0.004)
JobComplx SkillEnd	0.0026***	0.0030***	0.0033***	0.0029***	0.0026***	0.0029***	0.0033***	0.0028***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
FinDep x FinDev	0.0139***	0.0055***	0.0110***	0.0060**	0.0138***	0.0055***	0.0109***	0.0057**
	(0.002)	(0.001)	(0.003)	(0.003)	(0.002)	(0.001)	(0.003)	(0.003)
Constant	-9.5024***	-3.1878***	-8.0929***	-4.1825*	-9.7008***	-4.1580***	-9.0460***	-4.7607**
	(1.494)	(1.205)	(2.803)	(2.358)	(1.467)	(1.187)	(2.463)	(2.023)
Observations	23,220	23,668	25,800	25,800	23,220	23,668	25,800	25,800
R-squared	0.689	0.768	0.704	0.766	0.713	0.784	0.759	0.819
Num. of clusters	2557	2540	2580	2580	2557	2540	2580	2580

Standard errors clustered at the country-pair level in parentheses, columns (1) to (4) are estimated using exporter, importer and industry fixed effects, columns (5) to (8) are estimated using exporter and importer-industry fixed effects; *** p<0.01, ** p<0.05, * p<0.1

negative and statistically significant for both, value added and gross exports, the material resource and intensity interaction does not seem to be economically significant. Therefore, I do not deem that it affects the main results by much.

Turning now to the institutional interactions, I also find support for the results already obtained from the separate estimations. Looking first at labor market institutions, firm-specific skill intensity interacted with the degree of labor market protection is positive and highly significant, while the counterpart for industry-specific skill intensity is negative and significant. Thus, these results would confirm that a higher degree of labor market protection indeed provides countries with a comparative advantage in industries that require relatively more firm-specific skills. Furthermore, as in the separate estimation, this result would be moderated by industry-specific skill requirements. This holds for both, gross trade and value added. Similar to the separate estimation of Chor (2010), I find support for the channel explored in Costinot (2009). However, while for both gross exports and value added the results show that countries with a higher relative high-skilled labor endowment have a comparative advantage in industries that feature a higher degree of task specialization, this is different for the second interaction. Only for value added trade do I find significant support for the prediction that countries with better-developed legal institutions as a proxy for contracting and monitoring abilities do have a comparative advantage in the above described industries. In contrast, when using OLS, the channel appears to be important with both trade flow measures.

The financial market interaction is positive and highly significant. As was the case when estimating the Chor (2010) model only, this is true for gross exports as well as value added, and confirms the prediction that countries with better-developed financial markets have a comparative advantage in industries that depend more heavily on external financing. In this framework however, I cannot explore specific channels in more detail. For example, comparative advantage could be due to lower credit costs. Alternatively, higher-quality

Table 4.6: Standardized Coefficients for Combined Model

	(1) Gross Exports	(2) Value Added
ProdCompl x Legal	-0.2442*	-0.2838**
	(0.145)	(0.121)
RelSpec x Legal	0.0012	0.3238**
	(0.140)	(0.138)
JobCompl x Legal	0.2635	0.6706***
	(0.163)	(0.151)
JobCompl x SkillEnd	0.6752***	0.5796***
	(0.101)	(0.092)
FinDep x FinDev	0.2522***	0.1309**
	(0.073)	(0.058)
FSpec x Labor	0.4327**	0.4621***
	(0.188)	(0.153)
ISpec x Labor	-0.2951*	-0.3861**
	(0.176)	(0.157)

financial markets could lower search costs for firms with respect to the necessary up-front financing, since it might be more difficult for firms in developing countries to find adequate financing at all.[25]

Looking at product market interactions, the results are rather mixed. Interestingly, in contrast to OLS, when using PPML I find support for the prediction that a higher-quality legal system, and thus better contracting institutions, provide countries with a comparative advantage in industries with a higher degree of relationship specificity concerning input investments in case of value-added trade. This result is a bit tarnished by the negative and significant coefficient for Levchenko's (2007) product complexity interaction and leaves doubts about the robustness of this institutional channel.

With both OLS and PPML, the coefficients for the institutional interactions are directly interpretable as semi-elasticities.[26] However, since there is no common scale to these terms,

[25] See Manova (2013) for an attempt to differentiate channels with respect to financial markets.
[26] Note that since the level effects are absorbed by fixed effects, I cannot make use of the full range of interpre-

I cannot directly compare them in terms of magnitude. To assess the relative importance of the institutional channels, I present standardized coefficients in table 4.6. It is interesting to note that the labor market channels introduced by Costinot (2009) and Tang (2012) appear to be the most important ones, especially when using value added exports. However, comparative advantage due to firm-specific skill intensity seems to be moderated by industry-specific skill intensity, and this might even be caused by multicollinearity. Thus, I can only credibly establish a better contracting and monitoring environment as an important channel for comparative advantage in industries with higher task specialization. Furthermore, a very interesting difference between the use of gross exports and value added exports arises with respect to product markets. For value added exports, relationship specificity interacted with the contracting environment is a significant and important determinant of comparative advantage. However, when using gross exports, it is not, and more importance is given to financial market development.

Still, the question remains if these effects are not only statistically, but also economically significant. To this end, I can conduct a "pseudo diff-in-diff exercise" as in Chor (2010), asking by how much export volumes would increase if I transferred a country from the 25th percentile of a country-level indicator distribution to the 75th percentile, in an industry at the 75th percentile of intensity versus the 25th percentile. I concentrate on the most important channel, the quality of contracting and monitoring environments providing countries with a comparative advantage in industries that are highly task-specialized. The difference between the 25th percentile and the 75th of the legal institutional quality is $8.686 - 5.939 = 2.747$. The difference between the 25th percentile and the 75th percentile of the job complexity distribution is $21.12 - 14.76 = 6.36$. From the estimate of the interaction coefficient in column (4), I can then infer that exports would increase by 34% ($\exp(2.747 * 6.36 * 0.0166) = 1.34$) for value added exports, whereas the coefficient

tation tools, especially with interaction effects in non-linear models.

for gross exports is not statistically significant.[27]Repeating this exercise for the interaction of job complexity with high skilled labor endowment yields a potential increase by 34% for gross exports and 28% for value added exports, respectively. Thus, I can conclude that the institutional channels are economically significant and, more importantly, there are substantial differences between gross exports and value added exports.[28]

Overall, these results might have a very strong implication. As already described, the predictions of the models certainly do not change when using value added exports instead of gross exports. However, when testing for the importance of the channels, it seems that great care is needed. While of course, my results might be due to the specific construction of the dataset with all its limitations, conclusions would be quite different for a model where value added exports are used compared to gross exports. Thus, if the argument is valid that value added exports are a much better measure when studying comparative advantage, my results cast doubt on previous studies and their policy implications. This leaves much scope for further research when the availability and quality of data on value added exports and the institutional measures improve.

4.6 Robustness Analysis

There are several issues, both technical and data wise, concerning the estimation that warrant robustness checks. First of all, the construction of the institutional measures as well as the Heckscher-Ohlin forces leaves scope for discussion. As already mentioned in section 4.4 on the variable description, for most of the country-level measures I have obtained data for the period 1996 to 2005. Thus, a natural first check is to use 2005 values

[27]If it were, the increase would be 12%.

[28]Technically, these exercises are not completely correct since such a change for a country in its institutional environment would also change multilateral resistance terms which are captured by the included fixed effects. For an accurate exercise, one would have to recover the multilateral resistance terms for the changed situation first and include them in the calculation. However, since the aim of this exercise is only to demonstrate economic significance, I can neglect this issue here.

only. Furthermore, a country's capital stock can be measured in different ways. From the Penn World Tables, I have data in constant (base year 2005) and current Purchasing Power Parity units as well as in constant and current USD. As already described, there are also different measures of human capital stock available, the index from the Penn World Tables and the percentage of secondary schooling and tertiary education from Barro and Lee (2013). Also, I can now employ the two other measures for the development of a country's financial market, private credit by deposit money banks as a percentage of GDP and the ratio of bank credit to bank deposits.

Concerning the industry-level measures, I would like to test whether imposing a US ranking on other countries significantly affects my results. Unfortunately, due to a lack of comparable data to construct the measures, this is not possible. However, there are a few other ways to test the robustness of these measures to a certain degree. Starting with Nunn's (2007) relationship specificity, this measure comes in various flavors. Firstly, in order to aggregate from 4-digit ISIC Rev. 3 to 2-digit ISIC Rev. 3 categories and further on to the OECD's classification, one can use either the mean or the median.[29] Furthermore, similar to Nunn (2007), I also calculate the measure considering not only differentiated goods, but also goods that are reference priced as requiring relationship-specific investments. Lastly, the Rauch (1999) classification itself comes in two versions, once using a liberal, once using a more conservative approach. Since I have to rely on second-hand sources to measure an industry's dependence on external finance, I also use all possible variants available to assess the robustness. This includes the original measures based on Rajan and Zingales (1998) as well as the respective modifications by Hattendorff (2012) and Kroszner, Laeven and Klingebiel (2007). Tang (2012) also provides additional versions of his measures of firm-specific and industry-specific skill intensity. On the one hand, I have a measure that includes a control for general work experience and on the other

[29]There are no obvious justifications to prefer one over the other.

hand, I have these measures for production workers only, since it is argued that production workers might be easily replaceable and firm-specific skills might only be relevant for non-production workers.

Overall, using different measures than the default ones does not change the results substantially. On average, the institutional channels are still important individually while the picture from the combined model also remains. Of course, when using this multitude of different measures interchangeably, results are not exactly the same quantitatively. However, qualitatively, my conclusion that there are substantial differences when using value added exports compared to gross exports prevails.

Another issue has already been discussed in section 4.4, namely distinguishing between the extensive and intensive margins of trade. Firstly, I can check if OLS results are greatly affected by the omission of zero-trade flows and hence the extensive margin of trade by using PPML on a sample restricted to positive trade flows and then comparing the results to those obtained by PPML using the whole sample.[30] Since coefficients for both gross exports and value added exports do not differ much between the two settings, it can be argued that differences between OLS and PPML results are rather due to heteroskedasticity than omitting zero-trade flows. Furthermore, the assumptions necessary for a Heckman selection approach to be consistent are very strong. Nevertheless, I conduct this exercise to see if I can credibly make inference on both margins of trade. In order to have valid exclusion restrictions for the first stage, I need at least one independent variable that explains the extensive margin of trade, but is irrelevant for the intensive margin. Following Tang (2012), I employ the days as well as the number of procedures necessary to start a business, which seem to satisfy the conditions. Data comes from the World Bank's Doing Business Database.[31] The first stage is estimated as a probit model. Afterwards, I include the inverse mills ratio as well as the predicted probabilities of exporting into

[30] Results can be found in table A6 in the appendix.
[31] See `http://www.doingbusiness.org/`.

the second stage to capture the extensive margin and the composition of exporting firms. The second stage is estimated by maximum likelihood.[32] There are substantial differences to the results obtained by OLS and PPML. Looking at the first-stage results, only financial market development and the Heckscher-Ohlin forces are relevant when using value added exports, while the picture is quite different when using gross exports. Here, both job complexity interactions, the relationship-specificity interaction, dependence on external finance interaction, the industry-specific skill-intensity interaction as well as the capital and skilled-labor intensity interactions are positive predictors for exporting. In contrast, the firm-specific skill intensity, product complexity, and material resource intensity interactions are negative predictors. For the second stage, the results also differ, albeit not that starkly from the results obtained by OLS and PPML.

Consequently, I do not put too much weight on these results for two reasons. Firstly, due to the strong assumptions, it can be argued that I use an inconsistent estimation approach which leaves the results severely biased. Since the results are indeed very different from those obtained by PPML, I am inclined to uphold those since PPML delivers consistent estimation results. Secondly, due to a lack of data availability from the Doing Business Database for a substantial number of countries, my sample size is much reduced. This also sheds doubt on the credibility of the two-stage results.

Another issue that has so far been mostly neglected in the literature is that of reverse causality. There is a growing literature of historical and contemporary studies on how trade and initial conditions of comparative advantage can affect domestic institutions (Nunn and Trefler, 2014). However, there are only very few studies that explicitly deal with reverse causality. Nunn (2007) and Tang (2012) deal with this issue by conducting an instrumental variable estimation using common legal origin as the instrument. However, since it is highly uncertain that common legal origin can be validly used as an exclusion

[32]These results are presented in table A7 in the appendix.

restriction, this approach leaves much to be desired. Manova (2013) makes use of financial liberalization episodes. However, her focus is mostly on financial market institutions. Furthermore, since I do not have panel data available, I cannot take up a similar approach here. Thus, I am left to argue that in general, institutions change very slowly. Additionally, it is the initial patterns of comparative advantage that matter for institutional change. Taking a short-term view, causality should run only in one direction.

Lastly, I can split the sample into OECD and non-OECD countries. Results are shown in table A5 in the appendix. Firstly, I can infer that there are also quite a few differences between models for gross exports and models for value added exports. Secondly, quite a few institutional results appear to be driven by non-OECD countries. This makes sense since here, institutional differences should be much more pronounced. Lastly, these results show that the composition of the sample also matters substantially for the results, further supporting the conclusion that adequate data is essential when studying the determinants of comparative advantage and drawing policy conclusions.

4.7 Concluding Remarks

This study tests whether studies on the determinants of comparative advantage are influenced by the measurement of trade flows. In light of global value chains, traditional gross export statistics reflect less and less what countries actually do export. Consequently, re-evaluating evidence on the determinants of comparative advantage seems a worthwhile exercise. The analysis is based on two frameworks by Chor (2010) and Tang (2012) that embed the impact of labor market, product market, and financial market institutions as well as Heckscher-Ohlin forces on exports. Both frameworks yield sectoral gravity-type equations which I estimate robustly employing Poisson Pseudo Maximum Likelihood. Specifically, the models are contrasted using on the one hand gross exports and on the

other hand the domestic value added embodied in gross exports by source country as the dependent variable.

Employing data from the newly developed OECD Trade in Value Added database for a sample of 56 OECD and non-OECD developed and emerging countries, I find interesting results that potentially have stark implications. Generally, the predictions of the two frameworks are confirmed in that no matter whether I use gross exports or value added exports, the quality of institutions plays an important role in determining global trade patterns. Applying a consistent estimator, using value added exports as the dependent variable yields the better model fit. I can confirm several hypotheses: countries with better-developed institutions appear to specialize in industries that more heavily depend on the quality of these institutions.

However, there are differences between the results for gross exports and for value added exports with respect to the extent and magnitude that specific channels appear to play a role. These findings imply that when trying to derive policy conclusions, care should be given to what is actually measured by the variables employed. If, as is argued here, valued added exports are superior in measuring what countries actually export, results from previous studies should be re-evaluated.

There is also much scope for future research. Firstly, as data on value added embodied in exports are refined, this will greatly improve reliability. For now, data construction also rests on assumptions that potentially influence the results. Secondly, constructing sector-specific measures not only from US data would also enhance credibility of studies on the determinants of comparative advantage. Thirdly, valid instruments to help alleviate potential biases due to reverse causality between institutional quality and trade are yet to be found. And finally, employing panel data and giving the models a dynamic dimension would make it possible to study the sequence of institutions' impact on trade.

