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Extensive and Intensive Margin Effects of Preferential Trade Liberalization

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Extensive and Intensive Margin Effects of Preferential Trade Liberalization

by

Christoph Wußmann

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Abstract

This paper scrutinizes the extensive and intensive margin effects of preferential trade agreements (PTA) on aggregated bilateral merchandise trade flows from 1960-2016, harnessing the 2019 data release of the Design of Trade Agreements (DESTA) database. Theory-consistent estimates suggest a positive, dynamically increasing effect of the extensive PTA-margin on trade flows whereas the intensive margin effect is found to be positive, dynamically decreasing.

JEL Categories: F13, F14

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1 Introduction

Trade relations, exhibiting considerable heterogeneity, have been existing for centuries. Over time, already complex trade cooperation has become more inclusive, while gaining depth and breadth.[1]

"Contemporary trade agreements go much beyond traditional trade restrictions at the border. They cover regulatory standards, health and safety rules, investment, banking and finance, intellectual property, labor, the environment, and many other subjects. They reach well beyond national borders and seek deep integration among nations...".[2] According to Limão (2016), preferential trade agreements are the most important source of trade policy reform in recent years, mirroring further deepening integration of the world economy and internationalization of previously domestic policies.[3]

Redding and Weinstein (2019) deem the gravity equation in international trade an extremely successful empirical relationship, capable of explaining the effects of bilateral frictions, origin, and destination characteristics on bilateral trade.[4] Head and Mayer (2014) as well as De Benedictis and Taglioni (2011) consider it one of the most important tools to quantify trade policy effects.[5] In line with Anderson (2011), Larch and Yotov (2016) reckon among its virtues solid theoretical foundations, a general equilibrium environment, flexible structure, modularity, and high predictive power.[6] More recent research, employing the gravity equation, encompasses Chaney (2018), Allen et al. (forthcoming), Shapiro and Walker (2018), and Arkolakis et al. (2019).

Due to increased scope and complexity of modern PTAs which don't fit the traditional analytical framework, introduced by Viner (1950), the objective of this paper is to shed light on ways to operationalize their content and to empirically determine the intensive and extensive margin effects of preferential trade liberalization on aggregated bilateral merchandise trade flows in a theory-consistent

[1]c.f. World Trade Organization 2011, pp.5,48
[2]Rodrik 2018, p.75
[3]c.f. Limão 2016, p.281
c.f. World Trade Organization 2011, pp.5,48
[4]c.f. Redding/Weinstein 2019, p.450
[5]c.f. Head/Mayer 2014, p.136
c.f. De Benedictis/Taglioni 2011, p.55
[6]c.f. Larch/Yotov 2016, p.3
c.f. Anderson 2011, p.134

way.
The paper is organized as follows: Chapter 2 reviews the evolution of preferential trade liberalization and the traditional analytical framework, followed by an introduction to the increased scope of more recent PTAs and approaches to operationalize their content. The chapter closes, summarizing publications within the gravity framework on PTA-induced trade creation. Chapter 3 provides an overview over research on the gravity equation as a tool for trade policy analysis. Chapter 4 derives structural gravity for theory consistent testing that follows in chapter 5. Chapter 6 concludes.

2 Preferential Trade Agreements

This chapter briefly reviews the historical evolution of preferential trade liberalization and outlines the traditional framework in economic analysis through which the latter has been perceived to date. Subsequently, more recent findings regarding the increased scope of agreements and approaches to operationalize their content are presented, followed by a survey on research, dealing with trade creation through PTAs.

2.1 Evolution

According to Limão (2016), "[a] PTA is an international treaty with restrictive membership and including any articles that (i) apply only to its members and (ii) aim to secure or increase their respective market access."[7]
After 1950, the number of active PTAs has been steadily on the rise until 1990, sharply increasing afterwards.[8] In 2010, their number had quadrupled compared to 1990.[9] The value of merchandise trade among PTA members has been soaring with the number of agreements up to fifty percent of of world trade in 2010.[10]
Confirming those trends, figure 1 depicts the number of PTAs (i.e. base treaties, and accessions) signed in a given year over a timespan from 1948-2018 as well as

[7]Limão 2016, p.284
[8]c.f. World Trade Organization 2011, pp.6,54,48
c.f. Dür et al. 2014, pp.356-357
[9]c.f. Limão 2016, p.281
c.f. World Trade Organization 2011, p.3
[10]c.f. World Trade Organization 2011, pp.7,72

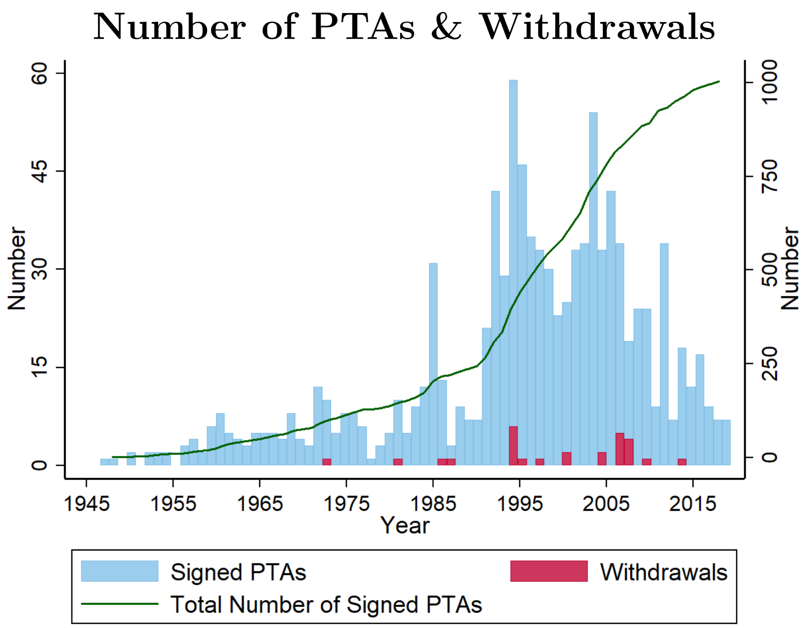

Figure 1: Source: Own Depiction based on Dür et al. (2014)

the number of withdrawals from aa existing PTA in a given year. The latter refer to the left vertical axis. The total number of PTAs signed from 1948 to 2018 is measured on the ordinal axis to the right.

