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# Greater Than the Sum of its Parts?

## How does Austria Profit from a Widening Network of EU Free Trade Agreements?

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## How does Austria Profit from a Widening Network of EU Free Trade Agreements?

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# Abstract

Political debates and economic analyses often focus on single free trade agreements and their potential economic effects on participating trading partners. This study contributes to the literature by shedding light on the significance of trade agreements in the context of countries' positions in worldwide trade agreement networks, by combining network theory with gravity trade modelling. We illustrate, both numerically and graphically, the evolution of the global web of trade agreements in general, and the network of the European Union specifically, accounting for the geographical and temporal change in the depth of agreements implemented. Gravity estimations for the period 1995-2017 distinguish the direct bilateral effects of trade agreements from indirect effects attributable to the scope of trade networks and countries' positions therein.

Keywords: free trade agreements, network effects, trade policy, structural gravity model

JEL classification: D58, F13, F14, F43

CONTENTS

## TABLES AND FIGURES



### Appendix

# 1. Introduction: Network theory in international trade

Economists regularly estimate the potential effects of free trade agreements (FTAs) on the economies of the participating parties[1]. The economic impact of FTAs differs, for example, by the trading partners involved, by the agreements' depth and scope, by the sectors subject to negotiations (or exempted from trade liberalisation), depending on whether non-tariff barriers are tackled in addition to tariff cuts, and by the level of complementarity between new FTAs and already established ones.[2]

In addition, there are reasons to assume that the overall impact of an established network of trade agreements might exceed the sum of the effects expected from the implementation of single agreements.

**Common rules.** Allee and Elsig (2019) show that in at least 100 preferential trade agreements, 80% or more of their content was copied and pasted from a single treaty. This pattern seems to be most prevalent among low-capacity governments (which rely on existing templates) and powerful economies (which aim to spread their rules globally). The European Union, as a major global economic power, has one of the largest trade agreement networks in the world, with agreements that are also among the deepest (Gruebler et al., 2018). When the EU-Japan trade agreement entered into force, the president of the European Commission stated that '[it] makes sure that our principles in areas such as labour, safety, climate and consumer protection are the global gold-standard'.[3] The more countries agree to adhere to international standards and rules,[4] the greater should be the economies of scale for companies whose domestic regulations are already aligned with these internationally agreed standards.

**Fragmentation of production.** Lower cross-border trade costs in general, and common rules and lower tariffs more specifically, render the dispersion of production across countries more profitable (Navaretti et al., 2006). The increase of the share of intermediate inputs in total goods trade is an important indicator for that (Escaith, 2017). FTAs therefore affect location choices of multinational enterprises, as well as their productivity and competitiveness and thus shape the geographical structure of international production and supply chains.

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1 See e.g. Baier and Bergstrand (2007) or Larch et al. (2019) for multi-country assessments of trade effects of FTAs. Studies on the most recently negotiated FTAs of the EU include, for example, Felbermayr et al (2016) for the Transatlantic Trade and Investment Partnership (TTIP) between the EU and the US; Breuss (2014) provides an overview of the range of ex-ante effects of TTIP estimated for Austria. Felbermayr et al. (2019) or Grübler et al. (2018) present ex-ante estimates on the effects of the Economic Partnership Agreement between the EU and Japan that entered into force in February 2019.

2 There is an extensive literature focusing on trade creation versus trade diversion effects, e.g. Lee et al. (2008) or Dai et al. (2014).

3 European Commission (31 January 2019): 'EU-Japan trade agreement enters into force'. Available at https://europa.eu/rapid/press-release_IP-19-785_en.htm

4 Using textual analysis for four 'new generation' trade agreements of the EU (with Canada, Central America, Singapore and South Korea), Young (2015) finds that these were not used to push for European standards. Where regulatory coordination occurred, it focused on establishing an equivalence of different rules or an agreement on international standards. Text analysis by Allee et al. (2017) suggests that the deep agreement between the EU and Canada (CETA) is particularly novel, with only 7% being copied from previous trade agreements; they conclude that CETA is not 'more of the same', but might play an important role as a model for future trade agreements.

**First-mover hubs.** The vast network of FTAs of the EU might also bring competitive advantages vis-à-vis countries that are not part of these FTAs. Considering the EU as a 'hub', EU firms enjoy, for example, advantages in trade with South Africa (for which an Agreement on Trade, Development and Cooperation has been provisionally applied since 1999), compared to Japan, which has no FTA in place with South Africa. Similarly, the EU faces lower tariff and non-tariff barriers when trading with Japan (for which the Economic Partnership Agreement (EPA) entered into force in February 2019), compared to South Africa.

Hur et al. (2010) find that FTAs increased trade between FTA members by 5.6% annually for the period 1960-2000; of this, 1.5% was attributable to the 'hub' effect. Lee et al. (2008) argue that effects are biggest for original members of an FTA, and lower for countries that subsequently join existing FTAs.

A way to empirically assess the network effects of EU FTAs is to combine gravity trade modelling[5] with network theory. Sopranzetti (2018) classifies countries according to their position in FTA networks. Computing a centrality measure for each trading partner according to a 'hub-and-spoke' network for the period 2000-2015, she finds a positive trade effect for hubs of overlapping FTAs. However, the number of spokes that are not linked to each other reduces the positive impact. Her findings suggest that multilateral trade negotiations should be preferred over an expansion of bilateral FTA networks, as the latter complicate navigation through the 'spaghetti bowl' of trade agreements (Baldwin, 2006).

We build on the approach of Sopranzetti (2018), yet apply a structural gravity framework and use different measures of FTAs and centrality in order to compare the effects of direct FTA linkages between trading partners with indirect FTA effects attributable to the free trade network.

The study has three central parts: the first numerically and graphically describes the evolution of the FTA network of the European Union over time, and its members' positions within the global web of trade agreements; the second uses the derived network measures of FTAs in a structural gravity framework, employing a global dataset of bilateral trade flows for the period 1995-2017; and in the third, we evaluate the direct and indirect effects of the EU-Japan EPA (in force since February 2019) and the envisaged EU-Mercosur trade agreement (for which a political agreement was reached in June 2019) for Austria. A final section concludes.

5 Based on work by Anderson et al. (2015).

# 2. The evolution of global free trade networks

Before delving into the analysis of FTA data, we need to introduce some nomenclature commonly used in network theory (but still rarely seen in trade analysis papers), as well as the concept of centrality.

A network is called a graph. A graph $G$ consists of a set of vertices (or nodes) $\mathrm{V}$ and a set of edges (or links, connections) $\mathrm{E}$ between the vertices, such that $G = (V, E)$. In our setting, our graphs comprise countries as vertices and FTAs as edges. A graph may consist of multiple components. As will be shown, four decades ago FTAs were established regionally without links between different regional clusters. Today, global FTAs form a fully connected graph containing only one component.

Directed edges can only run from the starting vertex to the ending vertex, and not the other way around. However, in this paper we only consider undirected edges, which can run in both directions.[6] Applied to our research question, this implies that we look at FTAs, but do not consider unilateral trade preferences, such as those provided by the EU to developing countries within its Generalised Scheme of Preferences.[7]

A path is a sequence of vertices (which need to have edges between them) that can be traversed sequentially. The shortest path[8] connects two vertices $i$ and $j$ at minimum cumulative distance/cost. Continuing with the example mentioned above, we would observe a path of length 1 between the EU and South Africa, as well as between the EU and Japan (if we do not impose any weight on the edges to account for FTA-induced trade cost reductions). However, the path between South Africa and Japan is at least of length 2 (e.g. via the FTAs connecting South Africa and Japan with the EU), as these two economies have not established an FTA between them.

## 2.1. REACH: TRADE AGREEMENTS GOING GLOBAL

The total number of regional free trade agreements in force and notified to the World Trade Organization (WTO) increased from 47 in 1995 to 302 in 2019 (Figure 1). One driving force is the European Union, whose agreements increased in number from 8 to 43 over the same period.

The European Single Market is the primary destination and source of EU members' trade flows. For example, in 2018, 52% of Austrian exports were destined for the EU15 countries (i.e. all those EU members that had joined by 1995), while 55% of imports stemmed from this region. Another 18% of exports and 15% of imports were attributable to the EU13 Central and Eastern European EU member states, which joined in 2004 or thereafter.

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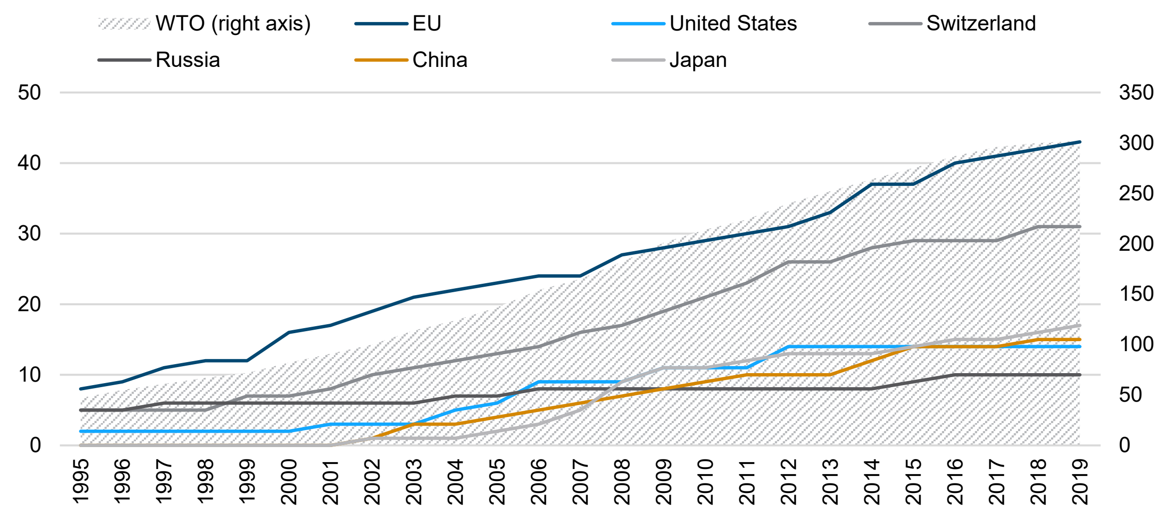
6 Example: Consider a graph where vertices are persons. If the edge represents a relationship between siblings, it is undirected: If *A* is a sibling of *B*, then *B* is automatically a sibling of *A*. If the edge represents a parent-child relationship, it is directed: If *A* is a parent of *B*, *B* cannot be a parent of *A*.

7 For further information on the EU GSP, see: https://ec.europa.eu/trade/policy/countries-and-regions/development/generalised-scheme-of-preferences/

8 The Dijkstra (1959) algorithm is typically used to find the shortest path connecting two vertices.

Only five non-EU countries featured among Austria's top 20 partners in terms of both exports and imports: China, Japan, Russia, Switzerland and the United States.[9] All of these display an increase in the number of established FTAs (Figure 1). This development appears particularly dynamic for the EU and for Switzerland, the latter being part of the European Free Trade Association (EFTA), which Austria left 25 years ago to join the EU.

**Figure 1 / Austria's most important trading partners: number of FTAs in force**




Note: Year of entry into force. wiiw visualisation.
Data source: Regional trade Agreements Database provided by the WTO.

During the period 1995-2017, the number of regional trade agreements in force and notified to the WTO increased by a total of 249. The Design of Trade Agreements (DESTA) database,[10] set up by Dür et al. (2014) and updated in 2019, reports that 432 agreements entered into force during that period. This dataset builds on agreements notified to the World Trade Organization,[11] as well as information from other institutions, such as the World Trade Institute, the Organization of American States' Foreign Trade Information System,[12] the Asian Development Bank,[13] the World Bank[14] and ministries of foreign, trade or economic affairs. Framework agreements, as well as trade and cooperation agreements that do not explicitly liberalise at least some trade, interim agreements (such as those with the Palestinian Authority) and agreements with some small island states (such as Tuvalu) are not covered by DESTA. The updated dataset provides information on the signing and date of entry into force, as well as on the provisions of more than 800 trade agreements signed by more than 200 countries between 1945 and 2018.

