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Assessment of Non-Tariff Barriers in Food and Agricultural Trade - An Empirical Approach

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Vorwort

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Manching, August 2015 Tanja Engelbert

Contents

Summary

Non-tariff barriers (NTBs) substantially govern and influence trade outcomes. They include a diverse range of policy and non-policy measures that directly or indirectly divert trade and are predominantly implemented on food and agricultural products. While multilateral negotiations of NTBs within the World Trade Organization (WTO) are a slow process, countries are more confident in accelerating the reduction and regulation of NTBs within free trade agreements (FTAs). Thus, considering NTBs might be of importance in analyzing potential effects of FTAs. This cumulative dissertation includes six articles addressing current research questions in agricultural economics on the identification of NTBs and their effects on trade and the evaluation of FTAs that explicitly consider NTBs. In all empirical analyses, the focus is on the agro-food sector. The first two articles serve as the foundation for policy analysis. The following articles draw on a two-step empirical approach to thoroughly assess regional trade liberalization by integrating econometric results from the theory-consistent gravity model into the computational general equilibrium (CGE) model Global Trade Analysis Project (GTAP) given a perfect match of data.

The first article presents an overview of NTBs and discusses methods to identify and measure the effects of NTBs. The empirical part of the article applies the inventory approach to identify countries that are most prevalent in using NTBs. Frequency and coverage ratios suggest that the prevalence of NTBs in the agro-food sector is very high and that developed countries and especially emerging countries dominate

the application of NTBs worldwide. The article closes with an idea of how to further extend the comprehensive analysis of NTBs.

The second article further extends the assessment of NTBs. It also elaborates on the WTO's approach in regulating NTBs and their role during the recent economic crisis. By applying different indicators for NTBs on a yearly basis from 2002 to 2012, the evolution of NTBs over time and their impacts on agro-food trade are analyzed. Data demonstrate the increasing relevance of NTBs, and estimations reveal negative effects on trade; however, the performance varies greatly across indicators and between imports and exports. The article ends with a requirement to further enhance data availability and quality on NTBs and to strengthen the awareness of the trade-distorting nature of NTBs, especially in times of economic crisis.

The third article assesses the new orientation in Turkish foreign policy towards the Arab world by comparatively analyzing the potential impact of Turkey's membership in either the European Union (EU) or the Greater Arab Free Trade Area (GAFTA). The gravity border effect approach and cross-sectional data for 2007 are employed to obtain ad-valorem tariff equivalents (AVEs) of NTBs. Before NTBs are integrated into the GTAP model, they are benchmarked to the integration level of comparable FTAs. Turkey would gain unambiguously from EU membership, whereas Turkey's gains from GAFTA membership would be more limited. The article presents that the welfare gains from the removal of NTBs are of considerable importance and would generally be greater than the gains stemming from the elimination of tariffs.

The fourth article addresses the question of whether the relevance of NTBs by jointly using the border effect approach in gravity modeling and CGE analysis in assessing FTAs can be confirmed for a different case study. Specifically, the EU-India FTA is analyzed. The gravity border effect approach suggests high AVEs of NTBs. After benchmarking the NTBs, they are implemented into the GTAP model to derive economy-wide effects. Again, the overall level of welfare gain stemming from NTB reduction is much higher compared to the ones coming from tariff elimination.

In contrast to the two previous articles, the fifth article tests a different strategy in gravity modeling to identify NTBs. An FTA categorical variable captures integration levels negotiated by FTA partners in the past. The gravity equation is applied to cross-sectional data for 2010 to estimate the effects of NTBs. NTBs are used to perform CGE simulations on the Transatlantic Trade and Investment Partnership (TTIP) between the European Union (EU) and United States (US). TTIP simulation results indicate considerable gains for the EU and US that are predominantly driven by the reduction of NTBs, whereas third countries gain from spillover effects and are only moderately affected by trade-diverting effects.

The sixth article explores how different data aggregation levels affect the gravity estimates of NTBs in the agro-food sector and examines their related impacts on policy simulations of an expansion to the EU that would include Turkey. Two sets of AVEs of NTBs are calculated by using the gravity model with the FTA dummy approach to disaggregated and aggregated data for 15 GTAP agro-food sectors. A panel data framework for the period 1988 to 2011 is employed. AVEs of NTBs vary substantially across products. Utilizing aggregated data primarily leads to an overestimation of the effects of NTBs. Transferring overestimated AVEs to the GTAP model directly affects the simulation results.

The empirical analyses presented illustrate and reaffirm the high relevance of NTBs in the agro-food sector that by far exceeds tariffs. The use of different specifications of the gravity model and alternative identification strategies supports the stability of results. The joint econometric-CGE approach offers an appropriate and comprehensive framework for analyzing the effects of the reduction of NTBs in the process of economic integration. Extending the CGE model and augmenting the database with econometrically estimated parameters increase the quality and confidence of CGE-based assessments of deep FTAs. The reliability of the results is further increased by considering the most disaggregated level of data.

Future research analyses might apply even more disaggregated data and rely on direct measures of NTBs by employing information from newly emerging databases on NTBs. To conduct CGE policy analyses, theory-consistent aggregation methods could be applied to obtain AVEs of NTBs at the CGE sector level. The composite-method approach that was selected for this thesis could be transferred to other case studies of regional trade liberalization. In addition, the method could be used to construct a detailed database of AVEs of NTBs for the CGE framework. This would enable one to conduct reliable and precise plurilateral and multilateral liberalization scenarios by considering NTBs.

Zusammenfassung

Nicht-tarifäre Handelshemmnisse spielen eine bedeutende Rolle in der Steuerung und Beeinflussung des internationalen Handels. Sie umfassen vielfältige politisch und nicht-politisch motivierte Maßnahmen, die direkt oder indirekt den Handel verzerren. Insbesondere der Handel mit Agrar- und Ernährungsprodukten ist von nicht-tarifären Handelshemmnissen betroffen. Multilaterale Verhandlungen über nicht-tarifäre Handelshemmnisse innerhalb der Welthandelsorganisation sind ein sehr langwieriger Prozess. In der Regel sind Länder zuversichtlicher, den Abbau von nicht-tarifären Handelshemmnissen und die Angleichung von Vorschriften und Regularien in regionalen Freihandelsabkommen umzusetzen. Dadurch ergibt sich die Notwendigkeit und Wichtigkeit, nicht-tarifäre Handelshemmnisse in der Analyse von Freihandelsabkommen zu berücksichtigen.

Die vorliegende kumulative Dissertation enthält sechs Artikel, die sich mit aktuellen Forschungsfragen aus der Agrarökonomie beschäftigen. Im Speziellen geht es sowohl um die Identifizierung von nicht-tarifären Handelshemmnissen und Messung der Handelseffekte als auch um die Auswertung von regionalen Liberalisierungsszenarien, in denen nicht-tarifäre Handelshemmnisse explizit berücksichtigt werden. In allen empirischen Analysen liegt der Fokus auf dem Agrar- und Ernährungsbereich. Während die ersten zwei Artikel als eine Basis für die Politikszenarien dienen, wird in den folgenden vier Artikeln eine empirische Analyse regionaler Handelsliberalisierung in zwei Schritten umgesetzt. In diesem Zwei-Schritte-Ansatz werden ökonometrische Ergebnisse aus dem theoretisch basierten Gravitationsmo-

dell in das allgemeine Gleichgewichtsmodell Global Trade Analysis Project (GTAP) integriert.

Der erste Artikel präsentiert einen Überblick über nicht-tarifäre Handelshemmnisse und diskutiert Methoden zur Identifizierung und Messung der Effekte. Der empirische Teil des Artikels verwendet die Bestandsmethode, um diejenigen Länder zu erkennen, die überwiegend nicht-tarifäre Handelshemmnisse einsetzen. Verhältniskennzahlen zu Häufigkeit und Deckungsgrad zeigen, dass die Verbreitung von nicht-tarifären Handelshemmnissen im Agrar- und Ernährungssektor sehr hoch ist und dass Industrie- und Schwellenländer weltweit die höchste Prävalenz aufweisen. Abschließend wird eine Idee zur Ausweitung der Analyse nicht-tarifärer Handelshemmnisse vorgestellt.

Der zweite Artikel schließt hier direkt an, indem er die Analyse von nicht-tarifären Handelshemmnissen erweitert. Dieser Artikel erarbeitet ferner die Herangehensweise der Welthandelsorganisation in Bezug auf nicht-tarifäre Handelshemmnisse und die Rolle dieser Maßnahmen in der jüngsten Weltwirtschaftskrise. Verschiedene Indikatoren für nicht-tarifäre Handelshemmnisse für einen Zeitraum von 2002 bis 2012 werden herangezogen, um die zeitliche Entwicklung und deren Auswirkungen auf den Handel mit Agrar- und Ernährungsprodukten zu analysieren. Die Daten zeigen eine steigende Relevanz der nicht-tarifären Handelshemmnisse, und ökonometrische Schätzungen decken negative Effekte auf den Handel auf. Allerdings hängt das Ergebnis stark von den Indikatoren ab und variiert zwischen Importen und Exporten. Der Artikel schließt mit der Notwendigkeit einer verbesserten Datenverfügbarkeit und –qualität und mit der Forderung nach Erhöhung des Bewusstseins für die handelsverzerrenden Wirkungen von nicht-tarifären Handelshemmnissen, vor allem während wirtschaftlich turbulenten Zeiten.

Der dritte Artikel bewertet die neue Orientierung der türkischen Außenhandelspolitik in Richtung der arabischen Welt. Hierbei wird eine komparative Analyse durchgeführt, indem die potentiellen Auswirkungen der Mitgliedschaft der Türkei entweder in der Europäischen Union oder in der Größeren Arabischen Freihandelszone untersucht werden. In der ökonometrischen Analyse mit dem Gravitationsmodell werden der Grenzeffekt-Ansatz und Querschnittsdaten für das Jahr 2007 angewandt, um Zolläquivalente von nicht-tarifären Handelshemmnissen zu bestimmen. Bevor die nicht-tarifären Handelshemmnisse in das GTAP Modell zur gegenüberstellenden Politikanalyse integriert werden, werden sie hinsichtlich eines Integrationsniveaus vergleichender Freihandelsabkommen normiert. Die Türkei würde eindeutig im Falle einer Mitgliedschaft in der Europäischen Union gewinnen, während die Gewinne aus der Mitgliedschaft in der Größeren Arabischen Freihandelszone nur beschränkt sein würden. Die Wohlfahrtsgewinne, welche aus der Reduktion von nicht-tarifären Handelshemmnissen resultieren, sind von erheblicher Bedeutung und generell höher als die Gewinne aus der Zolleliminierung.

Der vierte Artikel beschäftigt sich mit der Frage, ob die hohe Relevanz von nicht-tarifären Handelshemmnissen in der Bewertung von Freihandelsabkommen mit Hilfe des kombinierten Methodenansatzes auch für eine andere Fallstudie bestätigt werden kann. Im Speziellen wird das Freihandelsabkommen zwischen der Europäischen Union und Indien untersucht. Die Gravitationsanalyse mit dem Grenzeffekt-Ansatz weist hohe Zolläquivalente von nicht-tarifären Handelshemmnissen auf. Nach deren Normierung, werden sie in das GTAP Modell integriert, um ökonomische Aspekte der Freihandelszone abzuleiten. Die Ergebnisse dieser Politikanalyse bestätigen die hohe Bedeutung von nicht-tarifären Handelshemmnissen. Die Wohlfahrtsgewinne, die aus der Reduktion von nicht-tarifären Handelshemmnissen hervorgehen, sind höher im Vergleich zu den Gewinnen, die aus der Eliminierung von Zöllen stammen.

Im Gegensatz zu den vorherigen Artikeln, prüft der fünfte Artikel eine alternative ökonometrische Strategie zur Identifikation nicht-tarifärer Handelshemmnisse. Eine kategorische Variable erfasst verschiedene Integrationsniveaus, die von Partnern einer Freihandelszone in der Vergangenheit verhandelt wurden. Die Gravitationsgleichung wird auf Querschnittsdaten für das Jahr 2010 angewandt. Im zweiten Schritt wird die Transatlantische Handels- und Investitionspartnerschaft zwischen der Europäischen Union und den Vereinigten Staaten mit dem GTAP Modell analysiert. Die Simulationsergebnisse zeigen erhebliche Gewinne für beide Partner auf. Diese werden hauptsächlich durch die Reduktion von nicht-tarifären Handelshemmnissen erklärt. Drittländer profitieren von positiven Spillover-Effekten und sind entsprechend nur moderat von handelsumlenkenden Effekten betroffen.

Der sechste Artikel untersucht inwieweit unterschiedliche Datenaggregationsebenen die Schätzungen von nicht-tarifären Handelshemmnissen mit dem Gravitationsmodell beeinflussen und prüft die entsprechenden Auswirkungen auf die Politiksimulationen einer möglichen Erweiterung der Europäischen Union um die Türkei. Zwei Datensätze von Zolläquivalenten von nicht-tarifären Handelshemmnissen werden berechnet. Hierfür werden disaggregierte und aggregierte Paneldaten für 15 GTAP Agrar- und Ernährungssektoren im Zeitraum von 1988 bis 2011 herangezogen. In der ökonometrischen Strategie erfasst eine binäre Variable alle positiven Effekte, die sich aus der Reduzierung von nicht-tarifären Handelshemmnissen und der Angleichung von Vorschriften in regionalen Liberalisierungsprozessen ergeben. Zolläquivalente von nicht-tarifären Handelshemmnissen variieren erheblich auf dem Produktniveau. Dabei führen aggregierte Daten hauptsächlich zu einer Überschätzung der Effekte von nicht-tarifären Handelshemmnissen. Die Übertragung dieser überschätzten Zolläquivalente in das GTAP Modell wirkt sich beachtlich auf die Simulationsergebnisse aus.

Die in dieser Arbeit präsentierten empirischen Analysen veranschaulichen eine hohe Relevanz von nicht-tarifären Handelshemmnissen im Agrar- und Ernährungsbereich. Die Effekte sind höher als bei Zöllen. Die Verwendung verschiedener Spezifikationen des Gravitationsmodells und alternativer Identifikationsstrategien bestätigt die Stabilität der Resultate. Der verwendete Ansatz durch die Kombination von ex-post und ex-ante Analysen bietet eine angemessene und umfassende Methode, um die Effekte von nicht-tarifären Handelshemmnissen in regionalen Liberalisierungsprozessen zu analysieren. Die Erweiterung des Gleichungssystems und der Datenbasis des allgemeinen Gleichgewichtsmodells mit ökonometrisch geschätzten Parametern erhöht

die Qualität der Simulationsergebnisse von allgemeinen Gleichgewichtsmodellen. Die Reliabilität der Ergebnisse wird weiter erhöht, wenn sowohl die ökonometrischen Analysen als auch die prospektiven Simulationen auf dem höchst möglichen Disaggregationsniveau erfolgen.

Zukünftige Studien könnten noch stärker disaggregierte Daten und direkte Messungen von nicht-tarifären Handelshemmnissen verwenden, um die Effekte zu schätzen. Hierfür könnten die Informationen aus den aktuell aufkommenden Datenbasen zu nicht-tarifären Handelshemmnissen einen Beitrag leisten. Zur anschließenden Politikanalyse mit allgemeinen Gleichgewichtsmodellen könnten theoretisch-konsistente Aggregationsmethoden verwendet werden, um Zolläquivalente von nicht-tarifären Handelshemmnissen auf der Ebene der allgemeinen Gleichgewichtsmodelle zu erhalten. Die Zwei-Schritte Analyse könnte auf andere Fallstudien regionaler Handelsliberalisierung übertragen werden. Künftig könnte auch mit der hier in der Arbeit gewählten Methode eine detaillierte Datenbasis von Zolläquivalenten von nicht-tarifären Handelshemmnissen für die Rahmenstruktur des allgemeinen Gleichgewichtsmodells erstellt werden. Dadurch könnten zuverlässige und präzise Analysen auch von plurilateralen und multilateralen Liberalisierungsszenarien ermöglicht werden.

1 Introduction

1.1 Research objectives

In recent decades, the multilateral trade negotiations of the General Agreement on Tariffs and Trade (GATT) and the successor World Trade Organization (WTO) have led to a considerable reduction in tariffs. Accordingly, other trade measures, particularly non-tariff barriers (NTBs), are now playing an increasing role in governing and influencing trade outcomes. NTBs include a diverse range of policy and non-policy instruments that directly or indirectly divert trade with respect to composition, regional orientation and size. Specifically, agro-food trade is heavily affected by NTBs, so that NTBs are a central topic of discussions in agricultural and trade policies. Most NTBs are of regulatory nature and are justified by following legitimate national regulatory interests, e.g., social, product and environmental standards or consumer protection regulations. However, they are characterized by complex and non-transparent designs and lack conceptual clarity. In addition, there are no comprehensive and effective control mechanisms, so they can easily and arbitrarily be misused by governments for protectionist and discriminatory purposes. Furthermore, different regulatory systems across countries further complicate smooth trade flows.

Policymakers and economists are aware that harmonization and mutual recognition of regulatory systems will lower trade costs and enhance commercial exchange. However, this requires deep institutional changes and is on the multilateral level both a tedious and resource-intensive process. Instead, countries are more confident about the potential to overcome NTBs and trade restrictions in form of regulatory divergence if they are considered within free trade agreements (FTAs). In fact, NTBs are one of the most important points in FTA treaties because future trade and welfare gains are expected through the reduction of restrictive NTBs and the harmonization or mutual recognition of regulatory systems.

How important are NTBs to international trade? How can NTBs be empirically measured and made to be useful for policy analysis of FTAs? Do FTA policy outcomes change if the reduction of NTBs is considered? There are many studies in the literature that try to empirically answer these questions by using either econometric approaches or applied partial and general equilibrium models. Combinations of both modeling approaches, econometric and equilibrium-based models, are rarely found. Predominantly, quantity-based econometric approaches are utilized to measure the trade effects of NTBs. Subsequently, econometric estimates can be used to calculate ad-valorem tariff equivalents (AVEs) which are applicable in equilibrium model-based policy analysis. Existing studies reveal high relevance of NTBs for trade by suggesting high AVEs of NTBs that mostly exceed tariffs. However, negligence in theoretical-sound derivations, empirical misspecifications to identify NTBs and data quality issues often lead to inconsistencies and discrepancies in estimation results. Yet, consistent and unbiased estimates of NTBs are particularly important when using them as inputs in further model-based policy impact analysis. While partial equilibrium models offer a powerful and efficient technique, computable general equilibrium (CGE) models are preferred because of their ability to derive economy-wide effects of the reduction of NTBs.

Tariff modeling in CGE frameworks is well established. In contrast, modeling of NTBs has only recently been employed in trade policy analyses. Because CGE models do not cover NTBs in their frameworks, they need to be specifically implemented in the equation system of the CGE model. While resource-wasting NTBs are modeled as efficiency losses, rent-generating NTBs are modeled as import tariff or export tax equivalents beyond the actual import tariffs and export taxes. In the past, studies considered mainly a uniform economy-wide efficiency improvement to model NTBs. Recently, studies have integrated econometrically estimated NTBs in CGE frameworks to model the potentials of deep FTAs. These studies focus on modeling NTBs as efficiency losses. Indeed most NTBs are of regulatory nature and increase the resources and hence costs of production, yet, a certain proportion of NTBs generates rents. Only very few studies examine and apply both modeling approaches. Simulation results of studies considering NTBs in FTA policy analysis suggest high overall welfare gains for the respective FTA trade partners, which are primarily driven by the reduction of NTBs. However, many studies do not allow for spillover effects to third countries or apply a homogenous design. Finally, the agro-food sector is mostly neglected or considered at a highly aggregated level, although NTBs are predominantly implemented on food and agricultural products and aggregation bias is of concern in trade policy analyses. How important is the distinction between different types of NTBs for FTA policy analysis? Do NTBs in food and agriculture and well-constructed spillover effects make a difference in evaluating FTA policies? How does data aggregation level influence econometric results of NTBs and hence simulation outcomes? These aspects are only rarely discussed in the literature, but are important for thorough trade policy analysis.

Against this background, the objective of this cumulative dissertation is to examine specific research questions in international agricultural economics by combining econometric-based ex-post analysis and CGE-based prospective evaluation given a perfect match in the data. Particularly, the thesis relies on the theory-consistent gravity model of trade and the CGE model Global Trade Analysis Project (GTAP) that both are successfully and extensively applied in trade policy analysis. The thesis emphasizes two critical issues, namely, the effects of NTBs on food and agricultural trade and the assessment of FTAs by specifically considering the agro-food sector and allowing for simultaneous reduction of tariffs and NTBs. In addition to these research questions from the international agricultural economics field, methodological purposes are also followed. With respect to the econometric approach, the explicit objectives are first to relate the theoretical gravity model to trade and other relevant data and current estimation techniques. In particular, the selection, gathering and processing of appropriate data to conduct gravity model analyses, the identification of current estimation techniques, and the establishment of the technical framework to conduct gravity model analyses are pursued. Furthermore, the thesis aims to assess estimation strategies to identify NTBs and different specifications of the gravity model to judge the stability of the results. In addition, alternative empirical designs to determine the levels of NTBs that are reducible in FTAs are evaluated. The aim is also to conduct empirical analyses at different data aggregation levels to investigate the effect of aggregation bias on estimation results. With respect to the CGE approach, the specific objectives are to identify the theoretical framework to implement and decompose different types of NTBs in the CGE equation system and to establish the technical framework to perform liberalization scenarios in FTA policy assessments with the GTAP model. Finally, theoretical considerations of spillover effects associated with NTBs and the practical advancement are covered.

1.2 Organization of the thesis

The thesis includes six articles that provide the basis for the cumulative dissertation. The articles are in the context of the above-described research objectives. While the first two articles serve as the foundation for the policy simulations by providing information on the prevalence and relevance of NTBs, the following four articles focus on the combination of ex-post econometric studies and ex-ante CGE analyses to assess the effects of NTBs in specific case studies. The following table presents the full list of the respective articles, the authors and the journals in which the articles have been published or to which they have been submitted.

The first article, *Methoden zur Messung von nichttarifären Handelsmaßnahmen: Welche Möglichkeiten bietet die bisherige Forschung?* (chapter 2), provides an overview on NTBs and discusses methods to identify and measure NTBs. The inventory approach is applied to discover countries that are most prevalent in employing NTBs. The article was published in WiSt Heft 6 (2011) and contributes insights to the high prevalence of NTBs in the agro-food sector worldwide.

Table: Overview of articles

Chapter	Title	Authors	Published in/Submitted to
2	Methoden zur Messung von nichttärifaren Handelsmaßnahmen: Welche Möglichkeiten bietet die bisherige Forschung?	Tanja Befus and Janine Pelikan	WiSt Heft Vol. 6, 2011, p. 301-307
3	Proliferation of Non-Tariff Measures and the Impacts on Food and Agricultural Trade	Tanja Engelbert and Eva Schlenker	Agricultural Economics, December 2014
4	Moving toward the EU or Middle East? An Assessment of Alternative Turkish Foreign Policies Utilizing the GTAP Framework	Tanja Engelbert, Beyhan Bektasoglu and Martina Brockmeier	Food Policy Vol. 47, 2014, p. 46-61
5	Analyse des Freihandelsabkommens zwischen der EU und Indien unter Berücksichtigung von nicht-tarifären Handelshemmnissen im Agrar- und Ernährungsbereich	Tanja Engelbert and Martina Brockmeier	Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaus e.V., Vol. 48, 2013, p. 297-308
6	Agriculture in the TTIP - A Joint Econometric-CGE Assessment	Tanja Engelbert, Martina Brockmeier and Joseph Francois	American Journal of Agricultural Economics, October 2014
7	The Effect of Aggregation Bias: An NTB Modeling Analysis of Turkey's Agro-Food Trade with the EU	Beyhan Bektasoglu, Tanja Engelbert and Martina Brockmeier	Review of World Economics, November 2014

Source: Own illustration.

The assessment of NTBs is further extended in the second article entitled *Proliferation of Non-Tariff Measures and the Impacts on Food and Agricultural Trade* (chapter 3). This paper, which was submitted to Agricultural Economics, also elaborates the WTO's approach to regulating NTBs and their role during the recent economic crisis. Based on panel data and a gravity-like model, the paper detects the evolution of NTBs over time and estimates their impacts on agro-food trade.

The third article, *Moving toward the EU or the Middle East? An Assessment of Alternative Turkish Foreign Policies Utilizing the GTAP Framework* (chapter 4), assesses the new orientation in Turkish foreign policy towards the Arab world by analyzing the potential impact of Turkey's membership in either the European Union (EU) or the Greater Arab Free Trade Area (GAFTA). A joint econometric-CGE assessment is conducted by using the gravity border effect approach to obtain NTBs for detailed agro-food sectors and the GTAP model to perform policy simulations. The paper was published in Food Policy 47 (2014) and contributes insights to the role of the agro-food sector and the importance of NTBs in determining the outcome of FTA policy simulations.

Whether the relevance of NTBs by jointly using the border effect approach in gravity modeling and CGE analysis in assessing FTAs can be confirmed for a different case study is analyzed in the fourth article entitled *Analyse des Freihandelsabkommens zwischen der EU und Indien unter Berücksichtigung von nicht-tarifären Handelshemmnissen im Agrar- und Ernährungsbereich* (chapter 5). The paper was published in Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e.V., Herausforderungen des globalen Wandels für Agrarentwicklung und Welternährung 48 (2013) and analyzes the potential effects of the EU-India FTA considering simultaneous reduction of tariffs and NTBs in detailed agro-food sectors.

The fifth article, *Agriculture in the TTIP - A Joint Econometric-CGE Assessment* (chapter 6), which was submitted to American Journal of Agricultural Economics, examines the Transatlantic Trade and Investment Partnership (TTIP) between the EU and US. The joint econometric-CGE analysis in this paper is extended compared to the two previous studies to consider different aspects in terms of NTB modeling and impacts. Estimated NTBs from gravity modeling are differentiated between resource-wasting and rent-generating NTBs and are accordingly implemented into the GTAP model. The CGE application is further advanced in that it also assesses spillover effects for third countries and bases the analysis on the econometrically obtained elasticity of substitution including the related confidence intervals to generate a distribution of the model's results. The simulation results contribute to a better understanding of the meaning of different types of NTBs and spillover effects associated with NTBs on overall welfare analysis.

The sixth article, *The Effect of Aggregation Bias: An NTB Modeling Analysis of Turkey's Agro-Food Trade with the EU* (chapter 7), explores the potential impact of data aggregation on gravity estimates of NTBs in the agro-food sector and examines their related impacts on policy simulations of an expansion to the EU that would include Turkey. The article was submitted to Review of World Economics and contributes insights into aggregation bias in gravity estimation and its consequences on CGE simulation results.

This thesis is divided into eight chapters. Following the introductory chapter, chapters 2 to 7 consist of the six articles, and chapter 8 summarizes the findings and draws the conclusions.

2 Methoden zur Messung von nichttarifären Handelsmaßnahmen: Welche Möglichkeiten bietet die bisherige Forschung?

Tanja Befus and Janine Pelikan

published in: WiSt Heft Vol. 6, 2011, p. 301-307.

Methoden zur Messung von nichttarifären Handelsmaßnahmen: Welche Möglichkeiten bietet die bisherige Forschung?

Tanja Befus, Stuttgart, und Dr. Janine Pelikan, Braunschweig

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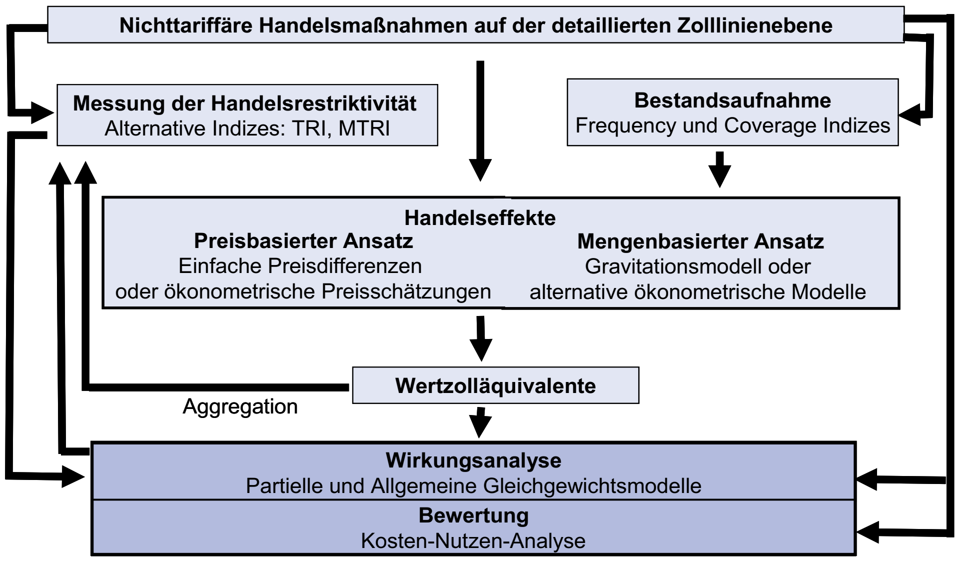
Nichttarifäre Handelsmaßnahmen sind ein häufig genutztes Instrument der Handelspolitik. Daher ist es von besonderem Interesse, diese Maßnahmen zu identifizieren und deren Bedeutung im internationalen Handel zu quantifizieren. Das Ziel dieses Beitrags besteht darin, Methoden zur Messung von nichttarifären Handelsmaßnahmen aufzuzeigen und zu diskutieren. Hierdurch soll der Einstieg in die Literatur zu diesem Themenbereich erleichtert und der Forschungsbedarf deutlich gemacht werden.

Stichwörter: Frequency-Index, Gravitationsmodell, Kosten-Nutzen-Analyse, nichttarifäre Handelshemmnisse, Trade Restrictiveness Index

1. Einleitung

Multilaterale, regionale und bilaterale Handelsabkommen haben in den vergangenen Jahrzehnten in vielen Bereichen zu einer Liberalsierung des Warenhandels geführt. Während die Höhe der Zollprotektion im internationalen Handel abnimmt, gewinnen nichttarifäre Handelsmaßnahmen (non-tariff measures, NTMs) immer mehr an Bedeutung. Diese Maßnahmen sind definiert als alle Handelsregulierungen, die nicht den tarifären Maßnahmen zugeordnet werden können. Zu den NTMs zählen mengenmäßige Beschränkungen wie beispielsweise Importquoten oder administrative Vorschriften wie technische und sanitäre Standards. Ein Unterschied zu den tarifären Maßnahmen besteht darin, dass keine Staatseinnahmen in Form von Zollabgaben entstehen. Im Gegensatz zu Zöllen können NTMs den Handel fördern indem sie zu mehr Transparenz, zu einer größeren Kompatibilität mit den heimischen Produkten oder zu einer Risikoreduzierung beitragen. Vielfach wirken diese Maßnahmen allerdings als **nichttarifäre Handelshemmnisse** (non-tariff barriers, NTBs) und lenken den Handel ab oder verhindern ihn sogar vollständig.