2.2 Traditional View

The traditional analytical framework, treating PTAs as static tariff reductions and emphasizing trade creation as well as diversion effects, was introduced by Viner (1950).[11]

The latter implies that trade between PTA members is boosted (trade creation) and simultaneously reduced between member and non-member countries (trade diversion). Exporters from nations within the PTA face lower tariffs to markets, included in the agreement, whereas countries outside become less competitive relative to economies included, suffering from lower exports to PTA members and a falling international price of their exports.[12]

[11] c.f. World Trade Organization 2011, p.3
c.f. Krishna 2004, pp.295-297
c.f. Limão 2016, p.281

[12] c.f. World Trade Organization 2011, p.9

2.3 Beyond Tariffs

Despite the prolonged existence of significant tariffs in agriculture and labor intensive manufactured goods, the former have plummeted on average over time and have even been excluded from modern PTAs. The latter go beyond traditional tariffs and comprise more structured institutional arrangements.[13] Non-tariff measures cover numerous policy areas, such as trade in services, investment, competition, government procurement, intellectual property rights, technical barriers to trade, dispute settlement, harmonization or mutual recognition of product and process standards, and movement of capital. Moreover, environmental laws, labor market regulations, and measures on visa and asylum form part of some PTAs. According to Whalley (2008), even cooperation in policy areas, such as poverty alleviation, rural development, and tourism have been included. Furthermore, agreements vary according to their legal enforceability and often affect domestic regulations.[14]

The findings of WTO (2011) suggest that coverage with respect to issue areas has risen over time.[15] Harnessing a classification of PTAs, first introduced by Frankel et al. (1997) and frequently employed in research, as for instance in Baier et al. (2014), distinguishing between nonreciprocal PTAs (NRPTA), reciprocal PTAs (RPTA), free trade areas (FTA), customs unions (CU), common markets (CM), and economic unions (EU), Limão (2016) finds that the relative importance of deeper PTAs has been strongly increasing since the mid 1980s, while the trade share of countries that were part of deeper agreements in world trade has been increasing from twenty-two in 1965, to sixty percent in 2010.[16]

2.4 Operationalization

Several concepts have been proposed to operationalize the content of modern PTAs.

Lawrence (1996) refers to PTAs that go beyond the notion of free trade areas as deep agreements and to those, including mainly border measures, as shallow

[13] c.f. World Trade Organization 2011, pp.3,10,114

[14] c.f. World Trade Organization 2011, pp.3,6-7,10,44,63
c.f. Limão 2016, pp.293-294

[15] c.f. World Trade Organization 2011, p.61

[16] c.f. Limão 2016, pp.285-287,293-294

agreements. The latter include non-discriminatory national treatment of foreign goods and firms, whereas the former also comprise rules on domestic policies within country borders.

WTO (2011) distinguishes between the extensive margin of deep integration, denoting the number of policy areas included in an agreement, and the intensive margin, capturing the degree of institutional depth, e.g. whether policy prerogatives are transferred to supranational institutions, with both dimensions being interrelated. Considering the latter is warranted due to research pointing at the need for political, legal, and social non-market institutions for markets to work properly, as for instance Casella (1996), Casella and Feinstein (2002), and Rodrik (2000).[17]

Horn et al. (2010) classify PTAs with respect to sectoral coverage of policy areas and legal enforceability, analyzing fourteen trade agreements of the United States and fourteen treaties of the European Union with other states in a three step procedure: First, policy area relevance is determined, i.e. whether some form of undertaking in the relevant field exists, from article and chapter headings. Second, to assess legal enforceability, treaty language is investigated. A clearer, more specific, and imperative legal language thereby increases the likelihood of enforceability. Third, depth is introduced for some policy areas covered to determine whether a legally binding provision may be relevant in practice. As a result, fifty-two policy areas are identified and assigned to two groups. WTO+ provisions (fourteen) represent policy areas already covered by WTO agreements in some form. WTO-X provisions (thirty-eight) denote stipulations outside the current WTO mandate.[18]

Limão (2016) proposes a different classification of PTAs, defining depth in economic policy cooperation, π^d, as follows: $\pi^d = \{\tau, \nu, \gamma, o\}$, with

- ◇ τ denoting import tariffs,
- ◇ ν non-tariff barriers, comprising
    - ⋆ contingent protection, e.g. antidumping, counterveiling measures, export taxes, and
    - ⋆ others, for instance product standards, customs procedures, and other technical barriers.

[17] c.f. World Trade Organization 2011, pp.9,110-111
[18] c.f. World Trade Organization 2011, pp.128-130
c.f. Horn et al. 2010, pp.1574,1577

- ◇ γ represents policies behind the border, not included in ν, which may invalidate national treatment, e.g.
  - ⋆ state aid, procurement, and competition policy.
- ◇ o stands for other policies that affect market access but may also have direct effects, such as
  - ⋆ financial assistance, regional, industrial, and agricultural cooperation.

Classification along the breadth of economic policy cooperation is proposed according to its effect on

- ◇ the type of trade (goods and services),
- ◇ technology (innovation and diffusion, intellectual property), and
- ◇ factors of production (capital and labor).

Augmenting the above classification by an additional dimension of depth, capturing whether a PTA addresses not only current, but also the expected policy, is recommended.[19] Moreover, inclusion of data on currency as additional breadth dimension is proposed besides disaggregation of commodities into final and intermediate goods, and a distinction between NRPTA, RPTA, FTA, and CU in τ.
Along the breadth and depth dimensions, Limão (2016) finds complementarity between economic depth and breadth in contrast to substitutability between economic depth and non-economic breadth.[20]

2.5 Trade Policy Effects

Several studies have investigated the effects preferential liberalization on trade flows within the gravity framework.
Magee (2008), Carrère (2006), and Acharya et al. (2011) confirm positive trade effects for PTAs among their members. Addressing potential endogeneity, i.e. nations may form PTAs for unobservable reasons that can be correlated with the level of trade, the work of Baier and Bergstrand (2007) suggests a robust positive effect on bilateral trade flows.[21] In line, harnessing econometric duration analysis, the results of Bergstrand et al. (2016) imply that economies closer to each other in terms of distance as well as dyads with higher GDPs and stronger

[19] c.f. Limão 2016, pp.287-290
[20] c.f. Limão 2016, pp.291-293
[21] c.f. World Trade Organization 2011, p.105
c.f. Dür et al. 2014, p.361

resemblance in economic size are more likely to enter a PTA or to enlarge one that already exists sooner than other country pairs.[22]

Dür et al. (2014) list among approaches that endeavour to differentiate effects by trade agreement type Baier et al. (2014) (partial scope agreements, free trade agreements, customs unions). In the long-run, Magee (2008) finds cumulative effects of CU exceeding those of FTAs, with partial scope agreements lacking significance. According to Roy (2010), after a period of five years, the CU trade effect is more than threefold the effect of FTAs.[23] Limão (2016) finds a large, positive, and robust average PTA-effect. Differentiating among types of agreements, he also finds that CU/CM/EU have a much stronger effect on bilateral merchandise trade flows than RPTAs and FTAs, suggesting that other policies besides tariff reductions matter.[24] In addition, results point at a dynamic effect, existing even after controlling for tariff reductions. Limão (2016) notes that his findings are at odds with the traditional Vinerian view of PTAs as static tariff reductions.[25]

Dür et al. (2014) find evidence for a positive significant effect, mainly caused by deep preferential trade agreements, employing an index of depth that corresponds to a combination of depth and breadth in the sense of the classification outlined by Limão (2016) above. They find that PTAs have positive long- and short-term effects on trade flows.[26]