4.A Appendix

Table A1: List of Institutional Interactions and Industry Availability

Indicator	Availability
Product Complexity (Levchenko, 2007)	01T05, 10T14, 15T16, 17T19, 20T22, 23T26, 27T28, 29, 30T33, 34T35, 36T37, 40T41, 45, 50T55, 60T64, 65T67, 70T74, 75T95
Relationship Specificity (Nunn, 2007)	01T05, 10T14, 15T16, 17T19, 20T22, 23T26, 27T28, 29, 30T33, 34T35, 36T37, 40T41, 45, 50T55, 60T64, 65T67, 70T74, 75T95
Job Complexity (Costinot, 2009)	01T05, 15T16, 17T19, 20T22, 23T26, 27T28, 29, 30T33, 34T35, 36T37
External Financial Dependence (Hattendorff, 2012)	01T05, 10T14, 15T16, 17T19, 20T22, 23T26, 27T28, 29, 30T33, 34T35, 36T37, 50T55, 70T74
External Financial Dependence (Aizenman and Sushko, 2011)	01T05, 10T14, 15T16, 17T19, 20T22, 23T26, 27T28, 29, 30T33, 34T35, 36T37, 50T55, 70T74
External Financial Dependence (Kroszner et al., 2007)	01T05, 10T14, 15T16, 17T19, 20T22, 23T26, 27T28, 29, 30T33, 34T35, 36T37, 50T55, 70T74
Firm-Specific Skill Intensity (Tang, 2012)	01T05, 10T14, 15T16, 17T19, 20T22, 23T26, 27T28, 29, 30T33, 34T35, 36T37
Industry-Specific Skill Intensity (Tang, 2012)	01T05, 10T14, 15T16, 17T19, 20T22, 23T26, 27T28, 29, 30T33, 34T35, 36T37
Skill Intensity	01T05, 10T14, 15T16, 17T19, 20T22, 23T26, 27T28, 29, 30T33, 34T35, 36T37, 40T41, 70T74
Physical Intensity	01T05, 10T14, 15T16, 17T19, 20T22, 23T26, 27T28, 29, 30T33, 34T35, 36T37, 40T41, 70T74
Material Intensity	01T05, 10T14, 15T16, 17T19, 20T22, 23T26, 27T28, 29, 30T33, 34T35, 36T37, 40T41, 70T74

Table A2: List of Exporters and Importers in Estimation Sample

ISO3	Exporter	ISO3	Exporter	ISO3	Importer	ISO3	Importer
ARG	Argentina	KOR	Korea	ARG	Argentina	KOR	Korea
AUS	Australia	LVA	Latvia	AUS	Australia	LVA	Latvia
AUT	Austria	LTU	Lithuania	AUT	Austria	LTU	Lithuania
BEL	Belgium	LUX	Luxembourg	BEL	Belgium	LUX	Luxembourg
BRA	Brazil	MYS	Malaysia	BRA	Brazil	MYS	Malaysia
BRN	Brunei Darussalam	MLT	Malta	BRN	Brunei Darussalam	MLT	Malta
BGR	Bulgaria	MEX	Mexico	BGR	Bulgaria	MEX	Mexico
KHM	Cambodia	NLD	Netherlands	KHM	Cambodia	NLD	Netherlands
CAN	Canada	NZL	New Zealand	CAN	Canada	NZL	New Zealand
CHL	Chile	NOR	Norway	CHL	Chile	NOR	Norway
CHN	China	PHL	Philippines	CHN	China	PHL	Philippines
TWN	Chinese Taipei	POL	Poland	TWN	Chinese Taipei	POL	Poland
CZE	Czech Republic	PRT	Portugal	CYP	Cyprus	PRT	Portugal
DNK	Denmark	ROU	Romania	CZE	Czech Republic	ROU	Romania
EST	Estonia	RUS	Russian Federation	DNK	Denmark	RUS	Russian Federation
FIN	Finland	SAU	Saudi Arabia	EST	Estonia	SAU	Saudi Arabia
FRA	France	SGP	Singapore	FIN	Finland	SGP	Singapore
DEU	Germany	SVK	Slovak Republic	FRA	France	SVK	Slovak Republic
GRC	Greece	SVN	Slovenia	DEU	Germany	SVN	Slovenia
HKG	Hong Kong, China	ZAF	South Africa	GRC	Greece	ZAF	South Africa
HUN	Hungary	ESP	Spain	HKG	Hong Kong, China	ESP	Spain
ISL	Iceland	SWE	Sweden	HUN	Hungary	SWE	Sweden
IND	India	CHE	Switzerland	ISL	Iceland	CHE	Switzerland
IDN	Indonesia	THA	Thailand	IND	India	THA	Thailand
IRL	Ireland	TUR	Turkey	IDN	Indonesia	TUR	Turkey
ISR	Israel	GBR	United Kingdom	IRL	Ireland	GBR	United Kingdom
ITA	Italy	USA	United States	ISR	Israel	USA	United States
JPN	Japan	VNM	Viet Nam	ITA	Italy	VNM	Viet Nam
				JPN	Japan		

Table A3: List of ISIC Revision 3 Industries and Corresponding OECD Classification

OECD TiVA	ISIC Rev. 3	ISIC Rev. 3 Description
01T05	01	Agriculture, hunting and related service activities
01T05	02	Forestry, logging and related service activities
01T05	05	Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing
10T14	10	Mining of coal and lignite; extraction of peat
10T14	11	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying
10T14	12	Mining of uranium and thorium ores
10T14	13	Mining of metal ores
10T14	14	Other mining and quarrying
15T16	15	Manufacture of food products and beverages
15T16	16	Manufacture of tobacco products
17T19	17	Manufacture of textiles
17T19	18	Manufacture of wearing apparel; dressing and dyeing of fur
17T19	19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20T22	20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
20T22	21	Manufacture of paper and paper products
20T22	22	Publishing, printing and reproduction of recorded media
23T26	23	Manufacture of coke, refined petroleum products and nuclear fuel
23T26	24	Manufacture of chemicals and chemical products
23T26	25	Manufacture of rubber and plastics products
23T26	26	Manufacture of other non-metallic mineral products
27T28	27	Manufacture of basic metals
27T28	28	Manufacture of fabricated metal products, except machinery and equipment
29	29	Manufacture of machinery and equipment n.e.c.
30T33	30	Manufacture of office, accounting and computing machinery
30T33	31	Manufacture of electrical machinery and apparatus n.e.c.
30T33	32	Manufacture of radio, television and communication equipment and apparatus
30T33	33	Manufacture of medical, precision and optical instruments, watches and clocks
34T35	34	Manufacture of motor vehicles, trailers and semi-trailers
34T35	35	Manufacture of other transport equipment
36T37	36	Manufacture of furniture; manufacturing n.e.c.
36T37	37	Recycling
40T41	40	Electricity, gas, steam and hot water supply
40T41	41	Collection, purification and distribution of water
45	45	Construction
50T55	50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
50T55	51	Wholesale trade and commission trade, except of motor vehicles and motorcycles
50T55	52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods
50T55	55	Hotels and restaurants
60T64	60	Land transport; transport via pipelines
60T64	61	Water transport
60T64	62	Air transport
60T64	63	Supporting and auxiliary transport activities; activities of travel agencies
60T64	64	Post and telecommunications
65T67	65	Financial intermediation, except insurance and pension funding
65T67	66	Insurance and pension funding, except compulsory social security
65T67	67	Activities auxiliary to financial intermediation
70T74	70	Real estate activities
70T74	71	Renting of machinery and equipment without operator and of personal and household goods
70T74	72	Computer and related activities
70T74	73	Research and development
70T74	74	Other business activities
75T95	75	Public administration and defence; compulsory social security
75T95	80	Education
75T95	85	Health and social work
75T95	90	Sewage and refuse disposal, sanitation and similar activities
75T95	91	Activities of membership organizations n.e.c.
75T95	92	Recreational, cultural and sporting activities
75T95	93	Other service activities
75T96	95	Private households with employed persons

Table A4: Descriptive Statistics for Estimation Sample

VARIABLES	(1) N	(2) mean	(3) sd	(4) max	(5) min	(6) p25	(7) p75
Gross Exports	54,234	174.8	1,168	78,293	0	0.100	42.50
Value Added Exports	54,234	129.9	750.6	61,720	0	0.600	45.10
Common Border	54,234	0.0412	0.199	1	0	0	0
Common Language	54,234	0.0743	0.262	1	0	0	0
Distance	54,234	6,837	4,833	19,539	160.9	2,004	9,941
Colony	54,234	0.0289	0.167	1	0	0	0
RTA members	54,234	0.401	0.490	1	0	0	1
Common Legal Origin	54,234	0.227	0.419	1	0	0	0
Common Currency	54,234	0.0445	0.206	1	0	0	0
Any Island	54,234	0.255	0.436	1	0	0	1
Any Landlocked	54,234	0.206	0.405	1	0	0	0
Product Complexity	54,234	-0.103	0.0342	-0.0618	-0.207	-0.124	-0.0782
Relationship Specificity	54,234	0.597	0.152	0.865	0.283	0.436	0.707
Job Complexity	30,130	17.49	3.853	21.70	10.46	14.76	21.12
Dependence on External Finance	39,169	0.320	0.248	0.755	-0.170	0.190	0.475
Skill Intensity	39,169	-1.230	0.250	-0.713	-1.603	-1.446	-1.153
Material Resource Intensity	39,169	0.477	0.0902	0.584	0.240	0.452	0.533
Physical Capital Intensity	39,169	4.593	0.475	5.373	3.814	4.298	4.776
Firm-Specific Skill Intensity	33,143	0.268	0.194	0.655	0	0.155	0.371
Industry-Specific Skill Intensity	33,143	0.308	0.234	0.758	0	0.102	0.415
Skilled Labor Endowment	54,234	19.29	10.65	52.82	1.482	10.35	24.34
Physical Capital Endowment	54,234	11.50	0.916	12.57	8.444	11.00	12.20
Material Resource Endowment	51,300	17,145	30,521	183,018	2	4,926	13,193
Quality of Legal Institutions	50,382	6.995	1.615	9.346	3.782	5.939	8.686
Index of Labor Market Rigidity	52,308	1.606	0.519	2.426	0.474	1.285	2.021
Development of Financial Markets	53,262	68.15	40.97	154.0	6.015	30.75	100.8

Table A5: OECD Versus Non-OECD Estimation Results

	(1) Non-OECD Gross Exports	(2) OECD Gross Exports	(3) Non-OECD Value Added	(4) OECD Value Added
Distance	-0.8412***	-0.7904***	-0.7359***	-0.7577***
	(0.074)	(0.047)	(0.069)	(0.047)
Colony	0.4334***	-0.2114**	0.5104***	-0.2001*
	(0.143)	(0.106)	(0.136)	(0.104)
Common Language	0.0425	-0.0153	0.0972	0.0095
	(0.122)	(0.083)	(0.119)	(0.083)
Common Border	0.0911	0.3955***	0.1486	0.4156***
	(0.119)	(0.068)	(0.121)	(0.068)
Common Legal Origin	0.1772**	0.2626***	0.1707**	0.2361***
	(0.073)	(0.053)	(0.069)	(0.054)
Common Currency	-0.3767*	0.0515	-0.1571	0.0584
	(0.194)	(0.076)	(0.212)	(0.079)
RTA members	0.3981**	0.4127***	0.5110***	0.4246***
	(0.168)	(0.099)	(0.159)	(0.101)
Any Landlocked	-0.3143	-0.2709*	-0.4355*	-0.2985**
	(0.246)	(0.144)	(0.243)	(0.148)
Any Island	-0.1405	-0.1828	-0.1366	-0.1845
	(0.314)	(0.200)	(0.337)	(0.198)
SkillInt x SkillEnd	-0.0192*	0.0120	-0.0202***	0.0302***
	(0.010)	(0.015)	(0.008)	(0.010)
CapInt x CapEnd	0.6947***	-0.1837**	0.5221***	-0.2088***
	(0.066)	(0.089)	(0.047)	(0.069)
MatInt x MatEnd	0.0004***	-0.0001**	0.0003***	-0.0000**
	(0.000)	(0.000)	(0.000)	(0.000)
FSpec x Labor	-4.4191***	1.5291***	-1.0806	1.1931***
	(0.936)	(0.534)	(0.776)	(0.447)
ISpec x Labor	4.0264***	-0.9024**	1.6046**	-0.8504**
	(0.834)	(0.419)	(0.738)	(0.364)
ProdCompl x Legal	4.9914**	-2.5004**	1.7800	-2.0678***
	(2.041)	(0.986)	(1.777)	(0.684)
RelSpec x Legal	-0.0378	-0.4677**	0.5218**	-0.2839**
	(0.264)	(0.187)	(0.231)	(0.123)
JobCompl x Legal	0.0111	0.0176***	0.0236***	0.0230***
	(0.008)	(0.005)	(0.008)	(0.005)
JobCompl x SkillEnd	0.0026***	0.0015**	0.0039***	0.0008
	(0.001)	(0.001)	(0.001)	(0.001)
FinDep x FinDev	0.0293***	0.0076	0.0185***	0.0053
	(0.003)	(0.005)	(0.002)	(0.004)
Constant	-19.1636***	18.8878***	-19.2148***	19.9571***
	(4.044)	(5.446)	(2.862)	(3.776)
Observations	9,860	15,940	9,860	15,940
R-squared	0.935	0.785	0.911	0.850
# of clusters	1594	1594	1594	1594

Standard errors clustered at the country-pair level in parentheses. Models are estimated by Poisson Pseudo Maximum Likelihood and include exporter and importer-sector fixed effects.
*** p<0.01, ** p<0.05, * p<0.1

Table A6: Results for Full Sample and Positive Trade Flows Only

	(1) Full Sample Gross Exports	(2) Positive Only Gross Exports	(3) Full Sample Value Added	(4) Positive Only Value Added
Distance	-0.7339***	-0.7317***	-0.6918***	-0.6908***
	(0.040)	(0.040)	(0.039)	(0.039)
Colony	-0.1198	-0.1193	-0.0995	-0.0992
	(0.091)	(0.091)	(0.090)	(0.090)
Common Language	0.0500	0.0481	0.0624	0.0610
	(0.073)	(0.073)	(0.074)	(0.074)
Common Border	0.3276***	0.3294***	0.3649***	0.3660***
	(0.062)	(0.062)	(0.063)	(0.063)
Common Legal Origin	0.2360***	0.2352***	0.2191***	0.2189***
	(0.047)	(0.047)	(0.048)	(0.048)
Common Currency	-0.0055	-0.0035	0.0010	0.0018
	(0.070)	(0.070)	(0.072)	(0.072)
RTA members	0.4560***	0.4551***	0.4812***	0.4809***
	(0.087)	(0.087)	(0.088)	(0.088)
Any Landlocked	-0.2747**	-0.2698**	-0.3148**	-0.3123**
	(0.135)	(0.135)	(0.136)	(0.136)
Any Island	-0.2801*	-0.2757*	-0.3028*	-0.3001*
	(0.164)	(0.164)	(0.162)	(0.162)
SkillInt x SkillEnd	-0.0281**	-0.0280**	-0.0069	-0.0069
	(0.011)	(0.011)	(0.009)	(0.009)
CapInt x CapEnd	0.3879***	0.3889***	0.2114***	0.2124***
	(0.054)	(0.054)	(0.039)	(0.039)
MatInt x MatEnd	-0.0000*	-0.0000	-0.0000***	-0.0000***
	(0.000)	(0.000)	(0.000)	(0.000)
FSpec x Labor	1.2610**	1.2646**	1.3468***	1.3514***
	(0.547)	(0.546)	(0.447)	(0.447)
ISpec x Labor	-0.7123*	-0.7227*	-0.9318**	-0.9386**
	(0.426)	(0.424)	(0.379)	(0.378)
ProdCompl x Legal	-1.0332*	-1.0382*	-1.2007**	-1.2070**
	(0.614)	(0.614)	(0.514)	(0.513)
RelSpec x Legal	0.0009	0.0008	0.2418**	0.2424**
	(0.105)	(0.105)	(0.103)	(0.103)
JobCompl x Legal	0.0065	0.0066*	0.0166***	0.0166***
	(0.004)	(0.004)	(0.004)	(0.004)
JobCompl x SkillEnd	0.0033***	0.0032***	0.0028***	0.0028***
	(0.000)	(0.000)	(0.000)	(0.000)
FinDep x FinDev	0.0109***	0.0109***	0.0057**	0.0056**
	(0.003)	(0.003)	(0.003)	(0.003)
Constant	-9.0460***	-17.3872***	-4.7607**	-10.4614***
	(2.463)	(4.033)	(2.023)	(3.125)
Observations	25,800	23,220	25,800	23,668
R-squared	0.759	0.758	0.819	0.819
# of clusters	2540	2540	2540	2540