Infolge der Finanzkrise ab 2007 hat die Nutzung von NTBs zum Schutz der Märkte wieder an Bedeutung gewonnen. Die *EU-Kommission* (2009, S. 6) berichtet von 223 handelsbeschränkenden Maßnahmen, die innerhalb eines Jahres (Oktober 2008 bis Oktober 2009) weltweit geplant oder umgesetzt wurden. Durch eine Obergrenze für Zölle, die durch die Welthandelsorganisation (WTO) festgesetzt wurde, ist der Spielraum vieler Länder für Zollerhöhungen sehr eingeschränkt. Nichttarifäre Maßnahmen sind aufgrund ihrer vielfältigen Ausgestaltung und der direkten und indirekten Wirkungen wesentlich schwerer zu regulieren und bieten daher die Möglichkeit, Märkte zu protektionieren. Dennoch gibt es auch hier Regulierungen durch die WTO. Eine Umwandlung bzw. Tarifizierung der klassischen NTBs (z. B. Importkontigente) in Zolläquivalente und die Erfassung und Überwachung von technischen Standards und sanitären sowie phytosanitären Maßnahmen sind Elemente, die seit der letzten Verhandlungsrunde (Uruguay-Runde, 1986–1994) im Regelwerk des multilateralen Handelssystems der WTO enthalten sind. Während die Anwendung der klassischen NTBs infolgedessen zurückgegangen ist, haben sich neue Maßnahmen der nichttarifären Protektion entwickelt. Deren Einsatz wird häufig mit dem Schutz von Menschen, Tieren oder Pflanzen gerechtfertigt. Vielfach ist jedoch die wahre Intention einer Maßnahme nicht eindeutig zu identifizieren. Beispielsweise hat China infolge des H1N1-Grippevirus zusätzliche Tests für Schweinefleischimporte aus der EU und eine Desinfektion von Containern angeordnet. Die EU-Kommission befürchtet, dass hierdurch der Handel mit China vollständig verhindert wird, da die geforderten Tests sehr aufwendig sind (*Agra Europe*, 2009, S. 3–4). In solchen Fällen ist es schwer zu entscheiden, ob die betrachtete Maßnahme zum Schutz der Konsumenten oder aus protektionistischen Motiven implementiert wurde.



Quelle: Eigene Darstellung.

Abb. 1: Methodenüberblick zur Messung von nichttarifären Handelsmaßnahmen

Solange das vorrangige Ziel einer Maßnahme nicht eindeutig identifiziert werden kann, ist es schwierig nichttarifäre Maßnahmen zu regulieren. Für Politik und Wissenschaft ist es daher von besonderem Interesse, die Bedeutung der nichttarifären Maßnahmen im internationalen Handel zu messen und ihre Wirkungen zu identifizieren. An dieser Stelle setzt der vorliegende Beitrag an. Es wird gezeigt, welche Methoden für die Quantifizierung der NTMs zur Verfügung stehen und welche Möglichkeiten und Grenzen diese Methoden aufweisen. Während sich einzelne Studien häufig nur auf die theoretische oder empirische Darstellung einer Methode beschränken, erfolgt in diesem Artikel eine Gesamtschau verschiedener Konzepte. Darüber hinaus wird dargestellt, wie die einzelnen Methoden miteinander kombiniert werden können. Hierdurch soll der Einstieg in die Literatur zu den NTMs erleichtert und der Forschungsbedarf in diesem Themenbereich deutlich gemacht werden. Schließlich werden zwei Indizes empirisch berechnet. Da NTMs häufig im Zusammenhang mit dem Handel von Agrargütern implementiert werden, wurde in dem vorliegenden Beitrag ein Anwendungsbeispiel aus dem Agrarbereich gewählt.

2. Übersicht über die Messmethoden

In *Abb. 1* sind Methoden dargestellt, die in der Literatur zur Messung von NTMs beschrieben und angewendet werden. Die Auswahl der geeigneten Methode ist dabei von der jeweiligen Fragestellung, der Form und Ausgestaltung der NTMs sowie der Datenverfügbarkeit abhängig. Es wird zwischen Methoden unterschieden, mit denen eine Bestandsaufnahme möglich ist, und Methoden, mit denen NTMs bzw. deren Zolläquivalente anhand ihrer Handelswirkung mit Hilfe des preis- oder mengenbasierten Ansatzes ermittelt werden können. Darüber hinaus gibt es die Möglichkeit NTMs anhand ihrer Handelsrestriktivität zu bestimmen und sie in Form von Indizes zu quantifizieren.

Weitergehende Analysen ermöglichen die Bewertung von NTMs aus wohlfahrtstheoretischer Sicht oder die Wirkungsanalyse auf verschiedene ökonomische Faktoren, wie beispielsweise Handel, Produktion oder Wohlfahrt. Die Bewertung (Evaluierung) von NTMs wird häufig mit dem Instrument der **Kosten-Nutzen-Analyse** durchgeführt während bei der Wirkungsanalyse partielle oder allgemeine **Gleichgewichtsmodelle** Anwendung finden. Der vorliegende Beitrag beschränkt sich auf die Methoden zur Messung von NTMs. Aufbauend auf diesen Konzepten kann dann eine Evaluierung oder Wirkungsanalyse durchgeführt werden. Ein guter Einstieg in die Literatur zur Bewertung von NTMs mit Hilfe der Kosten-Nutzen-Analyse bietet *van Tongeren* et al. (2009). Unterschiedliche Möglichkeiten zur Abbildung von NTMs in partiellen oder allgemeinen Gleichgewichtsmodellen werden von *Fugazza/Maur* (2008, S. 475 ff.) dargestellt.

3. Bestandsaufnahme

Eine Bestandsaufnahme von NTMs kann mit Hilfe des Frequency und des Coverage Indexes durchgeführt werden. Der **Frequency Index** misst die Häufigkeit der Anwendung von NTMs. Der **Coverage Index** misst ebenfalls die Häufigkeit der Anwendung von NTMs, gewichtet diese Information jedoch mit Hilfe von Handels- oder Produktionswerten. Beide Indizes ermöglichen eine Identifikation der Sektoren und Länder, in denen NTMs konzentriert sind und lassen somit einen intersektoralen und interregionalen sowie einen intertemporalen Vergleich zu. Außerdem können die Indizes als Inputs in ökonometrischen Analysen Verwendung finden.

Die Handelsrestriktivität oder die handelsfördernde Wirkung einzelner NTMs kann mit der Bestandsaufnahme allerdings nicht erfasst werden. Zudem wird nicht berücksichtigt, dass einige NTMs nur gemeldet werden, aber keine Wirkung für den Handel haben bzw. gar nicht in Kraft treten.

3.1 Frequency Index

Der Frequency Index beschreibt das Verhältnis zwischen der Anzahl der NTMs eines Landes und der Gesamtanzahl der Produkte, die von diesem Land importiert werden. *Laird* (1997, S. 51) berechnet den Frequency Index ($FI_{j,t}$) für ein Importland *j* im Jahr *t* als

$$FI_{j,t} = \left[\frac{\sum_{i=1}^{n} D_{i,j,t} \cdot U_{i,j,t}}{\sum_{i=1}^{n} U_{i,j,t}} \right] \cdot 100 \qquad (1)$$

wobei $D_{i,j,t}$ eine Dummyvariable darstellt, die den Wert Eins annimmt, wenn mindestens eine nichttarifäre Maßnahme auf das Produkt *i* mit $i = (1,......,n)$ des Landes *j* im Jahr *t* angewendet wird. Ansonsten ist diese Dummyvariable Null. $U_{i,j,t}$ ist ebenfalls eine Dummyvariable, die den Wert Eins annimmt, wenn Importe des Produktes *i* des Importlandes *j* im Jahr *t* stattfinden.

Ist die Protektion eines Landes prohibitiv hoch, gibt es keine Importe in diesem Bereich und die NTMs gehen nicht in die Berechnungen des Frequency Indexes ein. Dieses Problem wird auch als Endogenitätsverzerrung bezeichnet. Als Ergebnis ergibt sich ein nach unten verzerrter Frequency Index. Um der Endogenitätsverzerrung entgegenzuwirken, nutzt die *OECD* (1996, S. 11) beispielsweise zur Berechnung des Frequency Indexes die Anzahl aller von NTMs betroffenen Produktlinien, ungeachtet dessen ob sie importiert werden oder nicht. In diesem Fall wird $U_{i,j,t}$ immer als Eins definiert, auch wenn es keine entsprechenden Importe gibt. Hierbei kann allerdings die Gesamtanzahl der Produkte, die von NTMs betroffen sind, die Anzahl der importierten Produkte eines Landes übersteigen. Darüber hinaus besteht die Gefahr einer Fehlinterpretation, da nicht davon ausgegangen werden kann, dass sich jeder Null-Import positiv entwickelt, wenn die NTMs abgeschafft werden. Der größte Nachteil des Frequency Indexes besteht in der Gleichgewichtung aller Produkte ungeachtet dessen, welche Bedeutung sie für den Handel haben. Hierdurch ist die relative Wichtigkeit der NTMs für die Exporteure im Ganzen als auch für die einzelnen Exportgüter nicht zu erkennen (*Laird*, 1997, S. 51).

3.2 Coverage Index

Der Coverage Index misst die Häufigkeit der Anwendung von NTMs, gewichtet diese Information allerdings mit Hilfe von Handels- oder Produktionswerten und ermöglicht hierdurch die Berücksichtigung der relativen Wichtigkeit von Handelsflüssen. *Laird* (1997, S. 50) berechnet den Coverage Index ($CI_{j,t}$) für ein Importland *j* im Jahr *t* als

$$CI_{j,t} = \left[\frac{\sum_{i=1}^{n} (D_{i,j,t} \cdot M_{i,j,t})}{\sum_{i=1}^{n} M_{i,j,t}} \right] \cdot 100 \qquad (2)$$

wobei $D_{i,j,t}$ eine Dummyvariable ist, die den Wert Eins annimmt wenn mindestens eine nichttarifäre Maßnahme auf das Produkt *i* mit $i = (1,......,n)$ des Landes *j* im Jahr *t* angewendet wird. $M_{i,j,t}$ ist der Wert der gesamten Importe des Produktes *i* des Landes *j* im Jahr *t*. In den meisten Literaturquellen wird der Coverage Index, wie in der hier vorgestellten Formel, mit den Importwerten gewichtet. Hierfür werden die bilateralen Importwerte oder die Importe aus der gesamten Welt herangezogen. Durch die Gewichtung mit den Welthandelswerten wird solchen Produkten ein höheres Gewicht gegeben, die im internationalen Handel eine wichtige Stellung einnehmen. Außerdem kann hierdurch die Endogenitätsverzerrung reduziert werden, da nicht alle Importländer das gleiche Produkt mit NTMs belegen. Allerdings sind die Weltimporte nicht immer repräsentativ für die Importstruktur des betrachteten Landes (*Laird*, 1997, S. 50). Die idealen Importwerte für eine Gewichtung wären diejenigen, die in der Abwesenheit von NTMs existieren würden. Um diese zu bestimmen, müsste allerdings ein komplettes Importnachfragemodell geschätzt werden. In der Regel lässt die Datengrundlage auf der detaillierten Zolllinienebene (Produktebene) die Schätzung eines solchen Modells nicht zu.

Eine alternative Gewichtung kann über Produktionswerte erfolgen. Hierbei wird der Anteil der heimischen Produktion gemessen, der von NTMs betroffen ist. Auf diese Weise kann der produktionsgewichtete Index einen Hinweis darauf geben, inwiefern NTMs die heimische Produktion schützen (*Andriamananjara/Nash*, 1997, S. 5). Ein Problem der Gewichtung mit Produktionswerten besteht darin, dass die Produktionsdaten nicht so detailliert vorliegen, wie die einzelnen Produktinformationen in den internationalen Zolltabellen.

4. Wertzolläquivalente

Die Quantifizierung der NTMs erfolgt in der Literatur häufig auf der Basis von Wertzolläquivalenten. Diese ermöglichen einen Vergleich der Protektion zwischen Ländern und Sektoren. Darüber hinaus können sie für weitere Analysen in Simulationen von partiellen und allgemeinen Gleichgewichtsmodellen Anwendung finden.

Die Wertzolläquivalente werden dabei direkt über den Preisvergleich oder indirekt über den Mengenvergleich ermittelt. Beim direkten Preisvergleich erfolgt die Berechnung der Wertzolläquivalente arithmetisch oder ökonometrisch. Beim indirekten Mengenvergleich werden die Wertzolläquivalente dagegen ausschließlich mit Hilfe von ökonometrischen Modellen geschätzt. Dabei wird der potenzielle Handel zwischen Ländern ermittelt und mit dem aktuellen Handel verglichen. Allerdings kann die Umwandlung der Handelsmengen in Zolläquivalente nur mit Hilfe zusätzlicher Informationen und Annahmen erfolgen. Bei der Ermittlung von Wertzolläquivalenten kann sowohl beim Preis- als auch beim Mengenvergleich berücksichtigt werden, dass ein Teil der Handelsrestriktivität durch Zölle entsteht.

4.1 Preisbasierte Methode

Die Methode des direkten Preisvergleichs basiert auf der Annahme, dass NTMs die Transaktionskosten im Handel erhöhen, so dass der Inlandspreis im Importland im Vergleich zu einem Referenzpreis steigt. Zwischen dem Inlandspreis und dem Referenzpreis entsteht auf diese Weise eine Differenz, ähnlich zur Situation bei einem Importzoll. Diese Preisdifferenz beinhaltet die Nettoeffekte von allen NTMs, die auf einem Markt existieren.

Der ideale Vergleich wäre zwischen dem unverzerrten Preis des Importgutes, der ohne NTMs bestehen würde, und dem Preis, der im Inland bei Vorliegen von NTMs herrscht. Da unverzerrte Preise nur schwer zu ermitteln sind, wird in der Literatur häufig der cif (cost-insurance-freight)-Preis des importierten Gutes p_f als Referenzpreis gewählt und mit dem Inlandspreis p_d verglichen. Damit kann das Wertzolläquivalent (*TE*) als prozentualer Unterschied zwischen den Preisen bestimmt werden:

$$TE = \frac{p_d - p_f}{p_f} \cdot 100 \tag{3}$$

Durch die Auswahl der Preise werden die Transportkosten zwar berücksichtigt, nicht jedoch die Zollprotektion.

Die Nachteile der direkten Preismethode bestehen darin, dass erstens die einzelnen Maßnahmen nicht separat berücksichtigt werden können, sondern als Aggregat vorliegen. Zweitens kann der berechnete Effekt überschätzt werden, da Preissteigerungen überall entlang der Wertschöpfungskette entstehen, ohne dass NTMs vorliegen müssen. Drittens können Preisunterschiede durch die unterschiedliche Fähigkeit der Preisdiskriminierung von ausländischen und einheimischen Unternehmen begründet sein, so dass die Preisdifferenz Renten reflektiert und weniger die Auswirkungen von NTMs. Viertens liegt die Annahme der perfekten Substitution vor, die nicht immer berechtigt ist, da häufig Qualitätsunterschiede zwischen heimischen und importierten Gütern bestehen (*Ferrantino*, 2006, S. 11 f.). In der Literatur sind allerdings Erweiterungen der preisbasierten Methode zu finden, welche die Nachteile dieses Ansatzes teilweise beheben. *Yue et al.* (2006) erweitern die Methode beispielsweise um die imperfekte Substitution zwischen heimischen und importierten Gütern.

Zu den konzeptionellen Schwächen kommen datentechnische Probleme hinzu. Informationen über die Preise der importierten Produkte sind relativ einfach zu bekommen, jedoch erweist es sich als schwierig, die entsprechenden Preise auf dem heimischen Markt zu erfassen, vor allem auf dem disaggregierten Niveau. Wegen der beschriebenen Datenproblematik ist die Methode für viele Produkte und Länder ungeeignet. Aus diesem Grund wird sie nur bei einzelnen Fallstudien mit ausgewählten und relativ standardisierten Produkten angewendet (*Beghin/Bureau*, 2001, S. 113).

Um die Handelseffekte von NTMs für eine Vielzahl von Produkten oder Sektoren in vielen Ländern simultan zu erhalten, werden zunehmend ökonometrische Preisschätzungen durchgeführt. Dabei werden systematische Gründe herangezogen, warum Preise in einigen Ländern und für einige Produkte höher sind und wie diese auf NTMs zurückzuführen sind. Die Schätzungen sind anspruchsvoller als einfache arithmetische Berechnungen. Allerdings stellt auch hier die Datenverfügbarkeit ein Problem dar. Ein weiterer Nachteil dieser Methode besteht darin, dass die Ergebnisse sensitiv gegenüber ökonometrischen Spezifikationen und Techniken sein können (*Ferrantino*, 2006, S. 9 ff.).

4.2 Mengenbasierte Methode

Bei der mengenbasierten Methode werden NTMs über die Handelsmengen quantifiziert. Das Ziel besteht darin, den Handel zu schätzen, der ohne NTMs existieren würde, und diesen dann mit dem Handel zu vergleichen, der tatsächlich vorherrscht. Mit Hilfe von Importnachfrageelastizitäten (*Kee* et al., 2009, S. 172 ff.) oder Substitutionselastizitäten (*Anderson/van Wincoop*, 2003, S. 178) wird dann der Handelseffekt in Wertzolläquivalente umgerechnet.

In der Literatur finden sich verschiedene empirische Ansätze zur ökonometrischen Schätzung von NTMs, die häufig Varianten von **Gravitationsmodellen** sind. Der Gravitationsansatz wird für eine Vielzahl von Fragestellungen genutzt, um bilaterale Handelsflüsse zu analysieren und vorherzusagen. Er basiert auf Newton's Gravitationsgesetz, welches besagt, dass die Gravitationskraft (GF_{ij}) zwischen zwei Objekten von den jeweiligen Massen (M_i, M_j) und der Distanz (D_{ij}) zwischen den Objekten *i* und *j* abhängt

$$GF_{ij} = \frac{M_i M_j}{D_{ij}} \quad i \neq j \tag{4}$$

Tinbergen (1962) und *Pöyhönen* (1963) haben unabhängig voneinander herausgefunden, dass dieser Zusammenhang auch auf die internationalen Handelsflüsse übertragen werden kann. Hierbei hängt das Handelsvolumen zwischen zwei Ländern positiv von deren ökonomischer Größe und negativ von den Transportkosten ab. Die klassische Gravitationsgleichung lautet

$$Q_{ij} = \alpha \frac{GDP_i^{\beta_1} GDP_j^{\beta_2}}{D_{ij}^{\beta_3}} \tag{5}$$

mit Q_{ij} als Handelsmenge zwischen Land *i* und *j* anstelle der Gravitationskraft, $GDP_{i,j}$ als Bruttoinlandsprodukt des Landes *i* und *j* anstelle der Massen, und D_{ij} als die Distanz zwischen den beiden Ländern, die den Transportkosten entsprechen soll. α ist die Konstante der Gravitationsgleichung und β_1, β_2, β_3 sind die Koeffizienten der Variablen. Durch Logarithmierung wird die Gravitationsgleichung in ein lineares Modell überführt (*Reinert*, 2009, S. 567 f.). Dadurch wird Gleichung (5) zu

$$\ln Q_{ij} = \ln(\alpha) + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln D_{ij}. \tag{6}$$

Die Berücksichtigung eines Fehlerterms erlaubt eine Schätzung mit der Ordinary Least Squares (OLS) Regressionsmethode. OLS ist die typische Schätztechnik für Gravitationsmodelle. Der Vorteil besteht in der Einfachheit und der Standardisierung dieser Schätztechnik. Allerdings werden die Ergebnisse verzerrt oder inkonsistent, wenn für bestimmte Produkte oder Länder keine Handelsströme vorliegen oder die Annahme der Homoskedastizität (gleiche Varianzen der Residuen) nicht erfüllt ist. Daher werden in der Literatur vermehrt alternative Schätzmodelle diskutiert und angewendet. Hierbei wird versucht, die Verzerrungen der OLS-Schätzung mit einer Pseudo-Maximum-Likelihood-Schätzung (*Santos Silva/Tenreyro*, 2006, S. 641 ff.) oder mit einer Poisson fixed-effects-Schätzung (*Burger* et al., 2009, S. 167 ff.) zu beheben.

Die klassische Spezifikation der Gravitationsmodelle bietet eine gute Anpassung für die meisten Datensätze der regionalen und internationalen Handelsflüsse. Dennoch fehlte es an theoretischer Fundierung. In den letzen Jahrzehnten haben viele Ökonomen die Gravitationsgleichung formal abgeleitet und Verbindungen zu wichtigen Handelstheorien hergestellt. Einen Überblick über die einzelnen Arbeiten in diesem Bereich findet sich in *Reinert* (2009, S. 567 ff.). Die Erkenntnis, dass das Gravitationsmodell mit verschiedenen Handelsmodellen konsistent ist, verstärkt dessen Anwendung in der Vorhersage von potenziellen Handelsflüssen. Das klassische Gravitationsmodell wurde nach und nach um weitere erklärende Variablen erweitert. Besonders häufig werden Landescharakteristika, wie das Vorliegen einer gemeinsamen Sprache und koloniale Verbindungen, das Teilen einer gemeinsamen Landesgrenze oder die gemeinsame Mitgliedschaft in einer Freihandelszone als Dummyvariablen in die Gleichung eingebracht. Darüber hinaus können Zölle und Subventionen in der Gravitationsgleichung berücksichtigt werden (*Winchester*, 2009, S. 821).

Die NTMs werden dann mit dem Residuenansatz durch den unerklärten Teil der Regression implizit quantifiziert. Der Vorteil des Residuenansatzes liegt darin, dass nicht nur die von der erklärenden Variablen ausgehende Komponente des Handelseffekts berücksichtigt wird. Vielmehr ist es mit diesem Ansatz auch möglich, die Handelswirkungen einer Vielzahl von NTMs auf jedem bilateralen Handelsweg zu erfassen (*Philippidis/Sanjuán*, 2006, S. 267).

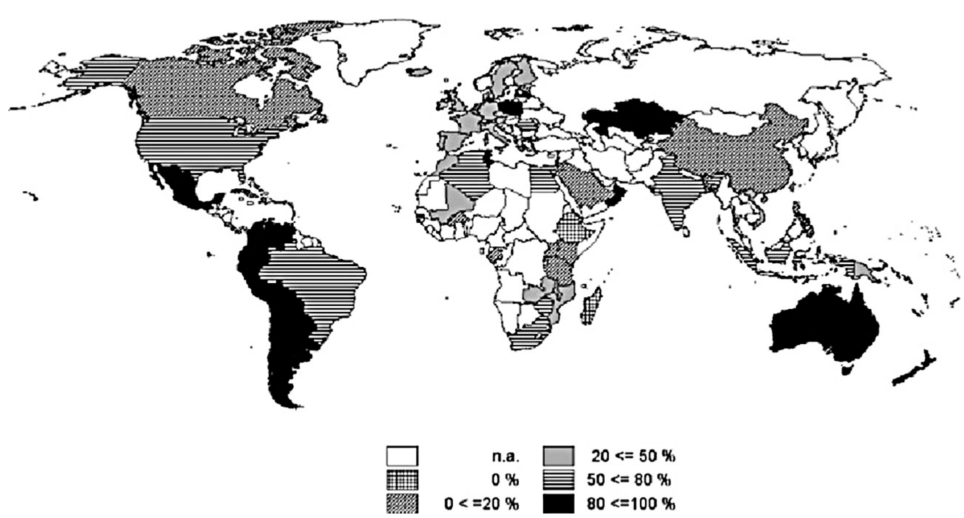
Alternativ können NTMs auch über Handelskosten approximiert werden. Diese Kosten werden durch eine Dummyvariable, welche die internationalen Grenzen beschreibt, erfasst. Hierbei wird der Einfluss von Ländergrenzen auf den Handel durch den Vergleich zwischen internationalen und inländischen Handelsflüssen gemessen (*McCallum*, 1995, S. 616). Der Koeffizient dieser „Grenz“-Dummy kombiniert mit Substitutionselastizitäten ermöglicht es dann, Wertzolläquivalente von NTMs zu berechnen (*Anderson/van Wincoop*, 2003, S. 178; *Winchester*, 2009, S. 826).

Die mengenbasierte Methode hat jedoch auch Einschränkungen, die bei der Anwendung berücksichtigt werden sollten. Neben den Nachteilen der ökonometrischen Schätzungen beschreiben *Bora* et al. (2002, S. 7) als hauptsächliches Problem die Endogenität zwischen Handelsbarrieren und Importen, da die Kausalitätsrichtung zwischen Handel und NTMs häufig nicht eindeutig ist. Hierdurch ist es schwierig zu erkennen, ob die Handelsbarrieren die Höhe der Importe bestimmen oder ob die Höhe der Importe die Anzahl der Handelsbarrieren bestimmt.

5. Alternative Indizes

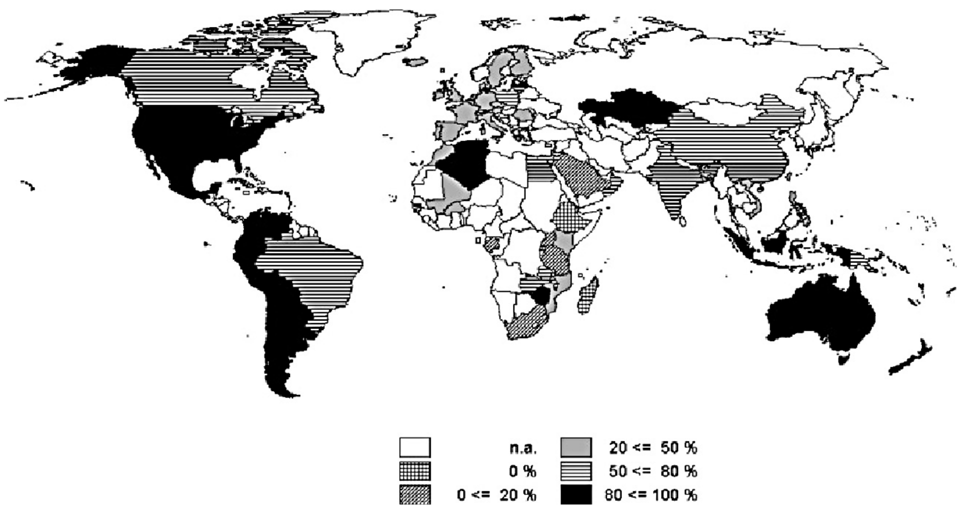
Für die Messung der Zollprotektion haben *Anderson/Neary* (1994, S. 151 ff., 2003, S. 627 ff.) den **Merkantilistischen Trade Restrictiveness Index** (MTRI) und den **Trade Restrictiveness Index** (TRI) entwickelt. Während der MTRI die importäquivalente Protektion misst, stellt der TRI einen wohlfahrtsäquivalenten Index dar. Die Indizes geben an, welche Handelsrestriktionen auf aggregiertem Niveau zu der anfänglich disaggregierten Protektionsstruktur import- oder wohlfahrtsäquivalent sind. Für den TRI heißt dieses beispielsweise, dass ein aggregierter Zoll aus mehreren einzelnen Zöllen abgeleitet wird, welcher in der Summe den gleichen Wohlfahrtsverlust hervorruft, wie die Gesamtheit der einzelnen Zölle.

Kee et al. (2009, S. 172) berechnen den TRI und MTRI erstmals für NTMs. Hierfür schätzen sie die Wertzolläquivalente mit ökonometrischen Modellen und aggregieren diese entsprechend des TRI- und des MTRI-Konzeptes (vgl. *Abb. 1*). Für die zukünftige Forschung wäre jedoch auch eine direkte Berechnung des TRI und MTRI ohne den Umweg über die Berechnung von Wertzolläquivalenten denk-



Quelle: Eigene Berechnungen, UNCTAD-TRAINS (http://r0.unctad.org/trains_new/datacoverage.shtm) und UN-COMTRADE (http://comtrade.un.org/) Datenbasis.

Abb. 2: Frequency Index von NTMs im Agrarbereich



Quelle: Eigene Berechnungen, UNCTAD-TRAINS (http://r0.unctad.org/trains_new/datacoverage.shtml) und UN-COMTRADE (http://comtrade.un.org/) Datenbasis.

Abb. 3: Coverage Index von NTMs im Agrarbereich

bar. Hierfür müssten Modelle spezifiziert werden, welche die Berechnung wohlfahrts- oder importäquivalenter NTMs ermöglichen. *Anderson/Neary* (2005, S. 131) liefern hierfür erste Ansätze indem sie die Handelsrestriktivität von Zollquoten und inländischen Subventionen theoretisch ableiten. Das Konzept der Handelsrestriktivität bietet noch viele Möglichkeiten für die weitere Forschung. Die Grenzen dieses Konzepts liegen allerdings in der mangelhaften Datenverfügbarkeit für empirische Berechnungen.

6. Anwendungsbeispiel

Abschließend wird der Frequency und der Coverage Index am Beispiel von Agrarprodukten empirisch berechnet. Auf der Grundlage der UNCTAD-TRAINS-Datenbasis konnten 150 verschiedene Maßnahmen für 97 Länder erfasst werden. Die Ergebnisse sind in den Abbildungen 2 und 3 dargestellt. Beide Indizes werden auf der Basis der bilateralen Importe ermittelt. Dabei erfolgt keine Berücksichtigung der prohibitiven Handelsbarrieren. Hierdurch wird die Häufigkeit der NTMs im internationalen Agrarhandel unterschätzt.

Beide Indizes weisen relativ ähnliche Werte aus und zeigen, dass NTMs im internationalen Agrarhandel eine große Bedeutung haben. Besonders häufig werden NTMs hiernach in Lateinamerika und Australien angewendet. Für viele andere Länder, wie beispielsweise die USA und Kanada weist der Coverage Index einen höheren Wert als der Frequency Index auf. Dies zeigt, dass in diesen Ländern insbesondere Produkte, die im Handel eine große Bedeutung haben, von NTMs betroffen sind.

Obwohl die zugrunde liegende Datenbasis sehr umfangreich ist und viele Informationen zu NTMs liefert, gibt es drei wesentliche Kritikpunkte, die bei der Interpretation der Ergebnisse berücksichtigt werden sollten. Erstens liegen den Länderdaten unterschiedliche Basisjahre (1993 bis 2005) zugrunde. Hierdurch ist ein Ländervergleich auf der Grundlage des gleichen Basisjahres nicht möglich. In dem Anwendungsbeispiel wurde daher immer das aktuellste Jahr gewählt. Zweitens weisen die Länder ihre NTMs auf unterschiedlich detaillierter Ebene aus. Um einen konsistenten Vergleich auf der gleichen Zolllinienebene zu ermöglichen, wurden im vorliegenden Beitrag die detaillierten Daten auf die kleinste gemeinsame Ebene aggregiert. Drittens sind die Länder in vielen Bereichen nicht dazu verpflichtet, ihre NTMs zu melden. Hierdurch spiegeln die Daten auch das Meldeverhalten der Länder wider und sind dahingehend verzerrt.

Ein Teil der beschriebenen Datenproblematik kann mit weiteren Quellen, wie beispielsweise der WTO-Datenbank oder der Datenbank der United States International Trade Commission (USITC), ausgeglichen werden. Dennoch stellt die Datenverfügbarkeit eine der größten Restriktionen für die Messung der NTMs dar. Daher zeigt dieser Beitrag auch Methoden auf, die eine indirekte Messung der NTMs ermöglichen. Dadurch kann die Höhe der Handelsrestriktion auch ohne direkte Informationen abgeschätzt werden.

Literatur

Agra Europe, EU rails at Chinese protectionism over pigmeat ban, Vol. AE2380, 25. September 2009, S. 3–4.

Anderson, J.E., J.P. Neary, Measuring the restrictiveness of trade policy, in: The World Bank Economic Review, Vol. 8/2 (1994), S. 151–169.

Anderson, J.E., J.P. Neary, Measuring the trade restrictiveness of international trade policy. MIT Press, Cambridge, Großbritannien, Massachusetts, USA 2005.

Anderson, J.E., J.P. Neary, The Mercantilist index of trade policy, in: International Economic Review, Vol. 44/2 (2003), S. 627–649.