3 Gravity Review

The following chapter briefly summarizes the evolution of the gravity framework as analytical tool in empirical trade research and highlights major developments. The equation draws an analogy to Newtons's universal law of gravitation, according to which the Force, F_{ij}, between two objects with masses M_i and M_j, located at a distance of d_{ij} from each other, is determined by

$$F_{ij} = G \cdot \frac{M_i \cdot M_j}{d_{ij}^2}$$

[22]c.f. World Trade Organization 2011, pp.97-98
[23]c.f. Dür et al. 2014, p.362
[24]c.f. Limão 2016, p.307
[25]c.f. Limão 2016, p.282,295
[26]c.f. Dür et al. 2014, pp.353-354,373

with G, denoting the gravitational constant.[27] Chaney (2018) states the economic relationship as follows:

$$Trade_{ij} \propto \frac{GDP_i^{\alpha} \cdot GDP_j^{\beta}}{Distance_{ij}^{\zeta}}$$

with α, β, and $\zeta \approx 1$.[28] The gravity equation, first introduced to economic research by Tinbergen (1962), implies a positive relationship between bilateral trade flows and economic country size as well as a negative relationship between dyadic trade flows and trade costs, the latter being frequently proxied by geographical distance.[29] De Benedictis and Taglioni (2011) argue that Tinbergen's work, paralleled by Pöyhönen (1963), followed earlier approaches by Ravenstein (1885) and Zipf (1946) who employed the gravity equation for migration flow modelling.[30] Elmslie (2018) even argues, that "[Adam] Smith did not use the 'gravity' terminology explicitly, but it is intriguing that for the determinants of the volume of trade Smith emphasized mass and distance, which is of course similar to Isaac Newton's theory of gravity."[31]

The gravity model has evolved from a rather intuitive notion with respect to factors affecting trade flows to more recent structural models.[32] However, Head and Mayer (2014) note that the development of a theoretical foundation by Savage and Deutsch (1960), containing a multiplicative model of bilateral trade, has been published even two years before Tinbergen's work. A crucial contribution to the development of theoretical underpinnings was the work of Anderson (1979) whose economic model of gravity accommodates constant elasticity of substitution (CES) preferences and national product differentiation (NPD), as introduced by Armington (1969).[33] Research by Anderson and van Wincoop (2003) as well by Eaton and Kortum (2002), the latter in a Ricardian setting, were decisive in providing sound microeconomic foundations for the gravity equation that do

[27] c.f. Feenstra 2015, pp.132-133
[28] c.f. Chaney 2018, pp.150-151
[29] c.f. Shepherd 2016, p.1
[30] c.f. De Benedictis/Taglioni 2011, p.56
[31] Elmslie 2018, p.220
[32] c.f. Shepherd 2016, p.1
c.f. Head/Mayer 2014, p.132
[33] c.f. Head/Mayer 2014, pp.134-135
c.f. Piermartini/Yotov 2016, p.3

not require imperfect competition or increasing returns to scale to prevail.[34] Piermartini and Yotov (2016) report microeconomic foundations in a Heckscher-Ohlin setting by Bergstrand (1989) and Deardorff (1998) in addition to contributions in a monopolistic competition setting by Krugman (1980) and Bergstrand (1985).[35]
Head and Mayer (2014) state that the publications of Melitz (2003), as specified by Chaney (2008), Helpman et al. (2008), and Melitz and Ottaviano (2008) marked the convergence of the heterogeneous firm research with gravity literature.[36] Furthermore, Allen et al. (forthcoming) count Dekle et al. (2008) as well as Caliendo and Parro (2015) among perfect competition models, Arkolakis et al. (2008), Di Giovanni and Levchenko (2010) among monopolistic competition models, and Bernard et al. (2003) among Bertrand competition models, consistent with the gravity framework.[37]

The notion of multilateral resistence (MR) terms introduced by Anderson (1979), became popular with the work of Anderson and van Wincoop (2003). Feenstra (2004) as well as Redding and Venables (2004) established the use of importer and exporter fixed effects in order to capture MR terms.[38]

The general formulation of the gravity equation by Head and Mayer (2014), also employed in Limão (2016) for trade policy analysis, is given by

$$X_{ij} = G \cdot S_i \cdot M_j \cdot \Phi_{ij}$$

where

- ◇ X_{ij} denotes the value of export from country i to country j,
- ◇ S_i exporter $i's$ supply capabilities to any j,
- ◇ M_j destination market $j's$ characteristics affecting demand from any i,
- ◇ $\Phi_{ij} \in [0, 1]$ bilateral market access, and
- ◇ G the gravitational constant.

The formulation encompasses all models providing the corresponding bilateral trade equations.[39]

[34] c.f. Head/Mayer 2014, p.136
[35] c.f. Piermartini/Yotov 2016, p.3
[36] c.f. Head/Mayer 2014, p.136
[37] c.f. Allen et al. forthcoming, p.2
[38] c.f. Head/Mayer 2014, pp.135-136
[39] c.f. Head/Mayer 2014, p.137
c.f. Limão 2016, pp.295-296

4 CES-Armington Model

This chapter outlines the derivation of the theoretical CES-Armington model, first introduced by Anderson (1979) and later on expanded by Anderson and van Wincoop (2003) to include MR terms in a perfect competition setting.

Departure from a well-defined theoretical model is key to clarify identification assumptions, avoid biased estimation results, and to ensure proper interpretation of PTA-effects.[40]

Model assumptions encompass CES-preferences, NPD, and transport costs, following the iceberg assumption, first introduced by Samuelson (1954).[41]

"The key implication of the theoretical gravity equation is that trade between regions is determined by relative trade barriers. Trade between two regions depends on the bilateral barrier between them relative to average trade barriers that both regions face with all their trading partners."[42]

Each country, $i \in N$, produces one distinct variety, whereas the amount of labor in each economy, L_i, supplied inelastically and exogenously given, constitutes the sole production factor. Productivity of each worker, A_i, i.e. how much of a good one unit of labor can produce, is assumed exogenous. The wage, w_i, is determined in equilibrium.

Deriving the gravity system in equilibrium requires to solve the representative consumer's utility maximization problem (demand side) and to determine the optimal price, given the market structure (supply side), taking into account transport costs. Subsequently, obtaining structural gravity requires to impose market clearing for the exporter and to determine the spatial expenditure allocation of the importer.[43]

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[40] c.f. Limão 2016, p.307
c.f. Head/Mayer 2014, p.132
c.f. Anderson/van Wincoop 2003, p.170

[41] c.f. Anderson/van Wincoop 2003, p.174
c.f. Head/Mayer 2014, p.141
c.f. Anderson 1979, pp.114-115

[42] Anderson/van Wincoop 2003, p.176

[43] c.f. Head/Mayer 2014, p.139
c.f. Feenstra 2015, p.140

4.1 Demand

Spending of country j is given by X_j, the value of exports from country i to country j by X_{ij}, and income of country i by Y_i. The price of good q_{ij} in country j, produced in and shipped from country i, is denoted by p_{ij}. The representative consumer's CES-utility function in country j can be stated as

$$U_j = \left(\sum_i a_i^{\frac{\sigma-1}{\sigma}} \cdot q_{ij}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

where $\sigma > 1$, stands for the elasticity of substitution over all national products. The exogenous utility shifter, a_i, can be understood as attractiveness of country i's product.[44] Consumers maximize their utility subject to the budget constraint:

$$\max_{q_{ij}} \left(\sum_i a_i^{\frac{\sigma-1}{\sigma}} \cdot q_{ij}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \qquad s.t. \qquad \sum_i q_{ij} \cdot p_{ij} \leq X_j$$