Standard errors clustered at the country-pair level in parentheses. Models are estimated by Poisson Pseudo Maximum Likelihood and include exporter and importer-sector fixed effects.
*** p<0.01, ** p<0.05, * p<0.1

Table A7: Results for Heckman Two-Stage Estimation

	(1) Probit Gross Exports	(2) Probit Value Added	(3) 2nd Stage Gross Exports	(4) 2nd Stage Value Added
Days to start business	-0.0839	-0.0162		
	(0.079)	(0.101)		
Procedures to start business	-1.0278**	-1.6824**		
	(0.495)	(0.656)		
SkillInt x SkillEnd	0.0376***	0.0992***	0.0038	-0.0043
	(0.011)	(0.018)	(0.009)	(0.007)
CapInt x CapEnd	0.1738***	0.3063***	0.3357***	0.3097***
	(0.064)	(0.086)	(0.039)	(0.035)
MatInt x MatEnd	-0.0000***	-0.0000	-0.0001***	-0.0001***
	(0.000)	(0.000)	(0.000)	(0.000)
FSpec x Labor	-1.9600**	-0.7319	0.3690	-1.8566***
	(0.941)	(1.264)	(0.511)	(0.484)
ISpec x Labor	2.4672***	1.2568	0.5392	2.1038***
	(0.771)	(1.027)	(0.420)	(0.406)
RelSpec x Legal	0.3519**	0.0897	0.1749*	0.0205
	(0.150)	(0.208)	(0.098)	(0.080)
JobCompl x Legal	0.0117**	0.0007	0.0237***	0.0260***
	(0.005)	(0.007)	(0.003)	(0.003)
JobCompl x SkillEnd	0.0017**	-0.0000	0.0024***	0.0021***
	(0.001)	(0.001)	(0.001)	(0.001)
FinDep x FinDev	0.0081***	0.0186***	0.0116***	-0.0001
	(0.003)	(0.004)	(0.002)	(0.002)
ProdCompl x Legal	-2.8733***	-0.5288	-2.6035***	-0.3543
	(0.792)	(1.070)	(0.485)	(0.406)
Probability to Export			0.8319	1.3390**
			(0.781)	(0.655)
Inverse Mills Ratio			1.3426***	1.5283***
			(0.455)	(0.333)
Observations	15,506	10,909	13,637	9,989
# of clusters	1668	1668	1668	1668

Standard errors clustered at the country-pair level in parentheses, estimations using exporter and importer-industry fixed effects; Second stage estimated by maximum likelihood; *** p<0.01, ** p<0.05, * p<0.1

Chapter 5

Vertical Industry Linkages and the Location of Foreign Direct Investment in Poland[1]

5.1 Introduction

The successful transition and economic integration of several Central and Eastern European (CEE) countries into the European Union (EU) resulted in an increased interest in the determinants of inward foreign direct investment (FDI) in these countries. In recent years, Poland has emerged as one of the most attractive FDI locations among the new EU member states (NMS), attracting over 245 billion USD in FDI (UNCTAD, 2015). However, the general pattern of spatial location of multinational firms within Poland is characterized by high geographic concentration, and not all regions have equally benefited from the inflow of foreign capital. The majority of multinational firms have concentrated in the most advanced, urbanized regions located in the central and south-western parts of Poland that host the largest agglomerations of economic activity, while traditionally underdeveloped regions in the eastern parts of the country have attracted so far very few foreign investors (e.g., Chidlow, Salciuviene and Young, 2009; Cieślik, 2005*a*,*b*,*c*, 2013; Domański, 2003; Gorzelak, 1996; Gauselmann and Marek, 2012).

There has been numerous anecdotal as well as case-study evidence in the economic geog-

[1]This study is joint work with Andrzej Cieślik, University of Warsaw, and Xenia Matschke, Trier University.

raphy literature explaining why multinational firms that invest in Poland prefer to locate in regions that host big agglomerations of economic activity. For example, Domański (2004, p. 52) argues that "they benefit from their growing, diversified economic base, so partners for cooperation, i.e. suppliers of specialized producer services, components and intermediate goods, can be found more easily here". According to Sadler (1998, 1999), the networks of specialized suppliers are especially widespread in the automotive industry where the local content in cars produced in Poland exceeds two-thirds.[2]

Despite some notable contributions by economic geographers and frequently raised concerns about regional divergence, the problem of vertical linkages and distribution of foreign direct investment within Poland has received so far relatively little attention in the mainstream economic literature. Therefore, the primary goal of this chapter is to investigate the role of upstream and downstream industry linkages in the spatial distribution of foreign direct investment within Poland, having controlled for other regional characteristics. In particular, we investigate the determinants of firm location separately for the manufacturing and service firms as they can differ across sectors with respect to the intensity of the linkage effects.

To account for the pattern of spatial location of FDI, we use an analytical framework based on monopolistic competition that relates to the New Economic Geography (NEG) literature. This framework allows us to derive a number of testable hypotheses that are subsequently validated empirically in a conditional logit framework using firm-level data from the Amadeus database and a Polish regional dataset at the NUTS II level of spatial aggregation. We find that, indeed, vertical linkages play a major role in determining the location choices of foreign investors.

Specifically, a 0.01 unit increase in our upstream agglomeration measure increases the

[2]According to Domański (2003), the development of a regional network of linkages among various foreign and domestic firms in the automotive industry is taking place in southern and especially south-western Poland.

odds of an investor choosing a specific region by about 15%. Similarly, a 0.01 unit increase in our downstream agglomeration measure increases the odds of locating in a specific region by about 13%. Interesting differences arise when looking at investments in the manufacturing and service sectors separately. While we are not able to confirm our expectations about the importance of linkages in the manufacturing sector, especially downstream linkages play an important role for firms in the services sector. In terms of infrastructure, road and telecommunication density as well as seaports and airports seem to be a considerable pull factor. In contrast, high unemployment rates and distance to the source country emerge as major barriers.

The structure of this chapter is as follows. The next section provides a review of the relevant literature. Section 5.3 describes the analytical framework used to derive our estimating equation and the statistical methodology. Section 5.4 describes the data sets and explanatory variables used in the empirical analysis. Estimation results are presented in Section 5.5. Section 5.6 concludes with final remarks and directions for future research.

5.2 Literature Review

The problem of location of foreign firms in CEE countries has been discussed using various research methodologies and data samples. Two strands in the literature on FDI and foreign firm location in the post-transition countries have emerged. The early literature neglected the spatial dimension of FDI in post-transition economies and focused entirely on studying the location factors at the country or sectoral levels. Studies that belong to this strand include Lansbury, Pain and Smidkova (1996); Brenton, Di Mauro and Luecke (1999); Resmini (2000); Garibaldi et al. (2001); Carstensen and Toubal (2004); Cieślik and Ryan (2004) and more recently Gorbunova, Infante and Smirnova (2012).

With the accession of some of the CEE countries to the EU and increasing European

integration, over the years the interest has shifted to studying the determinants of foreign firm location in particular post-transition countries at the regional level. Examples of studies that belong to this strand in the literature include Cieślik (2005*a*,*b*,*c*, 2013); Cieślik and Ryan (2005); Chidlow, Salciuviene and Young (2009) for Poland, Boudier-Bensebaa (2005) for Hungary, and Hilber and Voicu (2010) for Romania, Spies (2010) for Germany (East and West) and Gauselmann and Marek (2012) for East Germany, the Czech Republic, and Poland.

The scope of the current chapter is closer to the second strand in the literature. Therefore, the relevant work for Poland deserves closer attention. In particular, in one of the earliest studies, Cieślik (2005*c*) studied the location determinants of foreign firms in Poland in the period 1993–1998 using data for the 49 former voivodships. He found that the concentration of foreign firms was positively related to industry and service agglomeration as well as the road network and negatively to the unemployment rate. Traditional characteristics such as GDP, wage rate, and education, often regarded as important location determinants, were not robust with respect to the specification of his estimating equation. Moreover, geographic location dummies confirmed that foreign firms preferred Central and South-Western regions over Eastern parts of Poland, having controlled for their characteristics.

The role of regional geographical characteristics was further investigated in a follow-up study (Cieślik, 2005*b*) based on the same dataset that focused on the role of national border effects. Cieślik's main result was that Polish regions that shared borders with Eastern EU non-accessing countries (i.e. Belarus, Russia, and Ukraine) were less attractive to foreign investors compared to central Polish regions or regions that shared borders with the current EU member countries as well as other EU candidate countries. The robustness of the border effects for the 1999-2003 pre-accession period was investigated by Cieślik (2005*a*) who used the regional NUTS II level dataset for the 16 new voivodships that

emerged as a result of the Polish administrative reform in 1998. His estimation results showed that regions located close to the Eastern border were still less attractive locations to foreign firms compared to their counterparts located in the central and western parts of the country.

Cieślik and Ryan (2005) investigated the location determinants of Japanese firms in Poland using a regional data set for the 16 new voivodships for the period 1991-2001. Special attention was given to the geographically targeted investment incentives (Special Economic Zones, SEZs) that were created during this period. In contrast to studies for other countries, they found that the SEZ measure's statistical significance disappeared when they controlled for a comprehensive set of region-specific characteristics.

In the most recent study, Cieślik (2013) investigated the determinants of foreign firm location in the Polish regions for the period 1999-2010 with a special focus on the role of firm size. His results revealed significant heterogeneity among different types of foreign firms with respect to the location determinants. In particular, the log-likelihood was falling with the size of the firm. This means that the location of bigger firms was better explained by the set of explanatory variables than the location of smaller firms where an arbitrary component was more important. Moreover, the study confirmed the role of border effects reported in the previous studies by Cieślik (2005*b*,*a*). In particular, the overall border effect was negative and statistically significant for almost all firm types with the exception of micro firms. This negative effect was mainly driven by the effects for the borders with Poland's Eastern neighbors.

Chidlow, Salciuviene and Young (2009) studied the location determinants of FDI in Poland in 2005 using survey data for 91 firms and 5 regions. They demonstrated that the knowledge-seeking factors alongside market and agglomeration factors acted as the main drivers of the inflow of FDI into the Mazowiecki region, while efficiency and geographical factors encouraged FDI to other areas of Poland.

Finally, Gauselmann and Marek (2012) investigated the impact of agglomeration and labor market characteristics on the location choice of MNEs in three post-transition economies. They compared data from 33 regions in East Germany, the Czech Republic and Poland using a mixed logit model on a sample of 4,343 subsidiaries for the period 2000-2010. Their results showed that agglomeration advantages, such as sectoral specialization as well as a region's economic and technological performance were the most important pull factors for FDI in post-transition regions. With respect to access to labor, their results suggested that FDI in post-transition regions is no longer dominated by efficiency seeking behavior, but also by access to well-qualified labor. In particular, their empirical results for Poland showed that wages were positively related to the probability of location.

The contribution of this chapter to the literature is threefold. First, in contrast to the majority of previous empirical studies, we aim at providing a direct link between the theory and the estimating equation by referring to the well-established New Economic Geography (NEG) framework that accounts for both upstream and downstream linkages and using more accurate measures of these linkages. Second, we study the role of vertical linkages for FDI location separately for the manufacturing and service sectors, having controlled for other regional characteristics in the single empirical setting. Third, we provide the most recent empirical evidence on determinants of greenfield FDI for Poland in the post-accession period.

To investigate the phenomenon of FDI concentration in Poland, we use an analytical framework in which agglomeration economies, infrastructure, and labor market conditions may have an impact on location decisions of foreign investors within Poland. If the framework is extended beyond Poland, also tax considerations become important, which could be very easily incorporated into the model as well. Our framework is based on the spatial version of the monopolistic competition model originally developed by Dixit and Stiglitz (1977) and later extended to the case of many regions by Fujita, Krugman and Venables (1999).

On the basis of these contributions, Head and Mayer (2004) developed a framework for studying the location choice of Japanese direct investment in the European Union which was later employed in many empirical studies, mainly for countries other than the new EU member states. Recent examples of such studies include Amiti and Smarzyńska Javorcik (2008) for China, Mayer, Méjean and Néfussi (2010) for French multinational firms, Spies (2010) for Germany, and more recently Bruelhart, Jametti and Schmidheiny (2012) for Switzerland and Gauselmann and Marek (2012) for East Germany and other selected Central European countries.

5.3 Analytical Framework and Statistical Methodology

In this study, we follow the previous literature in adopting a Dixit-Stiglitz type monopolistic competition model. This framework is then used to derive the empirical specification of a location choice equation. We assume that foreign investors face a set of location choices when deciding to undertake an investment abroad. The choice of a particular location depends on the potential profits associated with that location exceeding the potential profits associated with all other available locations. In particular, we assume that multinational firms choose their location with the aim of maximizing their total profits. Throughout, we assume that demand is local in the sense that consumers and firms of a region only buy regional products, but it is quite easy to generalize the model to the case where products from other regions can be imported. The assumption that inputs are bought and outputs are sold locally seems appropriate since our data set includes mainly observations from the service sector where tradability (or the lack thereof) is still an issue.

Following Puga and Venables (1997), we start by deriving the demand function in a region i for a product variety k of a service good produced in region i when the utility function of consumers is a Cobb-Douglas composite in a numeraire good and an aggregate service

good with exponent $0 < \gamma < 1$ on the service good and CES with exponent $(\sigma - 1)/\sigma$ with $\sigma > 1$ in the consumption quantities of the different varieties included in the composite service good. Denoting the price faced by the aggregate household living in location i with m_i income for any variety k produced in location i by $p_i(k)$, the household demands a quantity of variety k of

$$\tilde{x}_i^h(k) = p_i(k)^{-\sigma} \frac{1}{q_i^{1-\sigma}} \gamma m_i, \tag{5.1}$$

where

$$q_i = \left[\int_{j \in N_i} (p_i(j))^{1-\sigma} dj \right]^{1/1-\sigma} \tag{5.2}$$

is the price index of the composite service good in region i.

