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## How intermediates trade affects the formation of free trade agreements: A study analyzing pairwise trade flows of 70 countries

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**How Intermediates Trade Affects the Formation of  
Free Trade Agreements:  
A study analyzing pairwise trade flows of 70 countries**

by

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# **How Intermediates Trade affects the Formation of Free Trade Agreements:**

**A study analyzing pairwise trade flows of 70 countries**

## **Abstract**

International trade and fragmentation of production lead to increased trade in intermediate goods. Increased multi-stage production promotes the formation of free-trade agreements (FTA). In this paper, the relationship between intermediates trade and FTAs is examined with a two-step Pseudo Poisson Maximum Likelihood model. The analysis of a comprehensive dataset of pairwise trade-flow data of 70 countries from the years 1995- 2011 shows a significant connection between trade in intermediates and the participation in free-trade agreements. A two-way relationship is identified: intermediates trade increases the probability to form a FTA and FTAs lead to an increase in intermediates trade.

## **Keywords:**

free-trade agreements, international trade, intermediates trade, multi-stage production, fragmentation of production, vertical linkages, third-country effects, gravity equations, distance coefficients, border effects

# 1 Introduction

The post-World War II era has seen a tremendous amount of trade liberalization. Much of this has occurred via various GATT rounds, which reduced global average tariff rates from more than 50% in 1947 to currently less than 5%. Another driving force was the formation of free-trade agreements (FTAs) such as the EC treaties, NAFTA, MERCOSUR, etc. In fact, there has been a proliferation of FTAs since 1995. According to WTO figures (World Trade Organization, 2016), there are currently more than 600 notifications of regional trade agreements of which more than 400 are in force – compared to less than 80 agreements that were in force at the end of 1999.

What drives the formation of FTAs? There is a large literature on the determinants of FTAs, which has identified economic and political drivers of FTA formation as well as geographical proximity as an additional force. This paper is an attempt to extend this literature by investigating the role of trade in intermediate goods. Trade in intermediate goods has become more important in the past two decades. Its share in total trade rose from 36% to 49% from 1995 to 2011 (World Trade Organization, 2016). A major driving force of this increase is the international fragmentation of production processes. Different stages of multi-stage production processes are performed in different countries and, correspondingly, intermediate products cross international borders several times. With increased fragmentation, transport and other trade-related costs have become more important. If these costs are low, the international division of labor in multi-stage production is easy and trade in intermediate products is intense. Since FTAs reduce trade-related costs, one is led to hypothesize that FTAs have a positive impact on international trade. However, there may be also the inverse relationship: countries involved in intense intermediates trade have additional incentives to enter into FTAs with their trading partners. Thus, trade in intermediate goods might be a driving force for the creation of FTAs. This is the central hypothesis to be addressed in this paper.

Trade in intermediates is driven to a large extent by fragmentation of production. Different levels in trade costs<sup>1</sup> foster international fragmentation of production stages (Fally and Hillberry, 2013). Additional factors influencing the vertical specialization are the comparative

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<sup>1</sup> Trade costs include transport and distribution costs and are closely linked to economic policy (tariffs, quotas). Moreover, they encompass costs of law enforcement, information costs and costs associated with different currencies or languages (Anderson and van Wincoop (2004)).

advantages of different economies (Kim, 2013). However, multi-stage production causes products to acquire trade costs multiple times (Yi, 2010).

As countries sought to decrease the costs of "border crossings", multilateral trade agreements were created (Anderson and van Wincoop, 2003). Due to these agreements, the trade costs decreased over the past decades and will probably be further reduced in the future (Baldwin and Lopez-Gonzalez, 2015). The decline of trade costs enables countries to specialize into advantageous production stages (Kim, 2013).

Several reasons for self-selection into an FTA are viable, which can be divided into the following categories:

- One of them is that only large high-productivity countries like the USA or Japan are capable of complete in-country production because they are able to produce more product varieties than smaller countries. Thus, small and/or low-productivity countries are more likely to join trade agreements because they profit more from production sharing (specialization) and are more affected by changes in trade costs (Fally and Hillberry, 2013). In other words for a country trading or producing more intermediates, there is a stronger incentive to join or create an FTA.
- Another incentive to form an FTA, is the "love of variety" of customers. The resulting demand for a large amount of differentiated product variants is mainly satisfied by large high-productivity countries. Small and/or low-productivity economies fairly have those capacities. Thus, for small countries it can be profitable to join an FTAs to provide more product varieties as well as to create more overall welfare (Krugman, 1980; Bergstrand, 1985).
- Regarding geography, empirical work has proven that distance is a major factor for the decision to join an FTA. In addition to distance, national borders have decisive effects on trade patterns which extend beyond formal trade barriers (McCallum, 1995). These border effects indicate the local concentration of economic activity compared to the activity abroad and are therefore a measure for economic integration (Magerman *et al.*, 2015). The relationship between distances and border effects is commonly addressed as the "border puzzle" in the literature (McCallum, 1995; Anderson and van Wincoop, 2003; Buch *et al.*, 2004).
- Not only the geographic location but also the number of suitable trade partners in immediate distance influence the trade decisions of a country. Countries are interested in building trade agreements with countries of similar legal and institutional frameworks.

They prefer common economic standards. An example is the harmonization of property rights, to ensure that important technology or knowledge cannot be used by third parties without authorization (Curtis, 2012). Cultural distance (e.g. language, religion) and stereotypes may influence trade decisions as well (Rydzek *et al.*, 2015).

"Third-country-effects" have an effect on trade as well. These effects are relevant, because trade between two countries does not only affect the parties involved directly, but also countries trading only with one of the two partners (Joshi and Chen, 2010). Therefore, it is necessary to dwell deeper into the structure of intermediate trade flows, because trade volumes can be affected by creation and diversion effects of third countries (e.g. third country technology shocks or spillover effects) (Krugman, 1980; Anderson and van Wincoop, 2004).