Anderson, J.E., E. van Wincoop, Gravity with gravitas: A solution to the border puzzle, in: American Economic Review, Vol. 93 (2003), S. 170–192.

Andriamananjara, *S*., *J. Nash*, Have Trade Policy Reforms Led to Greater Openness in Developing Countries? World Bank Policy Research Working Paper No. 1730. Washington, D.C. 1997.

Beghin, J.C., *J.-C. Bureau*, Quantitative Policy Analysis of Sanitary, Phytosanitary and Technical Barriers to Trade, in: Économie internationale, Vol. 87/3 (2001), S. 107–130.

Bora, B., *A. Kuwahara*, *S. Laird*, Quantification of Non-Tariff Measures. Policy Issues in International Trade and Commodities Study Series No. 18. UNCTAD 2002.

Burger, M.J., F.G. van Oort, G.-J.M. Linders, On the Specification of the Gravity Model of Trade: Zeros, Excess Zeros and Zero-Inflated Estimation, in: Spatial Economic Analysis, Vol. 4/2 (2009), S. 167–190.

EU-Kommission, Fifth report on potentially trade restrictive measures in the context of the global economic crisis for the 133 Committee, November 2009.

Ferrantino, M.J., Quantifying the Trade and Economic Effects of Non-Tariff Measures, OECD Trade Policy Working Paper No. 28. OECD, Paris 2006.

Fugazza, M., J.C. Maur, Non-tariff barriers in CGE models: How useful for Policy?, in: Journal of Policy Modeling, Vol. 30 (2008), S. 475–490.

Kee, H.L.; A. Nicita, M. Olarreaga, Estimating Trade Restrictiveness Indices, in: The Economic Journal, Vol. 119/1 (2009), S. 172–199.

Laird, S., Quantifying Commercial Policies, in: *J.F. Francois, K.A. Reinert* (Hrsg.), Applied Methods for Trade Policy Analysis: A Handbook (1997), S. 27–75.

McCallum, J., National border matter: Canada-US regional trade patterns, in: American Economic Review, Vol. 85 (1995), S. 615–623.

OECD, Indicators of tariff and non-tariff trade barriers, OECD, Paris 1996.

Phillipidis, G., A.I. Sanjuán, An Examination of Morocco's Trade Options with the EU, in: Journal of African Economies, Vol. 16/2 (2006), S. 259–300.

Pöyhönen, P., A Tentative Model for the Volume of Trade between Countries, in: Weltwirtschaftliches Archiv, Vol. 90 (1963), S. 93–100.

Reinert, K.A., Gravity Models, in: *K.A. Reinert, R.S. Rajan, A.J. Glass, L.S. Davis* (Hrsg.), The Princeton Encyclopedia of the World Economy, Band 1 (2009), S. 567–570.

Santos Silva, J.M.C., S. Tenreyro, The Log of Gravity, in: The Review of Economics and Statistics, Vol. 88/4 (2006), S. 641–658.

Tinbergen, J., Shaping the World Economy. Suggestions for an International Economic Policy, New York 1962.

Van Tongeren, F., J.C. Beghin, S. Marette, A cost-benefit framework for the assessment of non-tariff measures in agro-food trade. OECD Food, Agricultural and Fisheries Working Papers Nr. 21, Paris, 2009.

Winchester, N., Is there a dirty little secret? Non-tariff barriers and the gains from trade, in: Journal of Policy Modeling, Vol. 31 (2009), S. 819–834.

Yue, C., J.C. Beghin, H.H. Jensen, Tariff Equivalent of Technical Barriers to Trade with Imperfect Substitution and Trade Costs, in: American Journal of Agricultural Economics, Vol. 88/4 (2006), S. 947–960.

3 Proliferation of Non-Tariff Measures and the Impacts on Food and Agricultural Trade

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Proliferation of Non-Tariff Measures and the Impacts on Food and Agricultural Trade

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Abstract

With decreasing tariffs, the importance of non-tariff measures (NTMs) is rising and profoundly distorting international trade flows. Most of the implemented NTMs are legitimate and support the purpose to reduce negative externalities. However, complex designs and hidden intentions make them perfect tools for disguised protectionism, especially in times of economic crisis. NTMs are not comprehensively documented, leading to lower quality data. In recent years, there was an attempt to considerably improve databases of NTMs. We make use of this improvement and gather different indicators on NTMs on a yearly basis to analyze their evolution and impacts on trade using a fixed-effects panel model. We particular focus on food and agriculture because this sector is mainly affected by NTMs. Based on our empirical results, we conclude that NTMs do have significant, negative effects on agro-food trade; but this greatly depends on the chosen indicator and the income level of the countries.

JEL classification: Q17, Q18, F14

Key words: non-tariff measures, food and agricultural trade, economic crisis, panel data, fixed-effects estimation

1 Introduction

Non-tariff measures (NTMs) are an integral part of agricultural trade policies and have become even more important since the recent economic crisis. While tariffs loose relevance due to commitments in multilateral frameworks of the World Trade Organization (WTO) and in preferential trade agreements, NTMs increasingly gain in importance and by far outweigh the relevance of traditional trade policies in distorting free trade flows (WTO, 2012). Traditional NTMs such as import quotas and voluntary export restraints are purely protectionist and controllable. In contrast, new instruments resulting from divergent regulatory systems and different perceptions of hazards and risks represent a major challenge for the future of liberalized trade, especially in sensitive sectors such as food and agriculture. These NTMs are mostly instruments to meet policy interests and objectives of the general public like the correction of market failures resulting from information asymmetries or imperfect competition. NTMs are also used to pursue non-economic goals like the protection of human and animal life and the environment (Bacchetta and Beverelli, 2012). Though trade-hindering, these measures can be useful and vital for both welfare and trade reasons. But NTMs are less transparent than tariff measures and consequently harder to identify and to discipline. That is why governments easily abuse NTMs for protectionist purposes in order to shield domestic producers from world markets, especially in times of economic crises and national policy challenges. Indeed, Baldwin and Evenett (2009) and Evenett and Wermelinger (2010) refer to NTMs as the dominant form of protectionism during the recent crisis. The slow redemption of these measures and unintended side-effects could aggravate the unstable economic situation and cause long-term trade-relation troubles of global nature.

For decades analysts have struggled to estimate the trade costs of NTMs to empirically reveal and to verify their impacts on trade. Contrary to tariffs, NTMs are difficult to tackle because of their complexity in design and high dimensionality in implications. Another central problem is in obtaining accurate data on NTMs. Adjustments in tariff schedules are well documented in publicly available databases and hence ready to analyze. In contrast there is no comprehensive reporting requirement for NTMs. Other reasons for missing data are the private nature of information such as of measures dealing with trade secrets of a business and because it is not possible to measure them directly. Publicly available data sets are limited and incomplete in terms of time and country coverage or there is no distinction for goods (Anderson and von Wincoop, 2004). However, NTMs vary considerably across goods and countries and indicate upward shifts in economically turbulent times. Besides, most data sets report recordings; but give no indication for the restrictiveness for the measures. On the one hand, more and more studies infer the effects of NTMs through comparisons of prices or trade quantities using gravity-like models, and on the other hand, there are more efforts in improving databases on NTMs on the global scale. In particular there are comprehensive data collection efforts by the United Nations Conference on Trade and Development (UNCTAD), the World Bank, the World Economic Forum and the International Trade Center which aim for transparency and sustainability of NTM data.

There is an increasing literature evaluating the effects of NTMs on trade using different direct indicators. However, we are unaware of any attempts made in comparing the performance of different proxies of NTMs and differentiating between effects on imports and on exports for the agro-food sector. We address this issue by making use of the improvement of databases and compose data on different indicators for NTMs on yearly basis to assess the effects on exports and imports separately. In general, we can conclude that trade costs are high and affect imports more than exports. Time to trade and burdensome customs procedures have the strongest impact on trade. We structure the remainder of the paper as follows. Section 2 gives an overview about the features and prevalence of NTMs. It also sketches WTO's approach to NTMs and examines their relevance in the recent economic crisis. Section 3 presents our data set and Section 4 describes the estimation methodology. The estimation results are presented in Section 5. Section 6 concludes.

2 Review on Non-Tariff Measures

2.1 Definition and Measurement of NTMs

Non-tariff trade measures include all policy instruments other than tariffs that can influence international trade flows. They distort commercial exchange by increasing trade costs. NTMs comprise a wide and diverse range of policy and regulatory measures. They can be divided into border measures and behind-the-border measures. The first category encompasses all measures impacting imports and exports such as quotas and other prohibitions, import licensing, customs procedures and other administrative fees, export taxes, export subsidies, and voluntary export restraints. The second category incorporates measures implemented in the domestic market such as domestic legislation in terms of food safety, animal and plant health, technical, labor and environmental standards, internal taxes or charges (Staiger, 2012). There are several other ways to categorize NTMs. The most detailed taxonomy on NTMs is served by UNCTAD classifying NTMs into 16 chapters and multiple subcategories (UNCTAD, 2013).

Diversity, complexity in design and lack of transparency in application make them very attractive to substitute tariff protection and challenge researchers in analyzing their effects on trade. A generally accepted and unified approach to evaluate NTMs does not exist. Analysts evaluate NTMs in studies using either qualitative or quantitative approaches. In addition, cost-benefit analyses provide systematic assessments of costs and benefits of NTMs as a basis for a policy decision making process (van Tongeren et al., 2009). Qualitative studies mostly consists of case studies and surveys examining specific countries, products or instruments and do not allow for drawing general conclusions. In terms of quantitative approaches, there are different methods and data to assess NTMs, including simple frequency and coverage ratios, price comparison measures and quantity impact measures based on gravity-type models. While the first group of measures only identifies countries and products where NTMs are most prevalent, the comparison measures bring all effective NTMs to one metric by calculating tariff equivalents. In that way the restrictiveness of NTMs is obtained that is directly comparable to tariffs.[1] This is the reason why simple frequency and coverage ratios for measuring NTMs have become less important. Instead, the theoretical and empirical exploration of methods to derive tariff cost equivalents of NTMs was intensified. The most ambitious study in terms of theoretical framework as well as country and product coverage is performed by Kee et al. (2009). They estimated ad-valorem tariff equivalents (AVEs) of NTMs using the information of NTMs from the UNCTAD Trade Analysis and Information System (TRAINS) database. The authors conclude that for

[1]See Deardorff and Stern (1997), Ferrantino (2006) and Carrère and De Melo (2011) for a review on methods to evaluate non-tariff trade measures.

the most products AVEs of NTMs are higher than the actual tariff. Also, other studies both empirical and qualitative confirm that NTMs are substantial barriers to trade, especially for developing countries (e.g. Anderson and von Wincoop, 2004; Chen and Novy, 2012; Hoekman and Nicita, 2011).

2.2 WTO and NTMs

On a multilateral level, NTMs have become an increasing concern for the WTO. While the General Agreement on Tariffs and Trade (GATT) adopted a marginal approach in treating NTMs, the WTO had to adapt this approach because of increasing relative dominance and global relevance (Staiger, 2012). After the success in decreasing tariffs to a minimum, the WTO is now aware of the danger of NTMs in distorting trade that erodes the long lasting efforts in trade liberalization. The conclusion of the Uruguay Round involved a tarification process to eliminate traditional welfare-reducing instruments such as quotas and voluntary export restraints. In addition, shortly after conception in 1995 the WTO implemented several agreements in order to strengthen the prohibition of some measures and to make the usage of NTMs more transparent. To support these measures, the WTO created the The Safeguard Agreement and the Subsidies and Countervailing Measures Agreement to regulate border measures. Behind-the-border measures are regulated in the Technical Barriers to Trade (TBT) and Sanitary and Phytosanitary Measures (SPS) Agreements. Nevertheless, there are many loopholes and flexibilities which allow governments to circumvent the rules and implement certain instruments as trade distorting measures. Though best implemented in a non-discriminate way and in justified cases, the reality shows that often the purpose is to protect domestic markets and to discriminate among trade partners. In addition, Long et al. (2013) show that the growing activity on food safety and animal and plant health issues in the last few decades is used as a substitute for traditional tariff barriers. Hence, regulating NTMs on multilateral level seems to be minimal and doubtful. The only promising progress in terms of NTMs regulation was made in the framework of the Trade Facilitation package within the Doha round negotiations. The perspective is to make trade easier by reducing trade costs resulting from complicated trade procedures, divergence in commercial rules and non-transparent information and procedures. In case of a conclusion of the Trade Facilitation talks, the trade community expects substantial gains through market access and more competitiveness (Carrère and De Melo, 2011).

In contrast to this relatively weak performance on the multilateral level, bilateral and regional agreements in terms of NTMs are more binding and hence allow deeper trade integration than in multilateral arrangements by covering a wide range of measures that are not issued on the multilateral framework. Hence, countries prefer negotiations on a bilateral level. On the one hand, it is easier to reach mutual recognition and harmonization of NTMs between two trade partners and hence foster trade within a special region. Considering spillover effects, regulatory systems are automatically spread oneself and could in some areas gradually lead to comprehensive regulatory convergence in world trade (CEPR, 2013). On the other hand, preferential agreements may contain the risk of creating unnecessary restrictive regulations, if asymmetric bargaining power exists.

Because of the lack of strict rules regarding non-tariff protection, NTMs are likely to be the reason for trade conflicts. On the multilateral level, WTO member countries are able to resolve trade quarrels under the Dispute Settlement Body (DSB) (WTO, 2013a). The DSB provides a platform upon which member countries may bring cases against other member countries for violations against agreements for commitments made in the WTO. Recording the disputes allows tracking the amount of incoming cases, the complaining countries, the respective agreements and the topics of trade conflicts. With the start of the Dispute Settlement Procedure in 1995, the number of cases increased rapidly and peaked in 1997 with 50 cases. After that there was a downward trend till 2005 with an exception in 2002. Since the recent financial and global economic crisis the amount of cases stagnated around an average of 16 cases and experienced a strong increase in 2012 with 27 cases (WTO, 2013b).

2.3 Economic Crisis and NTMs

There is a considerable amount of activity in the research community aimed at analyzing the features of the recent global crisis in general, and the origins and consequences of the trade collapse in particular (e.g., Anderton and Tewolde, 2011; Behrens et al., 2011; Eaton et al., 2011; Freund, 2009; Levchenko et al., 2010; OECD, 2010). Bems et al. (2012) present a thorough study on the causes for the trade breakdown based on a survey of the recent literature and conclude that changes in trade policies only have a marginal role in explaining the trade collapse, at least at the aggregate level. Also, Kee et al. (2013) assess trade policies during the economic crisis but differentiate between manufacturing and agriculture. They agree that protectionist measures did not cause the trade breakdown and they also conclude that protectionism did not rise due to economic downturn. However, they apply a narrow definition of trade policies considering only tariffs and trade defense measures such as anti-dumping and countervailing duties in their analysis, excluding all other forms of non-tariff policies. Other authors find evidence that many countries responded to the unstable and worrisome conditions of the economic crisis with protectionist policy instruments (e.g., Bussière et al., 2011). Brock (2009) states that policy makers tend to drift back into old habits by implementing protectionist measures in challenging policy situations. Also, Eaton et al. (2011) show that increasing trade barriers independently contribute to the alarming trade picture. Although changes in trade policies were heterogeneous across countries and relatively muted, they still have a strong impact. Evenett and Wermelinger (2010) emphasize that for specific sectors or trade partners increase in protectionist instruments might have been enormously involving significant changes in future trade policy agendas. Furthermore, it is argued that protectionism can be accounted as a reinforcing mechanism which challenges and aggravates the economic recovery. Hence, protectionist activity should neither be ignored nor understated. That is why the WTO and other organizations also call for alertness in terms of protectionist trade policies and their future resistance.

Generally, countries increase trade barriers in economic turbulent times to protect their domestic industries from foreign competitors and to boost local production (Basu et al., 2012). This time there were strongly contrasting developments as a result of the accompanied upward spike in the international food prices. Net importers of agro-food products reduced import barriers and net exporters raised export barriers, both with the aim of reducing the domestic price of food (Anderson and Nelgen, 2012). Though meant as short-term reaction to the crisis, there is a consensus that governments do not easily remove trade barriers and that protectionism is likely to persist in long-term jeopardizing more free trade in the future (e.g., Evenett, 2013). The leading industrial countries are aware of the danger of intensified protectionism for future economic growth and political relations. That is why the G-20 leaders publicly committed to open trade and investment regimes, resist protectionism and to expand markets. In order to have a control of these commitments, they authorized the WTO, UNCTAD and OECD to jointly monitor trade and investment policy measures adopted all over the world. The last report on that series was published in June 2013 and covers the review period mid-October 2012 to mid-May 2013. In that period more than 100 trade restrictions were recorded, which cover around 0.5% of G-20 imports, or equivalently 0.4% of world imports. The most frequent measures implemented during mid-October 2012 and mid-May 2013 were the initiation of trade defense actions, in particular, anti-dumping investigations, followed by tariff increases. In spite of the slowdown in the imposition of new trade restrictive measures, these measures add to the set of restrictions put in place since the outbreak of the global crisis. Most of these measures are still effective in distorting trade flows (WTO, 2013e).

The recent economic crisis led to the establishment of new databases to globally monitor the use of NTMs during the crisis and thereafter. Specifically, there are the Trade Monitoring Database as an initiative of the WTO and the Global Trade Alert (GTA) project providing information on policies that affect world trade since the outbreak of the crisis. According to the Trade Monitoring Database, import related measures (229) make the majority of implemented trade restricting measures, followed by trade defense actions (76) and export related measures (69). The initiation of other measures (2) constitute the smallest group of adopted trade distorting measures (WTO, 2013d). According to WTO estimates, the trade coverage of all import restrictions implemented since 2008, excluding those that have been withdrawn up to mid-May 2013, is around 3.6% of world imports, and around 4.6% of trade of G-20 countries. The slow removal of previous trade restrictions leads to the accumulation of trade restrictions. This development is of severe concern because the benefits of trade openness will be slowly and incrementally undermined (WTO, 2013e).

GTA database offers information on measures taken by governments during the last global economic downturn that are likely to affect cross-border trade. This initiative not only identifies countries implementing policies but also the trading partners that could potentially be harmed by these measures. The independent GTA team divides the measures according to the traffic lights color system, whereby green indicate low discriminatory power of the implied measures and red the highest discriminatory power (GTA, 2013a). Since January 2008 over 4,200 measures were implemented of which nearly 2,500 are protectionist measures. Manufacturing is the most affected sector, followed by the agro-food sector and services. The majority of applied protectionist measures comprise trade defense measures (524) as well as bailouts and state aid measures (519) (see Table 1).

Table 1: Global Trade Alert Measures

Measure Type	Total Measures	Green Measures	Amber Measures	Red Measures
Bail out / state aid measure	577	4	54	519
Competitive devaluation	6	0	0	6
Consumption subsidy	18	4	8	6
Export subsidy	116	3	29	84
Export taxes or restriction	216	57	37	122
Import ban	83	11	21	51
Import subsidy	14	4	9	1
Intellectual property protection	14	5	6	3
Investment measure	301	124	65	112
Local content requirement	89	4	32	53
Migration measure	212	85	31	96
Non tariff barrier (not otherwise specified)	289	69	45	175
Other service sector measure	49	9	20	20
Public procurement	94	3	38	53
Quota (including tariff rate quotas)	76	14	23	39
Sanitary and phytosantiary Measure	39	9	13	17
State trading enterprise	8	1	0	7
State-controlled company	32	3	4	25
Sub-national government measure	12	0	5	7
Tariff measure	863	455	135	273
Technical barrier to Trade	49	17	14	18
Trade defense measure	911	7	380	524
Trade finance	151	1	28	122

Source: GTA (2013b).

Russia, Argentina, India, Belarus and Germany are at the top of applying the most protectionist measures since the outbreak of the crisis. In general, the EU is the most active region in adopting protectionist measures. The country that is most affected by protectionist measures is China. About 45% of all protectionist instruments implemented worldwide negatively influence Chinese trading activities. In terms of implementing liberalizing and transparency-improving measures, Russia and Brazil are exemplary with over 100 measures (GTA, 2013b). Despite these high numbers, the GTA researchers conclude in their last report that there is an underestimation of the true extent of government interventions during the crisis due to hidden and obscured instruments. Furthermore, the time lag in reporting protectionist measures hides the jump in protectionism. As such, quarterly data show that there is a relatively stable number of implemented measures, partly with a decreasing rate, with two peaks, in the first quarter of 2009 and in the fourth quarter of 2012. First, this makes it clear that countries continue to implement harmful trade-related measures. However, the decreasing rate might give the impression that countries are eager to remove harmful measures. Because of the reporting lags, this development is misleading. GTA researchers conclude that there is an upward trend in protectionist measures and that there are no or only weakened efforts in withdrawing them affecting the long-term global trade picture (Evenett, 2013).

3 Estimation Strategy

To assess the relevance of trade barriers for food and agricultural trade, we apply a gravity-like equation. The gravity model is widely used in the international trade literature to assess different trade-related policies. The standard model explains bilateral trade flows by the sizes of the trading countries and other variables that affect the costs of trading between the two countries (e.g., distance, import tariffs, cultural adjacency, etc.). Anderson (2011) and Head and Mayer (2014) offer a thorough review of the theoretical and empirical developments of the gravity model. We adapt the standard specification of the gravity model in that we use aggregated trade flows from each country to the world. Specifically, we regress measures of tariff and non-tariff protection on the yearly level of food and agricultural imports and exports within each country. We apply a panel estimation for 141 countries covering the years 2002 to 2012. One major problem that can occur when estimating the effect of trade barriers on the level of agricultural trade is witnessing unobserved heterogeneity between countries. Unobserved heterogeneity causes biased and inconsistent estimates. Therefore, we use panel data to control for unobserved heterogeneity between countries to ensure unbiased and consistent estimators. The basic regression equation reads as follows:

$$\begin{aligned} ln(TRADE_{it}) &= \beta_1 + \beta_2 \; ln(TARIFF_{it}) + \beta_3 \; ln(NTM_{it}) + \\ & \quad \beta_4 \; CONTR_{it} + YD_t + c_i + \epsilon_{it}. \end{aligned} \tag{1}$$

Here, $ln(TRADE_{it})$ denotes the logarithmized imports or exports of food and agricultural trade. The variable $ln(TARIFF_{it})$ is the log of 1 plus the ad-valorem tariff on food and agricultural products and $ln(NTM_{it})$ denotes the logarithmized measure for non-tariff protection. $CONTR$ denotes a vector of control variables and YD is a yearly time dummy variable. c_i is a country fixed effect and ϵ is a random error term. The subscript i corresponds to the country dimension of our panel and t is the corresponding time subscript. Within our set of control variables, we try to capture factors other than tariff and non-tariff trade barriers that influence the level of trade in the agro-food products in countries. The most important aspects concern the country's level of industrial development. Fluctuations in macroeconomic activity do not affect different sectors within the production equally. The impact of economic expansion and recession upon trade in general and especially in the agro-food sector is rather asymmetric. An increase in the food and agricultural production enlarges the amount to be offered while the expansion of industrial production can reduce the number of workers as well as other resources like soil for the agro-food sectors. This effect may be most pronounced in lower income countries that are more likely to impose tariffs. We try to catch these effects through two control variables; the GDP growth in percent and the population density. In addition, we consider the political status of a country, the corruption perception and agricultural policy costs. This is supposed to capture effects of policy-driven dispersion of trade levels due to subsidies and external political pressure. Finally, we also control for trade effects resulting from regional trade agreements (RTAs). RTAs tend to increase trade among signatory countries because of duty-free commerce and harmonization of standards and regulations. The construction and sources of these variables are explained in the following section.[2]

To estimate specification (1) consistently, we have to be aware of the fact that a correlation between the country fixed effect c_i and the random error term ϵ cannot be ruled out completely. Even if the different control variables used reduce the correlation we cannot be sure that no heterogeneity is left unexplained. Therefore, we have to choose an estimation method that allows a correlation structure between the country fixed effect c_i and all other explanatory variables: the estimation of fixed-effects panel data models. It has to be kept in mind that fixed-effects estimation only use within-variation for the estimation. However, our panel spreads enough variation over time to ensure the identification of the variables of main interest. We estimate specification (1) for all trade measures by fixed-effects.

[2]Except for the GDP growth, all control variables enter the model in logarithmic form.

4 Data Set

We compile a panel data set containing information on trade flows, tariffs and NTMs and important control variables for the years 2002 to 2012 on a country-level. We source data on total agricultural import and export flows (in 1,000 US$) from the United Nations Commodity Trade Statistics (COMTRADE) database and average agricultural tariffs from UNCTAD TRAINS database using the World Integrated Trade Solution (WITS) software (World Bank, 2013b). Since there is no unique database on NTMs measures, we employ different available indicators from several sources. First, we use indicators on the prevalence of trade barriers and customs burden which come from the Global Competitiveness Dataset of the World Economic Forum (World Economic Forum, 2013). The data for constructing the indices was gathered through an executive opinion survey. In terms of prevalence of trade barriers, the respondents were asked "In your country, to what extent do non-tariff barriers (e.g., health and product standards, technical and labeling requirements, etc,) limit the ability of imported goods to compete in the domestic market?" The answer options scale ranges from 1 (strongly limit) to 7 (do not limit at all). In terms of customs burden, respondents were asked "In your country, how efficient are the customs procedures (related to the entry and exit of merchandise)?" The answer options scale ranges from 1 (not efficient at all) to 7 (extremely efficient). We multiply the indicators by -1 for interpretation reasons. Second, we use indicators from the Doing Business Dataset of the World Bank that offers country specific information on the costs (excluding tariffs) associated with exporting and importing a container by ocean transport (in US$ per container), time (in days) and the number of documents necessary to complete the transaction (World Bank, 2013a). Third, we use the number of notified SPS measures to the WTO from the SPS Information Management System (WTO, 2013c). Availability of data on yearly basis from 2002 to 2012 restrict our analysis to these indicators of NTMs.

To control for other factors that influence trade flows, we include variables that measure a country's economic and social performance. Specifically, we use data on GDP growth and population density (people per km^2 of land area) which are obtained from the World Bank. Information on political freedom is taken from the Freedom House. The index ranges from 1 (very good) to 7 (very bad). Hence, the higher the indices the more political constraints the countries experience (Freedom House, 2013). For interpretation convenience we multiply this index by -1. Additional controls are the total number of existing RTAs and an index of corruption perception. Information on RTAs is taken from de Sousa (2014) and on corruption from Transparency International (International Transparency, 2014). Finally, we also include an indicator for agricultural policy costs which come from the Global Competitiveness Dataset of the World Economic Forum. The data for constructing the index was gathered through an executive opinion survey in which respondents were asked "In your country, how would you assess the agricultural policy?" The answer options scale ranges from 1 (excessively burdensome for the economy) to 7 (balances well the interests of taxpayers, consumers, and producers) (World Economic Forum, 2013). Also here, we multiply the indicator by -1 for interpretation reasons.

All data is available on a yearly basis for 141 countries all over the world.[3] According to the World Bank classification, 48 of all countries are high-income countries, 93 are middle- and low-income countries. Detailed summary statistics on all variables separated for these groups of countries are presented in Table 2.

Our data set shows that high income countries have the highest trade flows compared to middle and low income countries. In terms of tariff protection, the applied weighted average tariff increases with the income level. More interestingly, the variance of tariffs is higher for high income countries than for the other group of countries referring to problems concerning tariff peaks and tariff dispersion in industrialized countries. Analyzing the competitiveness on the basis of the two available variables from the World Economic Forum that are related to NTMs, it is obvious that the competitiveness is better in high income countries than in middle and low income countries. In the same spirit, the Doing Business database measures on trading across borders reveal that high income countries have the lowest trade costs in terms of both imports and exports. This is particularly the case for the time indicator, where middle and low income countries have an almost three times larger value than high-income countries. In terms of the number of SPS notifications, high income countries notify on average four times more new SPS measures than middle and low income countries. The remaining variables reveal the characteristic differences between industrial and developing countries.

[3]Due to issues with data unavailability, we lack data for some countries in some years and therefore, we must adopt an unbalanced panel.

Table 2: Descriptive Statistics

High-Income Countries	Mean	Std	Min	Max	Obs
Import value	1.31e+07	1.95e+07	25057.9	1.13e+08	511
Export value	1.09e+10	2.04e+10	37548	1.45e+11	576
Weighted average tariff	5.329	11.5381	0	113.55	511
Time to import	12.744	7.1797	4	45	402
Documents to import	5.3532	2.0394	2	13	402
Cost to import	1079.535	419.7685	367	2780	402
Time to export	12.8532	5.6947	6	30	402
Documents to export	4.4801	1.4749	2	10	402
Cost to export	957.0373	331.6923	400	2595	402
Prevalence of NTBs	5.1894	.6506	3.4739	6.6587	339
Burden of customs procedures	4.8097	.7444	2.4660	6.4695	293
SPS notifications	35.1254	44.9570	0	410	542
Population density	674.8507	2498.632	.1372	19885.11	647
Total Nr of RTAs	34.1797	22.1018	0	71	612
GDP growth	2.9430	4.9365	-17.9550	27.4987	579
Corruption perception index	6.5460	1.9415	1.7	9.7	404
Freedom index	1.9625	1.7471	1	7	587
Agricultural policy costs index	4.0493	.6552	2.5156	6.1339	339
Middle- and Low-Income Countries					
Import value	1942206	5220842	741.694	8.72e+07	859
Export value	3.38e+09	8.20e+09	295	8.28e+10	876
Weighted average tariff	10.4347	7.8003	0	76.93	859
Time to import	32.8867	19.3212	8	104	1024
Documents to import	8.3506	2.5716	3	21	1024
Cost to import	1763.452	1177.977	317	9800	1024
Time to export	28.7949	16.6092	8	102	1024
Documents to export	7.0918	2.0638	3	15	1024
Cost to export	1471.479	939.495	295	8450	1024
Prevalence of NTBs	4.1927	.5248	2.2229	5.7356	572
Burden of customs procedures	3.6015	.6454	1.8256	5.5908	500
SPS notifications	9.2799	22.6791	0	196	636
Population density	119.7271	163.4581	1.5996	1188.41	1311
Total Nr of RTAs	15.9454	14.1875	0	71	1412
GDP growth	4.9093	4.6078	-17.6690	34.5	1264
Corruption perception index	3.0306	1.0254	.8	7.1	978
Freedom index	3.8346	1.7309	1	7	1412
Agricultural policy costs index	3.7630	.5717	1.5863	5.4868	572

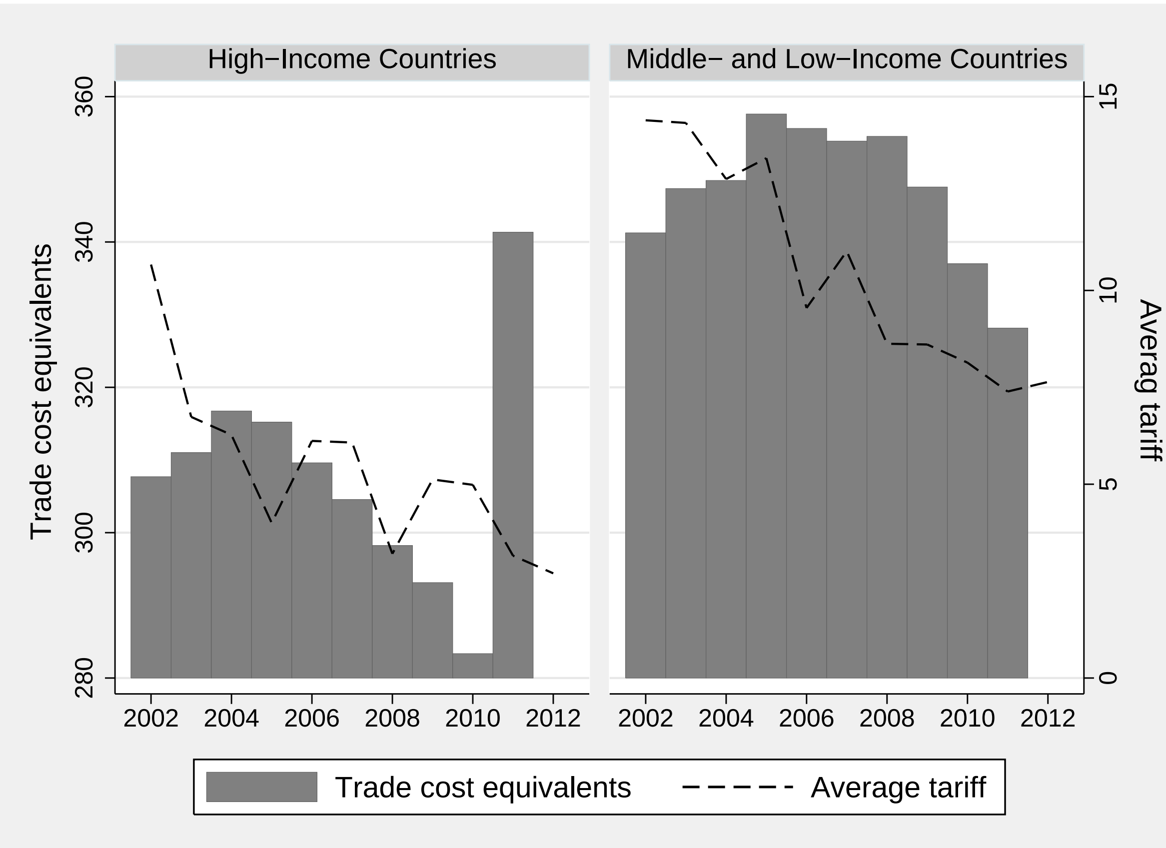
Source: Authors' calculations.