Similarly, the service good is also used as an input for any variety k. More specifically, a firm uses a Cobb-Douglas technology with labor and the aggregate service good as inputs where the exponent on the service good is μ and the service good is CES with exponent $(\sigma - 1)/\sigma$ on the varieties. Assuming that production in i of variety k requires a fixed cost and a variable cost for producing an amount $x_i(k)$, the cost function of variety k produced in location i is equal to

$$C_i(k) = q_i^{\mu} w_i^{1-\mu} (\alpha + \beta x_i(k)) \tag{5.3}$$

By Shephard's Lemma then, the aggregate firm demand in market i for variety k produced in location i equals

$$\tilde{x}_i^f(k) = p_i(k)^{-\sigma} \frac{1}{q_i^{1-\sigma}} \int_{j \in N_i} C_i(j) dj. \tag{5.4}$$

For the monopolistic producer of variety k producing in location i, this means that his production necessary to cover demand from the aggregate households and firms located in market i equals

$$x_i(k) = \tilde{x}_i^h(k) + \tilde{x}_i^f(k) = p_i(k)^{-\sigma} \frac{1}{q_i^{1-\sigma}} \left[\gamma m_i + \mu \int_{j \in N_i} C_i(j) dj \right]. \quad (5.5)$$

Given the symmetry of firms, the fob price of any firm k producing in location i is the same, i.e. $p_i(k) = p_i$. Moreover, the monopolistic competition framework with constant price elasticity of demand implies that the fob price is a constant relative markup over marginal cost, i.e.

$$p_i = \frac{\sigma\beta}{\sigma - 1} q_i^{\mu} w_i^{1-\mu} \quad (5.6)$$

Hence the firm producing variety k in location i has the following profit equation:

$$\pi_i(k) = \frac{\sigma\beta}{\sigma - 1} q_i^{\mu} w_i^{1-\mu} x_i(k) - \alpha q_i^{\mu} w_i^{1-\mu} \quad (5.7)$$

or after substituting for $x_i(k)$ and simplifying

$$\begin{aligned} \pi_i(k) &= \beta^{1-\sigma} (\sigma - 1)^{\sigma-1} \sigma^{-\sigma} q_i^{\mu(1-\sigma)} w_i^{(1-\mu)(1-\sigma)} \frac{1}{q_i^{1-\sigma}} (\gamma m_i + \mu \int_{j \in N_i} C_i(j) dj) \\ &- \alpha q_i^{\mu} w_i^{1-\mu} \end{aligned} \quad (5.8)$$

According to this framework, multinational firms maximize their profits and optimally choose their locations taking into account factors that affect both their revenues and costs. In the location decision itself, the investor chooses that production location i which leads to the highest profit. While the actual profits associated with each location cannot be observed, information about the location choice and regional characteristics is at hand.

The derived observable and unobservable variables influence the profits of each alternative location and therefore the probability of investing in region i.

Hence, we conclude that the location decision depends on:

1. the regional price index q_i and factor prices w_i in the available production locations: lower factor prices make a certain production location more attractive. In particular, a bigger input factor pool typically leads to lower factor prices ceteris paribus, whereas more factor demand originating from more firms in the same production location, holding factor supply constant, drives up factor prices (but at the same time and outside the theoretical model specified here, more firms in the same industry may also facilitate knowledge spillovers, so the profit effect of more firms in a production location is ambiguous).
2. the market size of the different locations: a bigger market makes a production location more attractive.
3. the distance from the FDI source country via an effect on the fixed cost parameter α, with higher (spatial and cultural) distance increasing the fixed cost.

The above framework motivates the following log-linear specification for the empirical profit equation for a firm (with foreign investor in F) located in region i and producing variety k in industry K:

$$\begin{aligned} \ln \pi_{iKF}(k) &= \xi_0 + \xi_1 \ln w_i + \xi_2 \ln U_{iK} + \xi_3 \ln D_{iK} + \xi_4 \ln R_{iK} \\ &+ \xi_5 \ln \tau_{iF} + \delta X_i + \epsilon_{iKF}(k). \end{aligned} \tag{5.9}$$

In equation (5.9), the coefficient ξ_1 on the wage variable should in principle be negative; however, higher wages may also reflect higher worker productivity, hence the actual sign of the wage coefficient remains unclear and needs to be determined empirically. U_{iK} is a measure of available input (upstream) concentration for industry K to which firm k

belongs in production location i, whereas D_{iK} denotes a similar measure for the sales (downstream) markets, including both information about downstream industries and private household consumption. We expect both ξ_2 and ξ_3 to be positive. R_{iK} is a similar measure for the concentration of firms of the same industry K, meant to capture competition, but also knowledge spillover effects within an industry. For this reason, we do not have any prior concerning the sign of ξ_4. The variable τ_{iF} measures the distance from the production location to the FDI source country, and we expect its coefficient ξ_5 to be negative. Finally, we also include a variety of region-specific variables X_i besides wage in the estimation equation. For the error terms $\epsilon_{iKF}(k)$, we assume that these are independently and identically distributed with zero mean.

Probably the most popular statistical model used to study firm location choice is McFadden's (1974) conditional logit model. The conditional logit model describes a firm's location decision in a particular region by estimating the relative probability of choosing a certain location depending on the characteristics of all alternative locations. Following McFadden (1974), a firm k in industry K with foreign investor from country F, provided it locates in region z, will derive a profit of $\pi_{zKF}(k)$ that depends on a linear combination of deterministic variables $u_{zKF}(k)$ and a stochastic error term $\epsilon_{zKF}(k)$ with zero mean, as described in equation (5.9). Region i will be preferred by the investor if:

$$\pi_{iKF}(k) \geq \pi_{zKF}(k), \forall z \neq i. \tag{5.10}$$

The stochastic nature of the profit function implies that the probability that location i is selected by an investor producing variety k equals:

$$P_{iKF}(k) = \Pr(\pi_{iKF}(k) > \pi_{zKF}(k)), \forall z \neq i. \tag{5.11}$$

Assuming that the error terms are distributed identically and independently according to

a type I extreme value distribution, it is possible to rewrite the probability of choosing region i as:

$$P_{iKF}(k) = \frac{\exp(u_{iKF}(k))}{\sum_z \exp(u_{zKF}(k))} \tag{5.12}$$

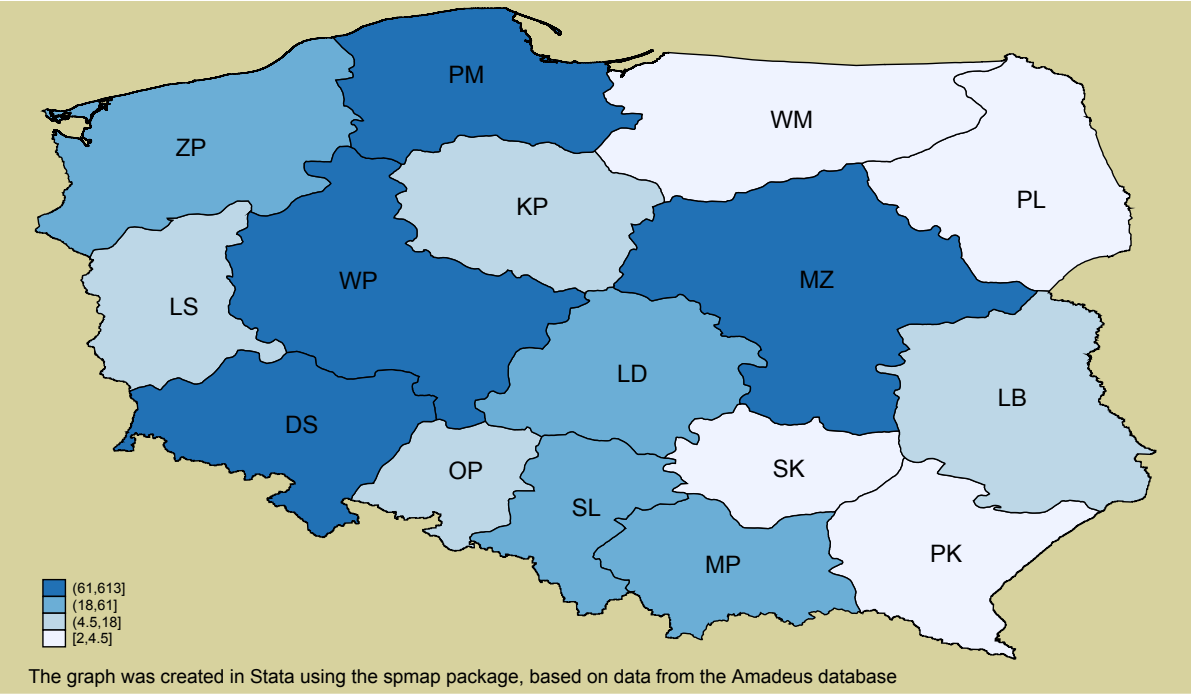
The above equation expresses the basic multinomial logit formulation. The estimation of the coefficient parameters will enable us to assess the importance of various factors influencing the location decisions of foreign firms in Poland.

5.4 Data and Explanatory Variables

The empirical study combines two sets of data for Poland: individual firm-level data on FDI location decisions and aggregate data on region specific economic variables. Detailed datasets that characterize the outward FDI of firms in European markets are available from Bureau van Dijk's Amadeus database.

The Amadeus database contains detailed information, including the sector, legal form, turnover, number of employees, balance sheet total, year of incorporation, and postal codes of firms in European markets. It further includes information on the country of origin, number of employees, turnover, and balance sheet totals of the respective shareholders. One caveat is that only for a certain number of firms, this set of information is complete. Amadeus' problems in terms of coverage have been discussed in CompNet Task Force (2014). However, for our present purposes, we only need information on the region in which a foreign investor sets up a subsidiary and the sector in which the firm is active. Another caveat is that we can only include recent greenfield investments in our sample (inferred from the year of incorporation), since we do not have information on when a particular shareholder invested in a given firm. A list of FDI source countries can be found

Figure 5.1: Number of Foreign Direct Investments per Region, 2010 and 2011



in table A7 in the appendix.

Predictions of the theoretical framework derived in Section 5.3, in particular the role of agglomeration externalities, can be tested using the set of Polish regional data on the current 16 Polish administrative units (voivodships) that correspond to the EU's NUTS II territorial units in 2010.

The spatial distribution of greenfield foreign investment across Polish regions is shown in Figure 5.1.[3]

The spatial location of FDI generally confirms the findings of previous studies mentioned in the literature review section. In particular, it can be seen that most FDI is located in the Mazowiecki capital region. Other regions favored by foreign investors include the Wielkopolski, Dolnośląski, and Pomorski regions located in the western parts of Poland, while regions located in the eastern part of the country do not seem to be attractive for

[3]Tables showing the distribution as well as Polish NUTS 2 regions and their abbreviations can be found in the appendix.

Table 5.1: Example for Agglomeration Measures

industry	number of persons employed (Region 1)	number of persons employed (Region 2)
1	a11	a12
2	a21	a22

foreign investors.

Our most important theoretical prediction is the importance of upstream and downstream agglomeration for the location choice. To test for the existence of these agglomeration forces, we introduce two measures apart from the controls for the other regional characteristics whose potential role was posited by the theoretical model described in Section 5.3. One industry K and region z specific measure relates to input suppliers from upstream firms, the other to market potential with respect to downstream firms and consumers. We construct both measures using regional data from Eurostat's Structural Business Statistics (SBS) database and national input-output tables, also provided by Eurostat. For each sector and region, the SBS database provides the number of firms, the number of persons employed as well as wages and salaries. To check the quality of our measures, we use all three characteristics in separate specifications.

To demonstrate the construction of our agglomeration measures, consider the following example: Assume two regions: 1 and 2. Assume two upstream industries: 1 and 2. The industry 1 and 2 input shares for our industry K in question (from national input-output accounts) equal s_{1K} and s_{2K}, respectively. The import shares for industry 1 and 2 are denoted by m_1 and m_2. Call the number of persons employed in industry j and region i a_{ji} as displayed in table 5.1.

Suppose our industry K in question lies in region 1. We then can calculate an agglomeration measure of upstream industries for K in region 1 as follows:

$$U_{1K} = (1-m_1)s_{1K}\frac{a_{11}}{a_{11}+a_{12}} + (1-m_2)s_{2K}\frac{a_{21}}{a_{21}+a_{22}} \tag{5.13}$$

Notice that the agglomeration measure is a true index, i.e., it lies between 0 (if a_{11} and a_{21} equal 0) and 1 (if a_{12} and a_{22} equal 0) in case that the import shares are zero.

The general formula for the agglomeration in region i in which our industry K lies would thus be

$$U_{iK} = \sum_j (1-m_j)s_{jK}\frac{a_{ji}}{\sum_z a_{jz}} \tag{5.14}$$

where summation over j is over industries and summation over z is over regions.

In principle, the downstream measure can be constructed in a way analogous to the procedure for upstream industries. It seems there is the problem that we would measure the size of industries by number of persons employed, whereas for final consumption we would have the number of inhabitants as measure, i.e. the numbers would not be compatible. However, notice that we never use the absolute numbers themselves in the calculation, but rather the shares of the region either for number of firms or for population.[4] This means that we can proceed indeed analogously to the case of upstream industries. The only other difference is that export shares are used for downstream industries instead of import shares.

For the industry concentration variable R_{zK}, we use the number of persons employed in industry K and region z and divide by the total number of persons employed in industry K in Poland. The number of persons employed is available from Eurostat at the 2-digit NACE Rev. 2 level. To measure the distance τ_{zF} between the investor country and a Polish voivodship z, we use Google maps.

[4]Alternatively, we could also employ consumer income in the respective region as a mass variable.

All the remaining regional characteristics were obtained from various issues of "The Regional Statistical Yearbook" published regularly by the Polish Central Statistical Office (CSO).

The theoretical framework predicts also that high factor costs in the region discourage foreign investors. The most important factors of production are capital and labor. With respect to capital, we can expect that its costs do not differ significantly across various locations in Poland as the Polish capital market is well integrated. Moreover, it is often the case that multinational firms bring the capital from their home country and do not rely on local capital markets. The most important part of costs that matters for locational choice is thus labor cost. Unlike the capital market, the labor market in Poland is segmented due to low labor mobility within the country, and wage rates differ considerably across regions. Therefore, in this study we focus entirely on the characteristics of regional labor markets. The main labor market characteristics are the average monthly real wage expressed in new Polish zloties (PLN) and the regional unemployment rate.

However, not only the cost, but also the quality of the labor force might be an important location determinant. Due to the lack of data on the skills of workers employed by foreign investors, we use the regional vocational school enrollment defined as the ratio of vocational school students to all people aged 16-18. This serves as a proxy for workers' skills as it is supposed to reflect the educational tradition in the region. We can expect that higher values of this index should be positively associated with FDI located in the region.

It is also frequently argued in the labor economics literature that the regional unemployment rate that affects workers' productivity might be an important location determinant. According to the proponents of the efficiency wage theories, workers would be more willing to work harder in regions where unemployment is high, hence the unemployment rate should be positively related to the number of multinational firms that locate in the region. However, according to the contrary view, high unemployment in the region may

signal adverse business conditions and lower quality of life that would discourage foreign investors. Therefore, the ultimate impact of the unemployment rate cannot be *a priori* determined and needs to be answered empirically.

According to the predictions of the theoretical framework, the final product price and the regional productivity parameter should positively affect multinational firms' profits and encourage location. Unfortunately, the final product price is not a variable that the econometrician can observe. However, following Head and Ries (1996), we can assume that variation in the final product price (CIF) received by multinational firms, whether exported abroad or shipped to other regions in Poland, arises due to inter-regional differences in the stock of transportation infrastructure. Therefore, the region will be more attractive to foreign investors the easier it is to send products to other markets from there.

The regional stock of transportation infrastructure is approximated with the length of road networks per thousand inhabitants expressed in kilometers and two dummy variables for the presence of at least one seaport and an international airport within the region. We expect that the number of multinational firms located in the region will be positively related to all transportation variables.