Although the aforementioned work has identified multiple mechanisms driving fragmentation and trade agreements, a possible linkage between the participation in FTAs and trading intermediate goods has not been analyzed yet. This paper intends to close this gap and is organized as follows. The next section outlines the research strategy including the crucial differentiation between final and intermediate goods and provides an econometric model in order to test the hypothesis. Section 3 provides a detailed description and specification of the trade data and the explanatory variables in use. The fourth section describes the estimation and the main results. The last section concludes.

## 2 The Approach

To examine the relationship between intermediates trade and the formation of Free-trade agreements (FTA), potential incentives for creating an FTA need to be addressed. In addition to the incentives, various reasons for self-selection into an FTA can be considered: insufficient productivity, geographical proximity, similar legal framework and common cultural history. As this paper focuses on trade in intermediates, which is to a large extent driven by the fragmentation of production, some additional assumptions have to be made.

### 2.1 Intermediates versus final goods

The differentiation between intermediate and final goods is a crucial part of this research. In order to classify goods as intermediates and final goods, the index measures proposed by (Fally, 2012) were used as an orientation. This method captures fragmentation as the number of border crossings of a good. If no border crossing takes place, one can assume that the country produces final goods only.

In this paper two types of goods (intermediates and final goods) are defined as follows:

- final goods entirely produced by one country
- intermediates are shipped to another country, as they are used in several production stages (still in progress) in more than one country

The dataset used for this research contains trade-data for 70 countries from 1995 until 2011. Figure 1 shows the corresponding percentage of intermediates trade to total trade for the data available<sup>2</sup>. The fluctuation of this share also reflects the macroeconomic global activities over time. Crisis affect trade in intermediates in particular as it accounts for approximately 70 percent of the trade flows.

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<sup>2</sup> This ratio was obtained by dividing the pairwise amount of intermediates trade (in million USD) by the pairwise amount of total trade (in million USD) and grouped by country.

### Share of intermediates trade to total trade (1995-2011)



Figure 1: Share of intermediates trade to total trade (1995-2011)

## 2.2 Hypothesis

Trade with intermediate goods is a significant part of international trade and has different characteristics than final goods trade. Intermediates trade reacts more sensitive by changes in trade costs as these costs are responsible for a larger fraction of the product price in comparison with final goods (Miroudot *et al.*, 2009).

Therefore, the probability to form a free-trade agreement increases as shipping of goods back and forth can be very expensive. Furthermore, trade partners need to be reliable especially when trading intermediates. Trade-partners need to be trustworthy and adhere to the contract, because production suffers even more, if an intermediate does not reach its next destination in the production chain (Fally and Hillberry, 2013). The principal hypothesis therefore is:

*"Countries with more trade in intermediates have a stronger incentive to form FTAs."*



## 2.3 Theoretical Model

Capturing all factors that influence the formation of trade agreements is a difficult task. Krishna (1998) developed a theoretical model where countries compare their possible gains and losses from joining a trade agreement. Access to a foreign market is considered to be positive, whereas the access to the home market (for the foreign country) may have negative effects. In order to capture intermediates trade information about production stages has to be included. Hillberry and Hummels (2005) assume, that production stages take part in an interval  $x[0,1]$ . If  $x = 0$ , no intermediate production stages were undertaken yet (so far only the raw material is present). If  $x = 1$ , it is a final good. If  $x$  is between 0 and 1, it is considered as an intermediate good (at different production stages). For example if  $t = 0.7$ , the good is to 70% complete. In order to find out the number of intermediates and production stages involved, it is important to know how much is produced within one country.

The model assumes only two countries  $i$  and  $j$ , which represent separate markets<sup>3</sup>. Both countries produce (different production stages of) a product  $x$  at production costs of  $\gamma$  (per unit of  $x$ ). Each country wants to maximize its profit  $\pi$  in the domestic as well as in the foreign market. The following functions show the profit for country  $i$  the own and in the foreign market respectively:

$$\begin{aligned}\pi_{ii} &= (P_i - \gamma_i)x_{ii} \\ \pi_{ij} &= [P_j - \gamma_i - t_{ij}(1 - g_{ij})]x_{ij},\end{aligned}$$

where  $P$  represents the inverse demand function,  $t$  denotes trade costs and  $g_{ij} \in \{0, 1\}$  indicates whether or not an FTA exists<sup>4</sup>. In the presence of an FTA  $t$  becomes zero and thus trade is increased. Moreover, competition increases and profits, generated in the home market, are split between the two countries (resulting in lower profits for country  $i$  in its domestic market) (Joshi and Chen, 2010). As consumers in both countries have a "love of variety" and thus demand additional product variations it can be profitable to join an FTAs to provide more product varieties as well as to create more overall welfare.

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<sup>3</sup> This Cournot model was adjusted and extended by Freund (2000), Goyal and Joshi (2006), Grossman and Helpman (1995) and Saggi (2006).

<sup>4</sup> Country  $i$  can increase its profit by increasing its tariffs for the foreign country ( $d\pi_{ij}/dt_{ij} > 0$ ). Those profits are decreased if the foreign country increases its tariffs.

The welfare  $W$  of country  $i$  is the sum of consumer surplus<sup>5</sup>, (producer) profits in the home and foreign market and the tariff revenue:

$$W_i = \frac{x_i^2}{2} + \pi_{ii} + \pi_{ij} + t_{ij}(1 - g_{ij})x_{ij}.$$

The consumer surplus increases with the formation of an FTA and decreases with tariffs. Tariff revenues on the other hand decrease with the formation of an FTA. Therefore, country  $i$  and country  $j$  will only form an FTA if:

$$W_i(g_{ij} = 1) > W_i(g_{ij} = 0), \text{ and} \\ W_j(g_{ij} = 1) > W_j(g_{ij} = 0).$$

Countries are only willing to engage in an FTA, if both parties gain from this union (Joshi and Chen, 2010). If a country cannot carry out all associated tasks itself, the chances of forming an FTA are increased, especially if transaction costs are high. The more production stages, the more likely that these are carried out in different countries, which again leads to a higher incentive to form an FTA (Coase, 1937).