9 Regularly updated data, summary tables and figures on Austrian trade based on data collected by Statistics Austria are provided by the Research Centre International Economics (FIW – Forschungszentrum Internationale Wirtschaft): https://www.fiw.ac.at/index.php?id=1140

10 See: https://www.designoftradeagreements.org/

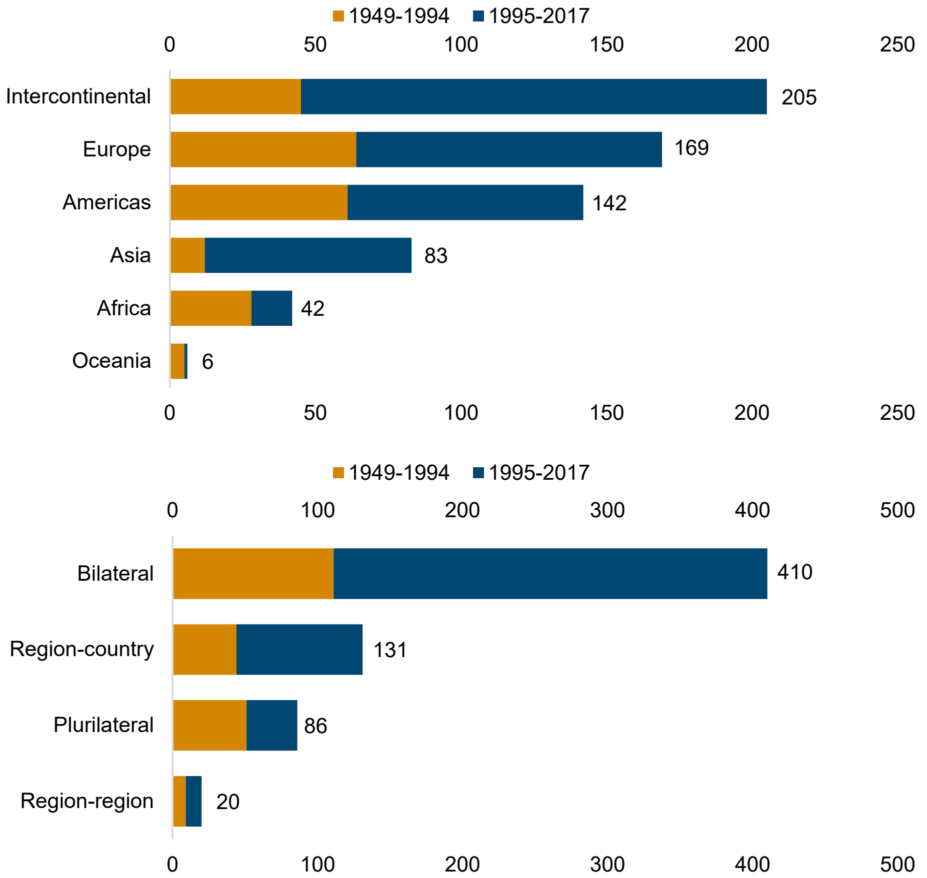
11 See Regional Trade Agreements Database of the WTO: http://rtais.wto.org

12 See: http://www.sice.oas.org/

13 See Asia Regional Integration Center: https://aric.adb.org/fta-all

14 See Global Preferential Trade Agreement Database (GPTAD): https://datacatalog.worldbank.org/dataset/wits-global-preferential-trade-agreement-database

**Figure 2 / Composition of FTAs in force**




Note: Year of entry into force. wiiw visualisation.
Data source: Dür et al. (2014), DESTA update 2019.

Despite its broader coverage, the DESTA data confirms that the geographical focus for FTAs lies in Europe (Figure 2). This is due not least to the fall of the Iron Curtain and the end of the Cold War 30 years ago, and Western Europe's subsequent ambitions to stabilise economic relations with the (in part newly independent) states of the former Eastern Bloc.

The database also reveals the dominance of bilateral agreements (Figure 2) over other constellations: while more than 400 bilateral agreements are recorded, there are only 20 interregional agreements. Most the latter have their roots in the colonial history of EU member states – France, the United Kingdom and Spain, in particular. These include the Yaoundé conventions,[15] the Lomé conventions[16] and the Cotonou Agreement, as well as EPAs with African, Caribbean and Pacific (ACP) states, which followed after the trade provisions of the Cotonou Agreement[17] expired on 31 December 2007.

[15] The two Yaoundé conventions were effective during 1964-1969 and 1971-1975, respectively, between member states of the European Economic Community and a group of 18 independent Associated African and Malagasy States (AAMS).

[16] The four Lomé conventions lasted from the mid-1970s (driven by the accession of Great Britain to the EU) until 2000.

[17] The Cotonou Agreement itself is a partnership currently encompassing 79 ACP countries, including 48 countries in Sub-Saharan Africa: https://www.consilium.europa.eu/en/policies/cotonou-agreement/ It was scheduled to expire by the end of February 2020. As negotiations on the future agreement are ongoing, its application has been extended to December 2020: https://ec.europa.eu/commission/presscorner/detail/en/ip_20_248

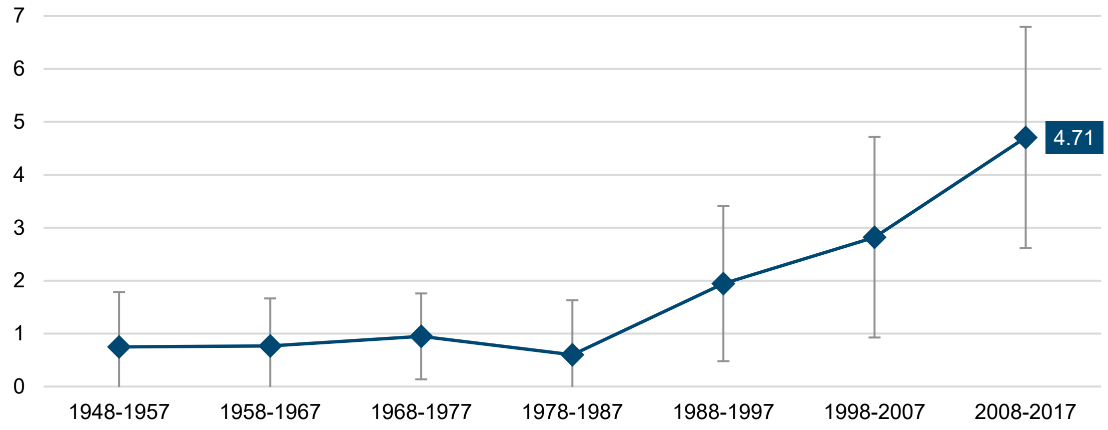
## 2.2. DEPTH: FROM SHALLOW TO DEEP FREE TRADE AGREEMENTS

In the context of trade liberalisation, FTAs typically enter analyses as unweighted edges in the form of dummy variables, taking the values 0 or 1. The use of binary variables does not allow the different purposes or potential effects of agreements to be distinguished. More recently, these FTA dummy variables have been complemented by additional trade policy variables capturing tariffs or aspects of non-tariff measures.

The edges connecting two countries may, however, be weighted differently as well, conveying the distance, costs and difficulty of going from one vertex to the other (or in our context, to trade with another). The applied weight depends on the scope and depth of the agreements considered.

Dür et al. (2014) have shown that the positive trade effect associated with FTAs is largely driven by deep agreements. In DESTA, they provide an additive index for each FTA, ranging from 0 (shallow agreement) to 7 (deep agreement).[18] In seven categories, the variable takes the value 1 if there is a substantive provision and 0 otherwise. For example, a national treatment clause is considered substantive, whereas stating 'the desire to open markets' is not. One component of the index captures whether the establishment of a free trade area with (almost) zero tariffs is foreseen ('Full FTA' in Figure 4). The remaining six areas of trade liberalisation go beyond tariff cuts and address services trade, investments, standards, public procurement, competition and intellectual property rights (IPRs). This last area has gained in importance (Figure 4) in more recent trade negotiations and public debates.

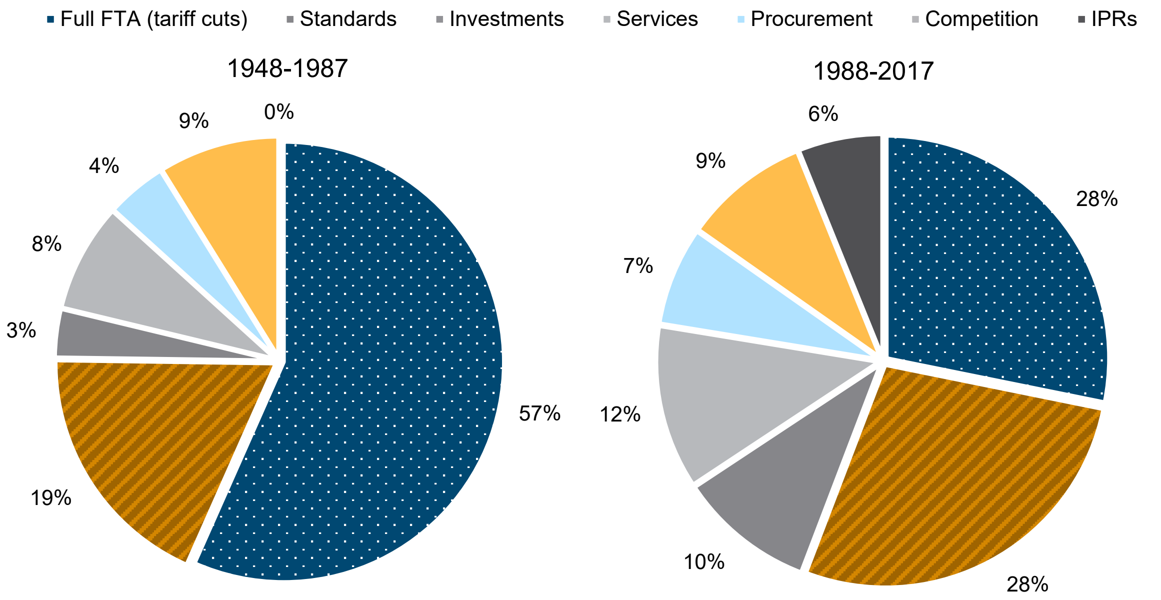
**Figure 3 / Evolving depth of FTAs – DESTA additive index (0-7)**




Note: Whiskers show standard errors. wiiw aggregation and visualisation.
Data source: Dür et al. (2014), DESTA update 2019. Note: Year of entry into force.

[18] In addition, they generate an indicator based on latent trait analysis, resulting in the same conclusions.

**Figure 4 / Shift towards non-tariff components of FTAs**




Note: Year of entry into force. wiiw aggregation and visualisation.
Data source: Dür et al. (2014), DESTA update 2019.

## 2.3. THE EU'S 'SPAGHETTI BOWL': MAPPING FTA LINKS OVER FOUR DECADES

The following network graphs illustrate the evolution of global FTA networks over the past 40 years. Only FTAs that have at some time or another entered into force are displayed, with different country colours representing continents.

The European Union (and its predecessors) are summarised in node only: first, in order to improve the readability of the graphs and second, because as trade policy is the exclusive responsibility of the European Commission (rather than national governments), all trade agreements apply to all EU member states. The size of the nodes corresponds to countries' degree centrality, which is directly related to the number of free trade agreements in place; meanwhile the thickness of the lines connecting countries is in proportion to the depth of the agreements. It is important to note that the great prominence of the EU in the graphs derives not from the sum of all EU member states; rather it represents the centrality that can be assigned to every single member of the EU.

**In 1977**, there were only a few 'islands' of free trade without connections between them (Figure 5). In network theory terms, this graph is said to consist of multiple components. The biggest component is centred around the EU9, with another group of European countries, including Austria,[19] grouped into EFTA. The EU9 countries had already established bilateral trade agreements with several African, Caribbean and Pacific countries (under the Yaoundé Convention). In addition, they had links with a component of the African

[19] Austria was a founding member of EFTA. When joining the European Economic Community in 1995, together with Finland and Sweden it left the EFTA group. Today's remaining members are Iceland, Liechtenstein, Norway and Switzerland.

economies in the form of the Casablanca Group, established in the early 1960s. Four components – Central America, South Asia, Southeast Asia and Oceania – were not yet connected to the EU.

**In 1987**, the node for the EU12 additionally encompassed Greece (which joined in 1981) and Portugal and Spain (1986). The EU still stands out as by far the biggest hub in the graph. The clusters of African states have grown; connections with countries in the Pacific and Caribbean have become thicker. However, some clusters in Asia – one component encompassing South Korea, a second being established around Singapore – as well as in the Middle East and Central America remain disconnected from the EU (Figure 6).

**In 1997**, we see a strongly interconnected centre surrounding the EU15, covering Finland, Sweden and Austria since 1995 (Figure 7). Austria has changed from an EFTA economy ‘neighbouring’ the EU to a full EU member at the core of the graph. An apparent difference between the graphs for 1987 and 1997 is the thickness of connections within regions, particularly in America and Europe. Latin America appears better connected internally and a new cluster of Eastern European and Central Asian economies has emerged. The graph also features the North American Free Trade Agreement (NAFTA) between the United States, Mexico and Canada, which entered into force in 1994. The USA and Canada also show a strong link with Israel, which itself has free trade agreements with several European countries. Mexico on the other hand features as a gateway to Central and South America.