In addition to transportation infrastructure, also telecommunications infrastructure might affect foreign firms' location decisions. Modern telecommunications is frequently seen as a means of fast acquisition and dissemination of information that reduces coordination costs between firms and positively affects regional productivity. Due to data limitations, telecommunications infrastructure is proxied by the number of telephone main lines per ten thousand inhabitants. Unfortunately, this is a fairly rough proxy that does not capture many aspects of modern telecommunications infrastructure related to information and communication technologies such as internet access that may be especially important for firms operating in the service sector. We also account for a region's average distance to the capital of the foreign investor home country, since this may affect the cost of setting up a

Table 5.2: Summary Statistics

	N	mean	sd	min	max
Upstream Agglomeration	1057	0.1228	0.0790	0	0.3804
Downstream Agglomeration	1057	0.1066	0.0901	0	0.4101
Firm Concentration	1057	0.0473	0.0318	0	0.2396
Unemployment Rate	1057	9.24	1.91	7.80	18.75
Wage Rate	1057	3,690.55	535.24	2,677.51	4,165.14
Vocational School Enrollment	1057	14.00	2.98	10.85	19.88
Km Roads per 10,000 People	1057	63.65	8.52	44.45	100.25
Telephone Main Lines per 1000 People	1057	272.74	39.80	185.16	307.46
Seaport	1057	0.11	0.31	0	1
Airport	1057	0.98	0.12	0	1
Distance to Source Country	1057	1,858.32	1,840.12	146	15,838

subsidiary in a certain region.

All explanatory variables come as lagged two-year (2008 – 2009) or three-year averages (2008 – 2010) to avoid potential simultaneity problems. In total, we have 1057 observations for the years 2010 and 2011.

5.5 Estimation Results

Summary statistics for our explanatory variables are presented in Table 5.2. We estimate the model for the current 16 Polish administrative units. We start out by only regressing the FDI choice on the upstream and downstream agglomeration measures. Then, we investigate the robustness of these estimates by including into the regression first the firm concentration and afterwards various groups of regional characteristics predicted by the theoretical model. Table 5.3 contains estimates obtained for the 16 present *voivodships* for 2010 and 2011.

In column (1) of Table 5.3, we present the estimates of the agglomeration-only regression using data for the 16 Polish regions. It turns out that both agglomeration measures display the expected positive sign and are significant at the 0.1% level. These results hold for the

downstream measure throughout all specifications, whereas the upstream measure turns insignificant in one specification. In column (2), industry-specific firm concentration is added. It takes positive values throughout, but is only marginally significant. In column (3), we extend the specification to control for regional labor market characteristics by including the average real monthly wage, vocational school enrollment and the unemployment rate. While our expectation for unemployment was ambiguous a priori, it turns out to be negative and highly significant at the 0.1% level.

This result is in line with the results of previous studies discussed in the literature review section such as Cieślik (2005*a*,*b*,*c*, 2013) and Gauselmann and Marek (2012). Vocational school enrollment is positive and significant which is also in line with our expectation. It is initially significant at the 0.1% level, which drops to the 5% level in column (5). The average wage is significant initially, turns insignificant in column (4) and is only significant at the 5% level in column (5), leaving some doubts about the robustness.

In column (4), we also control for the regional stock of infrastructure by adding four new variables: roads, seaport and airport dummies, and telecommunications density. All infrastructure controls display the expected signs and are significant at least at the 1% level. The inclusion of the infrastructure variables affects the statistical significance of the wage rate and the firm concentration that were added previously. They are now not significant anymore. Our agglomeration measure and the unemployment rate maintain their respective sign, the significance "falls" to the 1% level.

Finally, in column (5), we extend the specification to include the distance to the country of origin. It displays a negative sign and is highly significant at the 0.1% level. The presence of the distance to the origin seems to have an impact on the statistical significance of some of the other variables, notably the upstream agglomeration and vocational school enrollment which are now significant "only" at the 5% level. In addition, the size of the upstream agglomeration measure drops considerably compared to column (4), while the

Table 5.3: Main Results

	(1)	(2)	(3)	(4)	(5)
Upstream Agglomeration	11.7282***	11.7677***	1.3888	3.6932**	2.7773*
	(14.06)	(14.08)	(1.33)	(3.04)	(2.28)
Downstream Agglomeration	7.4863***	7.4775***	3.2095***	2.5163**	2.6618**
	(7.57)	(7.58)	(3.87)	(2.72)	(2.91)
Firm Concentration		0.6622	2.8715**	1.9477	2.1784+
		(0.71)	(2.98)	(1.62)	(1.79)
Unemployment Rate			-0.1157***	-0.2024***	-0.2291***
			(-4.89)	(-6.04)	(-6.21)
Wage Rate			0.0027***	0.0008	0.0012*
			(18.57)	(1.57)	(2.22)
Vocational School Enrollment			0.1630***	0.0998***	0.0680*
			(6.99)	(3.50)	(2.29)
Km Roads per 10,000 People				0.0197**	0.0171**
				(3.02)	(2.63)
Telephone Main Lines per 1000 People				0.0193***	0.0153**
				(3.59)	(2.70)
Seaport				0.6356***	0.7157***
				(4.00)	(4.29)
Airport				1.4466***	1.1721***
				(4.20)	(3.32)
Distance to Source Country					-0.0018***
					(-6.48)
Pseudo-R-squared	0.270	0.270	0.407	0.429	0.437
N	16912	16912	16912	16912	16912
AIC	4.053	4.054	3.302	3.183	3.140
BIC	-3066.128	-3059.662	-3839.723	-3946.211	-3986.165
LR-Test F-Value		0.4967	800.9507	134.3405	46.9176
LR-Test P-Value		0.4810	0.0000	0.0000	0.0000

Z-values in parentheses. The agglomeration measures are calculated using # of persons employed as a size measure. Since firms choose among 16 regions, the number of observations has to be divided by 16 to obtain the number of firms in the dataset.
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

size of the other coefficients is not greatly affected.

Since all models are nested, we perform likelihood ratio tests to determine if the inclusion of additional explanatory variables significantly adds explanatory power to the preceding specification. This seems to be the case for all specifications except for the one in column (2), hence we view the one in column (5) as our preferred specification.

In order to interpret the coefficients' size and determine the economic impact, table 5.4 displays the coefficients translated into odds ratios. Recall that our agglomeration variables are true indices, thus, even if the odds coefficient appears huge, it is displayed for a one unit increase. Evaluating smaller changes renders the coefficient more plausible. In particular, a 0.01 unit increase in our upstream agglomeration measure in a certain region increases the odds of a firm locating in this region by about 15%. Given that the mean for this measure is 0.12 with an associated standard deviation of 0.079, the economic size of the coefficient is also considerable.

Similarly, a 0.01 unit increase in our downstream agglomeration measure in one region increases the odds of a firm choosing that particular region by about 13%. Given a mean value of 0.107 and a standard deviation of 0.09, this coefficient implies a considerable economic size as well. These results suggest that both the presence of specific intermediate input suppliers as well as market potential significantly increase the attractiveness of a Polish region for a foreign investor.

The other factors that seem to have a robust influence on the location decision also display a significant economic size. In particular, a 1% point increase in the unemployment rate in a certain Polish region decreases the odds of a foreign firm setting up a subsidiary in that region by about 20%. Since the standard deviation is about 2 percentage points, this effect is quite large. Apparently, high unemployment renders a region particularly unattractive for FDI. Vocational school enrollment also seems to exert a positive influence on a region's attractiveness. An increase by one standard deviation in a certain region increases the

Table 5.4: Odds for Main Results

	(1)	(2)	(3)	(4)	(5)
Upstream Agglomeration	1.24e+05***	1.29e+05***	4.0102	40.1745**	16.0748*
	(14.06)	(14.08)	(1.33)	(3.04)	(2.28)
Downstream Agglomeration	1783.3872***	1767.8182***	24.7660***	12.3824**	14.3218**
	(7.57)	(7.58)	(3.87)	(2.72)	(2.91)
Firm Concentration		1.9391	17.6631**	7.0123	8.8319+
		(0.71)	(2.98)	(1.62)	(1.79)
Unemployment Rate			0.8907***	0.8167***	0.7953***
			(-4.89)	(-6.04)	(-6.21)
Wage Rate			1.0027***	1.0008	1.0012*
			(18.57)	(1.57)	(2.22)
Vocational School Enrollment			1.1770***	1.1050***	1.0703*
			(6.99)	(3.50)	(2.29)
Km Roads per 10,000 People				1.0199**	1.0172**
				(3.02)	(2.63)
Telephone Main Lines per 1000 People				1.0195***	1.0154**
				(3.59)	(2.70)
Seaport				1.8881***	2.0456***
				(4.00)	(4.29)
Airport				4.2486***	3.2288***
				(4.20)	(3.32)
Distance to Source Country					0.9982***
					(-6.48)
Pseudo-R-squared	0.270	0.270	0.407	0.429	0.437
N	16912	16912	16912	16912	16912

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

odds of a foreign firm locating in that region by about 21%. Also, all infrastructure variables display a sizable economic effect. A one standard deviation increase in the road and telecommunications density in a specific region increases the odds of a foreign firm locating there by about 14% and 60%, respectively. The presence of an airport or a seaport in a region also greatly increases the odds of a foreign firm establishing a subsidiary there, although the coefficients appear to be huge. In contrast, an increasing – physical and cultural – distance to the FDI source country negatively affects the location decision. In particular, a one standard deviation increase in the distance decreases the odds of location by about 3.5%.

To further refine our results, we split our sample into location choices of investors from the manufacturing sector and those from the service sector.[5] In terms of the two-digit NACE Revision 2 classification, manufacturing refers to divisions 10 to 33, while service refers to divisions 35 to 96. This yields 152 observations for manufacturing and 888 observations for services. It seems the majority of FDI in Poland is concentrated in the service sector. Figure 5.2 shows the number of FDI investment projects for each two-digit NACE Revision 2 division.

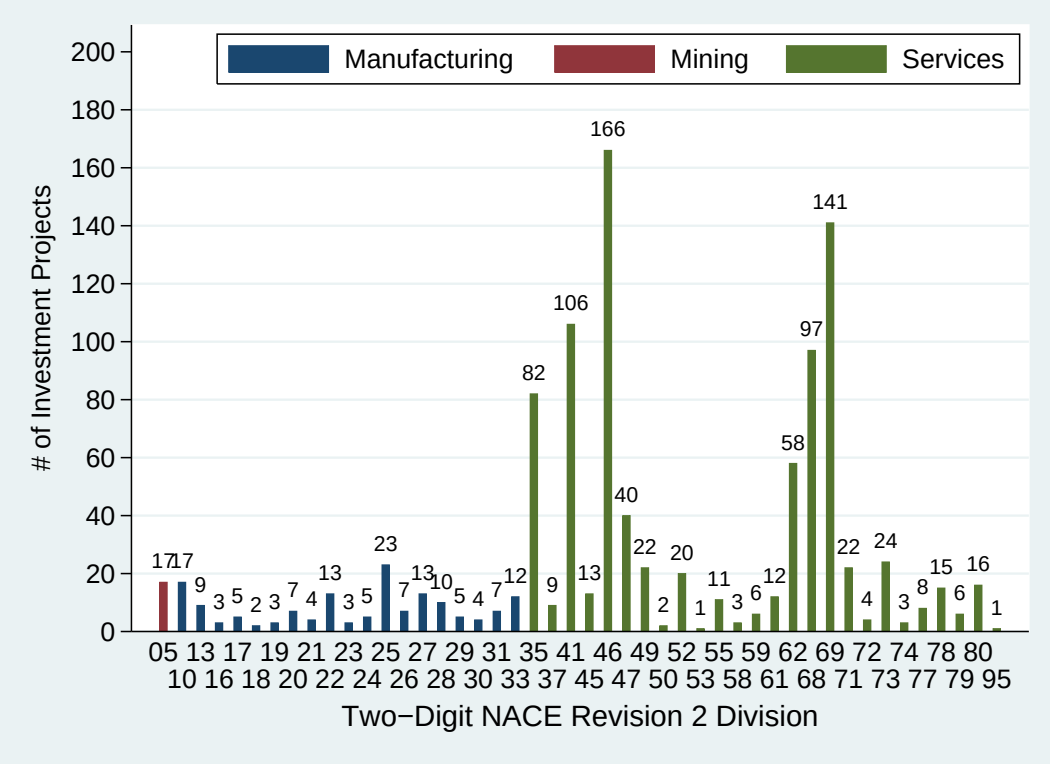
Regarding the manufacturing-only sample, we would expect that if the purpose of the investment is outsourcing of a production step, only the upstream agglomeration measure should display a significant effect. In contrast, if the purpose of the investment is serving a market more directly, then the downstream agglomeration measure should be highly relevant as well. For the service-only sample, we would expect the downstream agglomeration measure to be of significant importance, since a sizable part of services is non-tradable.[6]

We would also expect infrastructure to play a crucial role, both in terms of easier communication as well as to reach the location more easily where services are performed. Results

[5] We do not take observations for agriculture or mining into account, since we cannot meaningfully incorporate them into either manufacturing or services. There are also not enough observations to estimate our model for these sectors separately.

[6] Unfortunately, our sample is not big enough to explore this issue at the industry level.

Figure 5.2: FDI Projects by Sector and NACE Revision 2 Division



are displayed in Table 5.5.

Choosing again by means of likelihood ratio tests, we only show results for our preferred specification here.[7] With respect to manufacturing-only results displayed in column (1), we obtain a positive effect for the wage rate, which is significant only at the 5% level, and a marginally significant effect for the presence of an airport. We obtain a negative and highly significant effect for the distance to the source country. Hence, we do not find confirmation regarding our expectations, especially concerning the agglomeration measures. However, the sample size for manufacturing only firms is rather small, which could explain the non-findings.

Turning to the results for the service-only sample which are displayed in column (2), we find that here, the downstream agglomeration measure appears to be much more robust –

[7] Complete results for all specifications are available upon request.

Table 5.5: Separate Estimation Results by Sector

	Manufacturing	Services
Upstream Agglomeration	-2.7188	0.7812
	(-0.39)	(0.53)
Downstream Agglomeration	5.5873	3.8283**
	(1.10)	(2.82)
Firm Concentration	-1.4739	3.7670*
	(-0.64)	(2.36)
Unemployment Rate	-0.0885	-0.3005***
	(-1.51)	(-6.37)
Wage Rate	0.0019*	0.0009
	(2.02)	(1.31)
Vocational School Enrollment	0.0706	0.0441
	(1.20)	(1.28)
Km Roads per 10,000 People	0.0029	0.0155*
	(0.22)	(1.98)
Telephone Main Lines per 1000 People	-0.0000	0.0188**
	(-0.00)	(2.65)
Seaport	0.3071	0.8099***
	(0.98)	(3.89)
Airport	1.0411+	1.2308**
	(1.69)	(2.83)
Distance to Source Country	-0.0027***	-0.0018***
	(-4.49)	(-5.44)
Pseudo-R-squared	0.222	0.483
N	2432	14208
AIC	4.461	2.894
BIC	-52.332	-3405.757

Z-values in parentheses. The agglomeration measures are calculated using # of persons employed as a size measure. Manufacturing at the two-digit level refers to NACE Rev.2 categories 10 to 33, services to categories 35 through 96. Since firms choose among 16 regions, the number of observations has to be divided by 16 to obtain the number of firms in the dataset.
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

it is positive and significant at the 1% level, while the upstream measure, though displaying a positive coefficient, is not significant. This would suggest that the main purpose of the service sector investments is to serve a market more directly instead of outsourcing. Firm concentration also displays a positive and significant effect, which may indicate the potential of (or believe in) spillover effects. Similarly to the full sample, unemployment seems to be a significant barrier for attracting FDI in the service sector. We also find significant and positive effects for all infrastructure variables. Here, especially the positive effect of telecommunication infrastructure makes sense in a service context. Again, the distance to the source country comes with a negative and highly significant coefficient, which, in a service sector context, makes sense especially when interpreted culturally.