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<sup>5</sup> The consumer surplus is derived from the aggregate consumption in country  $i$ ,  $(\Sigma(x_{ii} + x_{ji}))$  and the inverse demand function.

## 2.4 Econometric Model

The creation of free-trade agreements is determined by economic and political factors. Recent literature suggests that FTAs are more likely to be created amongst large, similarly-sized, geographically close countries with modern political systems (Fally and Hillberry, 2013). Trading intermediates causes bilateral trade. FTA membership does not affect only participating countries but also non-participants (via third country effects) (Joshi and Chen, 2010).

### 2.4.1 Bilateral trade flows

The model applied by Egger *et al.* (2011) uses one sector and  $N$  countries and takes love-of-variety preferences into account. The nominal bilateral exports are:

$$X_{ij} = (y_i - y_j) * t_{ij}^{1-\sigma} * \Pi_i^{\sigma-1} * P_j^{\sigma-1},$$

where  $X_{ij}$  represents the nominal exports from country  $i$  to country  $j$ . Trade costs (including tariffs) from country  $i$  to country  $j$  are denoted by  $t_{ij}$ . The variables  $y_i$ ,  $y_j$  and denote the difference of the GDPs of country  $i$  and country  $j$  (according to Joshi and Chen (2010) similar countries are assumed to link up easier). The elasticity of substitution among variants is denoted by  $\sigma$  (assumption:  $\sigma < 1$ ).  $\Pi_i$  and  $P_j$  represent the multilateral resistance (MR) terms for exporters and importers. These MR terms capture multilateral trade costs faced by exporting firms and by consumers in importing countries.

MR terms cannot be observed directly, but must be derived implicitly:

$$\Pi_i^{\sigma-1} = \sum_{j=1}^N (t_{ij}^{1-\sigma} P_j^{\sigma-1} y_j); P_j^{\sigma-1} = \sum_{i=1}^N (t_{ij}^{1-\sigma} \Pi_i^{\sigma-1} y_i) \forall i, j$$

The term  $\Pi_i^{\sigma-1}$  is the outward multilateral resistance. It describes the attractiveness of exporting to other destinations for country  $i$ . This involves trade costs, which influence the decision to trade. The term  $P_j^{\sigma-1}$  is the inward multilateral resistance, which is equal to the price level and therefore representing the toughness of competition in market  $j$ . If the prices in this market are low, it is less attractive to trade, which leads to less competition. This

increases the prices in turn (Bergstrand, 1985). Possible third-country effects are captured in the MR-terms as well.

Bilateral trade may not only influence the two countries involved, but also third parties, thus these effects can have a significant impact (Joshi and Chen, 2010).

## 2.4.2 Structural gravity model

In general equilibrium models (GEM) it may happen that standard evaluations are deceptive if country-pair specific choices affect the outcomes of other economies as well (spillover effects) (Baldwin, 2014). Therefore, all impacts on trade costs  $t_{ij}$ , exporter GDP  $y_i$ , importer GDP  $y_j$  and the MR terms  $\Pi_i$ ,  $P_j$  have to be taken into account. MR terms dampen the effects of trade costs directly. The parameter  $\alpha_i$  is defined as  $\ln(y_i \Pi_i^{\sigma-1})$  whereas  $\gamma_j$  is defined as  $\ln(y_j P_j^{\sigma-1})$ . Therefore,  $\alpha_i$  and  $\gamma_j$  can be defined as country fixed-effects<sup>6</sup> (Egger *et al.*, 2011). Information on trade costs  $t_{ij}$  is usually not available. Therefore, proxy variables are used. These include the distance between the main cities of the countries ( $DIST_{ij}$ ), information concerning the existence of a common border ( $BORD_{ij}$ ), and information about a common spoken official language ( $LANG_{ij}$ ). Furthermore, a dummy for the existence of a FTA is needed ( $FTA_{ij}$ ). The connection between these proxy variables can be described as follows:

$$t_{ij}^{1-\sigma} = \exp(\beta_1 DIST_{ij} + \beta_2 BORD_{ij} + \beta_3 LANG_{ij} + \dots + \delta FTA_{ij}).$$

The gravity model is assumed to be exponential, as the traditionally used log-linear form cannot guarantee a constant and efficient estimation (for example in the case of country-pairs with bilateral trade-flows of zero) (Silva, J. M. C. Santos and Tenreyro, 2006). The parameter  $\delta$  reflects only the direct effects of FTA membership on trade costs.

Substituting the expression above into the equation for the nominal bilateral exports gives:

$$X_{ijt} = \exp(Z'_{ij}\beta + \delta FTA_{ijt-1} + \alpha_i + \gamma_j),$$

where the vector  $Z_{ij} = (1, DIST_{ij}, BORD_{ij}, \dots)'$  contains a constant as well as all trade cost and other variables influencing trade except for  $FTA_{ijt-1}$ . The vector of coefficients referring to the

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<sup>6</sup> The parameters  $y_i$ ,  $\Pi_i$  and  $P_j$ , may change over time and are treated as exporter and importer fixed-effects, although they are just an approximation.

elements in  $Z_{ij}$  is denoted by  $\beta$ . In this model,  $\beta$  represents the indirect effects and  $\delta$  represents the direct effects of FTA on exports. The country fixed-effects  $\alpha_i$  and  $\gamma_j$  can be influenced by the vector  $Z_{ij}$  and the variable  $FTA_{ijt-1}$ , therefore, a two-way fixed effects model is used. Each country is an exporter as well as an importer and the dataset is a trade matrix where trade flows between all countries are included (Egger *et al.*, 2011).

### 2.4.3 The final model

With the differentiation between final and intermediate goods, information concerning border effects, vertical fragmentation, and the possibility to calculate the number of intermediate production stages, a gravity model capturing the effects of distance and trade costs can be established.