**By 2007**, the EU had geographically expanded towards the east and had grown to 27 members, to which the same trade agreements have subsequently applied. Formerly separated FTA components of the graph have connected to each other to form one big network of trade links (Figure 8). A new feature of the graph is the visible integration of China. Back in 1997, it was not included in the picture at all, as it had no trade-liberalising trade agreement in place before it became a member of the WTO in 2001. That said, some trade agreements did exist, e.g. an Agreement on Trade and Economic Cooperation between the European Union and China, established in 1985.[20] However, trade and cooperation agreements of this type, without explicit trade-liberalising measures, do not enter the DESTA database. By 2007, China had not only become a major global trading power, but also had some formally established trade ties. Particularly noteworthy are those with the members of the Association of Southeast Asian Nations (ASEAN).[21]

**As of 2017**, the node of the European Union, representing all 28 pre-Brexit member states, has shrunk in relative terms (Figure 9), due to the expansion of the FTA networks of other economies. Today, the EU is directly connected with the members of the Commonwealth of Independent States (CIS).[22] Five out of nine CIS economies have established the Eurasian Economic Union, which entered into force in 2015. In addition, the EU is indirectly connected with the CIS economies via Ukraine, Moldova and Georgia, with which the EU recently established Deep and Comprehensive Free Trade Areas (DCFTAs).[23] Apart from direct links between African economies and the EU, South Africa (ZAF) and Morocco (MAR) act as hubs connecting Africa to other world regions. The EU’s most recent trade agreements, such as the agreement with Canada (provisionally in force since 21 September 2017), Japan (in force since 1 February 2019),

20 OJ L 250, 19.9.1985, p. 2-7: https://eur-lex.europa.eu/legal-content/GA/TXT/?uri=CELEX:21985A0919(01)
Parties started negotiations on a trade-liberalising agreement in 2007; however, these stopped again in 2011.

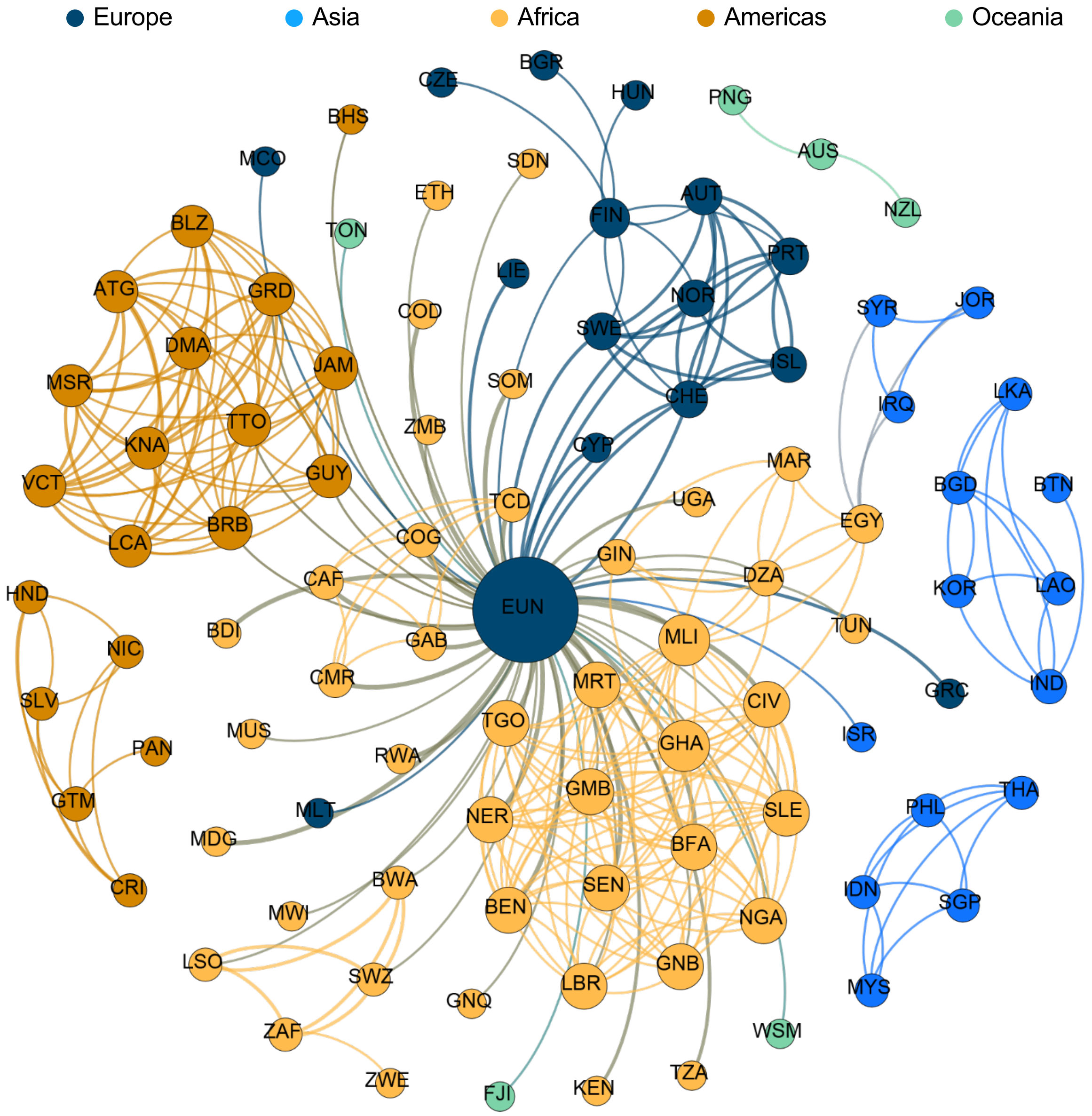
21 ASEAN members: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam (https://asean.org/). The ASEAN+3 conference includes China, Japan and South Korea.

22 The Commonwealth of Independent States is formed of nine post-Soviet republics: Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan and Uzbekistan.

23 The agreements with Moldova and Georgia entered into force in July 2016; the DCFTA with Ukraine entered into force in September 2017.

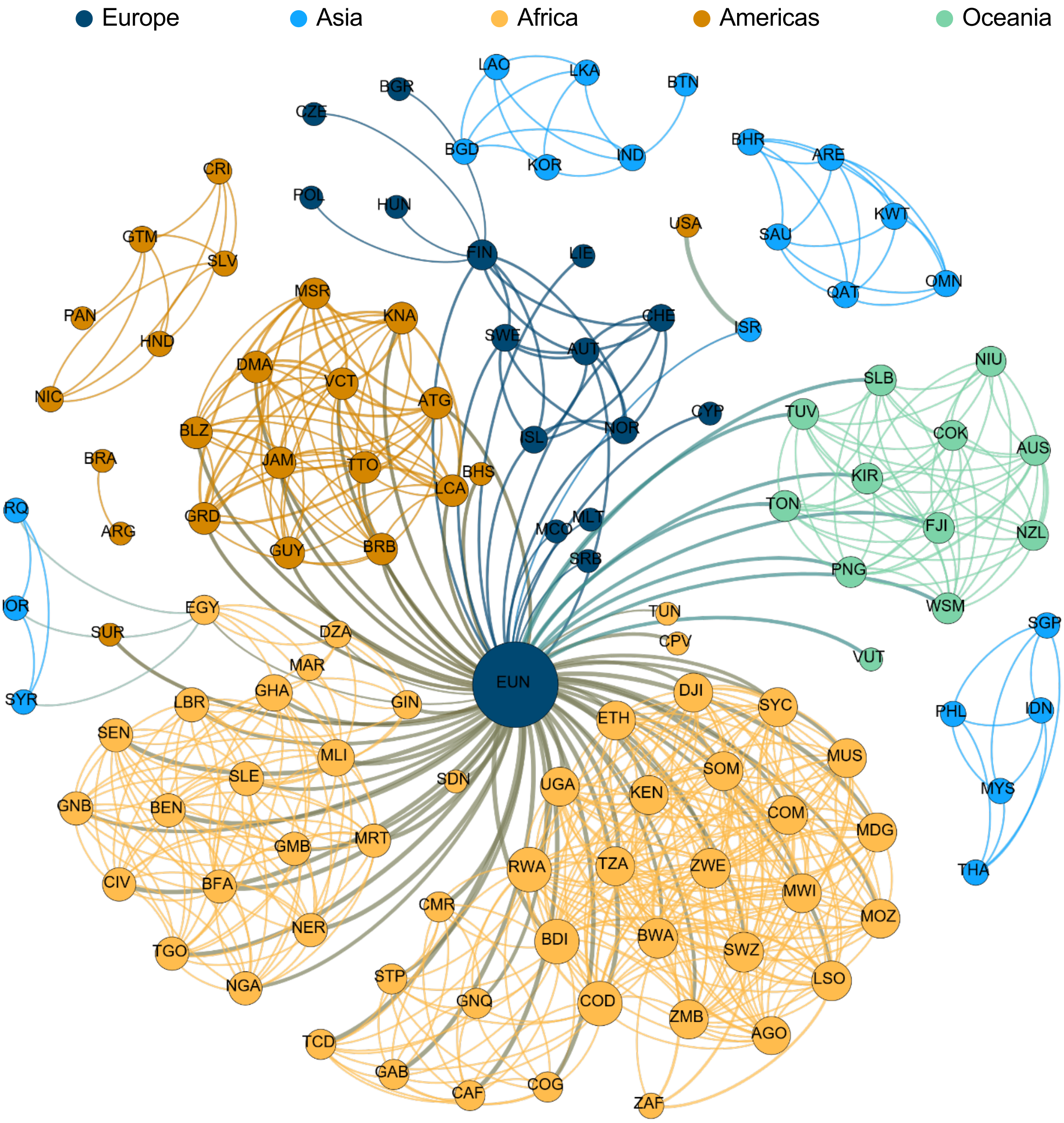
Singapore (in force since 21 November 2019) and Vietnam (signed on 30 June 2019), are going to alter the picture further in the direction of the greater centrality of Asia.

**Figure 5 / Free trade network in 1977**




Notes: FTAs in force. Country labels correspond to ISO 3166-1 alpha-3 country codes, except for the European Union (EUN). Thickness of connections is relative to the depth of the agreement. Node size corresponds to its degree centrality. Only agreements with a depth greater than 0 are displayed. wiiw calculations and visualisation, created with Gephi (Bastian et al., 2009), applying the Fruchterman and Reingold (1991) algorithm.
Data source: Dür et al. (2014), DESTA update 2019.