We also test the robustness of our results by using the number of firms as well as wages and salaries in a certain sector in a specific region to construct our agglomeration measures. Qualitatively, our main results hold throughout almost all specifications. We also use different measures of infrastructure like railway density as well as different measures of densities and distance. None of these changes affect the results for our agglomeration measures, for unemployment or for the distance to the source country in a significant manner.[8]

5.6 Conclusion

The primary goal of this chapter is to evaluate empirically the role of upstream and downstream industry linkages, after having controlled for a number of other regional characteristics. To derive testable hypotheses concerning the location choice, a NEG theoretical framework is used. In this framework, agglomeration economies along with the existing economic base of the region, transport and telecommunication infrastructure and labor

[8]The results for the alternative agglomeration measures can be found in tables in appendices A8, A9, A10 and A11.

market conditions may affect location decisions of foreign investors. These theoretical hypotheses are tested using data from the Amadeus database and Polish regional datasets at the NUTS II level of spatial aggregation. The econometric model is used to first explain the FDI choice by upstream and downstream agglomeration variables only and then to investigate the robustness of this relationship by controlling for various groups of regional characteristics.

The assembled empirical evidence confirms the role of vertical linkages in the location of greenfield foreign direct investment in Poland. It is found that the coefficients of our agglomeration measures in the region always exhibit a positive sign and are statistically significant in all estimated regressions for downstream agglomeration, while they are often significant for upstream agglomeration. The signs and significance of the control variables depend on the specification of the estimating equation, but are mostly in line with our expectations. Interesting differences arise when looking at investments in the manufacturing and service sectors separately. We are not able to confirm our expectations for the manufacturing sector which may be due to the small sample size. We are, however, able to confirm our expectations regarding the service sector, where downstream linkages as well as potential spillovers appear to play an important role. In terms of infrastructure, transportation and communication infrastructure also seem to be considerable pull factors. In contrast, high unemployment rates as well as distance from the FDI source country emerge as major investment barriers.

5.A Appendix

Table A1: Polish NUTS 2 Regions

Abbreviation	Region
DS	Dolnośląskie
KP	Kujawsko-Pomorskie
LB	Lubelskie
LS	Lubuskie
LD	Łódzkie
MP	Małopolskie
MZ	Mazowieckie
OP	Opolskie
PK	Podkarpackie
PL	Podlaskie
PM	Pomorskie
SL	Śląskie
SK	Świętokrzyskie
WM	Warmińsko-Mazurskie
WP	Wielkopolskie
ZP	Zachodniopomorskie

Table A2: List of Two-Digit NACE Revision 2 Divisions

Description of two-digit NACE Revision 2 Division	NACE Rev. 2	NACE adjusted to I-O
Mining of coal and lignite	05	05
Extraction of crude petroleum and natural gas	06	05
Mining of metal ores	07	05
Other mining and quarrying	08	05
Mining support service activities	09	05
Manufacture of food products	10	10
Manufacture of beverages	11	10
Manufacture of tobacco products	12	10
Manufacture of textiles	13	13
Manufacture of wearing apparel	14	13
Manufacture of leather and related products	15	13
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	16	16
Manufacture of paper and paper products	17	17
Printing and reproduction of recorded media	18	18
Manufacture of coke and refined petroleum products	19	19
Manufacture of chemicals and chemical products	20	20
Manufacture of basic pharmaceutical products and pharmaceutical preparations	21	21
Manufacture of rubber and plastic products	22	22
Manufacture of other non-metallic mineral products	23	23
Manufacture of basic metals	24	24
Manufacture of fabricated metal products, except machinery and equipment	25	25
Manufacture of computer, electronic and optical products	26	26
Manufacture of electrical equipment	27	27
Manufacture of machinery and equipment n.e.c.	28	28
Manufacture of motor vehicles, trailers and semi-trailers	29	29
Manufacture of other transport equipment	30	30
Manufacture of furniture	31	31
Other manufacturing	32	31
Repair and installation of machinery and equipment	33	33
Water collection, treatment and supply	36	36
Sewerage	37	37
Waste collection, treatment and disposal activities; materials recovery	38	37
Remediation activities and other waste management services	39	37
Construction of buildings	41	41
Civil engineering	42	41

Table A3: List of Two-Digit NACE Revision 2 Divisions continued

Description of two-digit NACE Revision 2 Division	NACE Rev. 2	NACE adjusted to I-O
Specialised construction activities	43	41
Wholesale and retail trade and repair of motor vehicles and motorcycles	45	45
Wholesale trade, except of motor vehicles and motorcycles	46	46
Retail trade, except of motor vehicles and motorcycles	47	47
Land transport and transport via pipelines	49	49
Water transport	50	50
Air transport	51	51
Warehousing and support activities for transportation	52	52
Postal and courier activities	53	53
Accommodation	55	55
Food and beverage service activities	56	55
Publishing activities	58	58
Motion picture, video and television programme production, sound recording and music publishing activities	59	59
Programming and broadcasting activities	60	59
Telecommunications	61	61
Computer programming, consultancy and related activities	62	62
Information service activities	63	62
Financial service activities, except insurance and pension funding	64	64
Insurance, reinsurance and pension funding, except compulsory social security	65	65
Activities auxiliary to financial services and insurance activities	66	66
Legal and accounting activities	69	69
Activities of head offices; management consultancy activities	70	69
Architectural and engineering activities; technical testing and analysis	71	71
Scientific research and development	72	72
Advertising and market research	73	73
Other professional, scientific and technical activities	74	74
Veterinary activities	75	74
Rental and leasing activities	77	77
Employment activities	78	78
Travel agency, tour operator and other reservation service and related activities	79	79
Security and investigation activities	80	80
Services to buildings and landscape activities	81	80
Office administrative, office support and other business support activities	82	80

Table A4: List of Two-Digit NACE Revision 2 Divisions continued

Description of two-digit NACE Revision 2 Division	NACE Rev. 2	NACE adjusted to I-O
Public administration and defence; compulsory social security	84	84
Human health activities	86	86
Residential care activities	87	87
Social work activities without accommodation	88	87
Creative, arts and entertainment activities	90	90
Libraries, archives, museums and other cultural activities	91	90
Gambling and betting activities	92	90
Sports activities and amusement and recreation activities	93	93
Activities of membership organisations	94	94
Repair of computers and personal and household goods	95	95
Other personal service activities	96	96

Table A5: Number of FDI Projects by NUTS 2 Region

NUTS 2 Region	Number of FDI Projects
Dolnośląskie	64
Kujawsko-Pomorskie	12
Lubelskie	5
Lubuskie	12
Łódzkie	24
Małopolskie	50
Mazowieckie	613
Opolskie	5
Podkarpackie	4
Podlaskie	2
Pomorskie	75
Śląskie	58
Świętokrzyskie	2
Warmińsko-Mazurskie	3
Wielkopolskie	92
Zachodniopomorskie	36

Table A6: Number of FDI Projects by Two-Digit NACE Revision 2 Division

NACE Rev. 2 Division	# of FDI Projects	NACE Rev. 2 Division	# of FDI Projects
05	17	49	22
10	17	50	2
13	9	52	20
16	3	53	1
17	5	55	11
18	2	58	3
19	3	59	6
20	7	61	12
21	4	62	58
22	13	64	32
23	3	66	10
24	5	69	141
25	23	71	22
26	7	72	4
27	13	73	24
28	10	74	3
29	5	77	8
30	4	78	15
31	7	79	6
33	12	80	16
37	9	86	4
41	106	90	1
45	13	93	4
46	166	95	1
47	40	96	4

Table A7: Number of FDI Projects by Source Country

# of FDI Projects	Source Country	# of FDI Projects	Source Country
2	United Arabian Emirates	3	India
1	Anguilla	34	Italy
20	Austria	2	Japan
3	Australia	3	South Korea
1	Barbados	5	Liechtenstein
28	Belgium	7	Lithuania
2	Bulgaria	81	Luxembourg
1	Belarus	2	Latvia
1	Canada	1	Malaysia
41	Switzerland	139	Netherlands
5	China	28	Norway
143	Cyprus	1	Panama
15	Czech Republic	6	Portugal
171	Germany	3	Romania
52	Denmark	1	Russia
3	Estonia	1	Saudi Arabia
35	Spain	45	Sweden
18	Finland	2	Singapore
45	France	8	Slovakia
88	United Kingdom	1	Thailand
3	Gibraltar	2	Turkey
6	Hong Kong	2	Ukraine
11	Hungary	39	United States
15	Ireland	1	British Virgin Islands
2	Israel		

Table A8: Main Results Using # of Local Units as Size Measure for Agglomeration Variables

	(1)	(2)	(3)	(4)	(5)
Upstream Agglomeration	25.4669***	25.6572***	6.4012**	5.3474*	3.3173
	(16.14)	(16.19)	(2.71)	(2.04)	(1.25)
Downstream Agglomeration	4.7140**	4.6000**	7.0422***	6.7582***	7.5362***
	(2.75)	(2.68)	(4.14)	(3.87)	(4.26)
Firm Concentration		1.5995	4.5837***	2.8696*	2.9616*
		(1.33)	(3.60)	(2.03)	(2.06)
Unemployment Rate			-0.0946***	-0.1806***	-0.2082***
			(-4.08)	(-5.50)	(-5.75)
Wage Rate			0.0021***	0.0004	0.0009
			(12.18)	(0.77)	(1.57)
Vocational School Enrollment			0.1689***	0.0937***	0.0623*
			(7.11)	(3.32)	(2.12)
Km Roads per 10,000 People				0.0097	0.0087
				(1.41)	(1.26)
Telephone Main Lines per 1000 People				0.0180***	0.0137*
				(3.29)	(2.38)
Seaport				0.5600***	0.6433***
				(3.62)	(3.94)
Airport				1.2125***	0.9736**
				(3.39)	(2.66)
Distance to Source Country					-0.0019***
					(-6.60)
Pseudo-R-squared	0.384	0.384	0.418	0.434	0.442
N	16912	16912	16912	16912	16912
AIC	3.422	3.423	3.241	3.158	3.113
BIC	-3732.713	-3727.474	-3904.834	-3972.555	-4014.666
LR-Test F-Value		1.7244	198.2495	95.5744	49.0733
LR-Test P-Value		0.1891	0.0000	0.0000	0.0000

Z-values in parentheses. The agglomeration measures are calculated using # of local units as a size measure. Since firms choose among 16 regions, the number of observations has to be divided by 16 to obtain the number of firms in the dataset. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table A9: Main Results Using Wages and Salaries as Size Measure for Agglomeration Variables

	(1)	(2)	(3)	(4)	(5)
Upstream Agglomeration	10.9581***	10.9478***	0.7757	1.7588+	1.2466
	(17.35)	(17.30)	(0.90)	(1.84)	(1.31)
Downstream Agglomeration	3.2826***	3.2845***	2.6736***	2.2536**	2.3932**
	(4.82)	(4.82)	(3.94)	(3.06)	(3.27)
Firm Concentration		-0.2049	2.2582*	1.6529	1.9428+
		(-0.25)	(2.48)	(1.43)	(1.66)
Unemployment Rate			-0.1306***	-0.2120***	-0.2378***
			(-5.69)	(-6.41)	(-6.52)
Wage Rate			0.0026***	0.0007	0.0011*
			(17.22)	(1.44)	(2.10)
Vocational School Enrollment			0.1589***	0.0935***	0.0612*
			(6.96)	(3.33)	(2.10)
Km Roads per 10,000 People				0.0158*	0.0135*
				(2.40)	(2.07)
Telephone Main Lines per 1000 People				0.0187***	0.0147**
				(3.53)	(2.64)
Seaport				0.5751***	0.6747***
				(3.72)	(4.15)
Airport				1.4868***	1.1973***
				(4.35)	(3.42)
Distance to Source Country					-0.0019***
					(-6.73)
Pseudo-R-squared	0.299	0.299	0.408	0.430	0.438
N	16912	16912	16912	16912	16912
AIC	3.889	3.891	3.295	3.182	3.136
BIC	-3239.671	-3232.769	-3847.642	-3947.509	-3991.179
LR-Test F-Value		0.0613	635.7620	127.7205	50.6330
LR-Test P-Value		0.8044	0.0000	0.0000	0.0000

Z-values in parentheses. The agglomeration measures are calculated using wages and salaries as a size measure. Since firms choose among 16 regions, the number of observations has to be divided by 16 to obtain the number of firms in the dataset. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table A10: Split Results Using # of Local Units as Size Measure for Agglomeration Variables

	Manufacturing	Services
Upstream Agglomeration	4.3481	-0.0419
	(0.41)	(-0.01)
Downstream Agglomeration	7.6530	7.6984***
	(1.11)	(4.13)
Firm Concentration	-1.4075	3.6215*
	(-0.47)	(2.07)
Unemployment Rate	-0.0605	-0.2923***
	(-0.98)	(-6.24)
Wage Rate	0.0010	0.0007
	(0.91)	(1.05)
Vocational School Enrollment	0.0890	0.0368
	(1.51)	(1.07)
Km Roads per 10,000 People	-0.0049	0.0115
	(-0.35)	(1.38)
Telephone Main Lines per 1000 People	0.0062	0.0176*
	(0.56)	(2.47)
Seaport	0.3558	0.7912***
	(1.15)	(3.89)
Airport	0.5967	1.1316*
	(0.86)	(2.52)
Distance to Source Country	-0.0026***	-0.0018***
	(-4.44)	(-5.46)
Pseudo-R-squared	0.223	0.486
N	2432	14208
AIC	4.451	2.877
BIC	-53.781	-3421.054

Z-values in parentheses. The agglomeration measures are calculated using # of local units as a size measure. Manufacturing at the two-digit level refers to NACE Rev.2 categories 10 to 33, services to categories 35 through 96. Since firms choose among 16 regions, the number of observations has to be divided by 16 to obtain the number of firms in the dataset.
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table A11: Split Results Using Wages and Salaries as Size Measure for Agglomeration Variables

	Manufacturing	Services
Upstream Agglomeration	0.9491	-0.1926
	(0.18)	(-0.18)
Downstream Agglomeration	2.5529	2.8579**
	(0.60)	(3.13)
Firm Concentration	-1.2680	3.5209*
	(-0.59)	(2.26)
Unemployment Rate	-0.0888	-0.3082***
	(-1.51)	(-6.61)
Wage Rate	0.0018+	0.0008
	(1.82)	(1.30)
Vocational School Enrollment	0.0784	0.0395
	(1.35)	(1.16)
Km Roads per 10,000 People	0.0033	0.0130+
	(0.25)	(1.66)
Telephone Main Lines per 1000 People	0.0010	0.0185**
	(0.10)	(2.67)
Seaport	0.3549	0.7763***
	(1.16)	(3.84)
Airport	1.0005	1.2625**
	(1.63)	(2.92)
Distance to Source Country	-0.0026***	-0.0019***
	(-4.47)	(-5.61)
Pseudo-R-squared	0.221	0.483
N	2432	14208
AIC	4.466	2.893
BIC	-51.561	-3406.718

Z-values in parentheses. The agglomeration measures are calculated using wages and salaries as a size measure. Manufacturing at the two-digit level refers to NACE Rev.2 categories 10 to 33, services to categories 35 through 96. Since firms choose among 16 regions, the number of observations has to be divided by 16 to obtain the number of firms in the dataset.
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Chapter 6

Conclusion

The aim and contribution of this thesis was to provide empirical evidence for several issues in international trade and political economy arising from recent globalization and unbundling processes. These processes have profoundly changed economic scholars' ways of thinking, adding firm-level as well as multinational considerations triggered by a change from integrated local production to spatially dispersed global value chains. Firstly, globalization and the unbundling of production have led to a stronger involvement of developing countries in the international sphere. Since these countries are highly dependent on development assistance, there are strong political economy forces at play. Building international trade relationships and gaining market access has been a strong motive for pursuing commercial interests, and thus questions have been raised if developing countries are caught in "stick-and-carrot" tactics of influential industrialized countries. These forces are studied in chapter 2.