In order to deal with possible biases like third-country effects, zeros in the trade matrix, or endogeneity, the preferable method of estimation is a two-part approach of a Poisson pseudo-maximum likelihood model. This approach is capable of controlling for the presence of heterogeneous countries, non-random selection into positive exports and endogenous FTA membership (Egger *et al.*, 2011).

The first stage tests the probability to form a FTA:

$$FTA_{ijt} = \exp(Z'_{ij}\beta + \delta W_{ijt-1} + \alpha_i + \gamma_j),$$

whereby it is more likely to form a FTA with higher intermediates trade. The vector  $W$  represents all factors which influence the decision of country  $i$  to form an FTA with country  $j$ .  $Z$  is defined as a vector of control variables influencing FTA membership. The exporter and importer fixed-effects are denoted by  $\alpha_i$  and  $\gamma_j$  (Egger *et al.*, 2011).

For the second stage, the effects of a free-trade agreement on trade are tested.

$$X_{ijt} = \exp(\beta Z'_{ij} + \delta FTA_{ijt-1} + \alpha_i + \gamma_j).$$

### 3 Data and Specification

The variables used in this paper cover pairwise as well as country-specific information for 70 countries<sup>7</sup> from 1995 until 2011.

Data on gross output and 'value added' was retrieved from the World Input-Output Database (WIOD) (Timmer *et al.*, 2015). Pairwise information about the existence of Free-trade agreements among the countries of interest is taken from Jeffrey Bergstrand's database (Bergstrand Jeffrey, 2013).

Control variables including distance, continent, capital, official languages, colonizer, landlockedness as well as pairwise information on a common border, common official language and common past or current colonial relationship were obtained from Thierry Mayer's database (Thierry Mayer and Soledad Zignago, 2011).

The values of the harmonized consumer price index (HCPI) were taken from the (European Central Bank, 2014) and OECD (Organisation for Economic Co-operation and Development, 2012). Information about exports and imports of goods classified in coded product categories were retrieved from the United Nations (UN) COMTRADE Database (UN COMTRADE Database, 2014).

#### 3.1 Trade data and HS classification

Products can be classified into categories and according to their features. One system to classify products is the Harmonized System (HS) of the United States. The harmonized system has been developed in several revisions from HS1992 to HS2012 (Harmonized System, 2012).

Bekkers *et al.* (2012) created a database for the product codes of the Harmonized System. In this dataset every product is classified as either intermediate or final good. The Harmonized System uses different lengths of codes to distinguish headings (2 digits), subheading (4 digits) and the actual product (6 digits). The classification was done for the HS1992 6 digit numbers. In this paper the HS1992 classification was used.

#### 3.2 Data and Specification of Variables

The self-selection of a country into participating in a FTA is executed according to three sets of characteristics.

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<sup>7</sup> The examined countries were mainly members of the EU-27, BRIC, NAFTA, Mercosur, ASEAN and ACP.

The trade cost variables summarized in  $Z_{ij}$  are variables that approximate trade costs: distance between the main cities of a country, information about a common border, common language, common continent, common colonial history and common national history<sup>8</sup>.

Another set of variables includes information about country size, GDP, GDP per capita (to capture productivity) and the Harmonized Consumer Price Index (HCPI) (to capture the price level according to the Balassa-Samuelson effect) (Drine and Rault, 2002).

Additional determinants are implicitly contained in the exporter and importer fixed effects.

Other variables influencing the selection of countries into FTAs are a common currency and landlockedness. Moreover, an indicator variable ranging from one (=low) to six (=high), describing transparency, accountability, and corruption in the public sector rating in a certain country is included.

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<sup>8</sup> Common national history captures if two separate countries were once a single country (e.g. Czechoslovakia).

### 3.3 Descriptive Statistics

Table 1 gives an overview of the means, standard deviations, minima and maxima of the dependent and explanatory variables used in the estimation models. About 19 percent of the 88,200 country-pairs in the data set used are members of an FTA and about 40 percent of the cells of the bilateral export matrices are zero.

Variable	Description	Mean	SD	Min.	Max.
FTA <sub>ij</sub>	Indicator variable taking value one if two countries established an FTA	0.193326	0.3949088	0	1
Totexp	Nominal exports in USD	1810093623.11	8892630909.35	0	293922406400
Totimp	Nominal imports in USD	1887733452.98	9151167399.54	0	321906638848
TVint	Intermediates trade in USD	2866316645.70	14764166460.23	1	561897300258
Logdist <sub>ij</sub>	Log distance	8.649924	0.9251221	4.087945	9.892039
Border <sub>ij</sub>	Indicator variable taking value one if two countries share a common border	0.308425	0.1729087	0	1
Comlang_off <sub>ij</sub>	Common official primary language indicator	0.0973286	0.2964354	0	1
Comlang_ethno <sub>ij</sub>	Indicator variable taking value one if a language is spoken by at least 9% of the population in both countries	0.1151377	0.3162211	0	1
Comcont <sub>ij</sub>	Indicator for a common continent	0.2877324	0.4527083	0	1
Colony <sub>ij</sub>	Value one for country pairs ever been in colonial relationship	0.0256782	0.1581898	0	1
Comcol <sub>ij</sub>	Common colonizer post 1945	0.310623	0.1735042	0	1
Curcol <sub>ij</sub>	Currently in a colonial relationship	0.0008283	0.0287718	0	1
Col45 <sub>ij</sub>	Colonial relationship post 1945	0.0107683	0.1032208	0	1
Smctry <sub>ij</sub>	Indicator if countries were or are the same country	0.0095258	0.0971442	0	1
Observations	88,200				

Table 1: Descriptive Statistics of the Data



## 4 Estimation

A probit model of a two-step Poisson Pseudo Maximum Likelihood (PPML) estimator was used to estimate the effect of intermediate trade on the formation of FTAs.