**Figure 6 / Free trade network in 1987**

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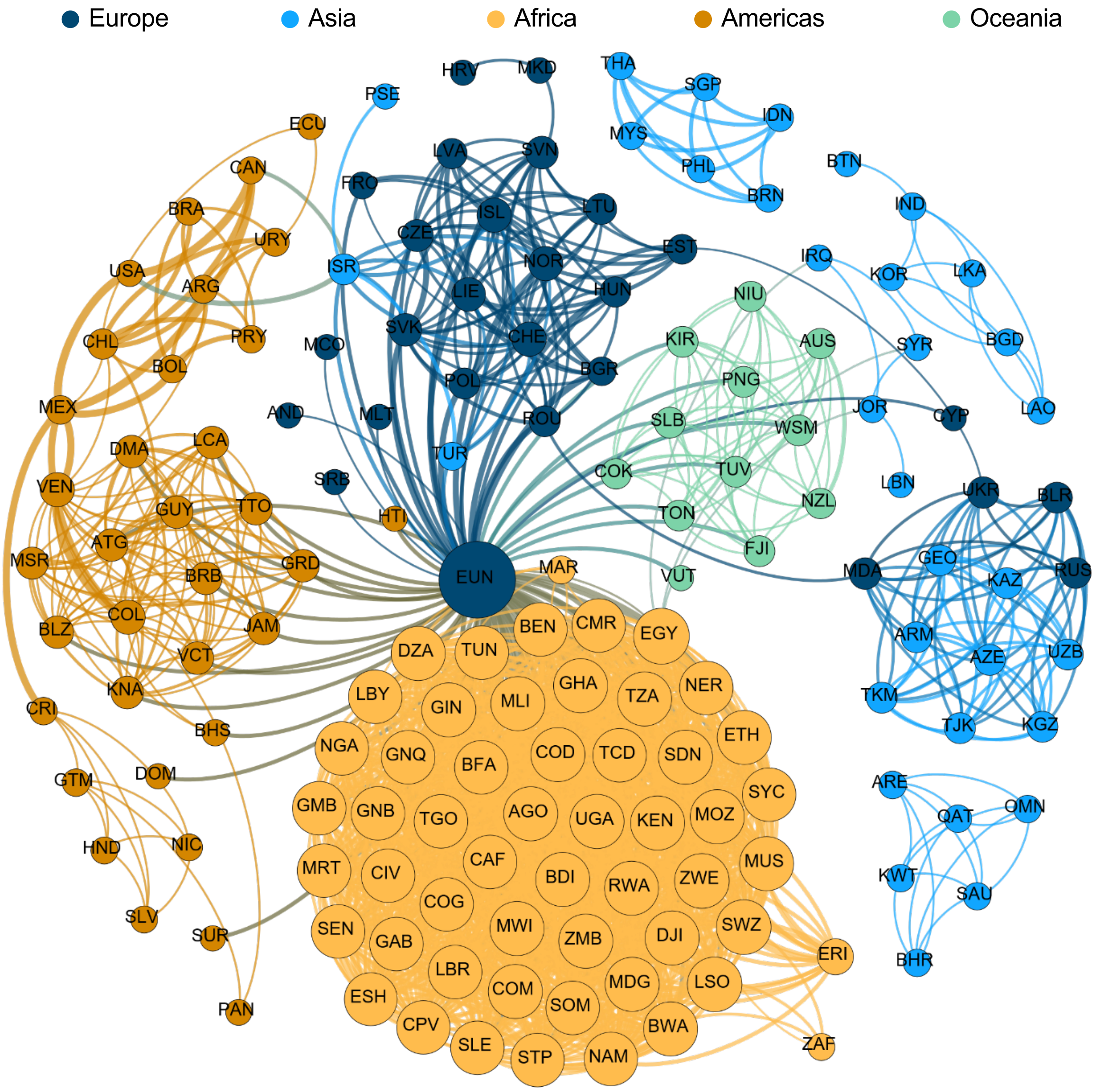
Data source: Dür et al. (2014), DESTA update 2019.

**Figure 7 / Free trade network in 1997**

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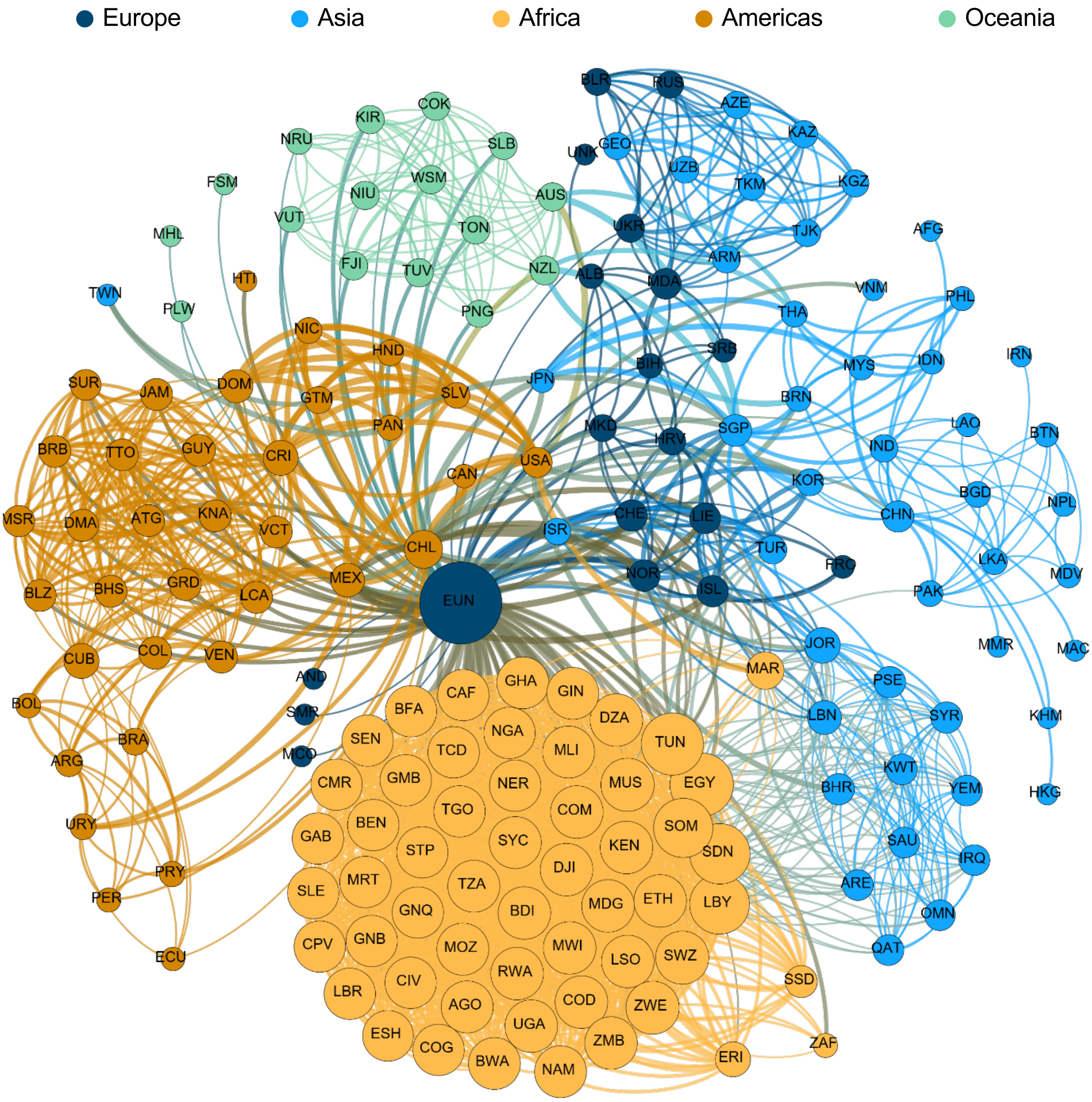
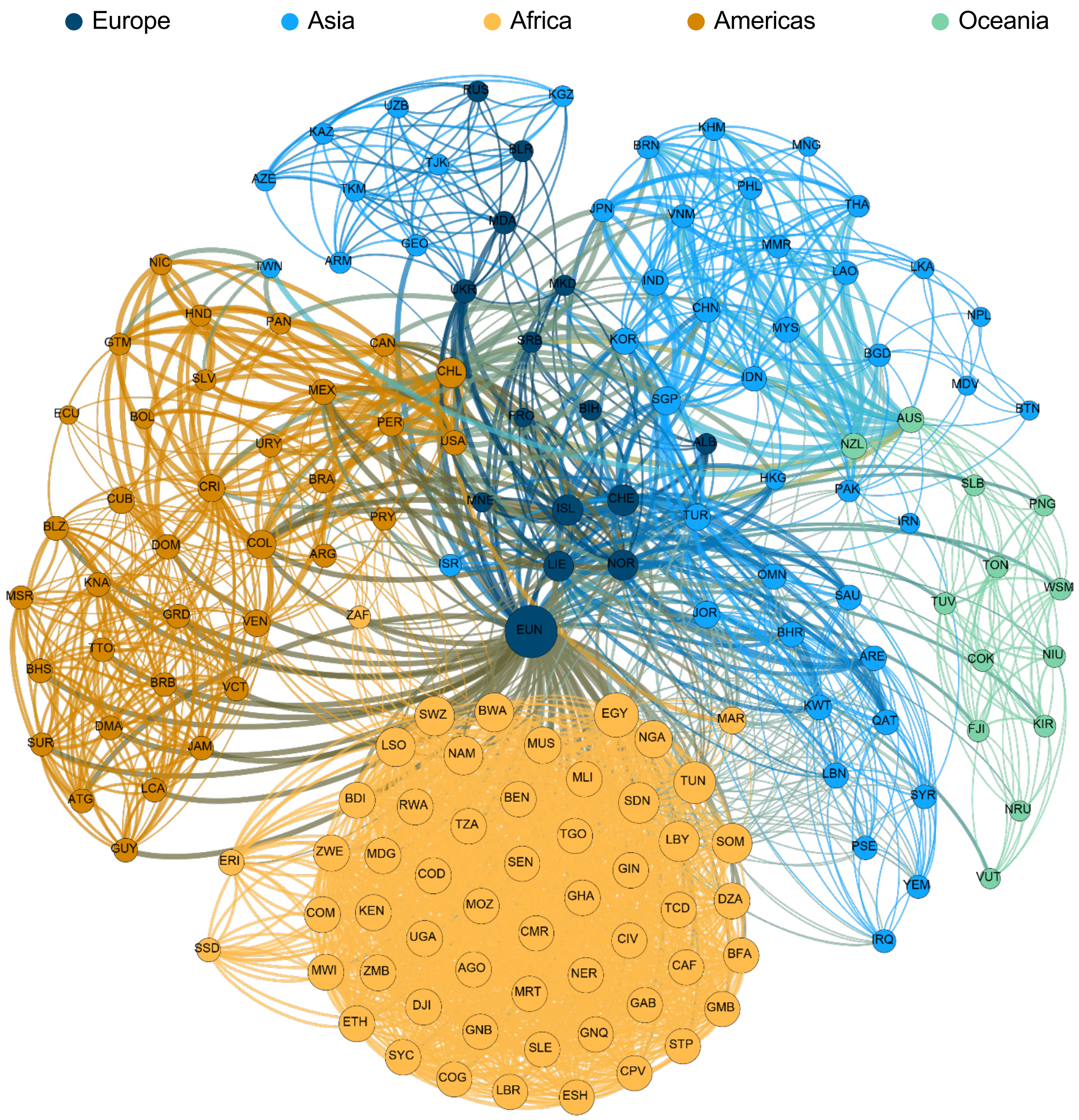
Data source: Dür et al. (2014), DESTA update 2019.

**Figure 8 / Free trade network in 2007**




Notes: FTAs in force. Country labels correspond to ISO 3166-1 alpha-3 country codes, except for the European Union (EUN). Thickness of connections is relative to the depth of the agreement. Node size corresponds to its degree centrality. Only agreements with a depth greater than 0 are displayed. wiiw calculations and visualisation, created with Gephi (Bastian et al., 2009), applying the Fruchterman and Reingold (1991) algorithm.
Data source: Dür et al. (2014), DESTA update 2019.

**Figure 9 / Free trade network in 2017**




Notes: FTAs in force. Country labels correspond to ISO 3166-1 alpha-3 country codes, except for the European Union (EUN). Thickness of connections is relative to the depth of the agreement. Node size corresponds to its degree centrality. Only agreements with a depth greater than 0 are displayed. wiiw calculations and visualisation, created with Gephi (Bastian et al., 2009), applying the Fruchterman and Reingold (1991) algorithm.
Data source: Dür et al. (2014), DESTA update 2019.

## 2.4. CENTRALITY: COUNTRIES' POSITIONS IN FTA NETWORKS

A key variable of the underlying study is the centrality measure of a country within a free trade network. We initially consider four different centrality indicators: (1) degree, (2) eigenvector, (3) closeness and (4) betweenness centrality. These indicators of centrality capture different aspects of the position of a node (such as Austria) on a graph, and can thus yield different results.

Since the trade policy of EU member states is carried on at the European Union level, all countries that were EU member states in a given year have the same centrality within the global network of free trade agreements. As such, the following statements about the centrality of Austria hold true for all remaining EU members.

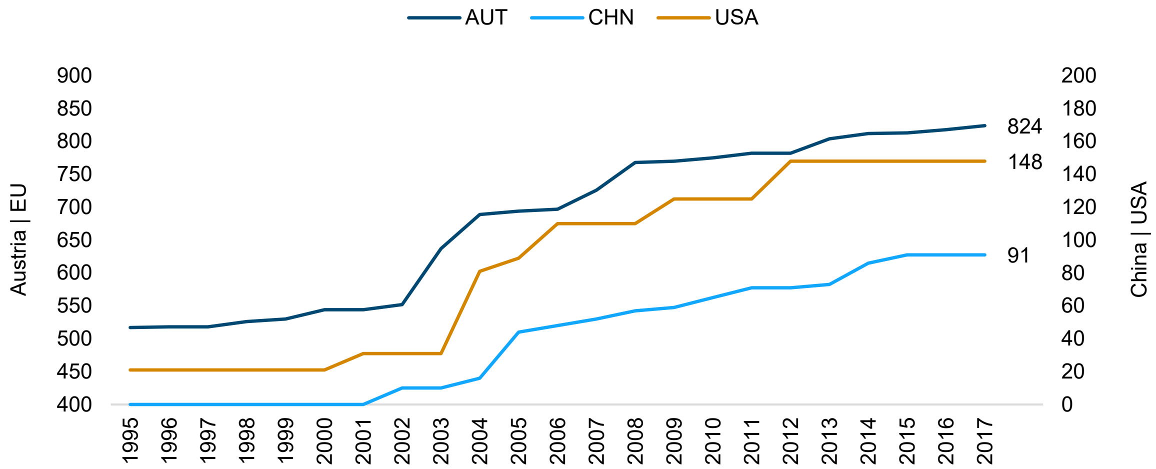
All four measures are computed first without any weights, treating all FTAs in a network alike. In a second specification, centrality measures are derived by using weights based on the additive depth index available in the DESTA database described above. However, we assign a value of 0 to country pairs without any FTA in place and add 1 to every index, so that a value of 1 represents a shallow agreement and a value of 8 corresponds to the deepest type of trade agreement. The resulting centrality measures were standardised one by one over all countries and years, so that they have a mean value of 0 and a standard deviation of 1.