There already is a large literature on how donor interests prevail in bilateral aid relationships (e.g., Alesina and Dollar, 2000; Younas, 2008; Hoeffler and Outram, 2011). Multilateral agencies such as the World Bank and the International Monetary Fund have been set up to reduce the impact of special interests. However, these agencies are still controlled by the largest developed countries and lending is subject to conditions that

recipient countries have to fulfill, mostly prior to disbursement. Consequently, multiple studies have shown that loan decisions are also influenced by special interests. This applies to the World Bank (e.g., Fleck and Kilby, 2006) as well as IMF lending (e.g., Dreher and Jensen, 2007). So far, the literature has largely focused on a preferential treatment of allied countries, the lending amount and the number of conditions without a direct benefit for the donor country. Copelovitch (2010) is a notable exception, showing that preferential treatment within the scope of IMF lending yields direct benefits for donors. In this chapter, the approach is taken one step further. It is analyzed to what extent the G5 (the United States, the United Kingdom, Japan, Germany and France), the five largest shareholders of the World Bank, exploit their position to extract benefits with respect to international trade by influencing the design of conditions attached to loan agreements. Though it is harder to influence the specific design of conditions, it offers attractive rewards since via conditions donors can impact a recipient country's policy design, given that conditions are generally implemented. With respect to trade liberalization, donors may reap direct benefits for their trade sectors. Countries can potentially pursue a trade intensification, a trade creation or a protective strategy, depending on their prior trade relationships with recipient countries.

In order to analyze this question empirically, a newly available dataset is exploited which details all conditions attached to World Bank loan development policy lending projects over the 1980 to 2011 period. Controlling for objective criteria to include conditions in such a project and other special interests, the study attempts to isolate if the G5 follow the above mentioned strategies to foster their trade relationships. Results show that trading partners of Germany face a significantly higher number of trade conditions which is interpreted as a trade intensification strategy, since results are most pronounced at the median of the trade distribution. Trade partners of the United States face a significantly lower amount of conditions, which is interpreted as a protective strategy since this result is strongest at

the upper end of the trade distribution. These effects are also much stronger for binding conditions that have to be fulfilled prior to disbursement. In contrast, no robust effects were found for Japan, France or the United Kingdom. Overall, the results demonstrate that major actors within the World Bank influence conditionality on top of lending decisions themselves and the amounts that are disbursed. These findings undermine the supposed impartiality of multilateral development agencies, which might lead developing countries to question their advice and legitimacy. However, they might also aid the discussion on transparency and distribution of power within the World Bank.

The thesis then moved on to study phenomena related to the 2nd great unbundling. Through fragmentation of production, large trade networks have evolved spanning around the world. Outsourcing, offshoring and global value chains have emerged as key words in this context (e.g., Feenstra and Hanson, 1996; Grossman and Rossi-Hansberg, 2008). This has led to an increase in importance of intermediate goods and services. However, to date the literature has only distinguished between primary products, parts *and* components and final goods. However, parts and components are potentially of a very different nature. While parts are more homogeneous, components are much more differentiated and complex, thus having very different characteristics. This is more closely examined in chapter 3. Since trade in parts and components has gained in importance during the last two decades, it is essential to know who trades what in order to gain a better understanding of the global value chain.

The study made use of highly disaggregated trade data and a newly available classification by the German Engineering Association, labelling product categories as either part, component or final good. Exports and imports of European Union member countries were then characterized accordingly. Afterwards, it was attempted to further analyze directions of trade within the global value chain for parts, components and final goods using a new indicator containing the average development level of trading partners. Two key features

emerged. Firstly, the development of trade in parts and components were quite different, and these sub-categories appear to be not equally important to individual countries. Thus, a distinction between parts and components for intermediate goods seems to be a step forward in further analyzing trade within the global value chain. Secondly, the premise from the literature that rich and poor countries mostly trade among their peers could only partially be confirmed. Furthermore, differences in income seemed to play a significant role in explaining trade in parts, components and final goods, suggesting linkages between rich and poor countries within the global supply chain. However, the evidence was not clear-cut and much more refined data is needed to obtain a better and more complete picture. Nevertheless, the dataset used in this chapter presented a promising step forward for a new direction in research on the global value chain.

A further key characteristic of global value chains is that goods and services cross borders multiple times during the production process. This feature has profound implications for studying international trade. Comparative advantage is still a key concept in the literature. A large strand of literature about the determinants of comparative advantage has evolved, finding that institutions have been key driving forces. This entails, among others, product market, labor market as well as financial market institutions (Nunn and Trefler, 2014). Countries enjoy a comparative advantage in industries that are highly dependent on the quality of said institutions. However, due to the nature of global value chains, to a certain degree gross trade does not reflect anymore what countries really export. Thus, in chapter 4 the evidence on institutions was re-evaluated using the domestic value added embodied in gross exports as a more accurate measure.

Frameworks by Chor (2010) and Tang (2012) were integrated, yielding gravity-type models that were subsequently evaluated using data from the newly available OECD TiVA database. Estimating the models consistently, the predictions of these models could largely be validated. Product and labor market institutions were found to be most important in

determining comparative advantage, not only statistically, but also economically. However, robust differences arose when contrasting estimations using gross exports as the dependent variable on the one hand and using value added exports on the other hand. For example, product market institutions have been found to be a key determinant only for value added exports. These findings have potentially large implications. While the study's results might be due to the specific construction of the dataset, policy conclusions from the various estimations would be quite different. If indeed, value added exports are a better measure, these results shed doubt on results from previous studies on comparative advantage. At the same time, this leaves much scope for future research. As data quality on value added exports increases, more robust policy conclusions can be drawn. The same applies to data on institutional dependence and institutional quality.

Lastly, chapter 5 examined another key phenomenon of global value chains, namely location decisions of multinational corporations. As Central and Eastern European Countries have integrated into the European Union and thus emerged as attractive locations to offshore production steps, these countries have experienced large inflows of Foreign Direct Investment, especially Poland. However, in Poland only few regions have benefited. The key question is: how do Multinational Corporations decide where to locate specifically? Previous empirical work concentrated either on country-level or sectoral decisions (e.g., Cieślik and Ryan, 2004; Gorbunova, Infante and Smirnova, 2012), neglected a direct theoretical link or did not account adequately for agglomeration (e.g., Chidlow, Salciuviene and Young, 2009; Gauselmann and Marek, 2012). The present study combined firm-level and regional-level data to examine the location decision of greenfield foreign direct investment in Poland for the years 2010 and 2011. Embedding the location decision in a New Economic Geography framework, the estimation equation was directly derived from the theoretical model and measures accounting for all potential upstream and downstream linkages were introduced to specifically test for agglomeration forces.

The results showed significant roles of upstream as well as downstream linkages on the whole. Expectations that for manufacturing, upstream agglomeration is more important could not be confirmed. In contrast, the importance of downstream linkages and potential spillovers for the service sector was in line with expectations. Furthermore, transportation and communication infrastructure emerged as significant pull factors. High rates of unemployment and distance from the source country resulted as major barriers to investment. There are several possibilities for future research. A very interesting one would be to conduct a study at the European level, examining the decisions to locate a subsidiary at both the country level and regional level sequentially in a common framework. Furthermore, measures to test for the significance of upstream and downstream linkages could be refined and enlarged in scope, including all potentially important regions in the vicinity. This would have the added benefit of also being able to examine the motive behind the offshoring decision, either reducing the costs of the production process or facilitating servicing of a market.

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German Summary - Deutsche Zusammenfassung

Globalisierung ist ein Prozess, der sich in mehreren Wellen vollzogen hat und weiter andauert. Sie hat bis jetzt erheblichen Einfluss auf Volkswirtschaften weltweit ausgeübt. Das Denken der Menschen und die Art, wie sie ihr Leben leben, hat sich durch Globalisierung grundlegend geändert. So ist es heutzutage etwa vollkommen normal, dass im Supermarkt Produkte aus der ganzen Welt angeboten werden. Auch verbringen die Menschen ihren Urlaub immer häufiger in einem fremden Land, viele Menschen leben und arbeiten sogar nicht dort, wo sie geboren und aufgewachsen sind.

Dieser dynamische Prozess hat auch die Organisation von Volkswirtschaften nachhaltig verändert. Mittlerweile gibt es, obschon durch große Distanzen und sogar Ozeane getrennt, vollkommen globale Märkte, in denen sich Volkswirtschaften immer weiter verzahnen. Geld aus Deutschland kann zum Beispiel innerhalb weniger Augenblicke in China investiert werden, oder man kann in einem Geschäft in Deutschland Möbel aus Ostasien kaufen. Diese Entwicklungen, vor allem die Globalisierung von Produktionsprozessen und internationaler Handel, haben auch ökonomische Forschung fundamental verändert.

Baldwin (2006) bezeichnet diese Phänomene als erste und zweite große Entflechtung. Die erste Entflechtung vollzog sich in zwei Wellen, wobei die erste um das Jahr 1850 startete und mit Beginn des Ersten Weltkriegs endete. Danach folgte eine Zeit des Nationalismus und Protektionismus und Globalisierung nahm erst ab dem Jahr 1960 wieder ihren Lauf. In dieser Zeit erlebte die Welt eine in diesem Ausmaß unbekannte Zunahme des internationalen Handels. Die asiatischen Tigerstaaten vollzogen einen enormen Entwicklungssprung,

wurden zur Factory Asia"(z.B., Baldwin, 2008) und Einkommen zwischen dem industrialisierten „Norden“ und dem sich entwickelnden „Süden“ begannen sich anzugleichen. Diese Internationalisierung der Produktion führte zu komplexen Netzwerken internationaler Ströme aus Gütern, Dienstleistungen, Know-How, Kapital und Menschen. Diese komplexe Struktur wird heute oft als globale Wertschöpfungskette bezeichnet (GVC) (Baldwin und Lopez-Gonzalez, 2014). Mehrere Schlüsselfaktoren haben zu ihrem Entstehen beigetragen. Zunächst einmal sind die Kosten für den internationalen Handel insgesamt stark gesunken.[1] Im Rahmen von GATT bzw. der WTO sind größere Zollsenkungen sowie in letzter Zeit auch vermehrt die Reduktion nichttarifärer Handelshemmnisse vereinbart worden. Eine Vielzahl regionaler Freihandelsabkommen (RTA), bilateraler Investitionsabkommen (BIT) sowie auch unilateraler Abbau von Handelshemmnissen, vor allem zwischen „Nord-“ und „Südländern“, haben einen „Spaghetti Bowl“ (Baldwin, 2006*b*) von Handelsbeziehungen erzeugt. Darüber hinaus hat auch die sogenannte „Containerrevolution“ durch eine dramatische Senkung von Transportkosten enscheidend zur Steigerung des Handels beigetragen (Bernhofen, El-Sahli und Kneller, 2013).[2]

Auch politische Prozesse haben im Rahmen dieser Entwicklung eine große Rolle gespielt. Obwohl schon David Ricardo gezeigt hat, dass Arbeitsteilung und internationaler Handel kein Nullsummenspiel ist, versuchen Länder trotzdem, ihre Interessen bezüglich der Öffnung neuer Märkte durchzusetzen und Wettbewerbsvorteile zu erlangen. Gleichzeitig herrschte längere Zeit, vor allem bezüglich Entwicklungsländern, das Paradigma vor, dass Länder sich schneller entwickeln, wenn sie sich stärker dem internationalen Handel öffnen (z.B., Williamson, 1993). „Aid-for-Trade“ ist in diesem Zusammenhang eine der größten Initiativen, um Entwicklung voranzutreiben. Letztlich ist so Entwicklungshilfe ein

[1] Anderson und van Wincoop (2004) bieten einen guten Überblick über alles, was grob unter Handelskosten zusammengefasst werden kann, vor allem über ihre Messung und darüber, wie wichtig sie im Vergleich zu anderen Aspekten sind.

[2] Die Autoren zeigen, dass der Einsatz von Containern eine Steigerung des Handels zwischen industrialisierten Ländern um etwa 700% bewirkt hat.

machtvolles Instrument, um Einfluss auf Entwicklungsländer auszuüben.

In der Literatur ist bereits ausführlich behandelt worden, wie Geber-Länder ihre Interessen in bilateralen Beziehungen durchsetzen (z.B., Alesina und Dollar, 2000; Younas, 2008; Hoeffler und Outram, 2011). Entsprechend sind multilaterale Institutionen wie die Weltbank und der Internationale Währungsfonds (IMF) mit dem Ziel entstanden, die Einflussnahme auf Grund von Partikulärinteressen zu begrenzen. Diese Institutionen werden allerdings trotzdem von den reichsten Ländern kontrolliert. Darüber hinaus ist die Vergabe von Geldern an Entwicklungsländer an Bedingungen geknüpft, die Nehmerländer größtenteils vor Auszahlung erfüllen müssen. Diverse Studien zeigen, wie Vergabeentscheidungen sowohl bei der Weltbank (z.B. Fleck und Kilby, 2006) als auch beim IMF (z.B. Dreher und Jensen, 2007) durch reiche Länder beeinflusst werden. Bisher konzentriert sich die Literatur allerdings auf die Bevorzugung „befreundeter" Länder, die Auszahlungshöhe sowie die Anzahl an zu erfüllenden Bedingungen, ohne direkte Vorteile für die Geberländer. Copelovitch (2010) ist hier bezüglich des IMF als Ausnahme hervorzuheben. Kapitel 2[3] geht einen Schritt weiter. Es wird analysiert, inwiefern die G5 (die Vereinigten Staaten, Japan, Frankreich, Großbritannien und Deutschland) als die fünf größten Anteilseigner der Weltbank ihre Position ausnutzen, um Handelsvorteile durch die Beeinflussung von Bedingungen in Kreditvereinbarungen der Weltbank zu erlangen. Obwohl es schwieriger ist, die spezifische Ausgestaltung der Bedingungen zu beeinflussen, lohnt es sich um so mehr, da die Bedingungen unmittelbar politische Entscheidungen in Nehmerländern tangieren. Wenn dadurch etwa Einfluss auf die Handelsoffenheit eines Landes genommen wird, können Geberländer ihre eigenen Handelsbeziehungen verbessern. Dabei können die Geberländer, abhängig von ihren vorherigen Handelsbeziehungen zu Nehmerländern, potentiell eine Handelsintensivierungs-, eine Handelsschaffungs- oder eine Protektionsstrategie verfolgen.

[3]Diese Studie ist eine gemeinsame Arbeit mit Maya Schmaljohann.