The corresponding Lagrangian and N+1 first order conditions are given by

$$\mathcal{L} = \left(\sum_i a_i^{\frac{\sigma-1}{\sigma}} \cdot q_{ij}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} - \lambda \cdot \left(\sum_i q_{ij} \cdot p_{ij} - X_j \right)$$

$$\frac{\partial \mathcal{L}}{\partial q_{\kappa j}} = \left(\sum_i a_i^{\frac{\sigma-1}{\sigma}} \cdot q_{ij}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{1}{\sigma-1}} \cdot a_\kappa^{\frac{\sigma-1}{\sigma}} \cdot q_{\kappa j}^{-\frac{1}{\sigma}} - \lambda \cdot p_{\kappa j} \stackrel{!}{=} 0 \tag{1}$$

$$\frac{\partial \mathcal{L}}{\partial q_{\ell j}} = \left(\sum_i a_i^{\frac{\sigma-1}{\sigma}} \cdot q_{ij}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{1}{\sigma-1}} \cdot a_\ell^{\frac{\sigma-1}{\sigma}} \cdot q_{\ell j}^{-\frac{1}{\sigma}} - \lambda \cdot p_{\ell j} \stackrel{!}{=} 0 \tag{2}$$

$$\vdots$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = X_j - \sum_i q_{ij} \cdot p_{ij} \stackrel{!}{=} 0 \tag{3}$$

[44] c.f. Head/Mayer 2014, p.141
c.f. Anderson/van Wincoop 2003, p.174

Combining equations (1) and (2) yields

$$\frac{\left(\sum_i a_i^{\frac{\sigma-1}{\sigma}} \cdot q_{ij}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{1}{\sigma-1}} \cdot a_\kappa^{\frac{\sigma-1}{\sigma}} \cdot q_{\kappa j}^{-\frac{1}{\sigma}}}{p_{\kappa j}} = \lambda = \frac{\left(\sum_i a_i^{\frac{\sigma-1}{\sigma}} \cdot q_{ij}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{1}{\sigma-1}} \cdot a_\ell^{\frac{\sigma-1}{\sigma}} \cdot q_{\ell j}^{-\frac{1}{\sigma}}}{p_{\ell j}}$$

By rearranging, the Marginal Rate of Substitution equals the relative price:

$$\frac{p_{\ell j}}{p_{\kappa j}} = \frac{a_\ell^{\frac{\sigma-1}{\sigma}} \cdot q_{\ell j}^{-\frac{1}{\sigma}}}{a_\kappa^{\frac{\sigma-1}{\sigma}} \cdot q_{\kappa j}^{-\frac{1}{\sigma}}}$$

Solving for $q_{\ell j}$ gives

$$q_{\ell j} = \left(\frac{p_{\kappa j}}{p_{\ell j}}\right)^{\sigma} \cdot \left(\frac{a_\kappa}{a_\ell}\right)^{1-\sigma} \cdot q_{\kappa j} \tag{4}$$

Substituting equation (4) for each q_{ij} in terms of κ into equation (3), except for good κ, produces the following expression:

$$X_j = p_{\kappa j} \cdot q_{\kappa j} + \sum_{i \neq \kappa} p_{ij} \cdot \left(\frac{p_{\kappa j}}{p_{ij}}\right)^{\sigma} \cdot \left(\frac{a_\kappa}{a_i}\right)^{1-\sigma} \cdot q_{\kappa j}$$

Incorporating $p_{\kappa j} \cdot q_{\kappa j}$ into the sum and rearranging yields

$$X_j = q_{\kappa j} \cdot \sum_i p_{ij} \cdot \left(\frac{p_{\kappa j}}{p_{ij}}\right)^{\sigma} \cdot \left(\frac{a_\kappa}{a_i}\right)^{1-\sigma}$$

Solving for $q_{\kappa j}$ gives

$$q_{\kappa j} = a_\kappa^{\sigma-1} \cdot p_{\kappa j}^{-\sigma} \cdot X_j \cdot P_j^{\sigma-1}$$

The CES-price index is defined by

$$P_j \equiv \left(\sum_i \left(\frac{1}{a_i}\right)^{1-\sigma} \cdot p_{ij}^{1-\sigma}\right)^{\frac{1}{1-\sigma}} \tag{5}$$

Holding for all i, the CES-demand function can be stated as

$$q_{ij} = a_i^{\sigma-1} \cdot p_{ij}^{-\sigma} \cdot X_j \cdot P_j^{\sigma-1} \tag{6}$$

4.2 Supply

Assuming perfect competition, the price of each good is determined by its marginal costs of production:

$$MC_i = \frac{w_i}{A_i} = p_i \tag{7}$$

with p_i denoting the factory gate price.

4.3 Trade Costs

The iceberg assumption implies that $\tau_{ij} \geq 1$ units of good q_{ij} need to be shipped from country i to country j for one unit to arrive. The fraction $(1 - \tau_{ij})$ melts on the way. Using equation (7), the price of consuming one unit of good q_{ij} in country j that has been produced in and shipped from country i is therefore

$$p_{ij} = MC_i \cdot \tau_{ij} = \frac{w_i}{A_i} \cdot \tau_{ij} = p_i \cdot \tau_{ij} \tag{8}$$

Moreover, the no-arbitrage condition, i.e. no individual can profit from purchasing a good in country i and selling it in country j (and vice versa), is given by

$$\tau_{ij} = \frac{p_{ij}}{p_i}$$

The latter requires the triangle inequality to hold, i.e for all i, j, and κ

$$\tau_{ij} \cdot \tau_{j\kappa} \geq \tau_{i\kappa}$$

4.4 Structural Gravity

The value of exports from country i to j, X_{ij}, is given by

$$X_{ij} = p_{ij} \cdot q_{ij}$$

Plugging in equation (6) for q_{ij} yields

$$X_{ij} = a_i^{\sigma-1} \cdot p_{ij}^{1-\sigma} \cdot X_j \cdot P_j^{\sigma-1}$$

By inserting equation (8) for p_{ij} the gravity equation becomes

$$X_{ij} = a_i^{\sigma-1} \cdot \tau_{ij}^{1-\sigma} \cdot \left(\frac{w_i}{A_i}\right)^{1-\sigma} \cdot X_j \cdot P_j^{\sigma-1} \tag{9}$$

Market clearing requires that total income of country i, Y_i, equals its total sales:

$$Y_i = \sum_j X_{ij} = \sum_j a_i^{\sigma-1} \cdot \tau_{ij}^{1-\sigma} \cdot \left(\frac{w_i}{A_i}\right)^{1-\sigma} \cdot X_j \cdot P_j^{\sigma-1}$$

Solving for the scaled prices, $a_i^{\sigma-1} \cdot \left(\frac{w_i}{A_i}\right)^{1-\sigma}$, gives

$$a_i^{\sigma-1} \cdot \left(\frac{w_i}{A_i}\right)^{1-\sigma} = \frac{Y_i}{\sum_j \tau_{ij}^{1-\sigma} \cdot X_j \cdot P_j^{\sigma-1}} \tag{10}$$