5 Empirical Results

5.1 Development over Time

To analyze the evolution of tariffs and non-tariff trade measures over time, we observe the average tariff and different proxies for NTMs. We particularly consider the trade cost measure offered by the World Bank to assess overall costs of trade policies (World Bank, 2014). The symmetric bilateral trade cost index which is expressed in tariff equivalents is derived from the inverse gravity framework and indirectly infers trade barriers from observable trade data. It summarizes all impediments at the border leading to the discrepancy between bilateral and domestic trade and hence represents a comprehensive measure of trade barriers (Novy, 2013). Figure 1 displays the development of tariffs and overall trade costs for two different income level countries. In general, there is a downward trend in the tariff both in high-income countries and in lower income countries. But the tariff in high-income countries is lower and is more characterized by falls and peaks. In contrast, lower income countries did not respond aggressively with tariffs during the economic crisis with an exception in 2007. In terms of trade costs, there is also a downward trend after 2004/2005. Even during the economic crisis there is no evidence of increases in trade costs. Very remarkable is the rise in trade costs for high-income countries in 2011.

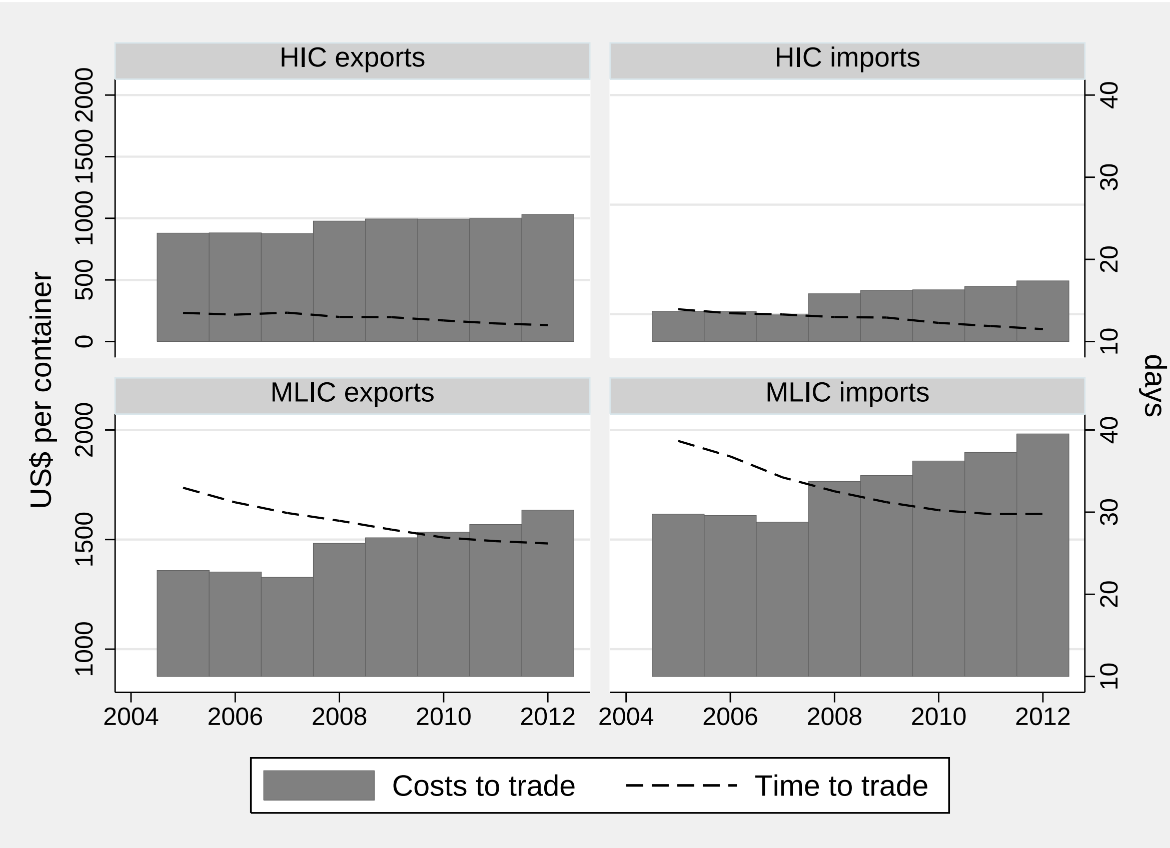
Figure 1: Tariffs and Overall Trade Costs over Time



Source: Authors' illustration. Data from World Bank (2013b, 2014).

We evaluate the development of NTMs over time using the indicators on import and export costs of cross-border trade from the Doing Business Database. The development is not clear cut. In terms of the absolute costs of ocean transport as a proxy for NTMs, both high-income and lower income countries experience an upward trend in imports and exports, whereas the costs to ship a container are much higher for lower income countries. In both income groups there is jump in trade costs in 2008 that might be an indication for protectionist responses in the economic crisis. However, in terms of the time to trade, there is clear downward trend; especially for lower income countries. With the onset of the economic crisis, trade costs stagnated in terms of time to trade.

Figure 2: Costs of Cross-Border Trade over Time



Note: HIC = High-Income Countries; MILC = Middle- and Low-Income Countries
Source: Authors' illustration. Data from World Bank (2013a).

5.2 Estimation Results

Now we turn to the discussion of the results obtained from the estimations that were previously elaborated. Table 3 reports the results for fixed-effects panel regressions of the logarithmic imports on tariff and non-tariff trade measures of each country. Equivalently, Table 4 exhibits results using logarithmic exports as dependent variable. The sample comprises all countries for the years 2002-2012. Tables A1 to A2 and Tables A3 to A4 in the Appendix show the results for subsamples according to income level. All columns include a set of control variables described above. Columns 1-6 contain the results for different proxies for non-tariff trade measures. In column (1), NTMs are measured by the time to import in days. Column (2) and (3) present estimates of the same model replacing the NTM indicator by the number of documents to import and the absolute cost to import. Column (4) and (5) employ the indicators on the prevalence of trade barriers and on burden of customs procedures, respectively. Finally, in column (6) we present estimation results using the number of SPS notifications as NTM proxy.

All control variables mostly show the expected signs and magnitudes of the effects, though they are not always significant. The higher the population density and the more RTAs countries have signed, the more they are expected to trade. In contrast, GDP growth and corruption tend to decrease import flows considering the whole sample. Exceptionally, higher corruption tends to increase trade for high-income countries. In terms of export flows, GDP growth has a positive effect; but the effect is mostly not significant. As expected agricultural policy costs decrease trade. Unexpectedly, more political freedom decreases trade. In regressions where we find a positive sign, the effect is not significant.

Turning to the results of trade measures in the whole sample regression, we find a negative effect of tariffs on food and agricultural imports throughout all six specifications. But the tariff effect is not significant. This result is in accordance with the trade literature that indicates tariffs as trade barriers. It also confirms the literature that tariffs are no longer significant impediments for trade. More importantly, we find a negative and significant effect of non-tariff protection for four NTM indicators. Estimation results from specification (1) and (2) show that time and the number of documents significantly affect the imports. Contradictory to our expectations, increased import costs have a positive and significant effect on imports. Also, using the indicator for the prevalence of NTBs and the number of SPS notifications reveal a positive effect. But this effect is not significant. In terms of NTMs related to customs procedures, the coefficient is negative and highly significant.

Table 3: Estimation Results (Dependent Variable: logarithmized imports)

	(1) time to import	(2) documents to import	(3) cost to import	(4) prevalence of NTBs	(5) customs burden	(6) sps notifications
log weighted tariff	-0.458	-0.744	-0.589	-0.851	-0.998	-0.427
	(0.589)	(0.600)	(0.581)	(0.602)	(0.639)	(0.573)
NTB measure	-0.514***	-0.340***	0.642***	0.226	-0.551***	0.000488
	(0.0862)	(0.110)	(0.0945)	(0.196)	(0.154)	(0.000509)
log population density	0.913***	1.179***	0.859***	1.136***	0.650***	0.922***
	(0.234)	(0.234)	(0.233)	(0.213)	(0.242)	(0.191)
log number RTAs	0.198***	0.234***	0.209***	0.239***	0.122**	0.344***
	(0.0486)	(0.0492)	(0.0478)	(0.0502)	(0.0530)	(0.0522)
GDP growth	-0.607**	-0.650**	-0.470	-0.756**	-0.224	-0.603**
	(0.294)	(0.301)	(0.293)	(0.303)	(0.293)	(0.280)
log corruption perception index	-0.375***	-0.430***	-0.396***	-0.423***	-0.348**	-0.309**
	(0.136)	(0.139)	(0.134)	(0.138)	(0.143)	(0.137)
log freedom rating	-0.245*	-0.379***	-0.288**	-0.378***	-0.239	-0.380***
	(0.140)	(0.142)	(0.138)	(0.143)	(0.146)	(0.129)
log agricultural policy costs	-0.315*	-0.339*	-0.215	-0.397**	0.397**	-0.528***
	(0.171)	(0.175)	(0.170)	(0.180)	(0.191)	(0.167)
Obs.	682	682	682	693	596	561
R^2	0.244	0.208	0.257	0.196	0.135	0.246

Note: Standard errors are reported in parentheses. Asterisks (*), (**) and (***) denote significance at the 10%, 5% and 1% levels, respectively.
Source: Authors' calculations.

A 1% increase in NTMs is expected to decrease imports by 0.34% to 0.55% on average. NTMs that are proxied by the number of documents have the lowest impact and burdensome customs procedures have the highest impact on imports. Due to the variables on time to import, documents on import and customs burdens only capture a fraction of all existing NTMs, the lower effects are reasonable. A possible explanation for the positive and insignificant coefficient for the prevalence of NTBs and the number of SPS notifications might be the countervailing effects of standards and technical regulations captured in these indicators. On the one hand, they can be trade beneficial in that they eliminate information asymmetries and hence expand demand. But on the other hand, they can work as trade barriers because of increasing compliance costs to meet the standards and regulations.

Analyzing the effects on exports, a similar picture appears, with the exception that the negative effect of tariffs is highly significant and much greater in magnitude. In terms of NTMs, there is a change in significance for the prevalence of NTBs and customs burdens and a change in the sign of the coefficient for the number of SPS notifications. Hence, customs procedures seem to be onerous for importing but not for exporting agro-food products. In contrast, a high prevalence of NTBs against foreign products significantly affects exports. Estimation results on trade barriers using subsamples according to income levels show mixed results (Tables A1 to A4 in the Appendix). Imports of lower income countries are mainly restricted by arduous customs procedures, followed by time consuming procedures and the amount of paperwork needed to facilitate importing. The same effects are observable for exports. Interestingly, the number of SPS notifications increase imports of lower income countries significantly. For high income countries only the time to trade is a significant restrictive factor. Thereby, exports are more affected than imports. Interestingly, high prevalence of NTBs in high income countries tends to significantly increase imports, but not the exports.

Table 4: Estimation Results (Dependent Variable: logarithmized exports)

	(1) time to export	(2) documents to export	(3) cost to export	(4) prevalence of NTBs	(5) customs burden	(6) sps notifications
log weighted tariff	-1.611***	-1.800***	-1.793***	-1.857***	-0.943	-1.629***
	(0.547)	(0.553)	(0.540)	(0.560)	(0.588)	(0.607)
NTB measure	-0.429***	-0.302**	0.445***	0.317*	-0.139	-0.0510
	(0.0908)	(0.120)	(0.0797)	(0.183)	(0.143)	(0.0522)
log population density	2.114***	2.388***	2.063***	2.590***	1.931***	2.273***
	(0.272)	(0.267)	(0.269)	(0.244)	(0.269)	(0.256)
log number RTAs	0.232***	0.255***	0.224***	0.238***	0.203***	0.347***
	(0.0434)	(0.0438)	(0.0432)	(0.0453)	(0.0469)	(0.0539)
GDP growth	0.111	0.123	0.291	0.0588	0.431	0.206
	(0.273)	(0.278)	(0.273)	(0.281)	(0.266)	(0.294)
log corruption perception index	-0.440***	-0.492***	-0.520***	-0.467***	-0.500***	-0.517***
	(0.137)	(0.138)	(0.134)	(0.138)	(0.144)	(0.153)
log freedom rating	-0.464***	-0.539***	-0.514***	-0.551***	-0.475***	-0.552***
	(0.132)	(0.133)	(0.130)	(0.134)	(0.136)	(0.136)
log agricultural policy costs	-0.283*	-0.315*	-0.220	-0.378**	0.136	-0.418**
	(0.161)	(0.163)	(0.160)	(0.168)	(0.179)	(0.175)
Obs.	629	629	629	640	551	534
R^2	0.343	0.322	0.354	0.339	0.241	0.340

Note: Standard errors are reported in parentheses. Asterisks (*), (**) and (***) denote significance at the 10%, 5% and 1% levels, respectively.
Source: Authors' calculations.

6 Conclusion

This paper analyzes the prevalence and the evolution of non-tariff trade measures and their impact on trade. Special focus is given to food and agricultural trade because protectionism is mainly concentrated in this sector. Using rich data from different sources, we can take advantage from a panel data set on yearly basis for most countries in the world. The estimation of fixed-effects models enables us to control not only for observed heterogeneity, but also for unobserved heterogeneity.

In our empirical analysis NTMs are measured either as an indicator of the prevalence of NTBs or of customs procedures provided by the Global Competitiveness Dataset of the World Economic Forum or by proxy variables such as the number of days to trade, the number of documents that are needed to complete the transaction and the costs to ship a standardized container across the border from the World Bank Doing Business Database. We also use the number of notified SPS measures to the WTO as a proxy for NTMs. In terms of evolution over time we also consider the trade cost index from the World Bank. Indicators for NTMs do not appear clear-cut in the development over time. While the costs of trading a container increased over time, the indicators of number on days and documents show the opposite development in the same time period. Also, the overall trade cost index is more likely to show a downward trend in trade costs. Instead, the competitiveness measures indicate an increase in NTMs starting with the economic crisis. Also, examining the data from the Trade Monitoring Database of the WTO and according to the analysis of the GTA project there was an increase in NTMs in recent years as implication of the economic crisis. In terms of trade impacts, our estimation results show that tariffs decrease imports in the agro-food sector, but this effect is not significant. In contrast, negative effects of tariffs on exports are highly significant. This indicates that tariffs in individual agro-food sectors harm the total agro-food exports more than imports through creating false incentives in diverting resources to protected sectors and neglecting the export industry. Additionally, we find a negative effect of non-tariff trade measures on imports and exports in most specifications. A 1% increase in NTMs is expected to decrease imports by 0.34% to 0.55% on average. Most measures indicate a drop in trade when NTMs are increased. The strongest impact is expected when applying the time cost measure and the lowest effect is observable when using the number of notified SPS measures as a proxy for NTMs. The prevalence of standards and technical regulations as well as the number of notified SPS measures do not reveal clear effects on trade. In differentiating the effects according to income level of countries the results become mixed in that the performance for imports and the subsample of middle and low income countries is generally better. Our results show that conclusions drawn with respect to the effects of NTMs on trade are sensitive to the chosen indicator for NTMs.

Our paper contributes to a large literature on the evolution and effects of non-tariff trade measures in the agro-food trade and it confirms the high relevance of these measures for international trade. Enhancing databases in terms of quality and comprehensiveness will foster the development of a consistent picture of NTMs and helps to understand their effects. However, our study affirms that more resources on data quality and collection are necessary to increase transparency and definiteness of NTMs, especially in times of economic crisis. Our study not only addresses the issue of data quality but also has implications for policy makers in pursuing the rules-based approach for NTM reduction on the multilateral level. There is a need to increase the awareness of the drastic and reinforcing effects of non-tariff protectionism on future structures of global trade. Since international trade is an engine for economic growth prevention of further implementation of protectionist trade barriers and the removal of existing measures should be a priority.

Appendix

Table A1: Estimation Results for High-Income Countries (Dependent Variable: logarithmized imports)

	(1) time to import	(2) documents to import	(3) cost to import	(4) prevalence of NTBs	(5) customs burden	(6) sps notifications
log weighted tariff	-0.630	-0.940	0.170	-0.199	3.917**	-0.637
	(1.458)	(1.491)	(1.441)	(1.431)	(1.751)	(1.454)
NTB measure	-0.365**	-0.0598	0.443***	0.691***	0.162	-0.000341
	(0.150)	(0.120)	(0.105)	(0.237)	(0.263)	(0.000469)
log population density	0.621***	0.695***	0.496***	0.623***	0.531***	0.644***
	(0.185)	(0.186)	(0.184)	(0.159)	(0.184)	(0.162)
log number RTAs	0.263***	0.294***	0.279***	0.246***	0.233***	0.300***
	(0.0504)	(0.0505)	(0.0471)	(0.0509)	(0.0539)	(0.0481)
GDP growth	-0.368	-0.347	-0.207	-0.415	0.186	-0.309
	(0.275)	(0.278)	(0.270)	(0.273)	(0.261)	(0.277)
log corruption perception index	0.309*	0.311*	0.282	0.360**	0.272	0.241
	(0.183)	(0.185)	(0.179)	(0.179)	(0.189)	(0.177)
log freedom rating	0.160	0.188	0.207	0.197	-0.00900	0.186
	(0.170)	(0.173)	(0.166)	(0.168)	(0.190)	(0.172)
log agricultural policy costs	-0.688***	-0.678***	-0.513***	-0.837***	-0.175	-0.727***
	(0.181)	(0.183)	(0.181)	(0.179)	(0.195)	(0.178)
Obs.	286	286	286	297	253	295
R^2	0.313	0.296	0.345	0.330	0.153	0.308

Note: Standard errors are reported in parentheses. Asterisks (*), (**) and (***) denote significance at the 10%, 5% and 1% levels, respectively.
Source: Authors' calculations.

Table A2: Estimation Results for Middle- and Low-Income Countries (Dependent Variable: logarithmized imports)

	(1) time to import	(2) documents to import	(3) cost to import	(4) prevalence of NTBs	(5) customs burden	(6) sps notifications
log weighted tariff	-0.455	-0.566	-0.609	-0.692	-1.199	0.00829
	(0.734)	(0.744)	(0.723)	(0.753)	(0.794)	(0.732)
NTB measure	-0.474***	-0.431**	0.692***	-0.0170	-0.619***	0.00185*
	(0.118)	(0.167)	(0.142)	(0.286)	(0.208)	(0.00111)
log population density	1.575***	2.161***	1.701***	2.376***	1.065**	2.158***
	(0.503)	(0.476)	(0.477)	(0.474)	(0.524)	(0.522)
log number RTAs	0.164**	0.207***	0.152**	0.203**	0.0770	0.427***
	(0.0771)	(0.0776)	(0.0763)	(0.0790)	(0.0830)	(0.114)
GDP growth	-0.777	-0.819	-0.725	-1.000*	-0.511	-1.005*
	(0.499)	(0.508)	(0.493)	(0.516)	(0.504)	(0.530)
log corruption perception index	-0.400**	-0.422**	-0.395**	-0.448**	-0.376*	-0.328
	(0.190)	(0.193)	(0.188)	(0.198)	(0.199)	(0.209)
log freedom rating	-0.251	-0.361*	-0.218	-0.370*	-0.250	-0.333*
	(0.202)	(0.203)	(0.200)	(0.206)	(0.204)	(0.194)
log agricultural policy costs	-0.132	-0.201	-0.150	-0.186	0.615**	-0.362
	(0.263)	(0.267)	(0.260)	(0.283)	(0.298)	(0.289)
Obs.	396	396	396	396	343	266
R^2	0.242	0.219	0.259	0.202	0.163	0.269

Note: Standard errors are reported in parentheses. Asterisks (*), (**) and (***) denote significance at the 10%, 5% and 1% levels, respectively.
Source: Authors' calculations.

Table A3: Estimation Results for High-Income Countries (Dependent Variable: logarithmized exports)

	(1) time to export	(2) documents to export	(3) cost to export	(4) prevalence of NTBs	(5) customs burden	(6) sps notifications
log weighted tariff	-6.204***	-6.494***	-4.395**	-5.170**	-6.033**	-5.577***
	(1.963)	(2.040)	(1.936)	(2.099)	(2.807)	(2.096)
NTB measure	-0.707***	-0.125	0.780***	0.440	0.226	-0.0486
	(0.195)	(0.237)	(0.146)	(0.322)	(0.379)	(0.0620)
log population density	1.771***	1.911***	1.561***	2.269***	1.856***	2.277***
	(0.330)	(0.337)	(0.324)	(0.297)	(0.344)	(0.298)
log number RTAs	0.325***	0.361***	0.296***	0.317***	0.291***	0.349***
	(0.0613)	(0.0636)	(0.0598)	(0.0686)	(0.0768)	(0.0639)
GDP growth	0.00152	0.0334	0.341	0.0916	0.657*	0.175
	(0.350)	(0.360)	(0.344)	(0.374)	(0.375)	(0.373)
log corruption perception index	-0.697***	-0.748***	-0.710***	-0.611**	-0.727***	-0.531**
	(0.231)	(0.237)	(0.224)	(0.242)	(0.268)	(0.236)
log freedom rating	-0.742***	-0.860***	-0.919***	-0.903***	-0.666**	-0.885***
	(0.220)	(0.224)	(0.211)	(0.232)	(0.275)	(0.233)
log agricultural policy costs	-0.564**	-0.520**	-0.288	-0.602**	-0.140	-0.537**
	(0.228)	(0.235)	(0.226)	(0.244)	(0.280)	(0.239)
Obs.	279	279	279	290	247	288
R^2	0.407	0.373	0.443	0.404	0.274	0.401

Note: Standard errors are reported in parentheses. Asterisks (*), (**) and (***) denote significance at the 10%, 5% and 1% levels, respectively.
Source: Authors' calculations.

Table A4: Estimation Results for Middle- and Low-Income Countries (Dependent Variable: logarithmized exports)

	(1) time to export	(2) documents to export	(3) cost to export	(4) prevalence of NTBs	(5) customs burden	(6) sps notifications
log weighted tariff	-1.486**	-1.558**	-1.680***	-1.676***	-0.684	-1.380**
	(0.595)	(0.601)	(0.595)	(0.605)	(0.606)	(0.665)
NTB measure	-0.368***	-0.325**	0.301***	0.150	-0.223	-0.00364
	(0.109)	(0.145)	(0.0991)	(0.236)	(0.165)	(0.0980)
log population density	2.608***	3.020***	2.755***	3.168***	2.073***	2.450***
	(0.437)	(0.414)	(0.428)	(0.412)	(0.440)	(0.502)
log number RTAs	0.144**	0.173***	0.142**	0.158**	0.131**	0.297***
	(0.0605)	(0.0612)	(0.0609)	(0.0618)	(0.0613)	(0.102)
GDP growth	0.321	0.321	0.377	0.155	0.201	0.395
	(0.411)	(0.418)	(0.415)	(0.423)	(0.383)	(0.482)
log corruption perception index	-0.464***	-0.482***	-0.537***	-0.525***	-0.469***	-0.641***
	(0.174)	(0.176)	(0.173)	(0.178)	(0.173)	(0.211)
log freedom rating	-0.333**	-0.373**	-0.350**	-0.384**	-0.390**	-0.408**
	(0.166)	(0.168)	(0.167)	(0.169)	(0.158)	(0.175)
log agricultural policy costs	-0.133	-0.224	-0.151	-0.218	0.234	-0.219
	(0.222)	(0.225)	(0.223)	(0.235)	(0.239)	(0.265)
Obs.	350	350	350	350	304	246
R^2	0.348	0.333	0.343	0.322	0.247	0.292

Note: Standard errors are reported in parentheses. Asterisks (*), (**) and (***) denote significance at the 10%, 5% and 1% levels, respectively.

Source: Authors' calculations.

References

Anderson, J.E. (2011), The Gravity Model, *Annual Review of Economics* 3, pp. 133–160.

Anderson, J.E. and von Wincoop, E. (2004), Trade Costs, *Journal of Economic Literature* 42(3), pp. 691–751.

Anderson, K. and Nelgen, S. (2012), Agricultural trade distortions during the global financial crisis, *Oxford Review of Economic Policy* 28(2), pp. 235–260.

Anderton, R. and Tewolde, T. (2011), The Global Financial Crisis. Trying to understand the global trade downturn and recovery, European Central Bank Working Paper No 1370.

Bacchetta, M. and Beverelli, C. (2012), Non-tariff measures and the WTO, VoxEU. URL `http://www.voxeu.org/article/trade-barriers-beyond-tariffs-facts-and-challenges`, accessed 15 September 2014.

Baldwin, R. and Evenett, S.J. (2009), Introduction and recommendations for the G20, in R. Baldwin and S.J. Evenett (eds.), *The collapse of global trade, murky protectionism, and the crisis: Recommendations for the G20*. CEPR 2009. A VoxEU.org publication. pp. 1-9.

Basu, S.R., Kuwahara, H., and Dumesnil, F. (2012), Evolution of Non-Tariff measures: Emerging Cases from Selected Developing Countries, Policy Issues in International Trade and Commodities Study Series No. 52, United Nations Publication.

Behrens, K., Corcos, G., and Mion, G. (2011), Trade Crisis? What Trade Crisis?, CIRPÉE Working Paper 11-17.

Bems, R., Johnson, R.C., and Yi, K.-M. (2012), The Great Trade Collapse, NBER Working Paper No. 18632.

Brock, W. (2009), Comments in Collapse in World Trade : A Symposium of Views, The International Economy.

Bussière, M., Perez-Barreiro, E., Straub, R., and Taglioni, D. (2011), Protectionist

Responses to the Crisis: Global Trends and Implications, *The World Economy* 34(5), pp. 826–852.

Carrère, C. and De Melo, J. (2011), Non-Tariff Measures: What Do We Know, What Might Be Done?, *Journal of Economic Integration* 26(1), pp. 169–196.

CEPR (2013), Reducing Transatlantic Barriers to Trade and Investment, an Economic Assessment, Final Project Report, Prepared Under Implementing Framework Contract TRADE10/A2/A16.

Chen, N. and Novy, D. (2012), On the measurement of trade costs: direct vs. indirect approaches to quantifying standards and technical regulations, *World Trade Review* 11(3), pp. 401–414.

de Sousa, J. (2014), International Economic Data and Programs. URL `http://jdesousa.univ.free.fr/data/rta/rta_faq.htm`, accessed 10 April 2014.

Deardorff, A.V. and Stern, R.M. (1997), Measurement of Non-Tariff Barriers, OECD Economics Department Working Papers, No. 179, OECD Publishing.

Eaton, J., Kortum, S., Neiman, B., and Romalis, J (2011), Trade and the Global Recessions, NBER Working Paper No 16666.

Evenett, S.J. (2013), What Restraint? Five years of G20 Pledges on Trade The 14th GTA Report, Center for Economic Policy Research.

Evenett, S.J. and Wermelinger, M. (2010), A snapshot of contemporary protectionism: how important are the murkier forms of trade discrimination?, in M. Mikic and M. Wermelinger (eds.), *Rising Non - Tariff Protectionism and Crisis Recovery*, pp. 8–26.

Ferrantino, M. (2006), Quantifying the Trade and Economic Effects of Non-Tariff Measures, OECD Trade Policy Papers, No. 28, OECD Publishing.

Freedom House (2013), Freedom in the World. URL `http://www.freedomhouse.org/reports#.VFLH X2doBSM`, accessed 02 November 2013.

Freund, C. (2009), The Trade Response to Global Downturn, Policy Research Working Paper No 5015.

GTA (2013a), Global Trade Alert - Measures. URL http://www.globaltradealert.org/measure, accessed 02 November 2013.

GTA (2013b), Global Trade Alert Database. URL http://www.globaltradealert.org/site- statistics, accessed 02 November 2013.

Head, K. and Mayer, T. (2014), Gravity Equations: Workhorse, Toolkit, and Cookbook, in K. Rogoff, E. Helpman and G. Gopinath (eds.), *Handbook of International Economics*, pp. 131–195.

Hoekman, B. and Nicita, A. (2011), Trade Policy, Trade Costs, and Developing Country Trade, *World Development* 39(12), pp. 2069–2079.

International Transparency (2014), Corruption by Country. URL http://www.transparency.org/country, accessed 10 April 2014.

Kee, H.L., Neagu, C., and Nicita, A. (2013), Is Protectionism on the Rise? Assessing National Trade Policies during the Crisis of 2008, *The Review of Economics and Statistics* 95(1), pp. 342–346.

Kee, H.L., Nicita, A., and Olarreaga, M. (2009), Estimating trade restrictiveness indices, *Economic Journal* 119, pp. 172–199.

Levchenko, A.A., Lewis, L.T., and Tesar, L.L. (2010), The collapse of international trade during the 2008-2009 crisis: in search of the smoking gun, NBER Working Paper No 16006.

Long, A.G., Kastner, J.J., and Kassatly, R. (2013), Is food security a new tariff? Explaining changes in sanitary and phytosanitary regulations by world trade organization members, *Global Economy Journal* 13(1), pp. 25–46.

Novy, D. (2013), Gravity Redux: Measuring International Trade Costs with Panel Data, *Economic Inquiry* 51(1), pp. 101–121.

OECD (2010), Trade and Economic Effects of Responses to the Economic Crisis, OECD Trade Policy Studies.

Staiger, R.W. (2012), Non-tariff measures and the WTO, Geneva, WTO Working Paper ERSD 2012-01.

UNCTAD (2013), Classification of Non-Tariff Measures February 2012 Version, United Nations Publication.

van Tongeren, F., Beghin, J., and Marette, S. (2009), A Cost-Benefit Framework for the Assessment of Non-Tariff Measures in Agro-Food Trade, OECD Food, Agriculture and Fisheries Working Papers No. 21, OECD Publishing.