In the second stage, a gravity equation including the instrumented values of the FTA from the first stage is performed. This stage is used to find out, if the variable FTA changes and by how much trade changes then. In order to achieve the desired outcome, the fitted values from the first stage  $FTA_{ij}$  are used and multiplied with the interaction term  $I$  (=gross output/value added). The interaction term is only used on  $FTA_{ij}$ , because otherwise the consequence would be multicollinearity. The interaction term represents the number of intermediates and is different for every country.

In order to make sure that the used instrument is exogenous, a first-stage probit is used, which does neither include a variable on intermediates trade, nor the variables colony, comcol and smctry.

For the second stage a PPML is used because it gives equal weights to all observations and is robust to heteroskedasticity problems (e.g. larger countries = larger error terms). This approach is best suited, as FTA membership of a country-pair not only affects their bilateral exports but also those of other country- pairs (third country effects). Furthermore, zeros can be accounted for, and in comparison to other approaches, it is more efficient and less sensitive to fixed effects. PPML is also more suitable for zeros in the trade matrix whose omission would lead to an efficiency loss and inconsistent parameter estimates (Silva, J. M. C. Santos and Tenreyro, 2006).

## 5 Estimation Results

**Fehler! Verweisquelle konnte nicht gefunden werden.**<sup>2</sup> provides detailed information about the estimation results concerning the formation of an FTA in connection with intermediates trade. Column 3 indicates the probability to form a Free-trade agreement, whereas column 4 indicates the marginal effects after the PROBIT. This column describes the discrete change from 0 to 1 for a dummy variable (e.g. language, colony, border, continent). In order to avoid reverse causality the lagged variable  $TVint\_TT_{t-1}$  represents intermediates trade.

The probability for an FTA with intermediates trade is 0.191 and highly significant. Common official language, common border and common continent have a positive impact on the probability for an FTA. Colonial relationships have a negative impact on the probability for forming an FTA. With an increase of one unit in the share of intermediates trade to total trade from the baseline (0.714), the probability to form a free-trade agreement increases by 3.51%. With an increase of one unit in distance from the baseline (8.44), the probability to form an FTA decreases by 10.3%. The probability to form an FTA is 0.0351 times greater for countries that were once a single country. Countries, that are located on the same continent have a probability to form an FTA of 0.526 times greater than other countries located on different continents. Countries, which share a common border have a probability to form a FTA of 0.0915 times greater than other countries without a common border.

With high intermediates trade, the probability for a free-trade agreement increases.

Estimation results for intermediates trade (1 <sup>st</sup> stage)			
Variable	Label	Probit Pr(FTA <sub>ij</sub> = 1   .)	Marginal effects after probit (dy/dx) y = Pr(FTA)
comlang_off	1 if common official language (pairwise variable)	0.0892 (0.0599)	0.171 (0.119)
colony	1 for colonial relationship (pairwise variable)	-0.513*** (0.105)	-0.0686*** (0.0096)
comcol	1 for common colonizer post 1945 (pairwise variable)	-0.378*** (0.0821)	-0.0552*** (0.092)
curcol	1 for current colonial relationship (pairwise variable)	-1.234*** (0.235)	-0.100*** (0.0053)
col45	1 for colonial relationship post 1945 (pairwise variable)	0.883*** (0.153)	0.249*** (0.0562)
smctry	1 if countries are/were same country (pairwise variable)	0.523*** (0.104)	0.128*** (0.0317)
Border	1 if common border (pairwise variable)	0.403*** (0.0746)	0.0915*** (0.0203)
comcont	1 if common continent (pairwise variable)	2.181*** (0.0519)	0.526*** (0.0135)
logdist	log distance between main cities (pairwise variable)	-0.560*** (0.0321)	-0.103*** (0.0060)
TVint_TT <sub>t-1</sub>	share of intermediates trade relative to total trade	0.191*** (0.0704)	0.0351*** (0.0129)
Pseudo R-squared		0.749	-
Observations		42,221	-

Robust standard errors in parentheses

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

Table 2: Estimation Results Intermediates Trade (Probit)<sup>9</sup>

<sup>9</sup> Exporter and importer fixed effects were included in the regression for all countries.

Table 3 shows the results for the Poisson Pseudo Maximum Likelihood with the instrument from the first stage (probit). The PPML is not based on the probit indicated in Tabel 2, but on a probit excluding the variables colony, *comcol*, *smctry* and *TVint\_TT* in order to make sure that the instrument is exogenous. Furthermore, the PLML was calculated for different lags in order to avoid reverse causality.

Two years after the formation of an FTA, bilateral intermediates trade increases by 83.13%, whereas without an FTA intermediates trade increases by only 42.19%<sup>10</sup>. Intermediates trade is 127% higher 16 years after the formation of an FTA, whereas this increase is only 29.17% higher without an FTA. The variables common official language, common border and common continent lead to a positive change in intermediates trade as well. Distance reduces intermediates trade by 45%.

If countries take part in an FTA, they are more likely to trade (more) intermediates<sup>11</sup>.

Estimation results for intermediates trade (2 <sup>nd</sup> stage)					
Variable	Label	PPML with Instrument from 1 <sup>st</sup> stage $E(X_{ij}   \cdot)$			
		FTA <sub>t-2</sub>	FTA <sub>t-5</sub>	FTA <sub>t-10</sub>	FTA <sub>t-16</sub>
FTA	1 if FTA (pairwise variable)	0.352*** (0.0659)	0.181*** (0.0496)	0.123*** (0.0312)	0.256*** (0.0325)
comlang_off	1 if common official language (pairwise variable)	0.251*** (0.0377)	0.277*** (0.0388)	0.288*** (0.0395)	0.287*** (0.0397)
curcol	1 for current colonial relationship (pairwise variable)	1.842*** (0.216)	1.837*** (0.220)	1.825*** (0.222)	1.806*** (0.222)
col45	1 for colonial relationship post 1945 (pairwise variable)	-0.421*** (0.0826)	-0.463*** (0.0831)	-0.480*** (0.0835)	-0.470*** (0.0834)
Border	1 if common border (pairwise variable)	0.423*** (0.0438)	0.434*** (0.0456)	0.437*** (0.0455)	0.454*** (0.0449)
comcont	1 if common continent (pairwise variable)	0.184*** (0.0504)	0.205*** (0.0506)	0.213*** (0.0506)	0.232*** (0.0501)
logdist	log distance between main cities (pairwise variable)	-0.599*** (0.0260)	-0.601*** (0.0258)	-0.603*** (0.0256)	-0.599*** (0.0249)
FTAfittedxshare_int	share intermediates trade/total trade x fitted value FTA (from probit without intermediates trade)	0.605*** (0.119)	0.789*** (0.108)	0.867*** (0.0983)	0.820*** (0.0966)
R-squared		0.765	0.760	0.758	0.757
Observations		47,069	47,066	47,061	47,055