Inserting equation (10) into equation (9) yields

$$X_{ij} = \tau_{ij}^{1-\sigma} \cdot \frac{Y_i}{\sum_j \tau_{ij}^{1-\sigma} \cdot X_j \cdot P_j^{\sigma-1}} \cdot X_j \cdot P_j^{\sigma-1}$$

The gravity equation can now be expressed as

$$X_{ij} = Y_i \cdot X_j \cdot \left(\frac{\tau_{ij}}{\Pi_i \cdot P_j}\right)^{1-\sigma} \tag{11}$$

with

$$\Pi_i \equiv \left(\sum_j \left(\frac{\tau_{ij}}{P_j}\right)^{1-\sigma} \cdot X_j\right)^{\frac{1}{1-\sigma}} \tag{12}$$

By replacing the scaled prices in equation (5) by equation (10), the CES-price index becomes

$$P_j \equiv \left(\sum_i \frac{Y_i}{\sum_j \left(\frac{\tau_{ij}}{P_j}\right)^{1-\sigma} \cdot X_j} \cdot \tau_{ij}^{1-\sigma}\right)^{\frac{1}{1-\sigma}} \equiv \left(\sum_i \left(\frac{\tau_{ij}}{\Pi_i}\right)^{1-\sigma} \cdot Y_i\right)^{\frac{1}{1-\sigma}} \tag{13}$$

Defining world nominal income as $Y^W \equiv \sum_j Y_j$, income shares are given by $\theta_j \equiv \frac{Y_j}{Y^W}$, implying $Y_j \equiv \theta_j \cdot Y^W$. Assuming balanced trade, i.e. $X_j = Y_j$, equations (12) and (13) can be stated as

$$\Pi_i \equiv \left(\sum_j \left(\frac{\tau_{ij}}{P_j} \right)^{1-\sigma} \cdot \theta_j \cdot Y^W \right)^{\frac{1}{1-\sigma}}$$

and

$$P_j \equiv \left(\sum_i \frac{\theta_i \cdot Y^W}{\sum_j \left(\frac{\tau_{ij}}{P_j} \right)^{1-\sigma} \cdot \theta_j \cdot Y^W} \cdot \tau_{ij}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$$

Thus, equations (11)-(13) are modified to yield the final structural gravity system:

$$X_{ij} = \frac{Y_i \cdot Y_j}{Y^W} \cdot \left(\frac{\tau_{ij}}{\Pi_i \cdot P_j} \right)^{1-\sigma} \tag{14}$$

with

$$\Pi_i \equiv \left(\sum_j \left(\frac{\tau_{ij}}{P_j} \right)^{1-\sigma} \cdot \theta_j \right)^{\frac{1}{1-\sigma}} \tag{15}$$

and

$$P_j \equiv \left(\sum_i \left(\frac{\tau_{ij}}{\Pi_i} \right)^{1-\sigma} \cdot \theta_i \right)^{\frac{1}{1-\sigma}} \tag{16}$$

With given values for σ, τ_{ij}, and income shares θ_i, both expressions, Π_i and P_j, can be calculated.[45] Equations (14)-(16) are contained in the definition of general gravity by Head and Mayer (2014) outlined in chapter 3 as a subset.[46]

The intuition behind this theoretical formulation of the gravity equation holds that once country size effects have been taken into account, bilateral trade between economy i and j is a function of the bilateral trade barrier τ_{ij} between both countries, relative to the product of their multilateral resistance indices, Π_i and P_j. An increase of importer j's multilateral resistance, P_j, for a given trade barrier, increases exports from economy i to j, since the price of i's good shipped to j, p_{ij}, has fallen relative to that of goods shipped to country j from all other

[45] c.f. Anderson/van Wincoop 2003, pp.174-175
[46] c.f. Head/Mayer 2014, p.138

destinations. An increase in multilateral resistance of the exporter country i for a given trade barrier between i and j, increases exports from i to j as the higher the trade barriers the exporter faces, the lower the demand for his product and hence the supply price p_i.[47] Equations (14)-(16) will be employed for theory consistent estimation in the subsequent chapter.

5 Empirical Part

This chapter introduces the dataset, followed by the empirical analysis of effects, generated by the extensive and intensive margins of preferential trade liberalization.

5.1 The Data

The following sources have been harnessed for construction of the panel data set: Aggregated merchandise trade flows of country pairs were drawn from the Direction of Trade Statistics data base of the International Monetary Fund. The nominal values of bilateral exports are denominated in US Dollars (USD) at current exchange rates.[48] Natural logarithms were taken to construct the dependent variable $lnExports_{ij,t}$.

Importer and exporter gross domestic products (GDP) stem from the World Development Indicators data set of the World Bank. The latter are nominal values, denominated in USD at current exchange rates. Natural logarithms were taken to construct the covariates $lnGDP_{i,t}$ and $lnGDP_{j,t}$.[49]

The definition of trade costs by Anderson and van Wincoop (2004) comprises all costs incurred getting a good to the consumer except its marginal cost of production. The former may be related to transportation (freight and time), policy barriers (tariff and non-tariff), information, contract enforcement, currency conversion, local distribution (wholesale and retail), as well as to regulations and laws.[50] Hence, the following variables are employed to proxy the latter:

Effective distance data were drawn from the Centre d'Études Prospectives et

[47] c.f. Anderson/van Wincoop 2003 p.176
[48] c.f. International Monetary Fund 2019
[49] c.f. World Bank 2019
[50] c.f. Anderson/van Wincoop 2004, pp.691-692

d'Informations Internationales (CEPII) GeoDist database as explained in detail by Mayer and Zignago (2011).

Approaching the border puzzle of McCallum (1995), Head and Mayer (2002) were able to significantly reduce border effect estimates with their effective distance measure.[51]

The methodology to compute effective distances of country pairs harnesses distances between nations' economic centers, weighted by their share in the country population.

Trade between countries i and j, x_{ij}, is assumed equal to the sum of trade between both countries among their sub-regions (κ in economy i and ℓ in economy j), each trade flow being a function of geographical distance d_{ij} and $d_{\kappa\ell}$ respectively:

$$x_{ij}(d_{ij}) = \sum_{\kappa \in i} \sum_{\ell \in j} x_{\kappa\ell}(d_{\kappa\ell}) \tag{17}$$

With y_i and y_j denoting total incomes of country i and j, as well as y_κ, and y_ℓ, standing for each sub-region's total income, and G as gravitational constant, the following gravity setup is chosen:

$$x_{ij} = G \cdot y_i \cdot y_j \cdot d_{ij}^{\theta} \tag{18}$$

and

$$x_{\kappa\ell} = G \cdot y_\kappa \cdot y_\ell \cdot d_{\kappa\ell}^{\theta} \tag{19}$$

Combining equations (17)-(19) yields

$$y_i \cdot y_j \cdot d_{ij}^{\theta} = \sum_{\kappa \in i} \sum_{\ell \in j} y_\kappa \cdot y_\ell \cdot d_{\kappa\ell}^{\theta}$$