World Bank (2013a), Doing Business Database. URL http://www.doingbusiness.org/data, accessed 02 November 2013.

World Bank (2013b), World Integrated Trade Solution (WITS). URL https://wits.worldbank.org/, accessed 02 November 2013.

World Bank (2014), Trade Costs Dataset. URL http://data.worldbank.org/data-catalog/trade-costs-dataset, accessed 10 April 2013.

World Economic Forum (2013), Global Competitiveness. URL http://www.weforum.org/issues/global- competitiveness, accessed 02 November 2013.

WTO (2012), World Trade Report 2012. Trade and public policies: A closer look at non-tariff measures in the 21st century.

WTO (2013a), Dispute settlement. URL http://www.wto.org/english/tratop_e/dispu_e/dispu_e.htm, accessed 02 November 2013.

WTO (2013b), I-TIP Goods: Integrated analysis and retrievel of notified non-tariff measures, Database. URL http://i-tip.wto.org/goods/Default.aspx, accessed 02 November 2013.

WTO (2013c), SPS Information Management System. URL http://spsims.wto.org/, accessed 02 November 2013.

WTO (2013d), Trade Monitoring Database. URL http://tmdb.wto.org/, accessed 02 November 2013.

WTO (2013e), WTO Report on G-20 Trade Measures. URL http://www.wto.org/english/news_e/news13_e/ igo_17jun13_e.htm, accessed 02 November 2013.

4 Moving toward the EU or the Middle East? An Assessment of Alternative Turkish Foreign Policies Utilizing the GTAP Framework

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Moving toward the EU or the Middle East? An assessment of alternative Turkish foreign policies utilizing the GTAP framework

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ABSTRACT

This paper assesses the new orientation in Turkish foreign policy towards the Arab world by analyzing the potential impact of Turkey's membership in either the European Union (EU) or the Greater Arab Free Trade Area (GAFTA). We utilize the most recent version of the Global Trade Analysis Project (GTAP) database, its global Computable General Equilibrium (CGE) model, and the gravity border effect approach to estimate the ad-valorem tariff equivalents (AVEs) of non-tariff barriers (NTBs). In our overall analysis, we account for 24 various sectors. However, in our evaluation, we focus primarily on the food and agricultural sectors because this sector is characterized by high tariff and non-tariff protection. In the CGE simulation analysis, we consider the removal of tariffs and NTBs simultaneously. After projecting the GTAP framework to 2020, we conclude that Turkey would gain unambiguously from EU membership, whereas Turkey's gains from GAFTA membership would be more limited. The paper also presents that the welfare gains from the removal of NTBs are of considerable importance and would generally be greater than the gains stemming from the elimination of import tariffs.

Introduction

Whether Turkey should be referred to as a European, a Middle Eastern or an Asian country has always been a crucial question. In recent years, this ongoing debate has attracted even more attention. The long-standing membership negotiations with the European Union (EU) and Turkey's so-called "axis shift" toward the Middle East have underscored the importance of this issue. There appears to be a trend in which Turkey is loosening its ties with the West and tightening its ties with the East.

The first step toward the integration of Turkey into the European community occurred in 1963 with the Ankara Association Agreement. The 1995 Customs Union Agreement continued this process with Turkey becoming an EU candidate country in 1999 and beginning its accession negotiations in 2005. Up until now the EU has always been Turkey's most important trading partner, accounting for 42% of Turkey's total trade in 2012 (Turkstat, 2013). Meanwhile, the EU continued to expand growing to its current size of 28 member countries. Since 2002, the Turkish government has restructured the direction of its foreign policy strategy becoming more politically aligned with the Arab world. The literature on Turkey's recent foreign policy seems to confirm this political shift and increasing involvement with the Middle East (e.g., Adam, 2012; Babacan, 2011; Candar, 2009; Ciftci and Ertugay, 2011; Evin et al., 2010; Sanberk, 2010). Turkey's Islamic roots, cultural and historical ties with the Arab world as well as its legacy to Ottoman Empire are identified as main triggers for this "axis shift" (e.g., Alessandri, 2010; Aybar, 2012; Habibi and Walker, 2011; Taspinar, 2008; Walker, 2011). This political realignment has directly affected the country's trade strategy. Although, the Turkish government claims that no exclusive policies are set for the Middle East and implementation of consistent foreign policies for different parts of the world are intended (Foreign Policy, 2010; Kara, 2011), the evidence clearly shows the opposite. Free trade agreements (FTAs) signed by Turkey in the last 10 years have mainly included countries in the Arab world. Currently, Turkey has eight FTAs with Middle Eastern countries.

Against this backdrop, we compare two options of the Turkish foreign policies by employing a global Computable General Equilibrium (CGE) model enriched with econometrically estimated ad-valorem tariff equivalents (AVEs) of non-tariff barriers (NTBs). Our aim is to contribute to the debate regarding whether Turkey will gain more from its political realignment toward the Middle

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East (e.g., through a potential membership in the Greater Arab Free Trade Area (GAFTA)[1]) over its potential EU membership.

There is an extensive body of literature assessing the potential impacts of Turkey's EU membership using CGE analyses (e.g., Acar et al., 2007; Eruygur and Cakmak, 2008; Philippidis and Karaca, 2009). However, only a small number of studies evaluate Turkey in terms of its FTAs as well as its integration with the Arab world (e.g., Acar and Aydin, 2011; Onthman et al., 2010; Sonmez et al., 2007). Recent literature indicates it is becoming more common to conduct a two-stage analysis by estimating the effects of NTBs and then implementing them in CGE models (e.g., Chang and Hayakawa, 2010; Fugazza and Maur, 2008; Philippidis and Sanjuán, 2006, 2007; Winchester, 2009). However, to the best of our knowledge, only Lejour and Mooij (2004) have utilized this approach to examine Turkey's potential EU membership. Zahariadis (2005) also considers technical barriers, although he does not use a gravity model to estimate the effects of NTBs. Moreover, none of the aforementioned studies reflect the economic effects of Turkey's relationship with Middle Eastern states. Therefore, this paper adds to the existing studies by assessing the impact of Turkey's relationship with its Eastern and Western neighbors and by simultaneously analyzing the removal of import tariffs and NTBs. We particularly focus on the food and agricultural sector, because in general this sector is characterized by high tariff and non-tariff protection, has therefore proven to be highly sensitive in negotiations of FTAs and is often left out when concluding an agreement of an FTA. The food and agricultural sector is also known for its heterogeneity in the tariff and non-tariff protection. We therefore work at the most disaggregated sector level to avoid aggregation bias in tariffs and NTBs (Brockmeier and Bektasoglu, 2014). Utilizing the gravity border effect approach and the Global Trade Analysis Project (GTAP) framework (Version 8), we compare Turkey's potential accession to the EU with its potential membership in GAFTA.

Our analysis is divided into two parts. In Section 'Introduction', we use the gravity border effect approach to estimate the effects of NTBs on the Turkey-EU and Turkey-GAFTA trade flows and convert the resulting effects into AVEs. In Section 'Overview of the Turkish trade structure and agreements', we incorporate these AVEs into the GTAP framework and derive economy-wide results for the enlargement of the EU and GAFTA to include Turkey. Accordingly, this paper is organized as follows. Following this introduction, we include a brief overview of the trade structure, focusing on the trade flows between Turkey and both the EU and GAFTA. We also consider Turkey's protection structure and its FTAs. In Section 'Econometric estimation with the gravity approach', we provide the theoretical and empirical framework that can be utilized to estimate AVEs of NTBs. In Section 'Simulations with the Global Trade Analysis Project (GTAP) framework', we explain how we integrate our results into the GTAP framework and present our final results. We conclude with Section 'Qualification of results'.

Overview of the Turkish trade structure and agreements

Turkey was ranked 32nd in world merchandise exports and 20th in world merchandise imports in 2011 (WTO, 2013). The most important destination for Turkish exports was the EU (46% of total Turkish exports), followed by Iraq, Russia, the United States and the United Arab Emirates. The majority of Turkish imports also originated from the EU (38% of total Turkish imports). Other important import markets for Turkey were Russia, China, the United States, and Iran (European Commission, 2013a). Although the EU share of Turkey's total trade has decreased since 1990, it has never fallen below 40%, and the EU remains a major trade partner of Turkey. Additionally, Turkey's trade share with other Middle Eastern countries in the last two decades hovered around the 10% mark; however, this share has increased in the last 5 years, reaching 22% in 2012, due to FTAs that came into effect in 2007 (Turkstat, 2013).

In Tables 1 and 2 below, we provide an overview of the commodity specific trade shares as well as source and destination specific trade shares between Turkey and its trading partners. Though we use data from 2007, the trade and protection structure of Turkey have predominantly remained unchanged. What has changed is the volume of trade from 2007 to 2013. The greatest shares of Turkey's exports to the EU and GAFTA are attributed to the light and heavy manufacturing sectors as well as services in the case of Rest of the World (ROW) (compare Table 1). Accounting for 71.47%, extraction ranks first in Turkey's imports from GAFTA. Heavy manufacturing contributes the most to Turkey's imports from the EU (58.92%).

Turkey's food and agricultural exports to the EU account for 6.03% of Turkey's total export to the EU, whereas the share of Turkish agro-food exports to GAFTA is equal to 11.13% of Turkey's total export to GAFTA. However, as shown in Table 2, the share of Turkey's agro-food imports from GAFTA (2.80%) is also not as high as the proportion of imports from the EU (30.42%). Moreover, the amount of food and agricultural exports, that is shipped to the EU, composes 44.21% of Turkey's total agro-food exports to the world, but this share is only equal to 17.45% for the Turkish agro-food exports to the GAFTA member countries (GTAP database, Version 8).

Table 3 presents the commodity-specific trade shares and applied tariff rates in the food and agricultural sector between Turkey and its trading partners. The italicized rows exhibit the sectors, in which exporters report where they most frequently face NTBs (European Commission, 2013b; Teknikengel, 2013; Önen, 2008; Özdemir, 2008). Vegetables and fruits (2.68%) and other food products (2.30%) compose the greatest share of Turkey's total exports to the EU within the agro-food sector, whereas other animal products (0.33%), other food products (0.89%) and beverages and tobacco (0.62%) comprise the largest groups of commodities imported by Turkey from the EU. In addition to the numbers given in Table 3, it is worthwhile to emphasize that Turkey already ships 52.97% of its vegetable and fruit exports and 43.55% of other food product exports to the EU. Also, 80.30% of Turkey's beverages and tobacco imports, 61.05% of other animal product imports and 56.46% of other food product imports are originating from the EU. These shares exhibit the importance of agro-food trade between Turkey and the EU.

The greatest agro-food share of Turkey's total exports to the GAFTA member countries is given for vegetables and fruits (1.74%), vegetable oils and fats (1.13%), and other food products (6.09%). Other animal products (0.15%), processed rice (0.44%) and other food products (0.15%) are the most important agro-food products in total imports from GAFTA to Turkey. Not shown in Table 3, but nevertheless important, is that Turkey ships nearly half of its other animal products and dairy exports to the GAFTA member countries. Turkey receives 65.04% of its processed rice imports and 45.26% of its sugar imports from GAFTA, whereas the shares of other animal products and other food products imports from GAFTA in total Turkish imports within these sectors are negligible (GTAP database, Version 8).

The Customs Union Agreement between the EU and Turkey provides for the free circulation of industrial goods but does not cover the food and agricultural products listed in Annex I of the Amsterdam Treaty.[2] The Turkish agro-food sector is moderately protected;

[1] GAFTA was established in 1957 and signed in 1997. It currently has 17 members, including Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, West Bank and Gaza, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates and Yemen.

[2] See http://.ec.europa.eu.

Table 1
Commodity specific trade shares between Turkey and trading partners (%).

	Turkey's exports to			Turkey's imports from		
	The EU	GAFTA	ROW	The EU	GAFTA	ROW
Food and agricultural products	6.03	11.13	9.31	3.04	1.43	5.99
Extraction	1.68	0.49	3.27	0.49	71.47	12.15
Light manufacturing	49.91	24.80	28.01	31.96	2.55	17.89
Heavy manufacturing	28.40	55.43	29.02	58.92	21.36	53.94
Services	13.99	8.15	30.39	5.58	3.20	10.03

Notes: please refer to Table A1 in Appendix A for the detailed regional and sector aggregation.
Source: GTAP Database, Version 8, Base Year 2007.

Table 2
Source and destination specific trade shares for commodities between Turkey and trading partners (%).

	Turkey's exports to			Turkey's imports from		
	The EU	GAFTA	ROW	The EU	GAFTA	ROW
Food and agricultural products	44.21	17.45	38.34	30.42	2.80	66.78
Extraction	46.40	2.91	50.68	1.75	49.97	48.28
Light manufacturing	70.35	7.47	22.18	61.01	0.95	38.04
Heavy manufacturing	50.22	20.95	28.83	47.82	3.40	48.78
Services	42.64	5.31	52.05	32.11	3.61	64.28

Source: GTAP Database, Version 8, Base Year 2007.

however, protection rates vary considerably at a more disaggregated level and for individual trade partners (compare Table 3). Sectors that have the greatest importance in Turkey's exports to the EU, namely vegetables and fruits and other food products, do not face high import tariffs. However, as it is reported by Turkish exporters, those are the sectors, in which the EU most frequently exhibits NTBs (highlighted in italics in Table 3). In Turkey, NTBs are reported to be high for the imports of other animal products and beverages and tobacco from the EU. Within these sectors, Turkish tariff rates are very high for beverages and tobacco imports (604.54%), whereas imports of other animal products from the EU are not restricted by tariffs. A similar picture is observed for the trade between Turkey and GAFTA. Turkey's most important exports to GAFTA (i.e., vegetables and fruits, vegetable oils and fats and other food products) are regulated by tariffs of 6.97%, 14.60% and 7.15%, respectively. However, it is also reported that Turkish exporters face NTBs specifically on these sectors. Imports of other animal products from GAFTA to Turkey are also not constrained by tariffs, although high NTBs are imposed on Turkey's exports of animal products to the GAFTA member countries (GTAP database, Version 8; European Commission, 2013b; Teknik Engel, 2013; Önen, 2008; Özdemir, 2008).

Turkey signed its first FTA with the European Free Trade Area member countries in 1991. This agreement was followed by the Customs Union Agreement between the EU and Turkey in 1996. Thereafter, several FTAs with Hungary, Romania, Lithuania, Estonia, Czech Republic, Bulgaria and Poland were signed. After the expansion of the EU in 2004 and 2007, those FTAs were modified according to Turkey's Customs Union Agreement with the EU. Turkey's recently concluded FTAs show the country's expanding relationship with the Arab world in recent years. Currently, Turkey has 8 FTAs with the Middle Eastern states. With the exception of its FTA with Israel, all of these agreements were signed after 2002.

Econometric estimation with the gravity approach

Theoretical and empirical framework

The estimation of trade costs of NTBs in this paper is based on the gravity model. The gravity model has become the standard model for empirically measuring expected bilateral trade using economy size and an additional set of control variables. The model's popularity is a function of its theoretical justification and its simple and flexible application.[3] In our analysis, we use the border effect approach to identify NTBs in the trade between Turkey and the EU and between Turkey and GAFTA member countries[4] in 2007. Originated by McCallum (1995) and theoretically advanced by Anderson and van Wincoop (2003), the border effect compares intra-national trade with international trade. The border effect reveals to what degree international trade falls below the trade within a country due to barriers resulting from an international border, i.e., tariffs, NTBs and all other border-related factors that might hinder trade. The border effect can also comprise of non-policy measures, such as transaction costs and consumer preferences for domestic products, and regulative measures which should not be eliminated. Restrictive regulative measures are a consistent subject of public debate caused by divergent perceptions of risks and different opinions on sensitive issues such as food safety and health issues. While the justifications of restrictive measures are reasonable in many cases, it might be doubtful in several others. The justification within the EU is administered within the process of achieving a Single European Market, and is, in many cases, a matter for the European Court of Justice. However, the elimination of these measures leads to higher welfare effects than the elimination of isolated border barriers related to policy measures would (Olper and Raimondi, 2008a). Although there might be an overestimation of border trade costs, the advantage of this approach is that the border effect takes into account all impediments, including those that are unobservable or that are difficult to measure directly. Particularly in agriculture, there is a dearth of reliable, updated statistics on the technical regulations and phytosanitary standards that significantly influence agro-food trade. To our knowledge, there are only a few papers that employ this border effect approach to agro-food trade in other countries; namely, Chang and Hayakawa (2010), Olper and Raimondi (2008a,b) and Winchester (2009).

Using the latest developments with regard to the specification of gravity models, we adopt the gravity-like equation developed

[3] See Anderson (2011) and Head and Mayer (2013) for a detailed review on gravity models.

[4] In our analysis, the GAFTA member countries include only 9 countries (Armenia, Bahrain, Egypt, Kuwait, Moroc-co, Oman, Qatar, Saudi Arabia and Tunisia) due to the available regional disaggregation in the GTAP database.

Table 3
Disaggregated agro-food specific trade shares in total trade and related bilateral applied tariff rates between Turkey and trading partners (%).

	Turkey's exports to				Turkey's imports from			
	The EU		GAFTA		The EU		GAFTA	
	Share of total	Tariff rate	Share of total	Tariff rate	Share of total	Tariff rate	Share of total	Tariff rate
Food and agricultural products	6.03	3.15	11.13	8.76	3.04	15.86	1.43	27.25
Wheat	0.02	4.90	0.00	6.20	0.10	92.26	0.03	116.24
Cereal grains	0.01	2.36	0.25	14.28	0.11	39.05	0.00	46.70
Vegetables and fruits	*2.68*	*3.20*	*1.74*	*6.97*	*0.06*	*1.22*	*0.13*	*6.39*
Oil seeds	0.07	0.00	0.02	29.91	0.32	0.00	0.01	17.24
Plant-based fibers	0.15	0.00	0.06	6.40	0.17	0.00	0.14	0.00
Crops	0.38	0.00	0.04	26.07	0.21	6.63	0.12	6.91
Cattle	0.01	0.31	0.00	0.32	0.02	1.84	0.00	4.43
Other animal products	*0.07*	*0.16*	*0.41*	*9.57*	*0.33*	*0.00*	*0.15*	*0.00*
Vegetable oils and fats	*0.09*	*104.48*	*1.13*	*14.60*	*0.07*	*44.92*	*0.03*	*39.62*
Dairy	0.04	25.94	0.55	2.47	0.06	102.41	0.02	127.31
Processed rice	0.00	23.84	0.00	19.94	0.03	13.60	0.44	20.73
Sugar	0.02	22.97	0.05	7.22	0.00	88.45	0.12	57.41
Other food products	*2.30*	*2.74*	*6.09*	*7.15*	*0.89*	*66.02*	*0.15*	*12.10*
Beverages and tobacco	*0.17*	*0.00*	*0.76*	*6.57*	*0.62*	*604.54*	*0.02*	*643.06*
Cattle meat	0.00	2.43	0.01	13.27	0.00	18.71	0.00	18.74
Other meat	0.01	2.16	0.02	11.02	0.02	50.41	0.00	50.49

Notes: Italicized rows exhibit the sectors, in which NTBs are most frequently reported by exporters.
Source: GTAP Database, Version 8, Base Year 2007.

by Anderson and van Wincoop (2003, 2004), in which relative prices play an important role. Their model takes the following form:

$$x_{ij} = \frac{y_j y_i}{y_w}\left(\frac{t_{ij}}{P_j \prod_i}\right)^{1-\sigma} \quad (1)$$

where x_{ij} is the value of the exports from country i to country j, y_i (y_j) is exporter (importer) production (consumption), y_w is the global output, t_{ij} is the bilateral trade resistance, σ is the elasticity of substitution between all goods, and Π_i and P_j are CES consumer price indices for i and j, respectively. The price indices in Eq. (1) represent the multilateral resistance terms (MRTs) that cannot be observed (Anderson and van Wincoop, 2003). These terms capture the costs of bilateral trade between two regions, which are affected by the average cost that each region incurs in trading with the rest of its trading partners. These MRTs form the substitutability between a country's different trading partners and make it possible to account for unobserved heterogeneity. Because each trading country has different prices for each commodity, we control for unobserved MRTs by specifying importer and exporter fixed effects (e.g., Chen, 2004; Feenstra, 2002; Olper and Raimondi, 2008a; Philippidis et al., 2013; Winchester, 2009). Thus, we include exporter and importer specific dummies. As such, the country dummies control not only for multilateral resistance but also for country-specific factors. Typically, the trade cost component t_{ij} is specified using a function of transport costs and a border variable. Replacing the cost function in Eq. (1) and taking the logarithm, we derive an empirical log-linear specification:

$$\ln x_{ij} = \alpha_i + \alpha_j + \beta_1 + \beta_2 \ln d_{ij} + \beta_3 \delta_{ij} \quad (2)$$

where $\alpha_i = \ln y_i - (1-\sigma)\ln \Pi_i$ is the fixed effect of the exporting country and $\alpha_j = \ln y_j - (1-\sigma)\ln P_j$ is the fixed effect of the importing country. Transport costs are approximated by distance (d_{ij}) between country i and j and the factor δ_{ij} takes a value of one if i and j are different countries and a value of zero if i and j are the same country; in this way, this border variable represents both international and intra-national trade (Anderson and van Wincoop, 2003). The constant β_1 is equal to $(-\ln y_w)$, $\beta_2 = (1-\sigma)\rho$ is the distant coefficient and $\beta_3 = (1-\sigma)\ln b_{ij}$ is the border effect coefficient to be estimated. Accordingly, $(b_{ij} - 1)$ is the tariff equivalent of all trade barriers resulting from an international border. Following the standard procedure in the literature, we extend our equation using an additional set of continuous and dummy control variables. The whole set of independent variables are defined in Table 4. We apply Eq. (2) with the full set of independent variables to 16 agricultural disaggregated sectors[5] and to one aggregated agro-food sector by pooling over the corresponding agricultural disaggregated sectors (see Table A1 in Appendix A).[6] In the pooled regression, we include sectoral dummies to account for sectoral heterogeneity and variables for production and consumption. Due to the use of the fixed effect approach, the importer-consumption and exporter-production coefficients explain only the sectoral dimension of bilateral trade. The most important parameters to estimate are the coefficients of the border dummies. Taking the antilog of the estimated border coefficient, we obtain the border effect, which quantifies to what degree international trade falls below intra-national trade. By controlling for the differences in tariffs, distance, and other unspecified trade costs in the gravity equation, we assume that the effects of the NTBs mainly determine the border effect.

Data and estimation technique

We source data on bilateral exports, production values, consumption values, bilateral tariffs, and export subsidies from Version 8 (base year 2007) of the GTAP database. To employ the border effect approach, we must also consider intra-national trade. Following Chen (2004), Wei (1996) and other authors, we calculate a country's exports to itself by subtracting each country's aggregate exports to all international destinations from its domestic production in each sector. The GTAP database offers information about 129 regions and 57 sectors. We reduce the number of regions to 79 by omitting composite regions and countries whose trade share with Turkey is less than 0.001 of total Turkish trade; we also

[5] In estimating border effects, we only use 16 of 20 food and agricultural sectors used in the simulations by omitting the generally untraded sectors paddy rice, sugar cane and beets, raw milk and wool.

[6] To avoid effects of aggregation bias in the econometric estimates and the CGE results we follow a disaggregated sector analysis. However, we only consider disaggregation in agro-food sectors because the inclusion of disaggregated non-food sectors goes beyond the scope of the paper. Therefore, the CGE analysis only considers a uniform efficiency improvement in the non-food sectors.

Table 4
Independent variables.

Independent variable	Description
Distance	Distance between i and j
Landlocked	Dummy variable; = 1 if country i and j are both landlocked
Contiguity	Dummy variable; = 1 if country i and j share a border
Language	Dummy variable; = 1 if country i and j have a common language
RTA	Dummy variable; = 1 if country i and j both are members of the RTA
WTO	Dummy variable; = 1 if country i and j both are members of the WTO
Colony	Dummy variable; = 1 if country i and j have colonial ties
Religion	Dummy variable; = 1 if main religion is the same in country i and j
LPI	Logistic performance index
Currency	Dummy variable; = 1 if country i and j have a common currency
Political restraint	Index for political restraint
AVEtariff	Ad-valorem tariff imposed by region j on imports from i
AVEesub	Ad-valorem export subsidy paid to exporters in region i for goods shipped to country j
EU	Dummy variable; = 1 if the dependent variable measures intra-EU trade
EUTUR	Dummy variable; = 1 if the dependent variable measures the exports to Turkey from the EU
TUREU	Dummy variable; = 1 if the dependent variable measures the exports to the EU from Turkey
GAFTA	Dummy variable; = 1 if the dependent variable measures intra-GAFTA trade
GAFTATUR	Dummy variable; = 1 if the dependent variable measures the exports to Turkey from GAFTA
TURGAFTA	Dummy variable; = 1 if the dependent variable measures the exports to GAFTA from Turkey
OTHER	Dummy variable; = 1 if the dependent variable measures any other international cross-border trade
Production	Production of country i
Consumption	Consumption of country j

reduce the number of sectors to the 16 food and agricultural sectors. Our regression analysis includes 99,856 observations. Of those 99,856 observations, 98,592 (= $79 \cdot 78 \cdot 16$) are bilateral cross-border trade observations, and 1264 (= $79 \cdot 16$) are intra-national trade observations. The information on distance, landlocked status, contiguity, common languages, currency and colonial relationships, and on membership in trade agreements and WTO membership comes from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII).[7] In our analysis, we use the population-weighted average distances between major cities in our countries of interest as the bilateral distances between countries. This enables us to use intra-national distances as well. Information on religion is gathered from the CIA Factbook[8] and on political freedom is taken from Freedom House.[9] The political freedom (political restraint) index included in the gravity equation is generated from the country-specific indices. The higher the index, the less politically free the countries are. The data on logistic performance are obtained from the World Bank.[10] The logistic performance index considered in the equation is the product of the country-specific logistic performance indices. The higher this index is, the higher the countries' logistic performance.

The presence of zero trade flows represents a serious challenge when estimating the log-linear gravity model using ordinary least squares (OLS). In our dataset, 7.3% of the total export flows are equal to zero, and the greatest percentage of zero trade flows are in the sectors oil seeds (24.6%), wheat (20.8%) and plant-based fibers (16.6%). Because the logarithm of zero is not defined, using OLS in these instances would involve the truncation or rescaling of the dependent variable. The deletion of zero trade flows and the subsequent loss of valuable information lead to biased results, particularly when those observations are non-randomly distributed. The second strategy, that of adding a small positive number to all trade values, is also theoretically and empirically inadequate. As several studies show, even small numbers can critically distort the results (Burger et al., 2009; Flowerdew and Aitkin, 1982; Linders and de Groot, 2006). An alternative way to handle zero trade values is to apply the two-stage Heckman selection procedure (Heckman, 1979). The first stage involves the use of a probit model which is the selection equation to capture the probability of trade. The second stage involves the use of an OLS regression augmented by the inverse Mills ratio, which is obtained from the first stage. A Wald test of the estimated coefficient of the inverse Mills ratio determines whether sample correction is required. The outcome equation is estimated using a dependent variable censored to nonzero values. The Heckit estimator offers a valid solution to the sample selection problem and thus has become the standard approach to specifying gravity equations (e.g., Philippidis et al., 2013; Raimondi and Olper, 2011; Xiong and Beghin, 2012). However, Santos Silva and Tenreyro (2006) show that using OLS to estimate the log-linear gravity model results in biased and inconsistent estimates in the presence of heteroskedasticity. The reason for this bias is Jensen's inequality, which implies that $E(\ln y) \neq \ln E(y)$ (Santos Silva and Tenreyro, 2006). Thus, the authors employ the more advantageous Poisson regression model derived from the Poisson distribution. This regression model deals with heteroskedasticity and addresses the skeweness and non-negativity constraint with an implicit log transformative function of the mean to adjust the critical issues. The model is estimated by maximum likelihood. Using the Poisson maximum likelihood estimator it is possible to account for zero observations making it favorable in gravity modeling. However, the equidispersion property of the Poisson distribution is very restrictive, requiring the conditional variance of the dependent variable to be equal to its conditional mean. Under weaker assumptions of correct specification of the conditional mean the Poisson pseudo-maximum likelihood (PPML) estimator provides robust estimates (Cameron and Trivedi, 2005).[11] In our econometric analysis, we proceed in three steps. First, we examine the gravity equation results for the pooled agro-food sector, comparing three different econometric specifications with a focus on the PPML estimator.[12] Second, we test the accuracy of the different estimators analyzing the out-of-sample prediction performance. Finally, we use the superior specification to further estimate the disaggregated border effects.

Estimation results

[7] Information on membership in trade agreements and in the WTO is updated using www.wto.org.

[8] See https://www.cia.gov/library/publications/the-world-factbook.

[9] See http://www.freedomhouse.org.

[10] See http://www.worldbank.org.

[11] Alternatively, Burger et al. (2009) suggest modified Poisson estimators that impose fewer restrictions on variance and allow more heterogeneity. The negative binomial (NB) specification properly accounts for overdispersion stemming from unobserved heterogeneity due to omitted variable bias by adjusting the distribution using a dispersion parameter. However, if the violation of equidispersion can be found in excess zeros, then the zip-inflated modeling techniques should be considered (the zip-inflated negative binomial or the zip-inflated Poisson model). These techniques address censored variables by specifying two equations. The first part is a logit regression that estimates the probability of zero trade values. The second part is a negative binomial or a Poisson regression. Because the NB and zero-inflated estimators have been criticized in terms of the sensitivity of the variance of their estimates (Santos Silva and Tenreyro, 2006) and convergence problems, we did not use these estimators in our study.

[12] In applying the Poisson estimation, we rearrange the gravity equation according to an exponential function.

In Table 5, we provide the estimation outcomes pooled over all observations. We use different econometric specifications. The first two columns report the OLS benchmark, and the last two columns show the Heckman and Poisson model results. Column 1 presents the OLS estimates using the logarithm of exports as a dependent variable and skips observations with zero trade flows (OLS1). Because the Breusch–Pagan test for heteroskedasticity confirms the presence of heteroskedastic estimators, we use a robust variance–covariance matrix. The results are comparable to other studies using OLS on truncated data with relatively high border effects. Column 2 shows the least squares results obtained using a rescaled dependent variable to overcome the problem of zeros (OLS2). Estimates differ slightly from the OLS1 regression and indicate a somewhat higher border effect. The third column reports the second-stage results of the Heckman regression. Like Raimondi and Olper (2011) and others, we exclude cultural dummies from the outcome equation for identification. In this way, we follow the theory of trade models with heterogeneous firms by assuming that those variables affect the fixed costs but not the variable costs of trade (Raimondi and Olper, 2011; Xiong and Beghin, 2012). The highly significant coefficient of the inverse Mills ratio provides sheds light on the sample selection problem. Using the Heckman procedure to correct for selection bias increases the effects of all variables except for currency and political restraint. The fourth column contains the Poisson model results considering all observations (PPML1). Compared to the OLS estimates, the Poisson estimates of nearly all of the variables are lower in absolute terms. The main differences are observed in the border effect coefficients. In 16 of 18 cases, the confidence intervals of the border effect estimates do not overlap. This result clearly indicates the serious bias, and thus, the overestimation of effects that is generated when OLS is used. Furthermore, the lower U-Theil statistic as a measure of forecast accuracy (Theil, 1958) supports the Poisson model. Because there is still a censoring at zero, the last column shows the results of the Poisson estimator using only positive observations (PPML2). The estimates are similar in magnitude and there is a consistent overlapping of confidence intervals. Hence, we can deduce that the zeros are not significantly dominating the results in the PPML estimation.[13] To check the robustness, we investigate the out-of-sample prediction performance of the different estimators in a Monte Carlo simulation for 50 replications. We obtain the mean squared error (MSE) as a measure for the precision of predictions[14] for a 20% random subset. The PPML1 estimator outperforms the other estimators because it presents the lowest MSE.[15] Thus, we conclude the PPML1 estimator is best indicated for use in the subsequent analysis of the disaggregated sector regressions to obtain bilateral border effects.