Robust standard errors in parentheses

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

Table 3: Estimation Results Intermediates Trade PPML (with instrument)<sup>12</sup>

<sup>10</sup> To calculate this effect the following formula is used:  $(e^{b_i}-1)*100\%$ , where  $b_i$  is the estimated coefficient.

<sup>11</sup> Estimation results concerning different sectors may be available upon request.

<sup>12</sup> Exporter and importer fixed effects were included in the regression for all countries.

Table 4 shows the results for the Poisson Pseudo Maximum Likelihood without the instrument from the first stage (probit), respectively.

Estimation results for intermediates trade (2 <sup>nd</sup> stage) cont.					
Variable	Label	PPML without Instrument from 1 <sup>st</sup> stage $E(X_{ij}   \cdot)$			
		FTA <sub>t-2</sub>	FTA <sub>t-5</sub>	FTA <sub>t-10</sub>	FTA <sub>t-16</sub>
FTA	1 if FTA (pairwise variable)	0.119** (0.0583)	0.0965** (0.0424)	0.121*** (0.0319)	0.255*** (0.0351)
comlang_off	1 if common official language (pairwise variable)	0.244*** (0.0380)	0.245*** (0.0379)	0.247*** (0.0377)	0.250*** (0.0379)
curcol	1 for current colonial relationship (pairwise variable)	1.691*** (0.219)	1.695*** (0.218)	1.697*** (0.217)	1.673*** (0.216)
col45	1 for colonial relationship post 1945 (pairwise variable)	-0.146* (0.0812)	-0.145* (0.0812)	-0.143* (0.0813)	-0.139* (0.0815)
Border	1 if common border (pairwise variable)	0.363*** (0.0428)	0.365*** (0.0429)	0.369*** (0.0429)	0.385*** (0.0418)
comcont	1 if common continent (pairwise variable)	0.267*** (0.0462)	0.265*** (0.0457)	0.259*** (0.0444)	0.268*** (0.0454)
logdist	log distance between main cities (pairwise variable)	-0.600*** (0.0275)	-0.597*** (0.0278)	-0.595*** (0.0278)	-0.589*** (0.0270)
FTAxTVint_TT	FTA x share intermediates trade to total trade	0.764*** (0.0806)	0.817*** (0.0729)	0.847*** (0.0751)	0.830*** (0.0760)
R-squared		0.767	0.768	0.771	0.770
Observations		49,089	49,086	49,081	49,075

Robust standard errors in parentheses  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 4: Estimation Results Intermediates Trade PPML (without instrument)

**Fehler! Verweisquelle konnte nicht gefunden werden.**<sup>5</sup> illustrates the results for intermediates imports. The probability to form an FTA with intermediates imports is 0.102 although this effect is not significant. Common official language, common border and common continent have a positive impact on the probability for joining an FTA. Colonial relationships have a negative impact on the probability for an FTA.

With an increase of one unit in the share of intermediates imports to total imports from the baseline (0.728), the probability to form a Free-trade agreement increases by 1.9% although this effect is not significant. With an increase of one unit in distance from the baseline (8.44), the probability to form an FTA decreases by 10.6%. Countries which were once the same country have a probability to form an FTA of 0.126 greater than other countries which were not. Countries which are located on the same continent have a probability to form an FTA of 0.529 greater than other countries located on different continents. Countries which share a common border have a probability to form an FTA of 0.0962 greater than other countries without a common border.

Estimation results for intermediates imports (1 <sup>st</sup> stage)			
Variable	Label	Probit Pr(FTA <sub>ij</sub> = 1   .)	Marginal effects after probit (dy/dx) y = Pr(FTA)
comlang_off	1 if common official language (pairwise variable)	0.0728 (0.0606)	0.0141 (0.0121)
comcol	1 for colonial relationship (pairwise variable)	-0.515*** (0.105)	-0.0539*** (0.0099)
smctry	1 if countries are/were same country (pairwise variable)	0.515*** (0.105)	0.126*** (0.0319)
Border	1 if common border (pairwise variable)	0.415*** (0.0753)	0.0962*** (0.0209)
comcont	1 if common continent (pairwise variable)	2.181*** (0.0526)	0.529*** (0.0136)
logdist	log distance between main cities (pairwise variable)	-0.568*** (0.0325)	-0.106*** (0.0062)
intimp_totimp	share of intermediates imports to total imports	0.102 (0.0651)	0.0190 (0.0121)
Pseudo R-squared		0.751	-
Observations		41,811	-
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

Table 5: Estimation Results Intermediates Imports (Probit)<sup>13</sup>

<sup>13</sup> Exporter and importer fixed effects were included in the regression for all countries.

Table 6 shows the results for the Poisson Pseudo Maximum Likelihood with the instrument from the first stage (probit). The change in intermediates imports with an FTA is high (0.981). The variables common official language, common border and common continent lead to a positive change in intermediates trade as well. Countries taking part in an FTA are more likely to import intermediates as intermediates imports increase by 97.58% two years after the formation of an FTA. Without an FTA, the increase in intermediates imports is only 26.74%.