The right hand side is modified by

$$y_j = \sum_{\ell \in j} y_\ell$$

and

$$d_{\kappa j} = \left(\sum_{\ell \in j} \left(\frac{y_\ell}{y_j} \right) \cdot d_{\kappa\ell}^{\theta} \right)^{\frac{1}{\theta}}$$

[51] c.f. Head/Mayer 2002, pp.4,9

Thus, the effective distance measure between country i and j is given by[52]

$$d_{ij} = \left(\sum_{\kappa \in i} \left(\frac{y_\kappa}{y_i} \right) \cdot \sum_{\ell \in j} \left(\frac{y_\ell}{y_j} \right) \cdot d_{\kappa\ell}^{\theta} \right)^{\frac{1}{\theta}}$$

Replacing total income as a size measure by population, as for instance done by Frankel and Romer (1999), yields[53]

$$d_{ij} = \left(\sum_{\kappa \in i} (\frac{pop_\kappa}{pop_i}) \cdot \sum_{\ell \in j} (\frac{pop_\ell}{pop_j}) \cdot d_{\kappa\ell}^{\theta} \right)^{\frac{1}{\theta}}$$

Populations of country i and country j are denoted by pop_i and pop_j, those of agglomeration κ in country i by pop_κ, and of agglomeration ℓ in country j by pop_ℓ. θ stands for the sensitivity of trade flows with respect to bilateral distance, $d_{\kappa\ell}$. Paper reviews by Head and Mayer (2002) and Head and Mayer (2014) suggest $\theta \approx -1$, yielding the effective distance variable *distwces* in the GeoDist data set. City coordinate and population information stems from the World Gazetteer web site. However, the calculations are based on 2004 data.[54] For empirical analysis, the natural logarithm of *distwces* was taken to construct the independent variable $lnDistance_{ij}$.

Cultural, political, and legal institutional proximity data were also drawn from the CEPII GeoDist dataset as control variables that may affect trade costs.[55] Two dummies are employed. $Comborder_{ij}$, indicating whether two countries are contiguous and $Comlang_{ij}$, capturing whether a certain language is spoken by at least nine percent of each country's population within a given dyad.[56] Language information stems from www.ethnologue.org, and the CIA World Factbook.[57]

GATT/WTO membership of a country pair has been coded as dummy with data

[52]c.f. Head/Mayer 2002, pp.11-13
[53]c.f. Frankel/Romer 1999, pp.382-383
[54]c.f. Head/Mayer 2002, p.13
c.f. Chaney 2018, p.151
c.f. Mayer/Zignago 2011, p.11
[55]c.f. Mayer/Zignago 2011, p.8
c.f. Mayer/Zignago 2005, pp.16-17
[56]c.f. Mayer/Zignago 2011, pp.10,12
[57]c.f. Mayer/Zignago 2011, p.8

from the World Trade Organization.[58]

Information on preferential trade liberalization was drawn from the DESTA database which is the most comprehensive regarding covered sectors and numbers of agreements included, to construct the dummy variable $PTA_{ij,t}$ for PTA-membership of a country dyad.[59] Data, comprising base treaties, accessions, and withdrawals for which a depth index according to Dür et al. (2014) was available have been included. Addressing the intensive margin of preferential liberalization, the covariate $\sum_{1960}^{t} PTA_{ij,t}$ is introduced, denoting the number of all PTAs that have been signed by a country pair since 1960 to capture the degree of institutional depth. Information about treaty breadth, i.e. the extensive margin, is contained in the variable $PTA_{ij,t}^{breadth}$. The latter is an additive index, consisting of four subcomponents, each taking on a value of one, if present within a given agreement and zero otherwise:

- ◇ Envisaged free trade agreement
- ◇ Substantive provisions on services (minimum one)
- ◇ Substantive provisions on investment (minimum one)
- ◇ Substantive provisions on intellectual property rights (minimum one)

The index enables to address the breadth dimensions for goods, services, technology and capital, mentioned in the operationalization proposed by Limão (2016). Merchandise trade depends on service provision and may therefore profit from service liberalization. More liberal investment policies could attract additional foreign direct investment, boosting vertical intra-industry trade. Improved protection of intellectual property rights may limit counterfeit goods production and therefore stimulate trade.[60] Dür et al. (2014) include in their additive index additional data on the depth dimensions as defined by Limão (2016), i.e. competition, standards and procurement.[61] Due to the strong positive correlation between breadth and depth, an index containing both may bias estimates. Hence, depth will not be taken into account explicitly.

[58]c.f. World Trade Organization 2019a
c.f. World Trade Organization 2019b
[59]c.f. Dür et al. 2014, pp.354,356
[60]c.f. Dür et al. 2014, p.363
[61]c.f. Dür et al. 2014, pp.258-260

5.2 Data Properties

This section summarizes the data properties with respect to the general intuition behind the gravity equation.
As depicted by table 1 and figure 2, the natural logarithms of bilateral exports are negatively correlated with logarithmized distance between both countries, visualized by the negative slope of the linear line of best fit. This implies that

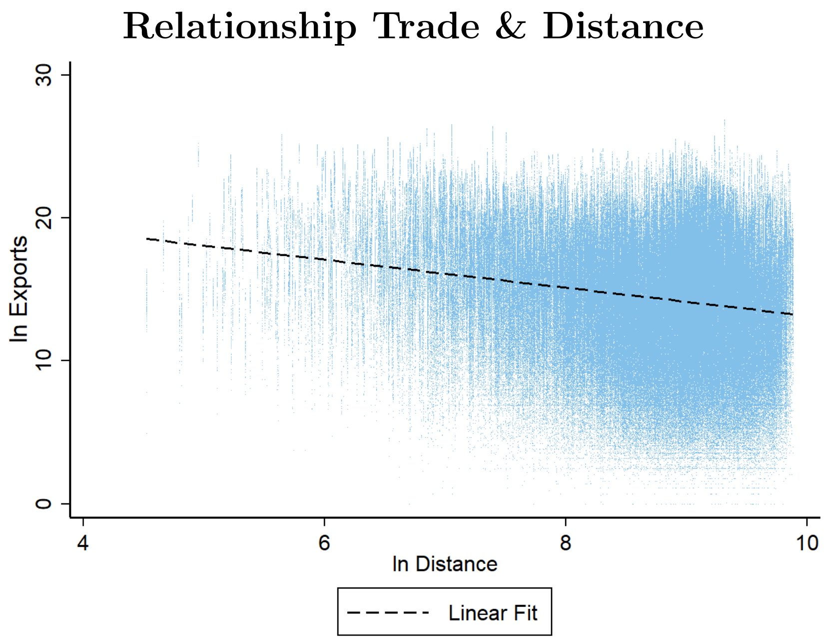

Figure 2: Source: Own Depiction based on IMF (2019) and Mayer/Zignago (2011)

countries farther apart tend to trade less with each other. In contrast, the data exhibit a strong positive correlation between logarithmized exports and natural logarithms of economic size, i.e. GDP of importer country j and exporter country

Correlation: Trade-Economic Size-Distance

$\boldsymbol{\rho}$	$lnGDP_{i,t}$	$lnGDP_{i,t}$	$lnDistance_{ij}$
$lnExports_{ij,t}$	0.4924	0.4012	-0.2068

Table 1

i, as shown in table 1 and figure 3. The latter depicts the relationsship between $ln(GDP_{i,t} \times GDP_{j,t})$ and $lnExports_{ij,t}$ with a positive slope of the linear line of best fit, indicating that country pairs with larger economic size tend to trade more with each other than smaller ones.