**Degree centrality** is conceptually the simplest (and oldest) centrality measure. It describes the number of links that a node has. These direct ties, in our case, describe the number of FTAs a country (vertex $i$) has in place at a certain point in time.

$$C_D(i) = \sum_{i \neq j} \omega_{ij} \tag{1}$$

where $\omega_{ij}$ is the weight of the agreement corresponding to the DESTA depth index, or equal to 1 in the unweighted case. The development of the degree centrality over time for Austria, China and the United States is plotted in Figure 10. The degree centrality for Austria is more than five times that of the US and nine times that of China. This picture is mainly driven by the evolution of the single market, and therefore by the eastern enlargements of 2004, 2007 and 2013.

**Figure 10 / Degree centrality**




Notes: The minimum value is 0; the maximum value is equal to the number of potential trading partners (i.e. countries in the world -1) multiplied by 8 (i.e. the deepest possible type of agreement). Year of entry into force; depth-weighted. China and the USA on the right axis. wiiw calculations.
Data source: Dür et al. (2014), DESTA update 2019.

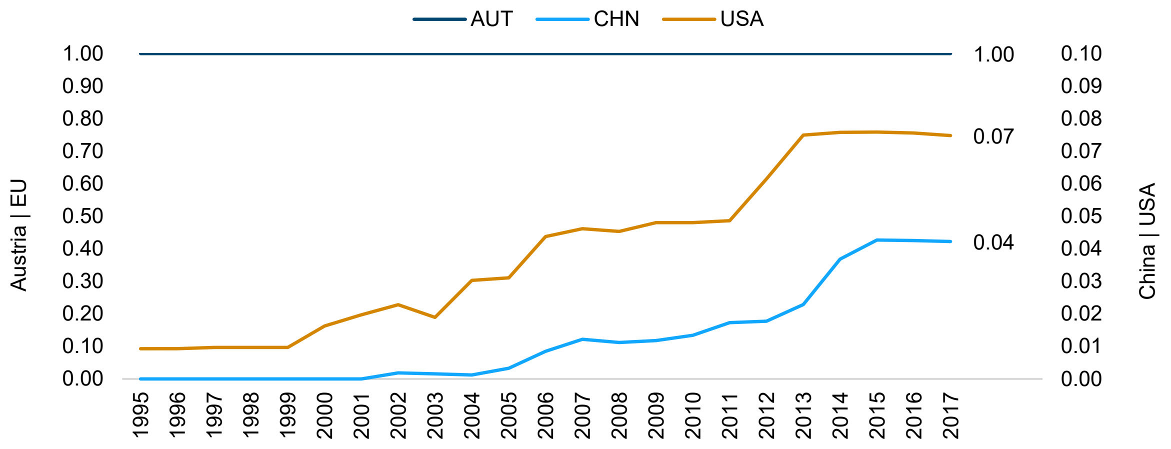
Degree centrality and **eigenvector centrality**[24] are concepts that measure connections (so-called walks) that start or end at a given vertex. However, while degree centrality looks at paths of length 1 (i.e. only direct FTA links), the eigenvector centrality measure considers paths of all lengths. It allows an explicit distinction to be drawn between more or less important trading partners. A node is more important if it is linked to other important nodes. In this regard, a country might exhibit a low eigenvector centrality, even though it has many FTAs in place, if its FTA partners are less important in the network. Likewise, a node might be well positioned according to the eigenvector centrality measure, even though it has only a few links to important players.

For the eigenvector centrality, we define an adjacency matrix $\mathrm{A} = (\omega_{ij})$, where the element $\omega_{\mathrm{ij}}$ is the edge from vertex $i$ to vertex $j$: if the edge (i.e. an FTA) exists, $\omega_{ij}$ is assigned the weight of the edge (or $\omega_{ij} = 1$ if no weights are implemented) and $0$ otherwise.

$$C_E(v) = \frac{1}{\lambda}\sum_{i \neq j} \omega_{ij} C_E(j) \tag{2}$$

The eigenvalue problem can be solved for matrix A: $\boldsymbol{Ac} = \lambda \boldsymbol{c}$, which gives the eigenvector centralities of the vertices. We can see that Austria (together with other European Union member states) attains the maximum eigenvector centrality of 1 over the whole period, while China and the USA exhibit very low centralities. These are increasing, but are barely visible in comparison to the EU. By 2017, the eigenvector centrality of EU members was 14 and 25 times greater than the centrality measures of the US and China, respectively (Figure 11). Given that the EU is the major hub with respect to global free trade agreements, the conclusion of an agreement with the EU does not affect the EU's eigenvector centrality, but strongly boosts the centrality of its trading partners. However, currently neither the US nor China is negotiating an FTA with the EU.[25]

**Figure 11 / Eigenvector centrality**




Notes: The values range between 0 and 1. Year of entry into force; depth-weighted. China and the USA on the right axis. wiiw calculations.
Data source: Dür et al. (2014), DESTA update 2019.

[24] The PageRank centrality used by Google to rank search-engine results builds on the eigenvector centrality algorithm.

[25] China and the EU aim to conclude a stand-alone investment agreement in 2020: http://www.europarl.europa.eu/legislative-train/theme-a-balanced-and-progressive-trade-policy-to-harness-globalisation/file-eu-china-investment-agreement

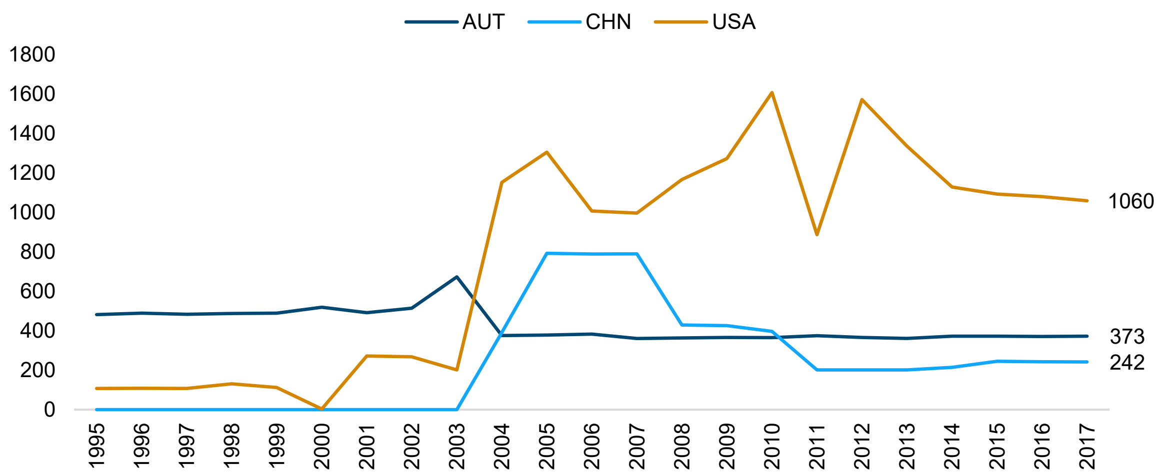
Degree and eigenvalue centrality are volume-focused radial concepts: the former means in our context that they look at the number of FTAs, while the latter means that countries are analysed from the perspective of a starting or an end point. The following two centrality measures differ in one dimension each: betweenness centrality takes a medial (rather than a radial) view, looking at how often a node is passed through, and not at how many edges start from the node. Closeness centrality, by contrast, is a radial measure, focusing not on the number, but on the distance of FTAs. These two measures require the computation of all shortest paths $\rho$ between all country pairs. As such, they depend both on a node's direct connections and on the connections that other nodes have.

**Betweenness centrality** focuses on vertices not as starting or end points, but rather as connecting nodes. It is calculated as the share of shortest paths $\rho$ between two vertices $j$ and $k$ that pass through the given vertex $i$. The concept of trade flows following FTA paths is interesting in the context of global value chains, as well as with respect to the discussion of rules of origin.

$$C_B(i) = \sum_{i \neq j \neq k} \frac{\rho_{jk}(i)}{\rho_{jk}} \tag{3}$$

Consider, for example, Uruguay in 1997. In the unweighted case, the shortest paths of FTAs between this Latin American country and the United States ran through either Argentina–Chile–Mexico or Ecuador–Chile–Mexico. For the country pair Uruguay–US, the betweenness centrality of Argentina and Ecuador was 0.5, whereas it was 1 for Chile and Mexico, as those two countries had to be crossed in any case. Repeating the procedure over the whole of Latin America, however, shows that the centrality of Argentina was much bigger than the centrality of Ecuador, as the former had FTA ties with Brazil and Paraguay, which Ecuador did not have. In the weighted case, we reverse the scoring of our depth measure, so that the deepest kind of agreement is associated with the smallest trade cost (i.e. $8 - depth_{ij}$), which is assigned to every edge before the shortest path is evaluated.

**Figure 12 / Betweenness centrality**




Notes: The minimum value is 0; the maximum value would be attained if every country in the world (n) had to pass through one specific node i in order to connect to other countries, i.e. n ·(n-1)/2 in the unweighted case. Assuming 195 countries in the world, the maximum value hence would be 18,915. Year of entry into force; depth-weighted. wiiw calculations.
Data source: Dür et al. (2014), DESTA update 2019.

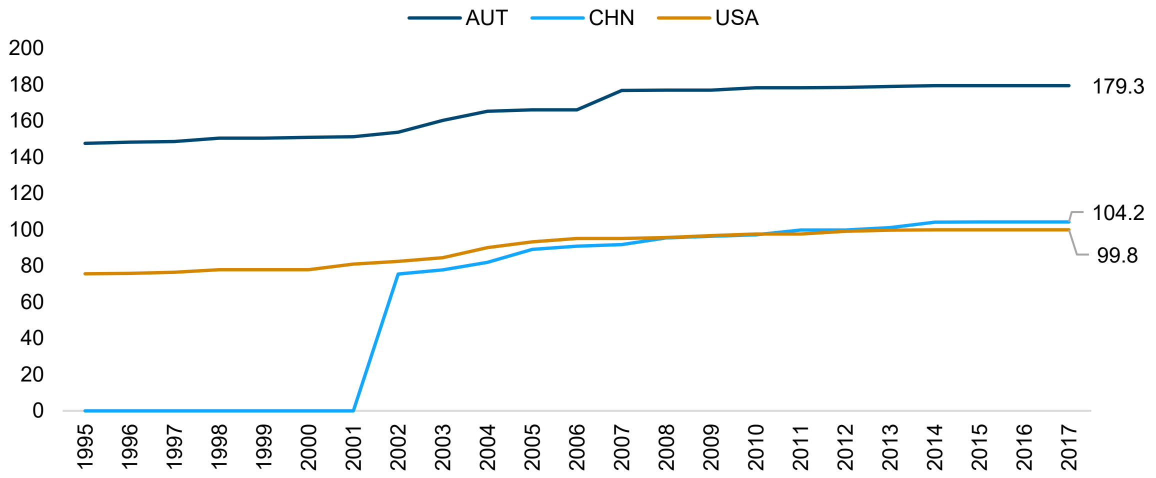
The betweenness centrality of the United States is exceptionally high, despite not having many direct FTAs in place (Figure 12). The few that it has had, however, have taken the form of important bridges between trading blocs in the network. On the one hand, since 1994 there has been the trilateral NAFTA between the US, Canada and Mexico (which recently became the United States–Mexico–Canada Agreement (USMCA)).[26] This constituted an indirect FTA link with Central and South America via Mexico. On the other hand, the USA had an agreement with Israel, which itself was well connected with European economies. Therefore, the betweenness centrality of the United States was boosted by the absence of direct transatlantic FTA connections between the EU and Latin America, as well as by the US FTA with Chile, established in 2004. The visible increase in the betweenness centrality of China is primarily driven by its FTAs with the members of ASEAN.