Ein neuer Datensatz der Weltbank, in dem zum ersten Mal für mehr als 870 Kreditvereinbarungen in den Jahren 1980 bis 2011 alle Bedingungen ausführlich erläutert werden, macht es möglich, diesen Sachverhalt empirisch zu untersuchen. Unter der Berücksichtigung objektiver Kriterien, die Bedingungen in den Vereinbarungen beeinflussen sollten, sowie anderer möglicher Partikulärinteressen wird versucht herauszufinden, ob die G5-Länder eine der genannten Strategien im Bezug auf Handelsliberalisierung verfolgen. Die Resultate zeigen, dass in den Kreditvereinbarungen deutscher Handelspartner eine signifikant höhere Anzahl an Handelsliberalisierungsbedingungen zu finden ist. Dies wird als Verfolgung einer Handelsintensivierungsstrategie interpretiert, da der Effekt um den Median der Handelsverteilung am stärksten ausgeprägt ist. Hingegen sehen sich Handelspartner der Vereinigten Staaten einer signifikant geringeren Anzahl an Handelsliberalisierungsbedingungen gegenüber. Dies wird als Protektionsstrategie interpretiert, da der Effekt am oberen Ende der Handelsverteilung am stärksten ist. Darüber hinaus sind diese Effekte stärker für tatsächlich bindende Bedingungen, die vor Auszahlung von Krediten erfüllt werden müssen. Für Japan, Frankreich und Großbritannien lassen sich keine klaren Effekte isolieren. Generell zeigen die Ergebnisse, dass die einflussreichsten Länder innerhalb der Weltbank zusätzlich zu Auszahlungsentscheidungen und Auszahlungshöhe auch speziell die an Kredite geknüpften Bedingungen beeinflussen. Dieser Fund unterminiert die eigentlich notwendige Unvoreingenommenheit multilateraler Entwicklungsinstitutionen, was dazu führen kann, dass Entwicklungsländer die Legitimität dieser Institutionen und deren technische Hilfe in Frage stellen könnten. Gleichzeitig sollten die Ergebnisse aber auch zu den Diskussionen über Transparenz und die Verteilung von Einfluss innerhalb der Weltbank beitragen.

Die zweite große Entflechtung, die etwa um die Jahrtausendwende begann, basiert vor allem auf der sogenannten „ICT-Revolution“ (siehe z.B. Baldwin 2006*b*). Diese brachte, getrieben durch das Aufkommen des Internets und die Verbesserung der Kommunikations-

technologie, eine erhebliche Reduktion von Transaktionskosten mit sich. Im Rahmen der Entflechtung verstärkte sich vor allem die weltweite Integration bezüglich der Produktion von Gütern und Dienstleistungen, vor allem die Auslagerung von Produktionsschritten aus reichen in ärmere Länder. Die Bedeutung des Handels von Zwischenprodukten erfuhr somit einen erheblichen Aufschwung und führte zu einer wahrhaften globalen Wertschöpfungskette. Weiterhin ist auch ein starker Anstieg ausländischer Direktinvestitionen zu verzeichnen. Heute besteht der Produktionsprozess aus einer immer weiter steigenden Anzahl an primären Gütern, Teilen, Komponenten und intermediären Dienstleistungen, deren Produktion sich auf die ganze Welt verteilt. Die Welt hat sich vom Handel in Gütern zu Handel in Arbeitsschritten bewegt (z.B., Grossman und Rossi-Hansberg, 2008). Diese Entwicklungen haben auch das Studium der internationalen Ökonomie nachhaltig verändert. Heute stellen sich Fragen, warum etwa manche Firmen in mehreren Ländern operieren oder warum bestimmte Produktionsschritte in bestimmten Ländern oder sogar bestimmten Regionen stattfinden. Das Konzept komparativer Kostenvorteile ist weiterhin ein wichtiger Bestandteil der Forschung, wenn es darum geht, wer etwas mit wem und warum handelt. Nicht zuletzt konnte ein starker Anstieg in Studien verzeichnet werden, die sich mit den Determinanten komparativer Kostenvorteile beschäftigen. Heutzutage sind diese Studien allerdings differenzierter und beschäftigen sich mehr damit, wo komparative Kostenvorteile in Produktionsschritten liegen.

Zu diesem Zweck ist es zunächst einmal wichtig, den Handel in Teilen, Komponenten und Endprodukten näher zu beleuchten. Dies geschieht in Kapitel 3.[4] Es gibt bereits einen größeren Literaturstrang, der den weltweiten Anstieg des Handels mit Zwischenprodukten dokumentiert. Schlagworte sind hierbei unter anderem Outsourcing, die Teilung der Wertschöpfungskette, Fragmentierung und der Handel in Tätigkeiten (siehe z.B. Krugman, Cooper und Srinivasan, 1995; Feenstra und Hanson, 1996; Jones und Kierzkowski, 2001;

[4]Diese Studie ist eine gemeinsame Arbeit mit Stephan Huber.

Grossman und Rossi-Hansberg, 2008). Diese Literatur hat bisher aber nur eine Dreiteilung von Gütern in (1) Primärgüter, (2) Zwischenprodukte und (3) Endprodukte vorgenommen. In Kapitel 3 werden Zwischenprodukte noch einmal weiter in Teile und Komponenten unterteilt. Dazu wird eine neue Klassifizierung des Verbands Deutscher Maschinen- und Anlagenbau benutzt, welche einem Großteil der Güter aus dem verarbeitenden Bereich auf 8-stelliger Ebene der Combined Nomenclature der EU das Label Teil, Komponente oder Endprodukt zuweist.

Mit Hilfe von Daten aus Eurostats COMEXT-Datenbank für die Jahre 2000 bis 2014 wird dann der Handel der 27 EU-Mitglieder[5] in Teilen, Komponenten und Endprodukten charakterisiert. Zusätzlich wird ein neues Maß für das durchschnittliche Entwicklungslevel der Handelspartner entwickelt, um die Richtungen des Handels in Teilen, Komponenten und Endprodukten innerhalb der globalen Wertschöpfungskette zu beleuchten. Dabei ist ein zentrales Ergebnis, dass der Handel in Teilen und der Handel in Komponenten sich stark unterschiedlich entwickeln und diese Untergruppen der Zwischengüter für verschiedene Länder eine sehr unterschiedliche Bedeutung haben. Somit ist diese feinere Unterteilung von Zwischenprodukten ein wichtiger Schritt, um die Analyse globaler Wertschöpfungsketten mit neuen, sogenannten „stylized facts“ voranzubringen. Die weitere Analyse bezüglich der durchschnittlichen Entwicklungsniveaus der Handelspartner liefert kein einheitliches Bild. Es lässt sich jedoch aufzeigen, dass alle Länder in der Untersuchung auf allen Ebenen der Wertschöpfungskette aktiv sind. Weiterhin werden etwa Teile eher mit Ländern auf niedrigeren Entwicklungsniveaus gehandelt, Komponenten hingegen eher mit reicheren Ländern. Es bleibt also festzuhalten, dass eine feinere Unterteilung der einzelnen Stufen der Wertschöpfungskette ein wichtiger Schritt nach vorne ist, um ein genaueres Bild über Richtungen des Handels innerhalb globaler Wertschöpfungsketten zu erhalten. Dazu braucht man allerdings noch weiter verfeinerte Daten, die so zur Zeit nicht verfügbar sind.

[5]Kroatien wird auf Grund fehlender Daten nicht berücksichtigt.

Kapitel 4 befasst sich mit institutionellen Determinanten komparativer Konstenvorteile vor dem Hintergrund globaler Wertschöpfungsketten. Mehrere wegweisende Studien haben gezeigt, dass neben Technologie und Faktorausstattung vor allem verschiedene Dimensionen institutioneller Rahmenbedingungen Ländern komparative Kostenvorteile in Industrien verschaffen, die stark von der Qualität dieser Rahmenbedingungen abhängig sind (Nunn und Treffler, 2014). Drei große Blöcke sind bisher untersucht worden. Der erste befasst sich mit Produktmarktinstitutionen. Nunn (2007) und Levchenko (2007) zeigen, dass Länder, in denen Rechtsinstitutionen, vor allem bezüglich der Möglichkeit, Verträge durchzusetzen, stark ausgeprägt sind, mehr in Industrien exportieren, die hoher Summen spezifischer Investitionen bedürfen und in denen komplexere Anbieter-Käufer-Beziehungen vorliegen. Der zweite Block befasst sich mit Finanzmarktinstitutionen. Hier zeigt sich, dass Länder mit gut funktionierenden Finanzmärkten mehr in Industrien exportieren, in denen hohe Anfangsinvestitionen zum Export notwendig sind (z.B. Manova, 2008). Im dritten Block geht es um Arbeitsmarktinstitutionen. Hier sind zwei verschiedene Dimensionen zu unterscheiden. Einerseits zeigt Costinot (2009), dass Länder mit guten Rechtsinstitutionen mehr in Industrien exportieren, in denen stärker spezialisierte Tätigkeiten den Produktionsprozess ausmachen und entsprechend bessere Überprüfungsmöglichkeiten vorhanden sein müssen. Andererseits untersucht Tang (2012) den Zusammenhang zwischen firmenspezifischer Skill-Intensität einer Industrie und dem Grad an Arbeitsmarktprotektion. Stärker protektionistische Arbeitsmärkte erhöhen die Anreize für Angestellte, sich solche Fähigkeiten anzueignen. Daher exportieren Länder mit stärker protektionistischen Arbeitsmärkten mehr in Industrien, die eines höheren Grads an firmenspezifischen Fähigkeiten bedürfen. Ein gemeinsamer Schwachpunkt der gesamten Literatur ist jedoch die Verwendung von Bruttohandel sowie eines nicht konsistenten Schätzers.

Im Zeitalter globaler Wertschöpfungsketten spiegelt Bruttohandel immer weniger wider, was Länder tatsächlich an Wertschöpfung exportieren. Um die Angebotsseite einer Volks-

wirtschaft und entsprechend auch komparative Kostenvorteile zu untersuchen, ist jedoch die Wertschöpfung entscheidend. Entsprechend wird in Kapitel 4 die empirische Evidenz bezüglich der institutionellen Kanäle neu evaluiert. Zu diesem Zweck werden zwei Analyserahmen von Chor (2010) und Tang (2012) integriert, die jeweils Gravitätsgleichungen auf der Ebene industriellen Handels liefern. Dazu werden Daten aus der neuen Wertschöpfungshandelsdatenbank der OECD herangezogen. So wird ein Datensatz mit 55 Exportländern, 56 Importländern und 18 Industrien erstellt. Zur Untersuchung werden dabei Schätzungen mit Hilfe eines konsistenten Schätzers und Bruttohandel auf der einen sowie Wertschöpfungshandel auf der anderen Seite durchgeführt. Die Modellvorhersagen können durch die Schätzresultate größtenteils bestätigt werden. Produkt- sowie Arbeitsmarktinstitutionen werden, sowohl statistisch als auch ökonomisch, als wichtigste Determinanten komparativer Kostenvorteile identifiziert. Dabei treten jedoch durchaus Unterschiede je nach verwendeter abhängiger Variable auf. So konnten etwa Produktmarktinstitutionen nur bei Verwendung von Wertschöpfung als robuste Determinante verankert werden. Diese Resultate haben potentiell starke Implikationen, da sich aus den Ergebnissen abgeleitete politische Handlungsempfehlungen je nach verwendetem Handelsmaß stark unterscheiden würden. Ist nun Wertschöpfung tatsächlich das bessere Handelsmaß, um komparative Kostenvorteile zu untersuchen, wirft dies Zweifel auf bisherige Studien. Gleichzeitig besteht hier großer Spielraum für zukünftige Untersuchungen. Sowohl eine Verbesserung der Datenlage bezüglich Wertschöpfungshandel als auch institutioneller Maße würde es erlauben, besser fundierte Handlungsempfehlungen abzuleiten.

Kapitel 5[6] befasst sich zu guter Letzt mit Standortentscheidungen multinationaler Firmen (MNCs). Durch fortschreitende Integration mit und Beitritt zur Europäischen Union sind mittel- und osteuropäische Länder attraktive Ziele für ausländische Direktinvestitionen und somit der Ansiedlung von Produktionsstandorten multinationaler Firmen geworden.

[6]Diese Studie ist eine gemeinsame Arbeit mit Andrzej Cieślik und Xenia Matschke.

Diese Standortentscheidung hat zwei Dimensionen. Zunächst muss sich die MNC für ein Land entscheiden, anschließend für einen spezifischen Standort innerhalb des Landes. Vor allem Polen sticht dabei mit einem Investitionsvolumen von 245 Millionen USD in den letzten Jahren heraus (Unctad, 2015). Die Ansiedlungen sind auf regionaler Ebene jedoch stark ungleich verteilt und konzentrieren sich vor allem auf die am stärksten entwickelten, urbanen Regionen. Diese Problematik ist in der Literatur bisher wenig untersucht worden.

Der Beitrag in Kapitel 5 umfasst mehrere Teile. Zunächst wird ein direkter Bezug zwischen Theorie und anschließender empirischer Untersuchung hergestellt, der in der Literatur bisher vernachlässigt worden ist. Dabei werden Vorhersagen auf der Basis eines Analyserahmens aus der neuen ökonomische Geographie (Fujita, Krugman und Venables, 1999) gemacht und eine Schätzgleichung direkt hergeleitet. Der wichtigste Beitrag der Studie ist jedoch die Untersuchung der Rolle vertikaler Beziehungen bezüglich der Standortentscheidung. Die zentrale Frage ist hierbei, inwiefern das Vorhandensein von Zulieferern und Abnehmern in einer Region diese besonders attraktiv macht. Dazu werden basierend auf Amiti und Smarzynska Javorcik (2008) Maße entwickelt, die diese Beziehungen besser abbilden als bisher in der Literatur üblich. Diese Maße beziehen potentiell alle vorgelagerten und nachgelagerten Industrien mit ein. Mit Hilfe eines Conditional-Logit-Analyserahmens werden die aus dem Modell abgeleiteten Hypothesen danach untersucht. Dazu werden Daten auf Firmenebene aus der Amadeusdatenbank mit regionalen Daten auf NUTS-II-Ebene von Eurostat und dem polnischen Statistikamt kombiniert.

Die Ergebnisse zeigen, dass sowohl das Vorhandensein vorgelagerter als auch nachgelagerter Firmen der Wertschöpfungskette eine entscheidende Rolle bei der Standortauswahl spielt, die Wahrscheinlichkeit zur Ansiedlung also signifikant erhöhen. Die Erwartung, dass für das verarbeitende Gewerbe das Vorhandensein vorgelagerter Firmen besonders wichtig ist, konnte nicht bestätigt werden. Dagegen zeigte sich entsprechend der Erwartung, dass für Dienstleistungsfirmen das Vorhandensein nachgelagerter Firmen und Endabnehmer

besonders wichtig ist. Darüber hinaus erwiesen sich Transport- und Kommunikationsinfrastruktur als Anziehungsfaktoren. Hingegen entpuppten sich eine hohe Arbeitslosenrate sowie eine höhere Distanz zum Mutterland als signifikante Abschreckungsfaktoren. Zukünftige Studien sollten vor allem die beiden Dimensionen der Standortentscheidung in einem gemeinsamen Analyserahmen vereinen. Weiterhin lassen sich in einem größeren Rahmen die Agglomerationsmaße verbessern, in dem alle Regionen der unmittelbaren Umgebung in die Maße mit einbezogen werden. Damit ließe sich auch das Motiv hinter der Direktinvestitionsentscheidung besser untersuchen, nämlich ob dieser die Auslagerung eines Produktionsschrittes zur Kostensenkung oder ein besserer Marktzugang zu Grunde liegt.