<b>Estimation results for intermediates imports (2<sup>nd</sup> stage)</b>					
Variable	Label	PPML with Instrument from 1 <sup>st</sup> stage $E(X_{ij}   \cdot)$			
		FTA <sub>t-2</sub>	FTA <sub>t-5</sub>	FTA <sub>t-10</sub>	FTA <sub>t-16</sub>
FTA	1 if FTA (pairwise variable)	0.237*** (0.0511)	0.108*** (0.0398)	0.0663** (0.0317)	0.232*** (0.0367)
comlang_off	1 if common official language (pairwise variable)	0.200*** (0.0397)	0.218*** (0.0396)	0.224*** (0.0396)	0.219*** (0.0398)
curcol	1 for current colonial relationship (pairwise variable)	2.375*** (0.274)	2.371*** (0.275)	2.362*** (0.276)	2.343*** (0.274)
col45	1 for colonial relationship post 1945 (pairwise variable)	-0.384*** (0.100)	-0.413*** (0.0999)	-0.424*** (0.0995)	-0.410*** (0.100)
Border	1 if common border (pairwise variable)	0.297*** (0.0444)	0.302*** (0.0449)	0.304*** (0.0450)	0.322*** (0.0447)
comcont	1 if common continent (pairwise variable)	0.181*** (0.0570)	0.199*** (0.0571)	0.205*** (0.0571)	0.220*** (0.0564)
logdist	log distance between main cities (pairwise variable)	-0.606*** (0.0298)	-0.609*** (0.0296)	-0.611*** (0.0295)	-0.605*** (0.0293)
FTAfittedxshare_int_imp	share intermediates imports/total imports x fitted value FTA (from probit without intermediates trade)	0.681*** (0.112)	0.805*** (0.108)	0.851*** (0.105)	0.786*** (0.101)
R-squared		0.738	0.737	0.736	0.739
Observations		46,641	46,638	46,633	46,627

Robust standard errors in parentheses  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 6: Estimation Results Intermediates Imports PPML (with instrument)<sup>14</sup>

<sup>14</sup> Exporter and importer fixed effects were included in the regression for all countries.

Table 7 shows the results for the Poisson Pseudo Maximum Likelihood without the instrument from the first stage (probit).

Estimation results for intermediates imports (2 <sup>nd</sup> stage) cont.					
Variable	Label	PPML without Instrument from 1 <sup>st</sup> stage $E(X_{ij}   \cdot)$			
		FTA <sub>t-2</sub>	FTA <sub>t-5</sub>	FTA <sub>t-10</sub>	FTA <sub>t-16</sub>
FTA	1 if FTA (pairwise variable)	0.0928* (0.0560)	0.0569 (0.0390)	0.0667** (0.0321)	0.230*** (0.0387)
comlang_off	1 if common official language (pairwise variable)	0.192*** (0.0408)	0.194*** (0.0407)	0.194*** (0.0406)	0.195*** (0.0406)
curcol	1 for current colonial relationship (pairwise variable)	2.186*** (0.281)	2.182*** (0.280)	2.181*** (0.280)	2.161*** (0.278)
col45	1 for colonial relationship post 1945 (pairwise variable)	-0.111 (0.102)	-0.111 (0.102)	-0.110 (0.102)	-0.105 (0.103)
Border	1 if common border (pairwise variable)	0.265*** (0.0465)	0.265*** (0.0467)	0.267*** (0.0468)	0.285*** (0.0463)
comcont	1 if common continent (pairwise variable)	0.301*** (0.0482)	0.303*** (0.0479)	0.301*** (0.0471)	0.305*** (0.0474)
logdist	log distance between main cities (pairwise variable)	-0.610*** (0.0316)	-0.609*** (0.0317)	-0.608*** (0.0318)	-0.600*** (0.0315)
FTAxintimp_totimp	FTA x share intermediates imports to total imports	0.609*** (0.0718)	0.659*** (0.0616)	0.675*** (0.0612)	0.644*** (0.0613)
R-squared		0.723	0.724	0.725	0.728
Observations		48,574	48,571	48,566	48,560

Robust standard errors in parentheses  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 7: Estimation Results Intermediates Imports PPML (without instrument)<sup>15</sup>

Estimation results for intermediates exports (1 <sup>st</sup> stage)			
Variable	Label	Probit $\Pr(FTA_{ij} = 1   \cdot)$	Marginal effects after probit ( $dy/dx$ ) $y = \Pr(FTA)$
comlang_off	1 if common official language (pairwise variable)	0.0587 (0.0608)	0.0119 (0.0127)
colony	1 for colonial relationship (pairwise variable)	-0.510*** (0.105)	-0.0749*** (0.0107)
smctry	1 if countries are/were same country (pairwise variable)	0.529*** (0.105)	0.137*** (0.0336)
Border	1 if common border (pairwise variable)	0.403*** (0.0751)	0.0977*** (0.0215)
comcont	1 if common continent (pairwise variable)	2.154*** (0.0523)	0.534*** (0.0135)
logdist	log distance between main cities (pairwise variable)	-0.572*** (0.0324)	-0.113*** (0.0066)
intexp_totexp	share of intermediates exports to total exports	-0.116** (0.0556)	-0.0230** (0.0110)
Pseudo R-squared		0,747	-
Observations		40,774	-

Robust standard errors in parentheses  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 8: Estimation Results Intermediates Exports (Probit)<sup>16</sup>

<sup>15</sup> Exporter and importer fixed effects were included in the regression for all countries.

**Fehler! Verweisquelle konnte nicht gefunden werden.**9 shows the estimation results for intermediates exports. The change in intermediates exports with an FTA is 0.679. Common official language, common border and common continent lead to a positive change in intermediates exports as well. Countries taking part in an FTA are more likely to export intermediates; this effect is stronger than the effect concerning intermediates imports (the effect for without an FTA is stronger as well).