**Closeness centrality** is calculated as the inverse of the length of the shortest path of a vertex to all other vertices on the graph. A vertex that is well connected and that can reach all vertices in only a few steps will have a high closeness centrality. As not all components of our global FTA network were well connected over time, we apply the harmonic version, taking the following form:

$$C_C(i) = \sum_{i \neq j} \frac{1}{d(i,j)} \tag{4}$$

where $1/d(i,j)$ is set to 0, if there is no path between the two vertices. The time when China surpassed the United States in terms of closeness centrality coincides with the global economic and financial crisis (Figure 13).

**Figure 13 / Harmonic closeness centrality**




Notes: The minimum value is 0; the maximum value would be attained if all countries were directly connected to each other with a distance of 1. Assuming 195 countries in the world, the maximum value would be 194. Year of entry into force; unweighted. wiiw calculations.
Data source: Dür et al. (2014), DESTA update 2019.

26 See, for example, information provided by the Government of Canada: https://www.international.gc.ca/trade-commerce/trade-agreements-accords-commerciaux/agr-acc/cusma-aceum/index.aspx?lang=eng

As a variant of classical centrality measures of network theory, we compute an indirect FTA variable, which is conceptually related to closeness and betweenness. It counts the shortest paths $\rho$ between two trading partners *other* than the direct link. Taking Austria and Canada as an example, it captures the shortest path between them when ignoring the Comprehensive Economic and Trade Agreement (CETA) – e.g. running through their agreements with the EFTA economies.

$$FTA^{I}_{ij} = \sum_{i \neq j \neq k} \frac{\rho_{ij}(k)}{\rho_{ij}} \tag{5}$$

A major difference between the indirect FTA variable and previously introduced centrality measures is that it is not a country characteristic, but describes the relation between a country pair. It is higher the more of the shortest paths there are between two country nodes and the shorter those connecting paths are.

# 3. The gravitational force of trade agreements

The (structural) gravity model is today's workhorse for research investigations in international trade.[27] Economists make use of the model to analyse the impact of FTAs and specific trade policy measures on trade flows and subsequently on macroeconomic indicators. such as gross domestic product (GDP).

The application of the gravity model to international trade flows was first proposed by Tinbergen (1962), and was embedded in a trade theoretical framework by Anderson (1979), Eaton and Kortum (2002), Anderson and van Wincoop (2003) and Baldwin and Taglioni (2006, 2007). Furthermore, Anderson et al. (2015) proposed a method for estimating general equilibrium effects building on the structural gravity model that can be used to simulate the effect of trade policy changes (such as tariff reductions or the establishment of an FTA) on welfare, prices and employment.[28]

This section sets out by estimating a gravity model, incorporating previously introduced variables that capture the existence and depth of FTAs, as well as countries' centrality in the FTA network. We derive implications for welfare and employment, following Anderson et al. (2015) and Heid and Larch (2014), respectively.

We perform the estimation for the 1995-2017 trade data provided by UN Comtrade[29]. A theory-consistent estimation requires the inclusion of intra-national trade flows – i.e. products produced and consumed in the same country without crossing the border. As these are not directly reported, they are computed by subtracting the sum of exports from countries' gross output, retrievable from national accounts.[30] As many countries did not trade with each other over the full period, our panel dataset contains a large proportion of zero trade flows, which are typically dealt with by applying Poisson Pseudo-Maximum Likelihood (PPML) estimators.[31] For large datasets, PPML estimation is computationally very intensive, particularly if we include various types of fixed effects to account for unobservables. Fortunately, there have recently been advances in algorithmic procedures that are able to perform the estimation more efficiently.[32]

The first specification of the gravity model to estimate the effect of FTA networks takes the following form:

Specification 1

$$y_{ijt} = \beta_1 FTA^E_{ijt} + \beta_2 FTA^D_{ijt} + \beta_3 FTA^I_{ijt} + \beta_4 C_{it} + \beta_5 C_{jt} + \beta_6 \tau_{ijt} + \beta_7 \mathbf{X}_t + \beta_8 \pi_{ij} \quad (6)$$

[27] For an overview, see e.g. Head (2014) and Yotov et al. (2016).

[28] This framework is applied e.g. in Reiter and Stehrer (2018), who estimate the welfare effects of the Stabilisation and Association Agreement between Serbia and the EU.

[29] The UN Comtrade database can be found at: https://comtrade.un.org/

[30] The UN collects this data and makes it available at: http://data.un.org/Default.aspx

[31] See Silva and Tenreyro (2006; 2011) for a collection of arguments in favour of PPML. Yotov et al. (2016) also recommend using PPML for estimating gravity equations.

[32] See Stammann (2017), Hinz et al. (2019).

where $y_{ijt}$ are bilateral imports of importer *j* from exporter *i* at time *t*. $FTA^{E}_{ijt}$ is a dummy variable indicating the *existence* of an FTA between countries *i* and *j* at time *t*, while $FTA^{D}_{ijt}$ accounts for the *depth* of the respective FTA. $FTA^{I}_{ijt}$ captures indirect effects through the expansion of the global FTA network. $C_{it}$ and $C_{jt}$ constitute the countries' respective depth-weighted (Degree/Eigenvector/Betweenness/Closeness) centrality measures.

$\tau_{ijt}$ contains effectively applied tariffs.[33] Since we explicitly include import tariffs, the FTA variables capture all trade effects that an FTA may bring beyond current tariff reductions, including the channels of, for example, regulatory convergence, mutual recognition or harmonisation of standards.

$\pi_{ij}$ is a bilateral dummy variable controlling for all time-invariant bilateral characteristics, such as common language or historical ties. As the centrality measures are country specific, it is not possible to include country-time fixed effects to control for multilateral resistances (Anderson and van Wincoop, 2003). In such cases, it is common practice to include country-specific time-varying variables; in our case $\mathbf{X}_t$ covers the trading partners' GDP to approximate for their market size.

First regression results are presented in Table 1. In all columns, we include bilateral tariffs. Even when controlling for developments in tariffs, the FTA dummy variable remains positive, but is only significantly different from 0 in two columns. Considering the first specification, which shows a significantly positive coefficient for the FTA dummy (column 4), it would suggest that an additional FTA increases trade on average by 5.13% $[(exp^{0.05} - 1) \cdot 100]$. The importance of the depth of an FTA appears ambiguous, while the indirect bilateral FTA effect shows a positive sign, even when we control for the trading partners' centrality.

## Table 1 / Regression results: the traditional approach

| | | (1)<br>Base | (2)<br>Depth | (3)<br>Indirect FTA | (4)<br>Degree | (5)<br>Eigenvector | (6)<br>Betweenness | (7)<br>Closeness |
|---|---|---|---|---|---|---|---|---|
| Tariffs | $\tau_{ijt}$ | -0.05 | -0.05 | -0.05 | -0.05 | -0.04 | -0.05 | -0.05 |
| | | (0.00)*** | (0.00)*** | (0.00)*** | (0.00)*** | (0.00)*** | (0.00)*** | (0.00)*** |
| FTA Dummy | $FTA^{E}_{ijt}$ | 0.04 | 0.01 | 0.04 | 0.05 | 0.08 | -0.01 | 0.01 |
| | | (0.02) | (0.02) | (0.02) | (0.02)** | (0.02)*** | (0.02) | (0.02) |
| FTA Depth | $FTA^{D}_{ijt}$ | | 0.01 | -0.00 | -0.01 | -0.02 | 0.02 | 0.00 |
| | | | (0.00) | (0.00) | (0.00) | (0.00)*** | (0.00)*** | (0.00) |
| FTA Indirect | $FTA^{I}_{ijt}$ | | | 0.07 | 0.08 | 0.08 | 0.00 | 0.07 |
| | | | | (0.02)*** | (0.02)*** | (0.02)*** | (0.02) | (0.02)*** |
| Centrality (Importer) | | | | | 0.05 | 0.07 | -0.01 | 0.09 |
| | | | | | (0.01)*** | (0.01)*** | (0.00)** | (0.03)*** |
| Centrality (Exporter) | | | | | 0.01 | 0.09 | -0.04 | 0.08 |
| | | | | | (0.01) | (0.01)*** | (0.00)*** | (0.03)** |
| Deviance | | 127,837 | 127,823 | 127,732 | 127,615 | 127,297 | 126,416 | 127,204 |
| Observations | | 632,943 | 632,943 | 632,943 | 632,943 | 632,943 | 632,943 | 632,943 |
| Intra-national flows | | No | No | No | No | No | No | No |
| Country pair FE | | 31,665 | 31,665 | 31,665 | 31,665 | 31,665 | 31,665 | 31,665 |
| Year FE | | 23 | 23 | 23 | 23 | 23 | 23 | 23 |

*** p < 0.001, **p < 0.01, *p < 0.05
Note: PPML estimation. Coefficients of exporter and importer GDP are positive and throughout highly significant.

33 Only where effectively applied tariffs were not available did we refer to most-favoured nation tariffs. We use simple average bilateral tariffs to avoid an endogeneity bias resulting from trade-weighted tariffs.

**Table 2 / Regression results: accounting for intra-national trade**

| Dependent variable: Imports | | (1) Base | (2) Depth | (3) Indirect FTA | (4) Degree | (5) Eigenvector | (6) Betweenness | (7) Closeness |
|---|---|---|---|---|---|---|---|---|
| Tariffs | $\tau_{ijt}$ | -0.13 | -0.12 | -0.11 | -0.30 | -0.28 | -0.09 | -0.60 |
| | | (0.05)** | (0.04)** | (0.04)** | (0.08)*** | (0.04)*** | (0.04)* | (0.12)*** |
| FTA Dummy | $FTA^{E}_{ijt}$ | 0.22 | -0.22 | 0.08 | 0.30 | -2.29 | -0.70 | 2.67 |
| | | (0.19) | (0.16) | (0.23) | (0.26) | (0.36)*** | (0.31)* | (0.74)*** |
| FTA Depth | $FTA^{D}_{ijt}$ | | 0.10 | 0.01 | 0.01 | 0.78 | 0.38 | -0.15 |
| | | | (0.04)* | (0.03) | (0.05) | (0.12)*** | (0.12)*** | (0.06)* |
| FTA Indirect | $FTA^{I}_{ijt}$ | | | 0.89 | 12.13 | 3.63 | 0.17 | 0.64 |
| | | | | (0.63) | (4.29)** | (0.57)*** | (0.47) | (0.24)** |
| Centrality (Importer) | | | | | -2.63 | -5.29 | -0.56 | -5.50 |
| | | | | | (0.98)** | (0.85)*** | (0.23)* | (0.99)*** |
| Centrality (Exporter) | | | | | -4.43 | -5.27 | -0.63 | -4.25 |
| | | | | | (1.71)** | (0.93)*** | (0.23)** | (0.81)*** |
| Deviance | | 1,046,654 | 1,046,616 | 1,046,415 | 795,813 | 550,179 | 871,273 | 448,118 |
| Observations | | 635,628 | 635,628 | 635,628 | 635,628 | 635,628 | 635,628 | 635,628 |
| Intra-national flows | | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country pair FE | | 31,814 | 31,814 | 31,814 | 31,814 | 31,814 | 31,814 | 31,814 |
| Year FE | | 23 | 23 | 23 | 23 | 23 | 23 | 23 |

*** p < 0.001, **p < 0.01, *p < 0.05
Note: PPML estimation. Coefficients of exporter and importer GDP are positive and mostly significant.

As trade agreements (or trade policy in general) might divert trade from domestic production to international sales, theory-consistent trade analyses include intra-national trade flows, e.g. products produced and consumed in Austria. The inclusion results in higher coefficients on trade policy variables (Table 2). However, the sign of the coefficient representing the effect of a bilateral FTA becomes unstable, and centrality measures for both the exporter and the importer turn negative. The indirect FTA variable is the only one persistently suggesting significantly positive effects.

Though following frequently used estimation procedures, these results might still be biased, as we do not fully account for multilateral resistances (Anderson and van Wincoop, 2003). Multilateral resistance means that trade flows between two trading partners are also dependent on how trade with, and trade policy towards, other economies evolve. We therefore set up a second specification, in which we include the full set of fixed effects (exporter-time $\chi_{it}$, importer-time $\phi_{jt}$ and bilateral pair fixed effects $\pi_{ij}$) to control for multilateral resistances, following Yotov et al. (2016). In order to avoid our fixed effects absorbing our country-specific centrality measures, we interact them with our FTA variables that capture the direct $(FTA^{E}_{ijt})$ and indirect $(FTA^{I}_{ijt})$ links between country pairs.