Most of the coefficients in Table 5 have the expected signs and are statistically significant. Production and consumption have a positive effect on trade flows in all regressions. As expected, the elasticity of trade with respect to distance is negative. According to the PPML1 regression, agro-food exports decrease by 0.81% if the distance between two countries increases by 1%. Furthermore, the coefficient of the number of landlocked countries indicates that the impact of geography on trade is very high in agro-food trade. Sharing a currency has a positive and significant effect, except in the truncated OLS and Heckman regressions. Consistent with our expectations, we find that contiguity and cultural adjacency also increase trade significantly. The effect of religious affinities is marginal and is only significant in the truncated OLS regression. Being in a mutual RTA increases trade significantly. Also as expected, we find that the membership of both countries in the WTO enhances trade. The coefficients for logistic performance and political restraint are within expectations and are highly significant. Tariffs have a significant and negative effect only in the Poisson model regressions. If tariffs increase by 1%, trade decreases by 0.4%. In the OLS regressions and in the Heckman model, tariffs and export subsidies have a significant positive effect. In contrast, the effect of export subsidies is not significant in the Poisson regression. Such contradictory and imprecise findings regarding the effects of policy variables are not uncommon in the literature and are also found by Philippidis and Sanjuán (2006, 2007), Philippidis et al. (2013) and Winchester (2009). Except for those of consumption, RTA, political restraint and logistic performance, the coefficients are greater in the OLS regressions than in the Poisson regression.

The coefficients of the border dummies are negative and highly significant. This result can be attributed to the negative effect of international borders. After controlling for distance and other trade cost, the ratio of i's exports to j to i's exports to itself is given by the exponential of the absolute value of the coefficient of the i–j border dummy (Anderson and van Wincoop, 2003). Because the value of the border coefficient for the EU in the PPML1 regression is -1.73, intra-national agricultural trade is 5.64 (= exp(1.73)) times greater than cross-border trade within the EU. This figure is similar to the results obtained by Chen (2004) and Olper and Raimondi (2008a). Intra-national agricultural trade is on average 4.9 times greater than cross-border trade among the GAFTA member countries. These numbers show that the incidence of NTBs among EU members is higher than the incidence of NTBs among GAFTA members, possibly because of European consumers' higher awareness of food safety and health issues. Furthermore, according to the PPML1 regression, the EU's exports to itself are 38.3 times greater than the EU's exports to Turkey. GAFTA's exports to itself are 39.2 times greater than GAFTA's exports to Turkey. These figures show that Turkey appears to implement similar NTBs for exports coming from the EU and GAFTA. Turkey's exports of agro-food products to itself are 18.1 times greater than Turkey's exports to the EU and 26.7 times greater than Turkey's exports to GAFTA. Thus, Turkey's exports to GAFTA face higher NTBs than Turkey's exports to EU member countries.

In Table 6, we report the border effects for the disaggregated food and agricultural sectors resulting from the PPML1 specification.[16] There are ten cases in which the coefficients of the border dummies are not significant and we thus assume a border effect of one. As expected, the border effects among EU member countries and GAFTA member countries are lower than the border effects affecting trade between Turkey and those countries. In the sectors for cattle, dairy, other food products, other meat and sugar, the border effects among EU member countries are significantly lower than those estimated for the trade between the EU and Turkey. By contrast, in the sectors beverages and tobacco, other animal products, other food products, other meat and processed rice, the border effects among GAFTA member countries are significantly lower than the border effect for GAFTA and Turkey. The greatest border effects are found to influence trade between Turkey and GAFTA, particularly when Turkey exports processed rice and cattle meat to GAFTA. Overall, the aforementioned sectors are characterized by very high border effects. The vegetables and fruits sector is subject to relatively low border effects, followed by the sectors of other food products, other animal products and cereal grains.

[13] We also analyzed the influence of zeros in the disaggregated sector regressions. In all 16 sectors the exclusion of zero trade flows does not significantly affect the PPML estimates.

[14] In order to compare the log-linear models with Poisson models we retransform the predicted values. The model producing the smallest MSE is being the better one.

[15] Detailed results on the out-of-sample prediction performance are available from the authors upon request.

[16] Detailed gravity estimation results for disaggregated sectors are available from the authors upon request.

Table 5
Regression results for pooled agro-food sector.

	OLS1 $\ln(X_{ij})$	OLS2 $\ln(1 + X_{ij})$	Heckman $\ln(X_{ij})$	PPML1 X_{ij}	PPML2 $X_{ij} > 0$
ln(Production)[a]	1.0975***	1.0743***	1.0769***	0.7444***	0.7454***
	(0.0066)	(0.0059)	(0.0063)	(0.0217)	(0.0218)
ln(Consumption)[b]	0.1017***	0.1058***	0.1021***	0.3196***	0.3186***
	(0.0077)	(0.0082)	(0.0074)	(0.0233)	(0.0234)
ln(Distance)	−1.0055***	−0.9980***	−1.0315***	−0.8058***	−0.8029***
	(0.0179)	(0.0190)	(0.0149)	(0.0387)	(0.0387)
Landlocked	−0.6334***	−0.6555***	−0.6362***	−0.5759***	−0.5739***
	(0.0629)	(0.0733)	(0.0863)	(0.0441)	(0.0441)
Contiguity	1.5758***	1.6457***	1.7389***	0.4073***	0.4101***
	(0.0547)	(0.0585)	(0.0438)	(0.0690)	(0.0689)
Language	0.2684***	0.2183***		0.5679***	0.5676***
	(0.0361)	(0.0390)		(0.0634)	(0.0633)
RTA	0.3832***	0.4164***	0.3938***	0.5211***	0.5181***
	(0.0322)	(0.0342)	(0.0296)	(0.0660)	(0.0659)
WTO	0.7310***	0.7400***	0.7608***	0.3058***	0.3045***
	(0.0802)	(0.0927)	(0.1034)	(0.0678)	(0.0678)
Colony	0.8203***	0.8499***		0.3306***	0.3282***
	(0.0585)	(0.0616)		(0.0962)	(0.0962)
Religion	0.0465*	0.0416		0.0594	0.0589
	(0.0229)	(0.0249)		(0.0663)	(0.0662)
LPI	0.0965***	0.0660**	0.1178***	0.4572***	0.4583***
	(0.0213)	(0.0228)	(0.0222)	(0.0841)	(0.0841)
Currency	0.0600	0.0980	0.0203	0.4696***	0.4688***
	(0.0573)	(0.0586)	(0.0567)	(0.0678)	(0.0678)
Political restraint	−1.4123***	−1.3620***	−1.3173***	−1.9695***	−1.9587***
	(0.1416)	(0.1507)	(0.1295)	(0.5716)	(0.5712)
ln(1 + AVEtariff)	2.9233***	3.1868***	2.9390***	−0.3951*	−0.4090*
	(0.1120)	(0.1211)	(0.0629)	(0.1910)	(0.1925)
ln(1 + AVEesub)	3.8500***	3.9109***	3.9166***	0.6133	0.6085
	(0.2396)	(0.2447)	(0.2070)	(0.3541)	(0.3547)
EU	−3.0648***	−3.2345***	−3.9144***	−1.7300***	−1.7350***
	(0.1083)	(0.1148)	(0.0924)	(0.1039)	(0.1039)
EU → TUR	−4.9996***	−5.1608***	−5.7638***	−3.6445***	−3.6494***
	(0.1916)	(0.2022)	(0.1641)	(0.2125)	(0.2125)
TUR → EU	−4.8756***	−5.0351***	−5.6452***	−2.8954***	−2.8961***
	(0.1689)	(0.1760)	(0.1620)	(0.2616)	(0.2617)
GAFTA	−2.9585***	−3.2023***	−3.5178***	−1.5881***	−1.5934***
	(0.1500)	(0.1581)	(0.1194)	(0.1803)	(0.1802)
GAFTA → TUR	−4.7011***	−4.9012***	−5.2797***	−3.6688***	−3.6715***
	(0.2542)	(0.2663)	(0.2328)	(0.5261)	(0.5263)
TUR → GAFTA	−4.7254***	−4.8531***	−5.3320***	−3.2842***	−3.2848***
	(0.1788)	(0.1848)	(0.2180)	(0.2696)	(0.2698)
Other	−4.1887***	−4.3516***	−4.9911***	−2.1621***	−2.1656***
	(0.1133)	(0.1201)	(0.0979)	(0.1353)	(0.1353)
N	92,550	99,856	99,856	99,856	92,550
R^2	0.7376	0.7524			
Pseudo R^2				0.9786	0.9783
Mills ratio			−0.4961***		
U-Theil			0.9954	0.0253	

Notes: standard errors in parentheses.
a and b Denote exporter's production and importer's consumption, respectively. Country- and sector-fixed effects are not reported.
Source: authors' own calculations.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

Calculation of tariff equivalents

The theoretical foundation of the gravity model enables us to utilize the quantitative effects of border barriers to compute border trade costs using the elasticity of substitution. The consideration of the substitution effect between domestic and foreign goods allows us to exclude consumer preferences from the border trade costs. Additionally, in controlling for transport costs approximated by distance and landlocked status as well as for other trade cost factors in the gravity equation the border trade costs are then supposed to reveal NTBs' effects (Winchester, 2009). To calculate the AVEs of non-tariff trade barriers, we use the formula $AVE_{ij} = \exp[\beta_{ij}/1 - \sigma] - 1$ (Anderson and van Wincoop, 2003), where AVE_{ij} is the AVE of border barriers. AVE_{ij} represents the average level of importing country protection and the minor effects of additional factors that are not captured by the trade barrier proxies in the gravity equation. The coefficient β_{ij} is applied to the border dummy δ_{ij}, and σ is the elasticity of substitution for domestic and imported goods. We employ the elasticity of substitution between goods from the GTAP database according to our disaggregated sector selection. In cases in which the border dummy coefficient is not significant, we assume that there are no border barriers or that the effects of these barriers are only marginal, which results in zero AVEs.

Table 7 reports the AVEs of the NTBs among EU and GAFTA member countries as well as the AVEs of the NTBs in the trade between the EU and Turkey and between Turkey and GAFTA. The AVEs of the NTBs among the EU member countries range from 17% for other meat to 428% for beverages and tobacco. In the total

Table 6
Border effects in disaggregated agro-food sectors.

	EU → EU	EU → TUR	TUR → EU	GAFTA → GAFTA	GAFTA → TUR	TUR → GAFTA
Wheat	4.2	25.6	30.2	161.1	115.3	2032.0
Cereal grains	5.1	14.0	121.2	17.7	46.0	21.9
Vegetables and fruits	1.0	11.9	4.7	4.7	20.7	6.8
Oil seeds	18.6	17.0	55.9	1.0	22.4	248.9
Plant-based fibers	20.9	434.8	26.2	91.4	474.5	21.5
Crops	27.0	19.8	60.8	6.1	12.2	388.5
Cattle	3.2	47.2	3.2	1.0	358.6	762.8
Other animal products	10.2	17.4	49.0	3.8	42.4	100.1
Vegetable oils and fats	1.0	22.4	28.3	1.0	537.8	36.8
Dairy	4.6	144.3	39.4	1.0	265.0	15.2
Processed rice	3.7	7.5	700.0	22.5	1.0	8920.4
Sugar	2.6	110.6	57.8	1.0	1.0	324.1
Other food products	6.0	42.3	21.3	4.6	106.5	15.7
Beverages and tobacco	8.7	25.6	17.0	16.9	1538.2	161.2
Cattle meat	3.3	449.6	118.9	39.3	510.9	1013.4
Other meat	3.5	282.9	260.2	6.0	300.8	310.2

Source: authors' own calculations.

Table 7
Ad-valorem tariff equivalents of NTBs (%).

	Among EU members	Among GAFTA members	On Turkey's exports to		On Turkey's imports from	
			The EU	GAFTA	The EU	GAFTA
Food and agricultural products	54.80	49.24	107.00	129.04	150.00	152.00
Wheat	19.89	90.28	53.91	162.26	50.78	82.38
Cereal grains	175.39	503.00	1905.54	588.56	421.41	994.83
Vegetables and fruits	0.00	77.82	77.06	103.43	150.16	207.38
Oil seeds	111.46	0.00	180.54	311.51	106.69	121.96
Plant-based fibers	113.84	209.23	126.22	115.31	356.63	366.72
Crops	82.03	38.78	111.02	195.67	72.04	57.67
Cattle	47.29	0.00	47.29	813.70	261.37	610.48
Other animal products	325.70	132.19	1038.87	1678.98	496.63	939.94
Vegetable oils and fats	0.00	0.00	81.68	90.42	74.17	207.33
Dairy	27.39	0.00	79.20	54.05	120.16	142.46
Processed rice	36.84	109.85	375.78	772.10	61.58	0.00
Sugar	24.51	0.00	151.47	272.07	191.40	0.00
Other food products	81.52	66.27	177.40	150.39	248.50	374.08
Beverages and tobacco	427.51	778.80	784.43	4889.51	1109.84	28,185.18
Cattle meat	19.76	73.00	104.05	180.95	148.85	153.64
Other meat	17.32	25.70	104.01	108.66	106.21	107.84

Source: authors' own calculations.

food and agricultural sector, the AVE of the NTBs for intra-EU trade is equal to 55%, which is nearly identical to the value of 56% that Olper and Raimondi (2008a) found in using a value of 5 for the elasticity of substitution. The AVEs of the NTBs among the GAFTA member countries vary between 26% for other meat and 779% for beverages and tobacco. In most sectors, the AVEs of the NTBs are higher among GAFTA countries than among EU member countries. The AVE of the NTBs of total food and agricultural trade is lower within GAFTA (49%) than within the EU. In seven sectors, the EU exhibits higher AVEs of NTBs than GAFTA. This is not surprising, since the EU is one of the regions with the most strict regulations and standards on food and agricultural products. Especially sensitive sectors such as sugar, meat, and milk products are highly protected by NTBs complicating the free trade flow even within the EU trade bloc. In contrast, the main obstacles for GAFTA member countries' intra-trade consist of customs and administrative inefficiencies and infrastructural problems. In spite of ambitious provisions in the agreement, there are a lot of NTBs in place which still represent massive hindrance in intra-GAFTA trade (Abedini and Peridy, 2008; IDIA, 2007; ITC, 2012). This might be reflected in our estimates showing a much higher magnitude of AVEs of NTBs among GAFTA members compared to intra-EU NTBs. In line with our results in terms of relatively high barriers in intra-bloc trade, the International Trade Center also concludes that NTBs cause many difficulties in trade and are mainly applied by partner countries within regional trade agreements (ITC, 2014).

In most sectors, Turkey's exports face higher NTBs in trade with GAFTA. The AVEs are much higher in the sectors of beverages and tobacco, cattle and other animal products. In contrast, Turkey's exports to GAFTA face much lower NTBs in the cereal grains sector. Turkey implements lower NTBs on exports from the EU than it does on products from GAFTA. The AVEs of the NTBs are much lower in the sectors of beverages and tobacco, cereal grains, other animal products and cattle. Only in three agro-food sectors (sugar, processed rice, and crops) are the AVEs of the NTBs for EU exports higher.

In general, the AVEs of the NTBs used in the trade between Turkey and the EU as well as in the trade between Turkey and GAFTA are very high. In particular, the NTBs in the trade involving GAFTA appear to be higher than the NTBs in the trade involving the EU. Very high AVEs for NTBs in food and agriculture are also estimated in other studies focused on the quantification of NTBs (e.g., Chang and Hayakawa, 2010; Philippidis and Sanjuán, 2006, 2007; Winchester, 2009). The AVEs of the NTBs in the disaggregated food and agricultural sectors that are presented in this paper are in most cases reasonably consistent with or lower than those given in the literature (Philippidis and Sanjuán, 2006, 2007; Winchester, 2009). The only exception is the strikingly high AVE of the NTBs in beverages and tobacco, which is not comparable to the value of 242.7–730.4% that was presented by Philippidis and Sanjuán (2006, 2007).

Following Winchester (2009), we use the existing border barriers among EU member countries as a benchmark for the scenario in which Turkey joins the EU. The calculated border trade costs among EU member countries mirror the current status of actual internal market barriers comprising justified, but also unjustified trade barriers (also compare Section 'Theoretical and empirical framework'). This current status of actual internal market barriers provides the most harmonized and least restrictive level of NTBs among the EU member countries compared to foreign trade (European Commission, 2013c; Weiler and Kocjan, 2005). In our analysis we assume that Turkey's integration into the EU would generate a similarly low level of NTBs for the EU and Turkey. With this approach, we furthermore assume that the current level of NTBs including a justified share related to comprehensible food safety, health concerns and cultural values, and a proportion of unjustified restrictive measures will be maintained.[17] Analogously, we also use the existing border barriers among GAFTA members as a benchmark for the scenario in which Turkey joins GAFTA, assuming that the effects of NTBs among GAFTA member countries are low and that this development would generate a similarly low level of NTBs for GAFTA and Turkey.

We calculate the AVEs of the NTBs for EU exports to Turkey by subtracting AVE_{EU} from $\text{AVE}_{EU/\text{TUR}}$ if AVE_{EU} is lower than $\text{AVE}_{EU/TUR}$. In the same way, we calculate the AVEs of the NTBs for Turkey's exports to the EU by subtracting AVE_{EU} from $\text{AVE}_{TUR/EU}$ if AVE_{EU} is lower than $\text{AVE}_{TUR/EU}$. In cases in which AVE_{EU} is greater than $\text{AVE}_{EU/TUR}$ and $\text{AVE}_{TUR/EU}$ in absolute terms, we assume that the accession of Turkey to the EU would not change the level of NTBs among the EU countries and Turkey. We also calculate the AVEs of the NTBs for GAFTA's exports to Turkey and for Turkey's exports to GAFTA in the same manner. In cases in which AVE_{GAFTA} is greater than $\text{AVE}_{GAFTA/TUR}$ and $\text{AVE}_{TUR/GAFTA}$ in absolute terms, we assume that Turkey's joining GAFTA would not change the level of NTBs between the GAFTA countries and Turkey.

Simulations with the Global Trade Analysis Project (GTAP) framework

GTAP model and data

The CGE simulations in this paper utilize GTAP which is a comparative static multi-region general equilibrium model. The standard GTAP model provides a detailed representation of the economy, including the linkages between the farming, agribusiness, industrial, and service sectors of the economy. The use of the non-homothetic constant difference of elasticity to handle private household preferences, the explicit treatment of international trade and transport margins and the inclusion of a global banking sector are innovative features of the GTAP model. Trade is represented by bilateral matrices based on the Armington assumption. Additional features of the standard GTAP model are perfect competition in all markets and the profit- and utility-maximizing behavior of producers and consumers. All policy interventions are represented by price wedges. The framework of the standard GTAP model is well documented in Hertel (1997) and is available on the Internet.[18]

Francois (1999, 2001) developed an approach in which NTBs are modeled as iceberg or dead-weight costs and used this method to study the Doha Round of the WTO negotiations. This approach has been extended by Hertel et al. (2001a,b), who also aimed to integrate NTBs into GTAP modeling, treating NTBs as unobserved trade costs that are not explicitly covered by the GTAP database. The authors introduce an additional "effective" import price that is a function of the observed import price and an exogenous unobserved technical coefficient. Hence, the removal of trade costs from a particular exporter is reflected in an increase in technology. The effective import price falls and thereby mirrors a reduction in real resource costs (Hertel et al., 2001a, p. 13). This approach to modeling the change in NTBs as a reduction in trade costs draws on the iceberg transport cost theory that was originally introduced by Samuelson (1954). An increase in technology and the corresponding efficiency enhancement furthermore implies that the effective imported quantity is increased. Thus, imports are more competitive and lead to the substitution of imports from other regions (Hertel et al., 2001a, p. 13).

In addition, NTBs also generate protection effects that might be captured via import tariffs. Andriamananjara et al. (2003, 2004) and Fugazza and Maur (2008) offer a thorough study of the impact of NTBs in regional and global CGE models comparing the iceberg cost approach and the approach that involves capturing NTBs via import tariffs. Effects of NTBs are measured by the price wedges between domestic and world prices, when NTBs are modeled with the help of import tariffs. This import-tariff approach to represent NTBs creates a rent that is associated with the NTBs and is captured by the importer. Modeling NTBs with the help of the iceberg cost approach is also referred to as the "sand in the wheels" of trade or the "efficiency approach" by the authors. In the iceberg cost approach, it is thus assumed that NTBs are efficiency losses rather than rent-creating mechanisms, and as aforementioned, by using import-augmenting technology shocks, real resource cost raising effect of NTBs are abolished. The results obtained from both papers show that there are surprisingly substantial differences in the outcomes of the experiments if NTBs are modeled with the help of import tariffs or technological change variables, although the two approaches tend to affect the terms of trade in a similar manner. The authors emphasize that the use of the import tariff approach to model NTBs and the corresponding artificial rent-creating and tariff revenue mechanism requires a very careful analysis of the resulting welfare effects (Fugazza and Maur, 2008). The authors also conclude that the efficiency modeling of NTBs tends to weigh heavily in the overall large, positive welfare gains. Chang and Hayakawa (2010), Philippidis and Carrington (2005), Philippidis and Sanjuán (2006, 2007) and Winchester (2009) obtained the same results using estimated AVEs of NTBs in a CGE model applying the iceberg cost approach. Based on these findings, we utilize the iceberg cost approach for our simulations with the GTAP model. By reducing the estimated AVEs of NTBs to the benchmark level, we try to obtain more reliable results than would be possible with the complete removal of the NTBs. However, the results obtained using this approach should still be interpreted with caution.

Experiment design

In the following GTAP analysis, we employ the most recent version of the GTAP database, Version 8. We combine the original 129 countries and regions and the original 57 sectors into a 24-sector, 14-region aggregated version. In so doing, we single out major trading partners of the EU and Turkey as well as other countries that are currently involved in FTAs with Turkey. In the sector

[17] We are unable to identify the justified and unjustified share of the trade barriers in our estimated NTBs.

[18] See https://www.gtap.org.

aggregation process, we match the sectors that are predefined in the gravity model approach. Hence, we use all available food and agricultural sectors and split the non-food sector into four sectors. Countries, regions and sectors are highlighted in more detail in Table A1 in Appendix A.

The base year in Version 8 of the GTAP database is 2007. In our study, we develop a baseline projected from the benchmark year 2007–2020. Given that the base year in this global database is 2007, it seems that the political environment is fairly up to date. The MFA quota has already been phased out (in 2005) and the 2004 and 2007 expansions of the EU have already occurred. China is a member of the WTO fulfilling its scheduled obligations.[19]

To generate a comparison with the baseline, two alternative enlargement experiments are conducted. We assume that by 2020, Turkey will be either an EU member or a GAFTA member country. We use pre-experiments to take into account political and economic changes in the environment that have taken place since 2007. In addition to changes in the political environment, economic developments, such as technical progress and the related growth of the economy, are of great importance. By considering these changes, we extend the GTAP framework to the year 2020. We include exogenous projections of GDP and factor endowments in the extended GTAP model. Technical progress is generated endogenously by the model to facilitate these projections. The data for the corresponding shocks are taken from the CEPII, the United Nations, and the World Bank. In the GAFTA simulation in which Turkey becomes a member, we simulate the FTAs with Turkey using those of Albania, Georgia, and Chile. We exclude the FTAs with Montenegro, Serbia and Jordan because these nations are part of composite regions in Version 8 of the GTAP database and thus, country-level data are not available for them. Algeria is also omitted despite having become a member of GAFTA in 2009 because Algeria is also part of a composite region in the GTAP database. In a scenario in which Turkey becomes a member of the EU, the country would need to withdraw from any FTAs with third-party nations (European Commission, 2013d; Turkish Undersecretariat of Foreign Trade, 2013). Hence, we disregard all of Turkey's FTAs in the EU expansion simulation.

Given the above information, in both simulations, we consider the bilateral elimination of import tariffs and the full removal of bilateral benchmarked NTBs from all sectors.[20] However, the scenarios in which Turkey becomes a member of either the EU or the GAFTA differs with regard to the change in the tariffs applied to imports from third countries. Turkey's import tariffs are unchanged in the case of the GAFTA membership. On the contrary, Turkey's import tariffs are adapted to the EU customs union's tariff level after becoming an EU member. Thereby, we account only for short-term effects of both trade agreements. Long-term effects of a deeper integration between the member countries are not taken into account. This is particularly important for Turkey's long-term EU membership, which might involve the effects of more policy changes such as the benefit of transfers within the first pillar of the common EU budget, the reform of environmental policies or the free movement of labor.

Simulation results

In this section, we discuss the results of the experiments that explore Turkey's inclusion into either the EU or GAFTA. In presenting the results, we focus on the welfare effects of the EU, GAFTA, and Turkey, which are assessed based on the equivalent variation (EV). Additionally, we discuss the change of the trade balance showing the change in trade pattern by agricultural product which is similarly reflected in the adjustment of domestic agricultural production. For this reason, we do not discuss the impact of domestic agricultural production here. The results are presented in millions of US$ for the year 2020. The simulations are performed using GEMPACK (Version 11.0) and RunGTAP (Harrison and Pearson, 1996). A fixed trade balance is adopted as a form of macroeconomic closure in the enlargement simulations.

Welfare effects

In the upper part of Table 8, we present the results of including Turkey in the EU, whereas the lower part considers the results of Turkey's membership in GAFTA. In both cases, we present the total EV in the first columns, whereas subsequent columns decompose the total EV according to the initiating shock. Thus, columns 2–6 show the effects of eliminating bilateral tariffs in the food and agricultural sector as well as the manufacturing sector in the EU, Turkey, and GAFTA. In the second part of Table 8 (Columns 7–15), we represent the effects of removing the NTBs for the food and agricultural, manufacturing, services, and extraction sectors for either the EU and Turkey or GAFTA and Turkey. In the experiments, the removal of import tariffs is considered in all sectors. Because the elimination of import tariffs in the services and extraction sectors induces very low or even no gains, the simulation results of removing import tariffs from these sectors are not included in Table 8.

The first column in the upper part of Table 8 shows that Turkey would unambiguously gain from EU membership. Turkey's total welfare gains amount to nearly 5 billion US$, whereas the EU's welfare gains of 2.26 billion US$ are more limited but remain considerable. These higher welfare gains for Turkey are in accordance with Acar et al. (2007), Lejour and Mooij (2004) and Zahariadis (2005). These results can primarily be traced back to the removal of NTBs in both regions. The overall effect from bilateral tariff elimination is equal to a 0.73 billion US$ gain for Turkey and 0.05 billion US$ loss for the EU and thus is much lower than the gains due to the removal of NTBs (3.42 billion US$ for Turkey and 2.55 billion US$ for the EU). This result is also consistent with Lejour et al. (2001), who show that the effects of NTBs are larger than the effects of the customs union if the EU is expanded to include Central and Eastern European countries. Due to the Customs Union Agreement between the EU and Turkey, considerable welfare effects of bilateral tariff elimination are only observed in the agro-food sector. The EU gains 0.37 billion US$ if Turkey eliminates the import tariffs in the protected food and agricultural sector (compare Section 'Overview of the Turkish trade structure and agreements' and Table 3). In addition to the welfare changes shown in Table 8, Turkey exhibits an additional gain caused by adopting a lower EU level for tariffs for imports from third-party countries after accession.

The removal of NTBs from the EU agro-food sector yields the highest gains both for Turkey (1.41 billion US$) and for the EU (1.87 billion US$). However, if the NTBs in the Turkish agro-food sector are abolished, the EU gains are more limited (0.18 billion US$) than those of Turkey (1.14 billion US$). Table 7 (Section 'Calculation of tariff equivalents') shows, that the AVEs of NTBs are estimated to be very high in the agro-food trade between Turkey and the EU. Accordingly, mutual welfare gains for Turkey and the EU are expected due to the abolition of high trade barriers between them.

Turkey's EU membership also creates welfare impacts on other economies. For instance, Asia experiences a welfare loss of 0.49 billion US$ and Latin America's welfare level decreases by 0.16 billion US$. These welfare losses stem from trade diversion. After Turkey's accession to the EU, the overall exports of Asia to Turkey and to the EU decrease. Particularly, EU's agro-food imports from

[19] Nearly all required import tariff reductions were initiated by 2005, but the implementation period lasted up until 2010.

[20] Due to our focus on food and agriculture, we assume the AVEs of NTBs in the non-food sectors to be 1%.

Table 8
Welfare results of enlargement experiments (million US$ relative to the baseline).

	Total EV	Bilateral tariff removal					Reduction of NTBs								
		EU		Turkey		Total	EU				Turkey				Total
		Food and Ag	Mnfc	Food and Ag	Mnfc		Food and Ag	Mnfc	Srvcs	Extrct	Food and Ag	Mnfc	Srvcs	Extrct	
Experiment 1: enlargement of the EU to include Turkey															
Turkey	4907	712	2	−49	68	733	1414	513	31	10	1143	234	74	8	3425
EU	2266	−480	−1	379	43	−58	1873	99	30	14	182	318	31	3	2550
GAFTA	−30	−51	0	6	−12	−58	−106	−26	−1	−5	3	−18	0	−3	−156
FSU	65	−37	0	−3	−5	−47	−79	−18	−1	−8	−10	−23	−3	−4	−146
Asia	−499	−90	0	35	−65	−120	−217	−132	−6	3	13	−59	1	1	−396
North Am.	80	−14	0	−12	−11	−38	−48	−21	−3	1	−33	0	−6	0	−110
Latin Am.	−167	−61	0	−25	−4	−90	−151	−6	0	−1	−18	−6	−1	0	−185
Oceania	−14	−11	0	−4	−2	−17	−20	−2	0	−1	−3	−4	−1	0	−30
SSA	−56	−39	0	−6	−2	−48	−46	−3	0	−2	−6	−14	−1	0	−72
ROW	−30	−10	0	−12	−8	−30	−14	−9	−1	−2	−12	−18	−1	0	−58
ROW	−86	−26	0	−5	−13	−44	−65	−19	−1	−4	−11	−25	−2	0	−127
Experiment 2: enlargement of GAFTA to include Turkey															
		GAFTA		Turkey		Total	GAFTA				Turkey				Total
Turkey	2486	89	942	261	−13	1259	250	107	7	2	715	29	6	107	1223
EU	−241	−6	−149	99	−33	−92	−14	−19	−2	0	26	−17	−1	24	−2
GAFTA	899	−34	−190	344	73	193	323	62	9	0	134	24	2	42	595
Iran–Israel	−17	−3	−21	15	−1	−12	−8	−3	0	0	4	1	0	1	−5
FSU	33	−10	−76	115	3	54	−25	−9	−1	−1	42	5	0	−85	−74
Asia	−405	−20	−280	187	−32	−129	−67	−33	−2	1	54	−12	0	−26	−84
North Am.	−48	−6	−48	47	−2	−6	−18	−5	−1	0	3	0	0	−2	−24
Latin Am.	−20	−7	−31	31	1	−8	−26	−4	0	0	7	2	0	−3	−23
Oceania	16	−3	−23	25	1	−1	−7	−3	0	0	10	2	0	0	3
SSA	−2	−2	−20	13	0	−11	−4	−3	0	0	5	1	0	−3	−3
ROW	−4	−6	−57	59	−2	−9	−16	−7	0	0	19	1	0	−3	−7

Note: our original mapping of ROW comprises Switzerland, Norway, Croatia, Rest of EFTA, Rest of Eastern Europe, Rest of Europe and Rest of the World (compare Table A1 in Appendix A). For reasons of simplification, we also aggregated Iran and Israel, Albania, Georgia and Chile to ROW to evaluate the results.
Source: authors' own calculation.