Figure 3: Source: Own Depiction based on IMF (2019) and World Bank (2019)

5.3 Estimation

For estimation, different econometric specifications are employed, since Head and Mayer (2014) recommend a toolkit approach.[62] Piermartini and Yotov (2016) propose several best practices. The use of panel data enhances estimation efficiency. Interval data allow for adjustment of trade flows over time. Olivero and Yotov (2012) find resemblance of gravity estimates in panels with three-, four-, and five-year lags. The inclusion of intra-national trade flows (gross production minus total exports, as in Wei (1996)), among other virtues, may improve consistency with theory, allowing for consumption of domestic products. Referring to the findings of Olivero and Yotov (2012), inclusion of exporter- and importer-time fixed effects to capture MR terms properly, is recommended. Absorption includes all observable and unobservable country-specific characteristics, encompassing inter alia economic size, national policies, institutions, and exchange rates. Moreover, country-time fixed effects enable general equilibrium estimation. Referring to Baier and Bergstrand (2007), introduction of pair fixed effects is advised to address potential endogeneity, as trade liberalization may for instance be more

[62] c.f. Head/Mayer 2014, p.132

likely to occur among already important trading partners. Furthermore, WTO (2011) argues that deep may complement shallow integration with the former generating demand for governance supplied by the latter. Increased trade openness could also cause policy externalities which in turn make unilateral compared to cooperative decision making inefficient. Research by Brou and Ruta (2011) and Aantràs and Staiger (2012) suggests that causality in both ways between deep integration and trade may exist, possibly developing dynamically. Estimation of the gravity equation in its multiplicative version, using the Poisson Pseudo Maximum Likelihood (PPML) estimator, enables additional inclusion of zero trade flows and to control for heteroskedasticity, increasing sample size. Occurrence of zero-trade flows is particularly frequent in samples, investigating sectoral disaggregated data and trade in services. The work of Santos Silva and Tenreyro (2006) is deemed seminal.[63]
The use of the PPML estimator and the inclusion of intra-national trade flows will be foregone in the remainder due to time constraints and the fact that aggregated bilateral merchandise trade flows exhibit a relatively small amount of zeros. Inclusion of intra-national trade, as for instance to compute counterfactuals, goes beyond the scope if this paper. The total sample size of 677 698 observations, covering the period from 1960-2016, is still relatively large. However, possible shortcomings with respect to sample selection are recognized. Potential heteroskedasticity of GDPs is taken into account by constructing adjusted bilateral trade flows as proposed by Anderson and van Wincoop (2003). Ordinary Least Squares estimation with interval data (three-year lags) is conducted. Standard errors are clustered by dyads, as explanatory variables within country pairs may correlate, possibly altering standard errors and therefore significance levels.

5.3.1 Intensive Margin

Static intensive margin effects are estimated in four different settings: Econometric model I, reflecting the traditional, non-theory-consistent approach, can be

[63] c.f. Piermartini/Yotov 2016, pp.4,6-14
c.f. World Trade Organization 2011, pp.10,110-111

stated as follows:

$$
\begin{aligned}
lnExports_{ij,t} = {} & \alpha_0 + \alpha_1\ lnGDP_{i,t} + \alpha_2\ lnGDP_{j,t} + \alpha_3\ lnDistance_{ij} \\
& + \alpha_3\ Comborder_{ij} + \alpha_4\ Comlang_{ij} \\
& + \alpha_5\ \left(PTA_{ij,t} \times \sum_{1960}^{t} PTA_{ij,t} \right) \\
& + \alpha_6\ GATT/WTO_{ij,t} + \delta_t + \epsilon_{ij,t}
\end{aligned}
$$

with

- ◇ $lnGDP_{i/j,t}$ denoting economic size of countries i and j at time t,
- ◇ $lnDistance_{ij}$ effective distance between both economies,
- ◇ $Comborder_{ij}$ existence of a common border between i and j,
- ◇ $Comlang_{ij}$, whether a common language is spoken in i and j,
- ◇ $GATT/WTO_{ij,t}$ joint GATT/WTO membership in t,
- ◇ $PTA_{ij,t} \times \sum_{1960}^{t} PTA_{ij,t}$ existence of an active PTA in t, interacted with the number of all PTAs, signed between i and j since 1960,
- ◇ δ_t the set of time-fixed effects, and
- ◇ $\epsilon_{ij,t}$ the dyad- and time-specific error term.

Econometric model II takes into account potential heteroskedasticity in $lnGDP_{i,t}$ and $lnGDP_{j,t}$. Following the approach mentioned by Piermartini and Yotov (2016) and introduced by Anderson and van Wincoop (2003), bilateral trade is adjusted for the product of both country size variables, such that $lnExports_{ij,t}^{adj.} = ln\left(\frac{Exports_{ij,t}}{GDP_{i,t} \cdot GDP_{j,t}}\right)$.[64] Hence, the model becomes

$$
\begin{aligned}
lnExports_{ij,t}^{adj.} = {} & \alpha_0 + \alpha_1\ lnDistance_{ij} + \alpha_2\ Comborder_{ij} + \alpha_3\ Comlang_{ij} \\
& + \alpha_4\ \left(PTA_{ij,t} \times \sum_{1960}^{t} PTA_{ij,t} \right) + \alpha_5\ GATT/WTO_{ij,t} \\
& + \delta_t + \epsilon_{ij,t}
\end{aligned}
$$

Econometric model III introduces exporter-time and importer-time fixed effects $\phi_{i,t}$ and $\psi_{j,t}$. Hence, the approach is consistent with theory (equations (14)-(16)),

[64]c.f. Piermartini/Yotov 2016, p.8

as the former absorb MR terms, besides the economic size variables $lnGDP_{i,t}$ and $lnGDP_{j,t}$. The econometric specification is therefore given by

$$\begin{aligned} lnExports_{ij,t} = {} & \alpha_0 + \alpha_1 \; lnDistance_{ij} + \alpha_2 \; Comborder_{ij} + \alpha_3 \; Comlang_{ij} \\ & + \alpha_4 \; \left(PTA_{ij,t} \times \sum_{1960}^{t} PTA_{ij,t} \right) + \alpha_5 \; GATT/WTO_{ij,t} \\ & + \phi_{i,t} + \psi_{j,t} + \epsilon_{ij,t} \end{aligned}$$

Econometric model IV adds country pair-fixed effects, π_{ij}, to account for potential endogeneity in PTA formation. The latter also capture $lnDistance_{ij}$, $Comborder_{ij}$, and $Comlang_{ij}$:

$$\begin{aligned} lnExports_{ij,t} = {} & \alpha_0 + \alpha_1 \; \left(PTA_{ij,t} \times \sum_{1960}^{t} PTA_{ij,t} \right) + \alpha_2 \; GATT/WTO_{ij,t} \\ & + \phi_{i,t} + \psi_{j,t} + \pi_{ij} + \epsilon_{ij,t} \end{aligned}$$