Specification 2

$$y_{ijt} = \beta_1 FTA^{E}_{ijt} + \beta_2 FTA^{D}_{ijt} + \beta_3 FTA^{I}_{ijt} + \beta_4 \left(C_{it} \cdot FTA^{E}_{ijt}\right) + \beta_5 \left(C_{jt} \cdot FTA^{E}_{ijt}\right) + \beta_4 \left(C_{it} \cdot FTA^{I}_{ijt}\right) + \beta_5 \left(C_{jt} \cdot FTA^{I}_{ijt}\right) + \beta_6 \tau_{ijt} + \beta_7 \chi_{it} + \beta_8 \phi_{jt} + \beta_8 \pi_{ij} \quad (7)$$

The results shown in Table 3 again confirm the negative effect of tariffs on trade and the positive effect of FTA links. However, the effect of the bilateral FTA links is on average reduced by the depth of agreements. Some statistics suggest that the increased complexity of agreements reduces the uptake of preferences granted.[34] Yet, referring to our network graph for the year 2017 (Figure 9), we rather suggest that the results on the global sample are influenced by Africa, for which our FTA variables indicate a strong interconnectedness, while its trade performance remains weak. For example, Sub-Saharan Africa, North Africa and the Middle East combined accounted for 7% of global exports in 2017, as opposed to 41% originating from Europe and Central Asia (primarily attributable to the EU), 34% from East Asia and 10% from North America. On the import side, 8% of global exports were destined for Sub-Saharan Africa, North Africa and the Middle East, while Europe, East Asia and North America were the destination markets for 38%, 28% and 16% of global trade flows, respectively.

The coefficient on the indirect FTA variable remains positive, as do the degree, eigenvector and closeness centrality measures for exporters. The results for importers are more mixed: the centrality of an importer shows a positive (albeit insignificant) effect on trade with trading partners with whom FTAs have been established. However, we find a negative coefficient on the importer's centrality for trade partners within overlapping FTA networks.

**Table 3 / Regression results: structural gravity estimation**

| | (1) Base | (2) Depth | (3) Indirect FTA | (4) Degree | (5) Eigenvector | (6) Betweenness | (7) Closeness |
|---|---|---|---|---|---|---|---|
| Tariffs $\tau_{ijt}$ | -0.05<br>(0.00)*** | -0.05<br>(0.00)*** | -0.04<br>(0.00)*** | -0.04<br>(0.00)*** | -0.04<br>(0.00)*** | -0.04<br>(0.00)*** | -0.04<br>(0.00)*** |
| FTA Dummy $FTA^E_{ijt}$ | 0.02<br>(0.02) | 0.01<br>(0.04) | 0.10<br>(0.04)* | 0.14<br>(0.04)*** | 0.17<br>(0.04)*** | 0.13<br>(0.04)** | 0.04<br>(0.05) |
| FTA Depth $FTA^D_{ijt}$ | | 0.00<br>(0.00) | -0.02<br>(0.01)*** | -0.03<br>(0.00)*** | -0.03<br>(0.00)*** | -0.01<br>(0.01)** | -0.02<br>(0.00)*** |
| FTA Indirect $FTA^I_{ijt}$ | | | 0.24<br>(0.01)*** | 0.16<br>(0.05)*** | 0.14<br>(0.05)** | 0.25<br>(0.02)*** | 0.15<br>(0.07)* |
| $FTA^E$ · Centrality (Exporter) | | | | 0.03<br>(0.02) | 0.06<br>(0.02)*** | -0.01<br>(0.00)** | 0.13<br>(0.03)*** |
| $FTA^E$ · Centrality (Importer) | | | | 0.01<br>(0.02) | 0.01<br>(0.02) | -0.01<br>(0.00) | 0.16<br>(0.04)*** |
| $FTA^I$ ·Centrality (Exporter) | | | | 0.10<br>(0.02)*** | 0.11<br>(0.03)*** | -0.03<br>(0.00)*** | 0.23<br>(0.05)*** |
| $FTA^I$ ·Centrality (Importer) | | | | -0.05<br>(0.03) | -0.04<br>(0.03) | -0.01<br>(0.00) | -0.18<br>(0.07)** |
| Deviance | 1,084 | 1,084 | 1,072 | 1,070 | 1,069 | 1,069 | 1,068 |
| Observations | 672,831 | 672,831 | 672,831 | 672,831 | 672,831 | 672,831 | 672,831 |
| Exporter-time FE | 5,246 | 5,246 | 5,246 | 5,246 | 5,246 | 5,246 | 5,246 |
| Importer-time FE | 3,498 | 3,498 | 3,498 | 3,498 | 3,498 | 3,498 | 3,498 |
| Country pair FE | 36,785 | 36,785 | 36,785 | 36,785 | 36,785 | 36,785 | 36,785 |

*** p < 0.001, **p < 0.01, *p < 0.05
Note: PPML estimation.

34 See e.g. the Annual Report on the implementation of the EU-Korea Free Trade Agreement by the European Commission (2016), showing that the preference take-up rate of EU member states varied between 6% and 91% during the first four years of the agreement's implementation.

# 4. Counterfactual analysis

The structural gravity model allows us to perform counterfactual analysis using various scenarios. In this section, we focus on two agreements: (1) the EU-Japan Economic Partnership Agreement (EPA) and (2) the EU-Mercosur Trade Agreement.

The EU-Japan EPA, which entered into force a year ago, in February 2019, is considered the most ambitious trade agreement with any Asian economy. Though not yet coded within DESTA, we assume that it would receive the highest score (comparable to CETA, i.e. 7 on the DESTA scale). In Table 4 we summarise implied changes in the centrality of Austria,[35] the USA, China and Japan resulting from the agreement coming into force. It shows that the position of EU member states is improving slightly, while Japan is the big winner in this picture. This is due to the fact that by 2017, Japan did not have many trade agreements in place, and by concluding an agreement with the EU it established a link to the biggest hub in the FTA network. China and the USA, by contrast, show a significantly declining score on their betweenness centrality, i.e. their function as hubs in the network.

**Table 4 / Counterfactual analysis: EU-Japan EPA**

| EU-JP EPA entering into force | | $C_D(i)$ Degree | $C_E(i)$ Eigenvector | $C_B(i)$ Betweenness | $C_C(i)$ Closeness |
|---|---|---|---|---|---|
| AUT | Pre-EU-JP | 824 | 1.00 | 373 | 179 |
| | Post-EU-JP | 832 | 1.00 | 378 | 180 |
| | Δ | **1.0%** | **0.0%** | **1.4%** | **0.3%** |
| USA | Pre-EU-JP | 148 | 0.07 | 1,060 | 100 |
| | Post-EU-JP | 148 | 0.07 | 835 | 100 |
| | Δ | **0.0%** | **-0.2%** | **-21.2%** | **0.0%** |
| CHN | Pre-EU-JP | 91 | 0.04 | 242 | 104 |
| | Post-EU-JP | 91 | 0.04 | 206 | 104 |
| | Δ | **0.0%** | **0.6%** | **-15.0%** | **0.0%** |
| JPN | Pre-EU-JP | 100 | 0.04 | 921 | 99 |
| | Post-EU-JP | 324 | 0.51 | 2,023 | 120 |
| | Δ | **224.0%** | **1,100.2%** | **119.6%** | **21.7%** |

In addition, we perform the thought experiment of how the EU-Japan EPA would have affected each trading partner's centrality in the global network, had the EU agreement with South Korea not been in place. The reason for this comparison is the argument that trade links with South Korea might be substitutes for connections with Japan. The two countries' geographical proximity, comparable level of development and focus on industrial goods might well have diverted trade from Japan towards South Korea when its agreement with the EU started to apply in 2011 (and entered into force in 2015).

Today, the US and Japan would enjoy a higher betweenness centrality if the EU agreement with South Korea had not been put in place. However, it would be lower for the EU and China.

[35] All European member countries have the same centrality values. Thus, Austria can be replaced with any other EU member country.

**Table 5 / Counterfactual analysis: EU-Japan EPA – omitting the South Korea FTA**

| EU-JPN EPA in absence of the EU-KOR FTA | | $C_D(i)$ Degree | $C_E(i)$ Eigenvector | $C_B(i)$ Betweenness | $C_C(i)$ Closeness |
|---|---|---|---|---|---|
| AUT | Pre-EU-JP | 817 | 1.00 | 367 | 179 |
| | Post-EU-JP | 825 | 1.00 | 375 | 179 |
| | Δ | **1.0%** | **0.0%** | **2.3%** | **0.3%** |
| USA | Pre-EU-JP | 148 | 0.07 | 1,213 | 100 |
| | Post-EU-JP | 148 | 0.07 | 906 | 100 |
| | Δ | **0.0%** | **-0.1%** | **-25.3%** | **0.0%** |
| CHN | Pre-EU-JP | 91 | 0.04 | 214 | 104 |
| | Post-EU-JP | 91 | 0.04 | 206 | 104 |
| | Δ | **0.0%** | **0.9%** | **-3.5%** | **0.0%** |
| JPN | Pre-EU-JP | 100 | 0.04 | 1,201 | 99 |
| | Post-EU-JP | 324 | 0.51 | 2,502 | 120 |
| | Δ | **224.0%** | **1,117.0%** | **108.4%** | **21.7%** |

A third and final consideration is the EU's envisioned trade agreement with Mercosur, the Southern Common Market (Mercado Común del Sur) comprising Argentina, Brazil, Paraguay and Uruguay. A political agreement was reached in June 2019, which is subject to legal revisions. After final amendments, the final texts will be presented for signature. They become binding only after each party has completed internal procedures for the entry into force (or the provisional application) of the agreement. Again, this agreement is not yet covered by the DESTA update of 2019. However, looking at the texts of the agreement in principle, it is evident that it is not as deep as the EU-Japan EPA. In particular, provisions on investments are absent, and on competition are vague, so that we assume a depth of 5 for the additive DESTA index.

For EU member states, the agreement with Mercosur economies has a greater impact on their position within the global FTA network. One obvious reason is that this single agreement establishes improved trade links with four Latin American economies at the same time. The potential role of the EU as a hub is also greater for trade flows originating in South America than in Japan. However, the betweenness centrality of the US and China is much less impaired. Looking at Brazil, as representative of the Mercosur group, it is interesting to observe a strong increase in its degree and eigenvector centrality, but no change in its betweenness or closeness centrality. This implies that, from a network point of view, the advantage of a trade agreement with the EU lies solely in its direct connections. It does not bring Mercosur members closer to other trading partners, and nor does it shift them from the outskirts towards the centre of the global FTA network.

For the counterfactual analysis, we use the regression results presented in Table 3, and set the direct FTA variable to 1 for EU member states and Japan in the first case, and for EU economies and Mercosur states in the second. In addition, we replace actual degree centralities and figures for the indirect FTA variable for the year 2017[36] with new, counterfactual figures for centrality that would result from the establishment of these agreements. Tariffs, however, remain untouched.

36 We need to rely on trade data for the year 2015 for the counterfactual analysis of the EU-Mercosur agreement, as there is no more recent information on intra-national trade available.

**Table 6 / Counterfactual analysis: EU-Mercosur FTA**

| EU-Mercosur FTA entering into force | | $C_D(i)$ Degree | $C_E(i)$ Eigenvector | $C_B(i)$ Betweenness | $C_C(i)$ Closeness |
|---|---|---|---|---|---|
| AUT | Pre-Mercosur | 824 | 1.00 | 373 | 179 |
| | Post-Mercosur | 845 | 1.00 | 382 | 180 |
| | Δ | **2.5%** | **0.0%** | **2.5%** | **0.3%** |
| USA | Pre-Mercosur | 148 | 0.07 | 1060 | 100 |
| | Post-Mercosur | 148 | 0.07 | 1032 | 100 |
| | Δ | **0.0%** | **-1.6%** | **-2.6%** | **0.0%** |
| CHN | Pre-Mercosur | 91 | 0.04 | 242 | 104 |
| | Post-Mercosur | 91 | 0.04 | 243 | 104 |
| | Δ | **0.0%** | **-1.7%** | **0.1%** | **0.0%** |
| BRA | Pre-Mercosur | 114 | 0.11 | 0 | 142 |
| | Post-Mercosur | 254 | 0.40 | 0 | 142 |
| | Δ | **122.8%** | **263.5%** | **N/A** | **0.0%** |

Our results, summarised in Table 7, suggest an increase in Austrian exports of 1.9% and a rise in real GDP of 0.06% over the period of the implementation of the EU-Japan EPA. The result is similar in magnitude for Germany. Within the EU, Austria's neighbours (in particular Hungary +0.12%, Slovenia +0.09%, the Czech Republic +0.08% and Slovakia +0.08%) benefit more than Austria. At the other end of the spectrum, we find Mediterranean economies (Italy, Portugal, France and Spain +0.04%), the United Kingdom (+0.03%) and Greece (0.02%). The estimated trade effects for Japan are higher (7%), accompanied by an increase in real GDP of 0.06%. We find positive, yet economically insignificant, changes in employment for the trading partners.