Estimation results for intermediates exports (2 <sup>nd</sup> stage)					
Variable	Label	PPML with Instrument from 1 <sup>st</sup> stage $E(X_{ij}   \cdot)$			
		FTA <sub>t-2</sub>	FTA <sub>t-5</sub>	FTA <sub>t-10</sub>	FTA <sub>t-16</sub>
FTA	1 if FTA (pairwise variable)	0.362*** (0.0624)	0.218*** (0.0471)	0.189*** (0.0328)	0.299*** (0.0351)
comlang_off	1 if common official language (pairwise variable)	0.229*** (0.0406)	0.252*** (0.0410)	0.264*** (0.0412)	0.267*** (0.0416)
curcol	1 for current colonial relationship (pairwise variable)	2.211*** (0.219)	2.192*** (0.226)	2.178*** (0.228)	2.153*** (0.229)
col45	1 for colonial relationship post 1945 (pairwise variable)	-0.444*** (0.0778)	-0.479*** (0.0783)	-0.495*** (0.0786)	-0.489*** (0.0780)
Border	1 if common border (pairwise variable)	0.477*** (0.0442)	0.489*** (0.0455)	0.494*** (0.0455)	0.509*** (0.0440)
comcont	1 if common continent (pairwise variable)	0.159*** (0.0534)	0.181*** (0.0531)	0.189*** (0.0532)	0.209*** (0.0529)
logdist	log distance between main cities (pairwise variable)	-0.614*** (0.0268)	-0.616*** (0.0267)	-0.617*** (0.0265)	-0.614*** (0.0251)
FTAfittedxshare_int_exp	share intermediates exports/total exports x fitted value FTA (from probit without intermediates trade)	0.679*** (0.114)	0.831*** (0.106)	0.897*** (0.0998)	0.879*** (0.0995)
R-squared		0.759	0.758	0.761	0.758
Observations		45,536	45,533	45,528	45,522

Robust standard errors in parentheses  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 9: Estimation Results Intermediates Exports PPML (with instrument)<sup>17</sup>

<sup>16</sup> Exporter and importer fixed effects were included in the regression for all countries.

<sup>17</sup> Exporter and importer fixed effects were included in the regression for all countries.



Estimation results for intermediates exports (2 <sup>nd</sup> stage) cont.					
Variable	Label	PPML without Instrument from 1 <sup>st</sup> stage			
		E(X <sub>ij</sub>   .)			
		FTA <sub>t-2</sub>	FTA <sub>t-5</sub>	FTA <sub>t-10</sub>	FTA <sub>t-16</sub>
FTA	1 if FTA (pairwise variable)	0.129** (0.0593)	0.136*** (0.0431)	0.188*** (0.0332)	0.306*** (0.0376)
comlang_off	1 if common official language (pairwise variable)	0.229*** (0.0412)	0.231*** (0.0412)	0.235*** (0.0410)	0.239*** (0.0414)
curcol	1 for current colonial relationship (pairwise variable)	2.070*** (0.220)	2.079*** (0.219)	2.087*** (0.217)	2.055*** (0.218)
col45	1 for colonial relationship post 1945 (pairwise variable)	-0.175** (0.0739)	-0.173** (0.0739)	-0.171** (0.0738)	-0.166** (0.0733)
Border	1 if common border (pairwise variable)	0.409*** (0.0443)	0.412*** (0.0445)	0.417*** (0.0443)	0.432*** (0.0423)
comcont	1 if common continent (pairwise variable)	0.250*** (0.0494)	0.243*** (0.0488)	0.229*** (0.0479)	0.244*** (0.0490)
logdist	log distance between main cities (pairwise variable)	-0.621*** (0.0287)	-0.617*** (0.0290)	-0.613*** (0.0291)	-0.609*** (0.0276)
FTAxintexp_totexp	FTA x share intermediates exports to total exports	0.800*** (0.0828)	0.837*** (0.0744)	0.877*** (0.0759)	0.869*** (0.0759)
R-squared		0.757	0.760	0.767	0.763
Observations		47,287	47,284	47,279	47,273
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1					

Table 10: Estimation Results Intermediates Exports PPML (without instrument)<sup>18</sup>

<sup>18</sup> Exporter and importer fixed effects were included in the regression for all countries.

## 6 Concluding remarks and policy implications

The aim of this paper was to analyze the connection between free-trade agreements and trade in intermediate goods. Based on a large dataset of bilateral trade of 70 countries paired with each other, I found that there is a bidirectional relationship:

- Free trade agreements promote trade in intermediate products. In the presence of an FTA, trade in intermediates is more intense than without an FTA.
- Trade in intermediates promotes FTAs. Country pairs with a large share of intermediates trade are more likely to form an FTA.

Moreover the regressions establishing the first result confirm the findings of Bekkers *et al.* (2012), (Miroudot *et al.* (2009) and Yi (2000) that international trade and fragmentation of production lead to increased trade of intermediate goods. The second result is novel. Although I am able to re-establish the impacts determining the formation of FTAs that have been found by Bergstrand (1985) and Egger *et al.* (2011), I identify another incentive that has not been mentioned in the literature yet. The fact that trade in intermediates promotes FTAs can be explained by the fact that economies involved in highly fragmented production chains in their manufacturing industries are particularly sensitive to changes in trade cost. Besides investment in better transport systems, an FTA is a major tool to reduce these costs. Regarding policy implications, the finding that FTAs support international trade is especially of importance for small or low-productivity economies which depend on intermediate production processes. Countries, which specialize in intermediates production (according to their comparative advantage) are reliant on international trade partners. Thus the formation of an FTA becomes more likely as the participation in such an agreement can strengthen international economic relations.

As an area of further research, one could look deeper into the channels through which trade in intermediates affects the formation of FTAs and vice versa. Moreover, one could attempt to identify the impact of increased trade in intermediates on the welfare gains from FTAs. Of course, one can also refine the scope of this study, e.g. by differentiation based on the various types of trade agreements, by distinguished trade in intermediate commodities versus services, or by including additional country pairs.

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