Asia are replaced by Turkish exports. Latin America also experiences a reduction in its food and agricultural trade to the EU.

In the lower part of Table 8, we illustrate the results of our second experiment, in which Turkey is treated as a GAFTA member. It is apparent that the overall welfare effect of this change is lower than in the simulation that evaluates Turkey's accession to the EU. Turkey's total welfare gains amount to 2.48 billion US$, whereas 0.89 billion US$ accrue to the GAFTA member countries. Unlike in our first experiment, we observe that Turkey's overall welfare gains from the removal of NTBs (1.22 billion US$) is nearly the same as its gains stemming from the elimination of import tariffs (1.25 billion US$). Conversely, for the GAFTA member countries, the effect of the removal of NTBs is greater (0.59 billion US$) than the effect of the elimination of import tariffs (0.19 billion US$). Duty free access to the manufacturing sector of the GAFTA member countries results in the highest welfare gains for Turkey at 0.94 billion US$. This gain for Turkey is resulting from its high share of manufacturing exports to GAFTA, which is also associated with high tariff rates (compare Section 'Overview of the Turkish trade structure and agreements' and Table 3). The tariffs imposed by Turkey on agro-food imports from GAFTA are higher than the tariffs imposed for the manufacturing sectors. Hence, for the GAFTA member countries, the improvement caused by the elimination of import tariffs from the Turkish agro-food sector is greater (0.34 billion US$) than the gain resulting from the removal of import tariffs from Turkish manufacturing sector (0.07 billion US$).

Abolishing the NTBs in the Turkish agro-food sector leads to a Turkish welfare gain of 0.71 billion US$, whereas this gain amounts to 0.13 billion US$ for the GAFTA member countries. In contrast, if the GAFTA member countries eliminate the NTBs in the same sector, the welfare gain increases to 0.32 billion US$ for the GAFTA member countries and decreases to 0.25 billion US$ for Turkey. Each region also experiences welfare increases if it removes its own NTBs in these sectors through efficiency gains.

Turkey's membership in GAFTA has also welfare impacts on other economies resulting from trade diversion. Similar to the EU-Turkey enlargement experiment, the largest decrease in welfare level is in the Turkey-GAFTA-FTA also observed for Asia. Asia experiences a welfare loss of 0.40 billion US$. Asia's welfare loss is caused by the decrease in its overall exports to GAFTA. However, in this case the decrease in exports is primarily observed in the manufacturing sector. Similar effects are also identified for the EU. The EU's welfare loss is predominantly caused by the decrease in its heavy manufacturing exports to GAFTA as well. GAFTA's imports of heavy manufacturing from the EU are replaced by the imports from Turkey.

In general, the effects of the removal of NTBs between GAFTA and Turkey yield smaller welfare gains than those caused by the removal of the NTBs between Turkey and the EU. The main reason for this result is the higher share and greater value of the agro-food trade between Turkey and the EU compared to the agro-food trade between Turkey and GAFTA. The EU enlargement to include Turkey increases the value of trade between Turkey and the EU by a value that is 2.3 times greater than the increase in the trade value resulting from the Turkey-GAFTA experiment. The next part therefore gives more insights into these changes in trade by focusing on the trade balance.

Trade balance effects

In Table 9, we present the impact on the trade balance caused by the two enlargement experiments disaggregated according to the 16 food and agricultural products. The first part of Table 9 shows the changes in the trade balance due to Turkey's membership to the EU; whereas the second part of the table demonstrates the changes in agro-food sector resulting from Turkey's joining the GAFTA. As mentioned in Section 'Welfare effects', Turkey is exhibiting higher welfare gains due to the EU membership. This result can be explained in more detail by the changes in trade balance of agro-food products.

The first part of Table 9 shows that Turkey's accession to the EU results in an increase of Turkey's agro-food trade balance by 3.16 billion US$. However, the EU's exports decrease relative to its imports by 1.95 billion US$. Turkey's relative sugar exports rise extensively (2.44 billion US$) as a result of its accession to the EU. The highest increase in the EU's agro-food trade balance is observed in dairy sector (1.24 billion US$), whereas Turkey's dairy imports decrease by 2.25 billion US$ more than its exports. All of these effects can be traced back to the pre-experiment high tariff rates and NTBs on the corresponding sectors (compare Section 'Overview of the Turkish trade structure and agreements' and Table 3 as well as Section 'Calculation of tariff equivalents' and Table 7). The removal of high trade barriers hence results in an increase of the trade volume.

Turkey's effect on the trade balance is particularly shown in the products that are highly traded between Turkey and the EU, namely, vegetables and fruits and other food products (compare Section 'Overview of the Turkish trade structure and agreements' and Table 3). The increase in Turkey's trade of vegetable and fruits (1.00 billion US$) and other food products (2.26 billion US$) is expected due to the removal of the NTBs from these sectors, which were estimated to be 77% and 177%, respectively (compare Section 'Calculation of tariff equivalents' and Table 7). This result is confirmed by Turkish exporters, 72% of whom indicate that they faced NTBs when exporting fresh vegetable and fruits to the EU in 2007 (Özdemir, 2008). The most frequent barriers are imposed for food safety reasons and are related to health and environmental labeling, pesticide use, genetically modified contents, quantity restrictions, and maximum residual limits for commodities. The aflatoxin level for hazelnuts, dried figs, pistachios, and commodities produced with these ingredients also creates barriers because the Turkish exports in these categories do not meet the relevant EU standards (Önen, 2008; Özdemir, 2008; Teknik Engel, 2013). Turkey ranked first in terms of aflatoxin hazard on fruits and vegetables products category. In 2012, 152 of 297 notices from the Rapid Alert System for Food and Feed[21] were for Turkish products exported to the EU due to high aflatoxin levels on hazelnuts, dried figs, and pistachios. In addition, Turkey was reported 60 times for high level of pesticide residues, primarily for fresh pepper exports (RASFF, 2013). Turkish beverage and tobacco exports also face high barriers, mostly due to a lack of appropriate labeling, which generates consumer concerns (Teknik Engel, 2013). Hence, we observe a slight increase in Turkey's beverages and tobacco exports to the EU due to the removal of the high NTBs on this sector (compare Section 'Calculation of tariff equivalents' and Table 7). The NTBs that the EU experiences in its exports to Turkey are generally related to meat and other livestock products as they have been put in place for public health reasons (European Commission, 2013b). Accordingly, the AVEs of NTBs on the EU's exports of cattle meat, other meat and other animal products to Turkey are estimated to be very high as 496%, 148% and 106%, respectively (compare Section 'Calculation of tariff equivalents' and Table 7). Hence, elimination of NTBs on these sectors results in a relative increase of EU's exports of meat and livestock products which increases the EU's trade balance in other animal products, cattle meat and other meat by 0.037 billion US$, 0.34 billion US$ and 0.027 billion US$, respectively. These findings are also in accordance with those of Oskam et al. (2004) who state that after Turkey's accession to the EU, Turkey remains to be a net exporter of vegetables and fruits, but imports of beef from the EU increase.

Turkey's membership to the EU also affects the trade balance of agro-food products in ROW. The agro-food trade balance of the ROW increases by 1.35 billion US$. Due to Turkey's adoption of a lower EU level for tariffs of imports from third countries after EU accession, relative food and agricultural imports from ROW to Turkey increase. These increases in agro-food trade balance are particularly observed in sugar and other food products sector (0.67 billion US$ and 0.83 billion US$, respectively).

In the second part of Table 9, we present the changes in the trade balance following the accession of Turkey to GAFTA. Turkey's membership to GAFTA results in a decrease of Turkey's agro-food trade balance by 2.69 billion US$. However, GAFTA's exports increase relative to its imports by 3.09 billion US$.

The largest decrease is given for the Turkish trade balance of dairy products (−3.12 billion). This is caused by the removal of high trade barriers on dairy imports from GAFTA to Turkey (compare Section 'Overview of the Turkish trade structure and agreements' and Table 3 as well as Section 'Calculation of tariff equivalents' and Table 7). Hence, after the removal of NTBs and the elimination of import tariffs on the dairy sector, Turkey's dairy imports substantially increase. Turkey also imports relatively more meat and livestock products due to the removal of trade distortions in this sector (compare Section 'Overview of the Turkish trade structure and agreements' and Table 3 as well as Section 'Calculation of tariff equivalents' and Table 7). Hence, following dairy products, GAFTA's trade balance of other meat increases the second highest by 0.26 billion US$.

Turkey's agro-food trade balance rises by 0.26 billion US$ and 0.22 billion US$, respectively for the vegetable oils and fats and other food products. These sectors include important export products from Turkey to GAFTA (compare Section 'Overview of the Turkish trade structure and agreements' and Table 3). After joining GAFTA, Turkey's relative exports of beverages and tobacco exports also rise (0.17 billion US$). Increasing relative exports of vegetable oils and fats, other food products and beverages and tobacco from Turkey to the GAFTA member countries are expected due to the removal of high trade barriers on these sectors as shown in Table 7 in Section 'Calculation of tariff equivalents'. In accordance, Turkish exporters also report that mostly NTBs for Turkish exports to GAFTA are related to plant-based food, owing to quality requirements regarding storage, labeling, transportation, sampling, and methods of testing. In particular, exports of tobacco products face high barriers resulting from labeling and consumer health protection concerns. Also, exports of alcoholic beverages are uncommon. Moreover, the NTBs for Turkey's meat and livestock products, vegetable oil and animal fats are a response to quality issues and the non-fulfillment of requirements for Halal accreditation (Teknik Engel, 2013). Turkey's accession to GAFTA also affects the trade balance of agro-food products in ROW. ROW's agro-food trade balance decreases by 1.42 billion US$ due to the relative decrease in imports of Turkey and GAFTA from third-party countries. These decreases in agro-food trade balance are particularly observed in vegetable oils and fats and other food products (−0.363 billion US$ and −0.37 billion US$, respectively).

Qualification of results

Empirical results always leave room for improvements and further research. The gravity approach employed here only allows the implicit estimation of trade costs of NTBs. We already discussed in Section 'Theoretical and empirical framework' that we control for many border-related factors in the trade cost func-

[21] The Rapid Alert System for Food and Feed is primarily a tool to exchange information between competent authorities on consignments of food and feed in cases where a risk to human health has been identified and measures have been taken.

Table 9
Changes of the trade balance of the enlargement experiments for disaggregated agro-food sectors (million US$).

	Experiment 1: enlargement of the EU to include Turkey		Experiment 2: enlargement of GAFTA to include Turkey	
	Turkey	EU	Turkey	GAFTA
Food and agricultural products	3164	−1950	−2692	3098
Wheat	−292	67	8	−32
Cereal grains	−98	63	17	−12
Vegetables and fruits	1001	−683	46	−12
Oil seeds	−58	27	19	−4
Plant-based fibers	−63	257	−27	109
Crops	−98	−99	1	108
Cattle	−4	9	−6	8
Other animal products	13	37	38	11
Vegetable oils and fats	761	−254	262	35
Dairy	−2251	1243	−3127	2564
Processed rice	−11	17	−27	28
Sugar	2442	−1500	−88	86
Other food products	2267	−1506	222	34
Beverages and tobacco	54	−1	174	−83
Cattle meat	−221	346	−9	8
Other meat	−280	27	−197	267

Source: authors' own calculation.

tion, but nevertheless the estimated AVEs do not include NTBs alone. Thus, using our estimated AVEs in GTAP model simulations might lead to the overestimation of our results. Additionally, the estimated AVEs might also include NTBs that are initiated for safety and health reasons. The elimination of those measures might not be desirable and might lead to biased welfare effects. With the help of benchmarking, we attempt to retain the NTBs of this type, although full control is impossible. A future improvement in the databases for NTBs might make it possible to estimate the effects of NTBs directly. In addition, we also need to emphasize that the EU and GAFTA benchmark settings are very ambitious. The trade relations between EU member countries and between GAFTA members have developed over a long period. Our estimates therefore indicate the potential long-term welfare effects of Turkey's integration to the EU or GAFTA. Also these welfare effects might be too high because we do not consider the WTO negotiation or tax replacement scenarios as well as political and social unrest in the Middle Eastern states. Further effects of Turkey's membership to the EU, such as financial and budgetary consequences on both parties as well as implications of potential labor movements between Turkey and the EU member countries can also be applied in future research.

In contrast, as also indicated by Winchester (2009), the results do not cover several welfare improving aspects; mainly traced back to the lack of dynamism of the CGE model. The standard GTAP model is static and does not include dynamic behavior. Hence, productivity improvements, foreign ownership of capital and changes in foreign and domestic wealth are not explicitly considered. If spillover effects were taken into account, we would expect Turkey to experience higher gains in terms of technology and knowledge transfer from the EU. As regards to Turkey's membership to GAFTA, we expect that these secondary effects of the FTA would be more limited for Turkey. Higher productivity improvements are expected to happen in GAFTA member countries, because knowledge and technology would be transferred from Turkey to the Middle East.

Another aspect that might lead to an overestimation of results is the so-called aggregation bias. Aggregation bias occurs in general equilibrium models due to the inability to implement tariffs at the six-digit level of the Harmonized System. The importance of the level of data disaggregation and the differences in results between models developed with aggregated and disaggregated databases are already emphasized by several authors (e.g., Charteris and Winchester, 2010; Grant et al., 2007; Narayanan et al., 2010a,b). These differences in results can be predominantly traced back to false competition (Narayanan et al., 2010a). False competition results from a situation in which competition does not initially exist between two exporting regions (e.g., in the EU and GAFTA) in a subsector (e.g., bananas). However, the trade data on this subsector may be available only in the form of an aggregated sector (e.g., vegetables and fruits) that also includes other competing sectors (e.g., tomatoes). Utilizing the aggregated sector in models causes false substitution effects caused by wrongly applied weights. False competition also applies to the situations that one of the subsectors aggregated in a sector may not face any NTBs whereas one of the other subsectors within the same aggregation can be subject to NTBs. Hence, false competition may result in the overestimation of trade effects when tariffs and/or NTBs are reduced or abolished and thereby may cause bias in the results.

Conclusion

This paper explores the economic implications of Turkey's membership in either the EU or GAFTA by considering both tariffs and NTBs. Particular emphasis is given to the food and agricultural sector. We use the GTAP database and the gravity approach to estimate the AVEs of border barriers that reflect the impacts of NTBs in 16 agro-food sectors. In general, the AVEs of the NTBs are comparable in magnitude with those reported in the results of recent studies on border effects for other countries.

According to the reports of Turkish and European exporters, we expected high NTBs on vegetables and fruits, other food products, other animal products and beverages and tobacco sector in the trade between Turkey and the EU. Those sectors are also strategically important for Turkey's trade flows with the EU and GAFTA as indicated by their high trade shares and protection structure. Turkish exporters report high barriers on other animal products, vegetable oils and fats, beverages and tobacco in the trade between Turkey and GAFTA. Our econometric estimates confirm that high AVEs of NTBs do indeed exist in these sectors. NTBs on Turkey's vegetables and fruits and other food products exported to the EU are, for example, equal to 77.06% and 177%, respectively. These barriers are much higher than the current barriers among the EU members (0% and 81.52%, respectively). Analogously, we find high AVEs of NTBs for other animal products, vegetable and oil and beverages and tobacco on Turkey's exports to GAFTA. Additionally, we also identified several sectors with high AVEs of NTBs which were initially not reported by exporters from either countries involved in the respective FTA. Those are cereal grains and processed rice in the case of the EU-Turkey enlargement and cereal grains, processed rice, and sugar in the case of the accession of Turkey to GAFTA.

We expect that sectors with particularly high AVEs of NTBs contribute the most to the gains resulting from the two FTA agreements compared in this paper. In a second step, we therefore use the GTAP framework to implement the AVEs in the general equilibrium model. In our analysis, we utilize the most recent version of the GTAP database, Version 8. Before using the AVEs, we extend the GTAP framework to the year 2020 by updating the political and economic environment. We also consider those of Turkey's FTAs that came into force after 2007 or that will be in force up until 2020. Thereafter, we run two enlargement experiments and compare the possible effects of Turkey's integration into the EU or GAFTA.

The results of our experiments indicate that higher overall welfare gains will accrue for Turkey through EU membership (4.90 billion US$) than through membership in GAFTA (2.48 billion US$). These gains result mainly from the higher share and greater value of the agro-food trade between Turkey and the EU compared to the

Table A1
Regional and sector aggregation.

	Regions		Sectors
1	Turkey	1	Paddy rice
2	European Union Austria, Belgium, Denmark, Finland, France, Germany, Ireland, United Kingdom, Greece, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, Czech Republic, Hungary, Malta, Poland, Slovakia, Slovenia, Estonia, Latvia, Lithuania, Cyprus, Romania, Bulgaria	2	Wheat
3	Greater Arab Free Trade Area Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Egypt, Morocco, Tunisia, Rest of North Africa, Rest of Western Asia	3	Cereal grains
4	Islamic Republic of Iran and Israel	4	Vegetables and fruits
5	Former Soviet Union Belarus, Romania, Russian Federation, Ukraine, Kazakhstan, Kyrgyzstan, Armenia, Azerbaijan, Rest of Former Soviet Union	5	Oil seeds
6	Asia China, Hong Kong, Japan, Korea, Mongolia, Taiwan, Cambodia, Indonesia, People's Democratic Republic of Lao, Malaysia, Philippines, Singapore, Thailand, Viet Nam, Bangladesh, India, Nepal, Pakistan, Sri Lanka, Rest of South Asia, Rest of Southeast Asia	6	Sugar cane, sugar beet
7	North America Canada, United States of America, Mexico, Rest of North America	7	Plant-based fibres
8	Latin America Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela, Costa Rica, Guatemala, Honduras, Nicaragua, Panama, El Salvador, Caribbean, Rest of South America, Rest of Central America	8	Crops
9	Oceania Australia, New Zealand, Rest of Oceania	9	Cattle
10	Sub-Saharan Africa Cameroon, Cote d'Ivoire, Ghana, Nigeria, Senegal, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Tanzania, Uganda, Zambia, Zimbabwe, Botswana, Namibia, South Africa, Rest of African Customs Union, South Central Africa, Rest of Eastern Africa, Rest of Western Africa, Central Africa	10	Other animal products
11	Rest of the World Switzerland, Norway, Croatia, Rest of EFTA, Rest of Eastern Europe, Rest of Europe, Rest of the World	11	Raw milk
12	Albania	12	Wool
13	Georgia	13	Sugar
14	Chile	14	Processed rice
		15	Dairy
		16	Cattle meat
		17	Other meat
		18	Vegetable oils and fats
		19	Other food products
		20	Beverages and tobacco
		21	Extraction Forestry, fishing, coal, oil, gas, minerals not elsewhere specified (nec)
		22	Light Manufacturing Textiles, wearing apparel, leather products, wood products, paper products, publishing, metal products, motor vehicles and parts, transport equipment nec
		23	Heavy Manufacturing Petroleum, coal products, chemical, rubber, plastic products, mineral products nec, ferrous metals, metals nec., electronic equipment, machinery and equipment nec
		24	Services Electricity, gas manufacture, distribution, water, construction, trade, transport nec, sea transport, air transport, communication, financial services nec, insurance, business services nec, recreation and other services, PubAdmin/Defence/Health/Educat, dwellings

Source: GTAP Database, Version 8, Base Year 2007.

trade between Turkey and GAFTA. As other authors have suggested, the new memberships will deliver higher gains for Turkey than for their partner economies; 2.26 billion US$ for the EU and 0.89 billion US$ for the GAFTA member countries. The removal of NTBs will predominantly result in greater economic effects rather than the elimination of import tariffs. These higher effects are more pronounced in the first simulation, in which we enlarge the EU to include Turkey. The abolition of trade costs of NTBs generates a welfare gain of 3.42 billion US$ for Turkey, whereas the welfare gain stemming from duty free access to the European market is only 0.73 billion US$. Similarly, the EU's and the GAFTA member countries' gains from NTB removal outweigh their gains due to the elimination of import tariffs in both experiments. This finding indicates the importance of NTBs in enlargement scenarios because eliminating NTBs contributes more to welfare increases than does tariff removal.

The changes in the trade balance show an increase of Turkey's trade balance for those products which are highly traded between Turkey and the EU and are often protected by tariffs and high AVEs of NTBs, namely, in vegetables and fruits and other food products sectors. After the enlargement to include Turkey, the EU imports relatively more vegetables and fruits, sugar and other food products, so that EU's trade balance of these sectors decreases. In contrast, the EU's trade balance of dairy products shows a substantial increase. The accession of Turkey to GAFTA leads to a decrease of Turkey's trade balance for dairy and meat and livestock products, while Turkey's trade balance increases for vegetable oils and fats and other food products, which are important export products of Turkey to GAFTA.

Policy makers might find our framework useful in their decision making process regarding Turkish foreign policy. Our experimental results verify the importance of the EU as a trade partner for Turkey and the narrow gains that will accrue from GAFTA membership. These gains will most likely be even lower due to the current political and military conflicts in the Middle Eastern states as well as the serious structural problems in the Arab economies. Turkey might obtain greater benefits if it strengthens its relations with the EU rather than with the GAFTA member countries.

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Appendix A

See Table A1.

References

Abedini, J., Peridy, N., 2008. The Greater Arab Free Trade Area (GAFTA): An estimation of trade effects. J. Econ. Integr. 23 (4), 848–872.

Acar, M., Aydin, L., 2011. Turkey's shifting axis to the East: implications of regional integration with the neighborhood. In: Presented at the 14th Annual Conference on Global Economic Analysis, Venice, Italy, June 16th–18th.

Acar, M., Afyonoglu, B., Kus, S., Vural, B., 2007. Turkey's agricultural integration with the EU: quantifying the implications. In: Paper Presented at the 10th Annual Conference on Global Economic Analysis, Indiana, USA, June 7th–9th.

Adam, L.B., 2012. Turkey's foreign policy in the AKP era: has there been a shift in the axis? Turk. Policy Q. 11 (3), 139–148.

Alessandri, E., 2010. The new Turkish foreign policy and the future of Turkey-EU relations. Inst. Affari Int. Doc. IAI 10 (03).

Anderson, J.E., 2011. The gravity model. Ann. Rev. Econ. 3 (1), 133–160.

Anderson, J.E., van Wincoop, E., 2003. Gravity with gravitas: a solution to the border puzzle. Am. Econ. Rev. 93, 170–192.

Anderson, J.E., van Wincoop, E., 2004. Trade costs. J. Econ. Lit. XLII (3), 691–751.

Andriamananjara, S., Ferrantino, M., Tsigas, M., 2003. Alternative approaches in estimating the economic effects of non-rariff measures: results from newly quantified measures. In: Working Paper 2003-12-C. U.S. International Trade Commission.

Andriamananjara, S., Dean, J.M., Feinberg, R., Ferrantino, M., Ludema, R., Tsigas, M., 2004. The effects of non-tariff measures on prices, trade, and welfare: CGE implementation of policy-based price comparisons. In: Working Paper 2004-04-A. U.S. International Trade Commission.

Aybar, S., 2012. Türkiye'nin Ortadoğu politikası ve "yeni coğrafya" algısı. Heinrich Böll Stiftung. Available at <http://www.tr.boell.org/web/111-1433.html>, (05.08.13).

Babacan, M., 2011. Whither an axis shift: a perspective from Turkey's foreign trade. In: Munich Personal RePEc Archive. MPRA Paper No. 29736.

Brockmeier, M., Bektasoglu, B., 2014. Model structure or data aggregation level: which leads to greater bias of results? J. Econ. Model. 38 (1), 238–245.

Burger, M., van Oort, F., Linders, G.-J., 2009. On the specification of the gravity model of trade: zeros, excess zeros and zero-inflated estimation. Spat. Econ. Anal. 4 (2), 167–190.

Cameron, A.C., Trivedi, P.K., 2005. Microeconometrics. Methods and Applications. Cambridge University Press.

Candar, C., 2009. Turkey's "soft power" strategy: a new vision for multi-polar world. In: SETA Policy Brief 38.

Chang, K., Hayakawa, K., 2010. Border barriers in agricultural trade and the impact of their elimination: evidence from East Asia. Develop. Econ. 48 (2), 232–246.

Charteris, A., Winchester, N., 2010. Dairy disaggregation and joint production in an economy-wide model. Aust. J. Agric. Resour. Econ. 54 (4), 491–507.

Chen, N., 2004. Intra-national versus international trade in the European Union: why do national border matter? J. Int. Econ. 63 (1), 93–118.

Ciftci, S., Ertugay, F., 2011. Türkiye'nin Dış Politikası Bağlamında Ortadoğu'ya Yönelik Tutumlar: Üniversite Öğrencilerinin Algıları Hakkında Bir Alan Araştırması. Uluslararası Hukuk ve Politika 7 (28), 1–26.

Eryugur, H.O., Cakmak, E.H., 2008. EU integration of Turkey: implications for Turkish agriculture. In: Paper presented at the 12th EAAE Congress 'People, Food and Environments: Global Trends and European Strategies', Gent, Belgium, August 26th–29th.

European Commission, 2013a. Turkey: EU bilateral Trade and trade with the world. Available at <http://.trade.ec.europa.eu/doclib/docs/2006/september/tradoc_113456.pdf>, (15.04.13).

European Commission, 2013b. Technical barriers to trade notification database. Available at <http://www.ec.europa.eu/enterprise/tbt/index.cfm?dspLang=en>, (05.01.13).

European Commission, 2013c. Single market for goods. Available at <http://ec.europa.eu/enterprise/policies/single-market-goods/index_en.htm>, (19.02.13).

European Commission, 2013d. Accession treaty: treaty concerning the accession of the Republic of Croatia. Available at <http://www.delhrv.ec.europa.eu/files/file/articles-st14409.en11-1323455241.pdf>, (14.02.13).

Evin, A., Kirisci, K., Linden, R.H., Straubhaar T., Tocci, N., Tolay, J., Walker, J.W., 2010. Getting to zero: Turkey, its neighbors and the West. Transatlantic Academy. Available at <http://www.transatlanticacademy.org/publications/getting-zero-turkey-its-neighbors-and-west>, (15.03.13).

Feenstra, R., 2002. Border effects and gravity equation: consistent methods for estimation. Scot. J. Polit. Econ. 49 (5), 491–506.

Flowerdew, R., Aitkin, M., 1982. A method of fitting the gravity model based on the Poisson distribution. J. Reg. Sci. 22 (2), 191–202.

Foreign Policy, 2010. Zero problems in a new era. Argument by Ahmet Davutoglu. Available at <http://www.foreignpolicy.com/articles/2013/03/21/zero_problems_in_a_new_era_turkey>, (01.08.13).

Francois, J.F., 1999. Economic effects of a new WTO Agreement under the Millennium Round. In: Report to the European Commission Trade Directorate.

Francois, J.F., 2001. The Next WTO Round: North-South Stakes in New Market Access Negotiations. Centre for International Economic Studies, Adelaide, ISBN 0-86396 474-5.

Fugazza, M., Maur, J.-C., 2008. Non-tariff barriers in CGE models: how useful for policy? J. Policy Model. 30 (3), 475–490.

Grant, J.H., Hertel, T.W., Rutherford, T.F., 2007. Tariff line analysis of U.S. and international dairy protection. Agric. Econ. 37 (s1), 271–280.

Habibi, N., Walker, J.W., 2011. What is Driving Turkey's Rearrangement with the Arab World? Brandeis University, Crown Center for Middle East Studies. Middle East Brief 49.

Harrison, J.W., Pearson, K.R., 1996. Computing solutions for large general equilibrium models using GEMPACK. Comput. Econ. 9, 83–127.

Head, K., Mayer, T., 2013. Gravity Equations: Workhorse, Toolkit, and Cookbook. In: Gopinath, G., Helpman, E., Rogoff, K. (Eds.), Handbook of International Economics, vol. 4.

Heckman, J.J., 1979. Sample selection bias as a specification error. Econometrica 47 (1), 153–161.

Hertel, T.W. (Ed.), 1997. Global Trade Analysis. Modeling and Applications. New York.

Hertel, T.W., Walmsley, T., Itakura, K., 2001a. Dynamic Effects of the "New Age" Free Trade Agreement between Japan and Singapore. In: GTAP Working Paper 15.

Hertel, T.W., Walmsley, T.L., Itakura, K., 2001b. Dynamic effects of the "New Age" free trade agreement between Japan and Singapore. J. Econ. Integr. 16 (4), 446–448.