Estimation results of models I-IV are depicted in table 2. Significance levels are denoted by asterisks and standard errors are reported in parenthesis. $R^2_{adj.}$-values indicate high explanatory power of the right hand side variables. Model II stands out due to the loss if economic size as covariates. The latter exhibit expected signs and impacts, with positive coefficients close to unity and significance at the one percent level in the first specification. The coefficients of $lnDistance_{ij}$ show the expected negative sign, significant at the one percent level, in all model specifications. However, being close to unity in models I and II, the variable appears to interact with $Comborder_{ij}$ in model III. Head and Mayer (2002) note that although adjacency may be interpreted as freight costs, e.g. by better connected traffic infrastructure, its inclusion could turn out problematic due to possible interaction with distance.[65] Coefficients of $Comborder_{ij}$ and $Comlang_{ij}$ also have the expected positive sign, significant at the one percent level, in all econometric settings, with the exception of $Comborder_{ij}$ in model III being relatively low and only significant at the ten percent level. Effects of the trade policy variables $GATT/WTO_{ij,t}$ and the intensive margin of preferential liberalization, $PTA_{ij,t} \times \sum_{1960}^{t} PTA_{ij,t}$, are positive throughout all four model specifications and

[65] c.f. Head/Mayer 2002, pp.9-10

Econometric Models I-IV$_t$

	Model I	Model II	Model III	Model IV
	$lnExports_{ij,t}$	$lnExports^{adj.}_{ij,t}$	$lnExports_{ij,t}$	$lnExports_{ij,t}$
$lnGDP_{i,t}$	1.127***			
	(0.00540)			
$lnGDP_{j,t}$	0.952***			
	(0.00555)			
$lnDistance_{ij}$	-1.212***	-1.190***	-1.495***	
	(0.0191)	(0.0191)	(0.0213)	
$Comborder_{ij}$	0.401***	0.435***	0.202*	
	(0.106)	(0.103)	(0.110)	
$Comlang_{ij}$	0.830***	0.794***	0.727***	
	(0.0393)	(0.0389)	(0.0401)	
$GATT/WTO_{ij,t}$	0.253***	0.284***	0.270***	0.126***
	(0.0253)	(0.0248)	(0.0600)	(0.0480)
$PTA_{ij,t} \times \sum_{1960}^{t} PTA_{ij,t}$	0.206***	0.213***	0.200***	0.154***
	(0.0106)	(0.0104)	(0.0115)	(0.0105)
N	218275	218275	218271	215332
$R^2_{adj.}$	0.638	0.354	0.731	0.859

Standard errors in parentheses

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

Table 2

Econometric Model IV$_{t-3,\ t-6}$

	$lnExports_{ij,t}$	
$GATT/WTO_{ij,t-l}$	0.0750	0.0637
	(0.0470)	(0.0476)
$PTA_{ij,t-l} \times \sum_{1960}^{t} PTA_{ij,t-l}$	0.117***	0.0994***
	(0.0106)	(0.0109)
$lags$	3	6
N	182395	160930
$R^2_{adj.}$	0.867	0.872

Standard errors in parentheses

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

Table 3

significant at the one percent level. By introducing three-year ($l = 3$) and six-year ($l = 6$) lags to model specification IV, dynamic effects are investigated next, as shown in table 3. $R^2_{adj.}$-values indicate high explanatory power. Trade policy coefficients suggest a prolonged positive and highly significant impact of the intensive PTA-margin which decreases over time, whereas the effect of WTO/GATT membership appears to wear out in addition to vanishing significance.

5.3.2 Extensive & Intensive Margin

Model IV* adds $PTA^{breadth}_{ij,t}$ as measure for the extensive margin of preferential liberalization, interacted with $PTA_{ij,t}$ to capture active PTA- membership, yielding the corresponding econometric equation

$$lnExports_{ij,t} = \alpha_0 + \alpha_1 \left(PTA_{ij,t} \times \sum_{1960}^{t} PTA_{ij,t} \right) + \alpha_2 \; GATT/WTO_{ij,t} + \alpha_3 \; \left(PTA_{ij,t} \times PTA^{breadth}_{ij,t} \right) + \phi_{i,t} + \psi_{j,t} + \pi_{ij} + \epsilon_{ij,t}$$

As depicted by table 4, values of $R^2_{adj.}$ remain high. Effects of the trade policy

Econometric Model IV*$_{\mathbf{t,\ t-3,\ t-6}}$

	$lnExports_{ij,t}$		
$GATT/WTO_{ij,t-l}$	0.125***	0.0718	0.0609
	(0.0481)	(0.0470)	(0.0475)
$PTA_{ij,t-l} \times \sum_{1960}^{t} PTA_{ij,t-l}$	0.144***	0.0833***	0.0576***
	(0.0125)	(0.0129)	(0.0132)
$PTA_{ij,t-l} \times PTA^{breadth}_{ij,t-l}$	0.0191	0.0688***	0.0895***
	(0.0121)	(0.0138)	(0.0142)
lags	0	3	6
N	215332	182395	160930
$R^2_{adj.}$	0.859	0.867	0.872

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 4

variables for joint GATT/WTO membership and the intensive margin of preferential trade liberalization resemble those of model specification IV. Extensive margin effects increase over time in size and significance.

6 Conclusion

Empirical analysis suggests a positive, dynamically increasing effect of the extensive margin as well as a positive, dynamically decreasing effect of the intensive margin of preferential liberalization on aggregated bilateral merchandise trade flows.

To better grasp PTA-effects, future research may scrutinize the impact of preferential trade liberalization along the breadth dimensions, as for instance done by Kimura and Lee (2006) for services, focusing on sectoral trade flows and intermediate goods.[66] In depth analysis of effects on the determinants of international trade may turn out fruitful, in addition. Construction of richer PTA-data sets to capture as many channels as possible, including for instance trade policy uncertainty, appears crucial.[67]

Distinguishing between entry and exit regarding PTA-membership may become feasible due to improved data availability as in Daigle et al. (2019).

A more detailed analysis of PTAs, as recommended by Dür et al. (2014), investigating the interactions of provisions within the intensive margin, as well as the interrelations with the extensive margin could be of great value.[68]

Examination of distributional and welfare effects may be of interest as Rodrik (2018) argues that despite their trade creating effect, deep trade agreements' impact on welfare and efficiency are uncertain.[69]

Capturing the complexity of PTA-effects in theoretical economic models, going beyond the traditional Vinerian framework to accommodate dynamic effects apart from tariff reductions, poses another challenge.[70] Feenstra (2018) argues that the iceberg representation of trade costs maybe too simplistic in economic models.[71] Improved understaning of trade cost structure may enhance estimation accuracy of policy effects.

[66] c.f. Shepherd 2016, p.1
c.f. Limão 2016, p.282

[67] c.f. Limão 2016, p.282

[68] c.f. Dür et al. 2014, p.373

[69] c.f. Rodrik 2018, p.76
c.f. Dür et al. 2014, p.373

[70] c.f. Rodrik 2018, p.76

[71] c.f. Feenstra 2018, pp.38-42

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