The estimated economic effects of the EU-Mercosur agreement are substantially larger. Austria is expected to experience an increase in exports of 3.4% and a rise in real GDP of 0.13%. Results for Germany are somewhat lower. The greatest GDP effects within the EU are computed for Belgium (+0.25%), followed by Hungary (+0.22%), Slovenia (+0.22%) and the Netherlands (+0.20%). Again, the United Kingdom and the same Mediterranean economies show the smallest effects within the EU (below 0.11%) – with one notable exception: Portugal is expected to experience GDP growth similar to Austria's (+0.13%), and even stronger export growth than Austria's (+4.7%).

Compared with Austria, the trade effects for the Mercosur economies are about five times greater (Paraguay 15.8%, Argentina 16.5%, Uruguay 17.6% and Brazil 19.0%). Likewise, the potential effects on real GDP are significantly more pronounced for Mercosur economies than for their European peers (Brazil 0.16%, Argentina 0.17%, Paraguay 0.29% and Uruguay 0.30%). Changes in employment are again found to be positive, but small.

Further analysis could incorporate negotiated tariff cuts, as well as a sectoral breakdown, as trade links with Japan are expected to affect mainly the medium-high and high-tech manufacturing industry (machinery, electronics, chemical products and vehicles), while the agricultural sector is of greater importance in trade with Mercosur economies. Data availability constraints so far do not allow us to employ the same structural model at the sectoral level, due to missing information on intra-national trade flows by sector.[37]

### Table 7 / Economic effects of counterfactual scenarios, in %

**Scenario 1: EU-JP EPA entering into force**

| Country | Exports | Real GDP | Prices | Employment |
|---|---|---|---|---|
| JPN | 7.00 | 0.06 | -0.71 | 0.00 |
| AUT | 1.88 | 0.07 | 0.42 | 0.01 |
| DEU | 1.78 | 0.06 | 0.44 | 0.01 |

**Scenario 2: EU-Mercosur FTA entering into force**

| Country | Exports | Real GDP | Prices | Employment |
|---|---|---|---|---|
| URY | 17.61 | 0.30 | -0.22 | 0.02 |
| PRY | 15.75 | 0.29 | -0.47 | 0.01 |
| ARG | 16.47 | 0.17 | -0.52 | 0.00 |
| BRA | 19.00 | 0.16 | -0.32 | 0.00 |
| AUT | 3.38 | 0.13 | 0.22 | 0.01 |
| DEU | 3.05 | 0.12 | 0.25 | 0.01 |

37 The Appendix provides tables of estimation results for the agricultural sector and the manufacturing sector by technological classification, excluding intra-national flows.

# 5. Conclusion

The European Union has a long history of negotiating trade agreements. In this paper, we present – both graphically and numerically – the evolution of the EU as the major hub within the global network of free trade agreements over 40 years. However, with free trade clusters growing together, the FTA network is becoming denser and harder to navigate. In addition, the EU's relative position in comparison to other economies is declining.

The intuition that the EU is a major beneficiary of free trade, given that it has been a first mover, is supported by the literature, as well as by our thought experiment on the hypothetical effects of the EU-Japan EPA on their respective positions in the global FTA network, if the EU had not established an FTA with South Korea.

Econometrically, combining network theoretical concepts of centrality and overlapping FTAs with structural gravity trade modelling confirms that FTAs on average have a positive effect on trade, even when tariffs are controlled for. These positive effects can be associated with other trade effects beyond tariff cuts, including the channels of, for example, regulatory convergence, mutual recognition or harmonisation of standards.

Our results additionally suggest that overlapping FTAs have a positive effect on bilateral trade flows. Thus, both direct and indirect links between two countries matter for trade. Centrality, too, shows mostly positive effects: on average, an FTA exhibits a bigger positive effect if the exporting country has a more central position in the network of free trade agreements.

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# Appendix

## Table A.1 / Agriculture

| | (1) Base | (2) Depth | (3) Indirect FTA | (4) Degree | (5) Eigenvector | (6) Betweenness | (7) Closeness |
|---|---|---|---|---|---|---|---|
| Tariffs $\tau_{ijt}$ | -0.01 (0.00)*** | -0.01 (0.00)*** | -0.01 (0.00)** | -0.01 (0.00)*** | -0.01 (0.00)** | -0.01 (0.00)** | -0.01 (0.00)*** |
| FTA Dummy $FTA^{E}_{ijt}$ | -0.04 (0.02)* | -0.09 (0.04)* | -0.06 (0.04) | -0.13 (0.04)*** | -0.12 (0.04)** | -0.07 (0.04) | -0.06 (0.05) |
| FTA Depth $FTA^{D}_{ijt}$ | | 0.01 (0.01) | -0.01 (0.01) | 0.02 (0.01)** | 0.02 (0.01)* | 0.00 (0.01) | 0.02 (0.01)* |
| FTA Indirect $FTA^{I}_{ijt}$ | | | 0.30 (0.03)*** | -0.35 (0.07)*** | -0.40 (0.08)*** | 0.44 (0.04)*** | -0.51 (0.08)*** |
| $FTA^{E}$ · Centrality (Exporter) | | | | -0.06 (0.02)** | -0.15 (0.02)*** | 0.00 (0.01) | -0.17 (0.04)*** |
| $FTA^{E}$ · Centrality (Importer) | | | | 0.02 (0.02) | 0.00 (0.02) | -0.01 (0.01)* | 0.04 (0.03) |
| $FTA^{I}$ ·Centrality (Exporter) | | | | 0.18 (0.02)*** | 0.29 (0.04)*** | -0.05 (0.01)*** | 0.43 (0.06)*** |
| $FTA^{I}$ ·Centrality (Importer) | | | | 0.06 (0.02)** | 0.10 (0.03)*** | -0.02 (0.01) | 0.16 (0.05)*** |
| Deviance | 1,087,347 | 1,087,260 | 1,084,322 | 1,080,024 | 1,079,123 | 1,082,905 | 1,080,179 |
| Observations | 417,912 | 417,912 | 417,912 | 417,912 | 417,912 | 417,912 | 417,912 |
| Exporter-time FE | 4,974 | 4,974 | 4,974 | 4,974 | 4,974 | 4,974 | 4,974 |
| Importer-time FE | 2,855 | 2,855 | 2,855 | 2,855 | 2,855 | 2,855 | 2,855 |
| Country pair FE | 23,942 | 23,942 | 23,942 | 23,942 | 23,942 | 23,942 | 23,942 |

***** p < 0.001,** ***p < 0.01,* *p < 0.05
Notes: PPML estimation. Excluding intra-national trade. NACE Rev. 2 categories 1-3 (Agriculture, fishing and forestry).

**Table A.2 / Low- and medium-low-tech manufacturing**

| | (1) Base | (2) Depth | (3) Indirect FTA | (4) Degree | (5) Eigenvector | (6) Betweenness | (7) Closeness |
|---|---|---|---|---|---|---|---|
| Tariffs $\tau_{ijt}$ | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 |
| | (0.00)*** | (0.00)*** | (0.00)*** | (0.00)*** | (0.00)*** | (0.00)*** | (0.00)*** |
| FTA Dummy $FTA^{E}_{ijt}$ | 0.04 | 0.02 | 0.02 | -0.05 | 0.04 | 0.02 | 0.07 |
| | (0.03) | (0.05) | (0.05) | (0.04) | (0.04) | (0.05) | (0.06) |
| FTA Depth $FTA^{D}_{ijt}$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.00 |
| | | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| FTA Indirect $FTA^{I}_{ijt}$ | | | -0.00 | 0.31 | 0.15 | -0.02 | 0.31 |
| | | | (0.02) | (0.07)*** | (0.09) | (0.03) | (0.08)*** |
| $FTA^{E}$ · Centrality (Exporter) | | | | -0.10 | 0.05 | -0.01 | -0.03 |
| | | | | (0.02)*** | (0.03) | (0.00)*** | (0.03) |
| $FTA^{E}$ · Centrality (Importer) | | | | -0.09 | 0.00 | 0.01 | -0.11 |
| | | | | (0.02)*** | (0.02) | (0.00)* | (0.05)* |
| $FTA^{I}$ ·Centrality (Exporter) | | | | 0.02 | -0.03 | 0.02 | -0.03 |
| | | | | (0.02) | (0.03) | (0.01)** | (0.05) |
| $FTA^{I}$ ·Centrality (Importer) | | | | -0.05 | -0.06 | -0.00 | -0.12 |
| | | | | (0.03) | (0.04) | (0.00) | (0.07) |
| Deviance | 6,789,286 | 6,788,984 | 6,788,984 | 6,761,973 | 6,782,236 | 6,784,284 | 6,775,426 |
| Observations | 567,801 | 567,801 | 567,801 | 567,801 | 567,801 | 567,801 | 567,801 |
| Exporter-time FE | 5,009 | 5,009 | 5,009 | 5,009 | 5,009 | 5,009 | 5,009 |
| Importer-time FE | 2,857 | 2,857 | 2,857 | 2,857 | 2,857 | 2,857 | 2,857 |
| Country pair FE | 33,966 | 33,966 | 33,966 | 33,966 | 33,966 | 33,966 | 33,966 |

***** p < 0.001,** ***p < 0.01,* *p < 0.05
Notes: PPML estimation. Excluding intra-national trade. NACE Rev. 2 categories 10-19, 22-25, 31-33.

## Table A.3 / Medium-high and high-tech manufacturing

| | (1) Base | (2) Depth | (3) Indirect FTA | (4) Degree | (5) Eigenvector | (6) Betweenness | (7) Closeness |
|---|---|---|---|---|---|---|---|
| Tariffs $\tau_{ijt}$ | -0.00 (0.00)* | -0.00 (0.00)* | -0.00 (0.00)** | -0.01 (0.00)** | -0.01 (0.00)** | -0.00 (0.00)** | -0.00 (0.00)** |
| FTA Dummy $FTA_{ijt}^{E}$ | -0.05 (0.02)** | 0.00 (0.03) | 0.01 (0.03) | -0.05 (0.03) | 0.04 (0.03) | 0.01 (0.03) | 0.03 (0.04) |
| FTA Depth $FTA_{ijt}^{D}$ | | -0.01 (0.00)* | -0.00 (0.00) | -0.01 (0.00) | -0.00 (0.00) | -0.00 (0.00) | -0.01 (0.00)* |
| FTA Indirect $FTA_{ijt}^{I}$ | | | -0.13 (0.02)*** | 0.16 (0.04)*** | -0.19 (0.05)*** | -0.16 (0.02)*** | 0.12 (0.04)** |
| $FTA^{E}$ · Centrality (Exporter) | | | | -0.06 (0.01)*** | 0.05 (0.01)*** | -0.00 (0.00) | -0.09 (0.03)** |
| $FTA^{E}$ · Centrality (Importer) | | | | -0.05 (0.01)*** | 0.01 (0.01) | -0.00 (0.00) | 0.04 (0.03) |
| $FTA^{I}$ ·Centrality (Exporter) | | | | 0.05 (0.01)*** | 0.08 (0.02)*** | -0.01 (0.00) | 0.16 (0.03)*** |
| $FTA^{I}$ ·Centrality (Importer) | | | | -0.09 (0.01)*** | -0.06 (0.02)** | 0.02 (0.00)*** | -0.30 (0.04)*** |
| Deviance | 5,389,495 | 5,387,880 | 5,372,819 | 5,345,124 | 5,352,658 | 5,362,661 | 5,355,696 |
| Observations | 558,209 | 558,209 | 558,209 | 558,209 | 558,209 | 558,209 | 558,209 |
| Exporter-time FE | 5,009 | 5,009 | 5,009 | 5,009 | 5,009 | 5,009 | 5,009 |
| Importer-time FE | 2,857 | 2,857 | 2,857 | 2,857 | 2,857 | 2,857 | 2,857 |
| Country pair FE | 33,259 | 33,259 | 33,259 | 33,259 | 33,259 | 33,259 | 33,259 |

***** p < 0.001,** ***p < 0.01,* *p < 0.05

Notes: PPML estimation. Excluding intra-national trade. NACE Rev. 2 categories 20-21, 26-30.

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