IDIA (Institute for Domestic & International Affairs, Inc.), 2007. League of Arab States. Greater Arab Free Trade Agreement.
ITC (International Trade Center), 2012. Two million jobs could be created in League of Arab States region if non-tariff measures were eliminated. Press Release: Geneva (24.02.12).
ITC, 2014. NTM business survey. In: <http://www.intracen.org/itc/market-info-tools/non-tariff-measures/business-surveys/>, (14.03.14).
Kara, M., 2011. ''Axis shift'' in Turkish foreign policy during AKP administration: new fundamental foreign policy principles and challenges. Master thesis submitted to the Institute of Graduate Studies and Research, International Relations, Eastern Mediterranean University, Gazimağusa, North Cyprus.
Lejour, A.M., Mooij, A.R., 2004. Turkish delight: does Turkish accession to the EU bring economic benefits? In: CESIFO Working Paper 1183. Category 7: Trade Policy.
Lejour, A.M., Mooij, A.R., Nahuis, R., 2001. EU enlargement: economic implications for countries and industries? In: CESIFO Working Paper 585.
Linders, G.J.M., de Groot, H-F.L., 2006. Estimation of the gravity equation in the presence of zero flows. In: Tinbergen Institute Discussion Paper, 2006-072/3.
McCallum, J., 1995. National borders matter: Canada–U.S. regional trade patterns. Am. Econ. Rev. 85 (3), 615–623.
Narayanan, B.G., Hertel, T.W., Horridge, J.M., 2010a. Disaggregated data and trade policy analysis: the value of linking partial and general equilibrium models. Econ. Model. 27 (3), 755–766.
Narayanan, B.G., Hertel, T.W., Horridge, J.M., 2010b. Linking partial and general equilibrium models: a GTAP application Using TASTE. In: GTAP Technical Paper No. 29, Center for Global Trade Analysis, Purdue University, West Lafayette.
Olper, A., Raimondi, V., 2008a. Agricultural market integration in the OECD: a gravity-border effect approach. Food Policy 33, 165–175.
Olper, A., Raimondi, V., 2008b. Explaining national border effects in the QUAD food trade. J. Agric. Econ. 59 (3), 436–462.
Önen, E., 2008. DTÖ yükümlülükleri kapsamında Türkiye ile Avrupa Birliği arasındakı tarım ürünleri ticareti ve bu ticarette önem arz Eden tarife dışı engeller. AB Uzmanlık Tezi. T.C. Tarım ve Köyişleri Bakanlığı, Dış Ilişkiler ve Avrupa Birliği Koordinasyon Dairesi Başkanlığı, Ankara.
Onthman, J., Acar, M., Jafari, Y., 2010. Impact of trade liberalization among the developing 8: a general equilibrium analysis. GTAP, Resource 3063.
Oskam, A., Burrell, A., Temel, T., van Berkum S., Longworth, N., Vilchez, I.M., 2004. Turkey in the European Union: Consequences for Agriculture, Food, Rural Areas and Structural Policy. In: Report comissioned by the Dutch Ministry of Agriculture, Nature and Food Quality, Wageningen University, Netherlands.
Özdemir, S., 2008. Türkiye'nin Avrupa Birliği ülkelerine yaş meyve-sebze ihracatı ve Avrupa Birliği cevre politikalarından kaynaklanan teknik engeller. Yüksek Lisans Tezi, Çukurova Üniversitesi, Fen Bilimleri Enstitüsü, Tarım Ekonomisi Anabilim Dalı, Adana.
Philippidis, G., Carrington, A., 2005. European enlargement and single market accession: a mistreated issue. J. Econ. Integr. 20 (3), 543–566.
Philippidis, G., Karaca, O., 2009. The economic impacts of Turkish accession to the European Union. World Econ. 32 (12), 1706–1729.
Philippidis, G., Sanjuán, A.I., 2006. An examination of Morocco's trade options with the EU. J. Afr. Econ. 16 (2), 259–300.
Philippidis, G., Sanjuán, A.I., 2007. An analysis of Mercosur's regional trading agreements. World Econ. 30 (3), 504–531.
Philippidis, G., Resona-Ezcaray, H., Sanjúan-López, A.I., 2013. Capturing zero-trade values in gravity equations of trade: an analysis of protectionism in agro-food sectors. Agric. Econ. 00, 1–19.
Raimondi, V., Olper, A., 2011. Trade elasticity, gravity and trade liberalisation: evidence from the food industry. J. Agric. Econ. 62 (3), 525–550.
RASFF (The Rapid Alert System for Food and Feed), 2013. The Rapid Alert System for Food and Feed: 2012 Annual Report. Available at <http://www.ec.europa.eu/food/food/rapidalert/docs/rasff_annual_report_2012_en>, (25.11.13).
Samuelson, P.A., 1954. The transfer problem and transport costs II: analysis of effects of trade impediments. Econ. J. LXIV, 264–289.
Sanberk, Ö., 2010. Transformation of Turkish Foreign Policy. In: Wise Man Center for Strategic Studies Report 21.
Santos Silva, J.M.C., Tenreyro, S., 2006. The log of gravity. Rev. Econ. Stat. 88 (4), 641–658.
Sonmez, Y., McDonald, S., Perraton, J., 2007. Turkey and Its preferential trade agreements. In: Presented at the 10th Annual Conference on Global Economic Analysis, Purdue University, USA, June 7th–9th.
Taspinar, Ö., 2008. Turkey's Middle East policies: Between Neo-Ottomanism and Kemalism. Carnegie Endowment for International Peace. Carnegie Middle East Center 10.
Teknik Engel (Ticarette Teknik Engeller Türkiye Bildirim Merkezi), 2013. Bildirim veritabanı. Available at <http://www.teknikengel.gov.tr/index.cfm?action=arama>, (12.01.13).
Theil, H., 1958. Economic Forecasts and Policy. North Holland, Amsterdam.
Turkish Undersecretariat of Foreign Trade, 2013. Trade agreements: Turkey's free trade agreements. Available at <http://www.economy.gov.tr/index.cfm?sayfa=tradeagreements&bolum=fta&region=0>, (14.01.13).
Turkstat (Turkish Statistical Institute), 2013. Statistics on foreign trade. Available at <http://www.turkstat.gov.tr/AltKategori.do?ust_id=4>, (15.08.13).
Walker, J.W., 2011. Turkey's global strategy: introduction: the sources of Turkish grand strategy – 'strategic depth' and 'zero-problems' in context. In: Kitchen Nicholas (Ed.), IDEAS Reports – Special Reports, SR007. LSE IDEAS, London School of Economics and Political Science, London, UK.
Wei, S.-J., 1996. Intra-national versus international trade: how stubborn are nations in global integration? In: Working Paper 5531. National Bureau of Economics Research, Cambridge, MA.
Weiler, J.H.H., Kocjan, M., 2005. The Internal Market: Non-Tariff Barriers. The Law of the European Union. Teaching Material Unit 9.
Winchester, N., 2009. Is there a dirty little secret? Non-tariff barriers and the gains from trade. J. Policy Model. 31, 819–834.
WTO (World Trade Organization), 2013. Country profile: Turkey. Available at <http://www.stat.wto.org/CountryProfile/WSDBCountryPFView.aspx?Language=E&Country=TR>, (01.08.13).
Xiong, B., Beghin, J., 2012. Does European aflatoxin regulations hurt groundnut exporters from Africa? Eur. Rev. Agric. Econ. 39 (4), 589–609.
Zahariadis, Y., 2005. A CGE Assessment of Regulatory Integration between EU and Turkey. GTAP, Resource 1668.

5 Analyse des Freihandelsabkommens zwischen der EU und Indien unter Berücksichtigung von nicht-tarifären Handelshemmnissen im Agrar- und Ernährungsbereich

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ANALYSE DES FREIHANDELSABKOMMENS ZWISCHEN DER EU UND INDIEN UNTER BERÜCKSICHTIGUNG VON NICHT-TARIFÄREN HANDELSHEMMNISSEN IM AGRAR – UND ERNÄHRUNGSBEREICH

Tanja Engelbert, Martina Brockmeier [1]

Zusammenfassung

In diesem Beitrag werden die Effekte eines Freihandelsabkommens zwischen der EU und Indien durch Senkung von Zöllen und nicht-tarifären Handelshemmnissen (NTBs) mit besonderer Berücksichtigung des Agrar- und Ernährungssektors analysiert. Mit Hilfe eines theoriebasierten Gravitationsmodells werden die Effekte von grenzinduzierenden Barrieren im Handel zwischen der EU und Indien geschätzt. Die in Bezug auf wirtschaftliche Größen und beobachtbare Handelskosten korrigierten Grenzeffekte spiegeln die Effekte von NTBs wider. Sie werden in Zolläquivalente (AVEs) umgewandelt und in das Global Trade Analysis Project (GTAP) Modell integriert. Drei verschiedene Experimente mit variierenden Zollkürzungen und implementierten AVEs der NTBs werden berechnet. Die ökonometrischen Schätzergebnisse zeigen die Bedeutung der NTBs im Agrar- und Nahrungsmittelhandel zwischen der EU und Indien auf. Die GTAP-Simulationen veranschaulichen, dass Indiens Wohlfahrtsergebnis von der Höhe der Zollkürzungen und der Normierung der NTBs abhängt. Der Wohlfahrtseffekt infolge NTB-Abbaus ist höher als der aus den Zollkürzungen resultierende Effekt. Der Abbau der NTBs im Agrar- und Ernährungssektor in Indien hat einen bedeutenden Anteil an den Wohlfahrtsgewinnen durch die NTB-Abschaffung. Dies zeigt die hohe Relevanz der NTBs im Handel von Agrargütern und Nahrungsmitteln zwischen der EU und Indien.

Schlüsselbegriffe

EU-Indien Freihandelsabkommen, nicht-tarifäre Handelshemmnisse (NTBs), Gravitationsmodell, Grenzeffekt, Zolläquivalente (AVEs), Global Trade Analysis Project (GTAP)

1 Einleitung

Mit dem Scheitern der Verhandlungen im Rahmen der Welthandelsorganisation (WTO) ist die Anzahl der nicht-WTO induzierten Handelsabkommen weltweit deutlich angestiegen. Insbesondere große Nationen sind bestrebt, die potenziellen Gewinne aus ökonomischer Integration mit Hilfe von Freihandelsabkommen (FTA) auszuschöpfen. Schwellenländer werden darüber hinaus immer mehr durch ökonomische Größe und wachsende Märkte gekennzeichnet und stellen daher zunehmend attraktive Handelspartner für Industrieländer dar. Das Ergebnis ist eine wachsende Tendenz zu Nord-Süd-Allianzen. Die Europäische Union (EU) verhandelt zurzeit mit mehr als 70 Ländern über Präferenzabkommen (EU KOMMISSION, 2012). Verhandlungen über ein Freihandelsabkommen zwischen der EU und Indien (EU-Indien FTA) starteten in 2007 und sollen nach dem zwölften Gipfeltreffen in Neu-Dehli Ende 2012 abgeschlossen werden. Das Interesse beider Parteien liegt hauptsächlich außerhalb des Agrar- und Nahrungsmittelsektors. Allerdings haben divergierende Interessen bezüglich Politiken im Agrar- und Ernährungsbereich zu den langjährigen Verhandlungen beigetragen.

Es gibt nur wenige Studien, welche die Effekte eines EU-Indien FTA mit einem allgemeinen Gleichgewichtsmodell (CGE Modell) bewerten (z. B. DECREAUX und MITARITONNA, 2007; ACHTERBOSCH et al., 2008; FRANCOIS et al., 2008; POLASKI et al., 2008). Die Ergebnisse

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dieser Studien zeigen, dass beide Parteien durch das Abkommen profitieren könnten, auch wenn dieser Gewinn nur auf asymmetrische Zollkürzungen und die Beibehaltung von hohen Handelsbarrieren auf dem indischen Markt zurückzuführen ist. Der Ernährungsbereich und die Agrarwirtschaft spielen eine wichtige Rolle in der indischen Ökonomie. Der Anteil der Bevölkerung, der in ländlichen Gebieten lebt, liegt über 70% (WELTBANK, 2011). Allerdings berücksichtigen die meisten empirischen Studien zur Bewertung des EU-Indien FTA nur hoch aggregierte Agrar- und Ernährungssektoren und bieten somit keine Möglichkeiten für detaillierte Einsichten und Interpretationen. Zusätzlich werden nicht-tarifäre Handelshemmnisse (NTBs) nicht in die Analysen einbezogen. Eine Ausnahme ist die Studie von FRANCOIS et al. (2008), in der NTBs im Dienstleistungssektor ökonometrisch geschätzt und in ein CGE Modell implementiert werden. Keine der oben genannten Studien berücksichtigt NTBs im Agrar- und Nahrungsmittelbereich, obwohl bekannt ist, dass NTBs gerade in diesen Sektoren sehr verbreitet sind. Haben NTBs im Agrar- und Nahrungsmittelsektor signifikante Auswirkungen oder resultiert der hauptsächliche Effekt des Freihandelsabkommens aus der Zollkürzung? Die vorliegende Studie leistet einen Beitrag zur existierenden Literatur, indem die Effekte eines EU-Indien FTA durch die Senkung von Zöllen und den Abbau von NTBs analysiert werden. Hierbei liegt der Schwerpunkt auf dem Agrar- und Nahrungsmittelsektor.

Die vorliegende Studie gliedert sich wie folgt. In Kapitel 2 wird ein Überblick über die Perspektiven eines EU-Indien FTA und dessen Potenziale aufgezeigt. Die empirische Analyse teilt sich in zwei Abschnitte. In Kapitel 3 wird ein umfassend spezifiziertes Gravitationmodell zur Schätzung der Grenzeffekte im Handel zwischen der EU und Indien aufgestellt und die resultierenden Handelseffekte der NTBs in Zolläquivalente (AVEs) umgewandelt. Im Kapitel 4 werden die AVEs in das Global Trade Analysis Project (GTAP) Modell implementiert, um Ergebnisse des EU-Indien FTA für die Volkswirtschaft insgesamt zu erhalten. Dabei wird der theoretische Hintergrund der Implementierung, die Datenzusammenstellung, die Bildung der Szenarien und die Ergebnisse vorgestellt. Im Kapitel 5 folgt ein Fazit.

2 Aspekte einer ökonomischen Integration zwischen der EU und Indien

Im Juni 2007 haben die Europäische Kommission und die Regierung Indiens Verhandlungen zu einer umfassenden Freihandelszone begonnen. Die EU-Verhandlungen mit Indien sind Teil der 2006 eingeführten europäischen globalen Handelsstrategie, die insbesondere auf Länder mit großen und schnell wachsenden, protektionistischen Märkten ausgerichtet ist (EU-KOMMISSION, 2006). Indien gehört zu den wichtigsten Handelspartnern der EU und ist auch ein wichtiger Akteur auf dem Weltmarkt geworden. Das jährliche BIP-Wachstum ist von 3% in den Jahren 1970-1980 auf 6% in den Jahren 1990-2000 gestiegen und liegt zurzeit bei mehr als 9% (WELTBANK, 2011). Diese beeindruckenden Wachstumsraten und ein Markt von mehr als 1,17 Mrd. Menschen lassen Indien zu einem interessanten Handelspartner für die EU werden. Allerdings beträgt das indische BIP nur 10% des BIP der EU und ist im Pro-Kopf-Einkommen vergleichbar mit dem der ärmsten Länder der Welt. In Indien leben mehr als 40% der Bevölkerung von weniger als 1,25 US$ pro Tag. Indien ist damit das Land mit der größten absoluten Anzahl an Armen weltweit (WELTBANK, 2011). Folglich besteht ein starkes Ungleichgewicht zwischen den Partnern des FTA bezüglich Anforderungen in sensiblen Handelsbereichen. Beim Gipfeltreffen in Neu-Delhi im Februar 2012 wurden wichtige Fortschritte erzielt, so dass ein FTA voraussichtlich Ende 2012 abgeschlossen sein wird. Es wäre das weltweit größte Handelsabkommen mit 1,7 Mrd. Menschen (EU-KOMMISSION, 2012).

Indiens Ökonomie und insbesondere die Agrarwirtschaft ist nur mäßig in die Weltwirtschaft integriert. Der Warenhandel hat einen geringen Anteil am BIP und ist von 20% in 2000/01 auf 36% in 2008/09 gestiegen, was eine geringe, aber steigende Offenheit Indiens im Welthandel repräsentiert (WELTBANK, 2011). In 2007 war die EU Indiens wichtigster Handelspartner bezüglich Gesamtimporte, aber auch die Importe von Industrieerzeugnissen, Dienstleistungen und Primärprodukten aus der EU waren bedeutend. Seit 2002 bewegte sich Indien vom 15.

zum 8. Platz nach oben auf der Liste der wichtigsten Handelspartner der EU (EU-KOMMISSION, 2012). Die wichtigsten von Indien in die EU exportierten Produkte sind Textilien und Bekleidung. Bezüglich des Agrar- und Nahrungsmittelsektors ist Indien der zehntwichtigste Handelspartner der EU. Die Agrarexporte von der EU nach Indien sind im Vergleich zu den Importen aus Indien sehr gering. Hinsichtlich der Agrarhandelsbilanz mit der EU beträgt der Überschuss der Exporte von Indien in die EU über den Importen aus der EU 2265,7 Mio. US$ in 2007. Indien besitzt ein hohes Protektionsniveau, das von 13,4% im Industriesektor bis zu 70% im Agrarsektor reicht. Im Gegensatz dazu erhebt die EU relativ niedrige Zölle auf Importe aus Indien. Die höchsten Zölle sind im Agrar- und Nahrungsmittelsektor (8,3%) sowie im Textil- und Bekleidungssektor (7,9%) vorhanden (GTAP, 2012). Allgemein weist die Zollstruktur in Indien eine höhere Protektion als in der EU auf. Eine weitgehende ökonomische Integration zwischen der EU und Indien würde jedoch nicht nur eine Zollsenkung, sondern auch eine Eliminierung der nicht-tarifären Protektion und die Harmonisierung technischer Standards und phytosanitärer Regulationen voraussetzen. Die EU ist bekannt für ihre hohen NTBs, die den Zugang von Exporten aus Entwicklungsländern insbesondere im Agrar- und Nahrungsmittelsektor erschwert. Allerdings erhebt Indien auch viele NTBs in Form von quantitativen Restriktionen, Importlizenzen, verbindlichen Tests und Inspektionen, technischen Regulationen, phytosanitären Maßnahmen als auch komplizierten Zollabfertigungen (EU-KOMMISSION, 2012). Beide Parteien führen die Gespräche auch hinsichtlich der NTBs. Bislang gibt es jedoch keine empirischen Ergebnisse wie die Eliminierung der nicht-tarifären Protektion im Agrar- und Nahrungsmittelsektor den Handel zwischen der EU und Indien beeinflussen würde.

3 Analyse mit dem Gravitationsmodell

3.1 Modellspezifikation

Die ökonometrische Analyse zur Schätzung der Effekte von NTBs zwischen Indien und der EU in 2007 stützt sich auf das Gravitationsmodell und dem theoriebasierten Grenzeffekt-Ansatz. Basierend auf ANDERSON (1979) wurde das klassische Gravitationsmodell durch eine Reihe von Handelsmodellen theoretisch fundiert. Dies und die Erweiterung der Spezifikation für verschiedene Fragestellungen in der Analyse außenwirtschaftlicher Beziehungen führten zum empirischen Erfolg des Gravitationsmodells. Ein Schwerpunkt bildet die Beobachtung von Grenzeffekten. Der Grenzeffekt vergleicht den innerstaatlichen mit dem internationalen Handel. Der Effekt zeigt, um wie viel der Handel innerhalb eines Landes den vergleichbaren grenzüberschreitenden Handel übersteigt (MCCALLUM, 1995). Der entscheidende Erklärungsansatz für diesen Grenzeffekt sind die mit der Existenz von nationalen Grenzen verbundenen Barrieren, wie z. B. Zölle und NTBs. Der Vorteil dieser Methode besteht darin, dass der Grenzeffekt alle Hemmnisse zusammenfasst. Darunter fallen auch solche, die nur sehr schwierig direkt zu messen oder schwer zu beobachten sind. Insbesondere im Handel von Agrargütern und Nahrungsmitteln besteht ein Defizit an verlässlichen und aktuellen Statistiken zu technischen Regulationen und phytosanitären Standards. Es gibt nur wenige Studien, welche die theoriebasierte Grenzeffekt-Methode auf den Agrarhandel anwenden (OLPER und RAIMONDI, 2008; WINCHESTER, 2009; CHANG und HAYAKAWA, 2010).

Das hier angewandte verallgemeinerte Gravitationsmodell von ANDERSON und VAN WINCOOP (2003) berücksichtigt Preise, die annahmegemäß zwischen den Ländern variieren. Diese Preisindizes reflektieren multilaterale Handelshindernisse, welche die relativen Handelskosten darstellen. Die Relevanz dieser relativen Kosten ist dadurch begründet, dass bilaterale Handelskosten von den Handelskosten, die jedes Land zu den übrigen Handelspartnern hat, beeinflusst werden. Das Weglassen dieser relevanten Faktoren führt zur Missspezifikation des Modells und damit zu verzerrten Schätzergebnissen. Es gibt verschiedene Möglichkeiten diese nicht beobachtbaren multilateralen Handelshindernisse zu berücksichtigen. Der am meisten angewendete Ansatz ist die Spezifikation mit fixen Effekten für Exporteure und Importeure. Eine alternative theoriebasierte Möglichkeit ist die Berechnung dieser Variablen durch die Approximierungsmethode von BAIER und BERGSTRAND (2009).[2] Unter Einbeziehung der typischen Erklärungsfaktoren für das Gravitationsmodell, der länderspezifischen Dummyvariablen und einem Fehlerterm ergibt sich für die vorliegende Studie die folgende log-lineare Schätzgleichung:

(1) $$ln\, x_{ij} = \beta_1 + \beta_2\, ln(Prod_i) + \beta_3\, ln(Consum_j) + \sum_{m=1}^{M} \beta_{3+m} Z_{ij}^{m} + \alpha_i + \alpha_j + \varepsilon_{ij}$$

Dabei ist x_{ij} der Exportwert von i nach j, $Prod_i$ ist die Produktion von Exporteur i und $Consum_j$ ist der Konsum des Importeuer j. α_i (α_j) sind die Exporter- (Importer-) Dummyvariablen und ε_{ij} ist der Fehlerterm. Z_{ij} ein Set an erklärenden Variablen, welche die Handelskosten approximieren. Dieses Set enthält die typischen Variablen einer Gravitationsgleichung wie die Geographie, soziokulturelle und -ökonomische Nähe als auch Politikvariablen wie Zölle und Exportsubventionen. Zusätzliche Dummyvariablen erfassen die Mitgliedschaft in gemeinsamen Handelsabkommen und in der WTO. Darüber hinaus werden Indizes berücksichtigt, welche die logistische Leistung und die politische Situation in den Ländern abbilden. Die interessantesten Variablen in diesem Set sind die Grenzdummyvariablen, welche die Handelsbarrieren an der Grenze erfassen. $b_{IND/EU}$ und $b_{EFTA/EU}$ nehmen den Wert Eins an, wenn die abhängige Variable die Exporte in die EU aus jeweils Indien und den EFTA Ländern misst. $b_{EU/IND}$ und $b_{EU/EFTA}$ nehmen den Wert Eins an, wenn Exporte aus der EU jeweils nach Indien und den EFTA Ländern erfasst werden. b_{OTHER} ist gleich Eins wenn Exporte irgendeine Grenze überqueren, die in den vorigen Grenzdummyvariablen nicht erfasst wurde.

Mit Hilfe des Antilogarithmus des geschätzten Grenzkoeffizienten kann der Grenzeffekt berechnet werden. Es gibt das Verhältnis von *i*'s Exporten nach *j* zu *i*'s Exporten zu sich selbst an und gibt damit an um wie viel der innerstaatliche Handel den grenzüberschreitenden Handel übersteigt. Nach Korrektur bezüglich der Unterschiede in wirtschaftlicher Größe, geographischer Distanz, Zöllen und anderen beobachtbaren handelskosteninduzierenden Variablen in der Gravitationsgleichung, wird angenommen, dass der Grenzeffekt hauptsächlich von den Effekten der NTBs bestimmt wird.[3]

3.2 Daten und Schätzergebnisse

Daten für bilaterale Export-, Produktions- und Konsumwerte, bilaterale Zölle und Exportsubventionen sind aus Version 8 der GTAP-Datenbasis bezogen. In Anlehnung an WEI (1996) und anderen Autoren, werden die Exporte eines Landes an sich selbst durch Subtrahieren der aggregierten Exporte jedes Landes (zu allen Handelspartnern) von deren Inlandsproduktion in jedem Sektor berechnet. Der Datensatz umfasst 99 Regionen und 57 Sektoren. Informationen über Distanz, Landumschlossenheit, Nähe, gemeinsame Währung, Sprache und koloniale Beziehungen sowie Mitgliedschaft in gemeinsamen Handelsabkommen und WTO sind der Datenbasis des Centre D'Etudes Prospectives et D'Informations Internationales (CEPII)[4] entnommen. Für die Analyse wird die bilaterale Distanz zwischen zwei Ländern als bevölkerungsgewichtete Durchschnittsdistanz zwischen den größten Städten verwendet. Dies ermöglicht auch die Berücksichtigung von innerstaatlichen Distanzen. Daten über logistische Leistung ist der Weltbank entnommen[5]. Aufgrund der fixen Effekte wird das Produkt der länderspezifischen „Logistic Performance Indices" in die Gravitationsgleichung eingefügt. Je

[2] Die Autoren approximieren Terme für relative Handelskosten durch eine First-Order Taylor Expansion. Diese Terme enthalten nur exogene Variablen und können in die lineare Gravitationsgleichung eingesetzt werden.

[3] Obwohl die theoriebasierte Gravitationsgleichung in (1) die Restriktion $\beta_2 = \beta_3 = 1$ impliziert, wird sie hier nicht eingeführt.

[4] Siehe http://www.cepii.fr/anglaisgraph/bdd/distances.htm

[5] Siehe http://go.worldbank.org/7TEVSUEAR0

höher dieser Index, desto leistungsfähiger die Logistik. Freedom House ist die Quelle für die Informationen über politische Freiheit[6]. Auch hier wird der „Political Freedom Index“ als Produkt der länderspezifischen Indizes berücksichtigt. Je höher dieser Index, desto geringer die politische Freiheit. Informationen über Religion sind dem The World Factbook der CIA entnommen[7]. Der Datensatz enthält 82272 Exportwerte, die gleich Null sind. Aus diesem Grund wird das Zero-Inflated Poisson (ZIP) Modell (z.B. BURGER et al., 2009) gewählt[8]. Für die Poisson Schätzung wird die Gravitationsgleichung in (1) entsprechend einer Exponentialfunktion verändert. Die ZIP Regression wird für 16 Agrar- und Nahrungsmittelsektoren[9] und für 4 aggregierte Nicht-Agrar-Sektoren[10] durchgeführt.

Entsprechend der Logit-Regression steigt in fast allen Sektoren erwartungsgemäß die Wahrscheinlichkeit für Exportwerte von Null mit der Distanz und sinkt mit gemeinsamer Grenze. Die signifikanten Koeffizienten und der positive Vuong Test sprechen für die ZIP Schätzung. Auch die Ergebnisse der Poisson Regressionen entsprechen den Erwartungen. Produktion und Konsum haben einen positiven Effekt auf den Handelsstrom in allen Sektoren und sind hochsignifikant. Die Handelselastizität hinsichtlich Distanz ist in allen aggregierten Sektoren signifikant negativ und deutlich unter Eins. Kulturelle Nähe zwischen zwei Ländern und eine gemeinsame Währung beeinflussen den Handel positiv in fast allen Sektoren. Auch logistische Leistung hat einen signifikant positiven Effekt. Die Zugehörigkeit zu einem Handelsabkommen und zur WTO erhöht den Handel signifikant. Nachteile in der geographischen Lage und Einschränkungen in der politischen Freiheit wirken sich negativ auf den Handel aus. Der Effekt von Zöllen ist in den meisten Sektoren hochsignifikant. Allerdings ist der Einfluss von Zöllen teilweise positiv. Auch der Koeffizient für Exportsubventionen ist entweder nicht signifikant oder hat das falsche Vorzeichen. Derartige Ergebnisse finden sich jedoch auch in der Literatur (vgl. PHILIPPIDIS und SANJUÁN, 2007; WINCHESTER, 2009). Die Koeffizienten der Grenz-Dummyvariablen sind erwartungsgemäß negativ und hochsignifikant in allen Regressionen. Dementsprechend liegt der eindeutige Nachweis für grenzinduzierte Barrieren vor. Im Handel von Agrargütern und Nahrungsmitteln insgesamt ist der Handel innerhalb der EU 46 mal größer als die Exporte von der EU nach Indien und nur 4 mal größer als die Exporte in die EFTA. Diese Werte zeigen, dass die von den EU Ländern zu den EFTA Ländern exportierten Agrarprodukte und Nahrungsmittel geringeren Barrieren ausgesetzt sind als die Exporte nach Indien. Der Handel innerhalb Indiens ist 11 mal größer als Exporte in die EU und der EFTA intra-Handel ist 9 mal größer als die Exporte in die EU. Dies zeigt auch, dass die EU gegenüber Indien höhere Barrieren hat als gegenüber den EFTA Ländern.

3.3 Berechnung der Zolläquivalente

Die theoretische Spezifikation des Gravitationsmodells ermöglicht es mit Hilfe der Substitutionselastizität die Effekte der Barrieren, die durch internationale Grenzen verursacht werden, in Handelskosten zu überführen. Für die Kalkulation der AVEs der NTBs wird die folgende Gleichung verwendet $AVE_{bij} = \exp[\beta_{ij}/1\text{-}\sigma] - 1$, in der AVE_{bij} das Zolläquivalent der Grenzbarrieren ist. $AVE_{bEU/IND}$ gibt beispielsweise die Schwierigkeiten der EU beim Export

[6] Siehe http://www.freedomhouse.org/

[7] Siehe https://www.cia.gov/library/publications/the-world-factbook/

[8] Die ZIP Schätzung wird anderen Poisson Schätzern vorgezogen, um den Überschuss an Null Werten und die Überstreuung zu berücksichtigen. Dies geschieht in zwei Prozessen: der erste Prozess generiert die Null Daten (Logit-Regression) und der zweite Prozess generiert die Daten des Poisson Modells (Poisson-Regression).

[9] Auf Grund der Kollinearität zwischen Produktion und exporter-spezifischen fixen Effekten und zwischen Konsum und importer-spezifischen fixen Effekten werden in den sektoralen Regressionen die Variablen Produktion und Konsum nicht berücksichtigt.

[10] In den aggregierten Sektorregressionen werden Sektor-Dummyvariablen berücksichtigt, um sektor-spezifische Charakteristiken aufzufangen. Tatsächlich erfordert die gewählte Spezifikation die Berücksichtigung von exporter-sektor- und importer-sektor-spezifischen fixen Effekten. Dies hätte jedoch zur Einbeziehung von 11286 (=2•99•57) Dummyvariablen geführt, was technisch nicht umsetzbar war.

ihrer Produkte nach Indien hinsichtlich des implizierten Preiseffekts an. Es umfasst das Durchschnittsniveau der Protektion des importierenden Landes und andere Grenzfaktoren, die nicht durch die berücksichtigten Variablen in der Gravitationsgleichung erfasst werden. β_{ij} ist der Koeffizient der Grenzdummyvariablen b_{ij} und σ ist die Substitutionselastizität zwischen den Produkten. Für die Berechnung der AVEs werden die Substitutionselastizitäten zwischen Gütern aus der GTAP-Datenbasis entsprechend der Sektoraggregation verwendet[11].

Tabelle 1: Zolläquivalente für NTBs (in Prozent)

Sektor	Auf EU's Exporte nach Indien	Auf EU's Exporte nach EFTA	Auf Indien's Exporte in die EU	Auf EFTA's Exporte in die EU
Weizen	0	0	75	145
Futtergetreide	1158	0	660	20697
Obst & Gemüse	0	0	0	192
Ölsaaten	454	115	92	492
Pflanzliche Fasern	210	133	337	504
Sonstige Getreide	162	65	102	116
Reis	0	0	43	0
Rinder	209	160	0	168
Schweine & Geflügel	615	309	467	379
Rindfleisch	0	53	123	71
Schweine - & Geflügelfleisch	49	31	57	34
Pflanzliche Fette & Öle	65	0	0	0
Milchprodukte	63	0	0	29
Zucker	48	0	0	97
Sonstige Nahrungsmittel	198	27	85	91
Getränke und Tabak	814	409	1015	1446
Agrargüter und Nahrungsmittel	162	41	82	76
Sonstige Primärsektoren	0	0	24	0
Textilien & Bekleidung	34	9	19	31
Industrie	31	17	39	33
Dienstleistungen	404	363	391	446

Quelle: Eigene Berechnungen.

Tabelle 1 listet die AVEs von NTBs auf EU's Exporte nach Indien und in die EFTA Länder und auf die Exporte von Indien und den EFTA Ländern in die EU. AVEs, die Exporte in den aggregierten Sektoren aus der EU nach Indien betreffen, reichen von 404% im Dienstleistungssektor bis 31% im Industriesektor. Im Agar- und Ernährungssektor und bei Textilien liegen die AVEs der NTBs bei 162% bzw. nur bei 34%. Bei sonstigen Primärsektoren liegt der AVE bei 0%. AVEs auf die Exporte der EU in die EFTA-Länder sind in den aggregierten Sektoren erwartungsgemäß niedriger. Insbesondere im Agrar- und Nahrungsmittelsektor ist der AVE um 120 Prozentpunkte geringer. Die 16 Sektoren für Agrargüter und Nahrungsmittel weisen AVEs auf, die von 48% bei Zucker bis 1158% bei Futtergetreide reichen. Auch hier liegen die AVEs auf EU's Exporte in die EFTA Länder niedriger. Die einzige Ausnahme ist der Rindfleischsektor. Während Indien keine NTBs auferlegt, besteht in den EFTA Ländern ein AVE von NTBs auf EUs Rindfleischexporte von 53%.

[11] Alternativ kann auch die geschätzte Substitutionselastizität aus der Gravitationsgleichung gewählt werden. Basierend auf der theoretischen Herleitung des Gravitationsmodells wird die Substitutionselastizität mit dem Absolutwert des geschätzten Zollkoeffizienten plus Eins berechnet. Infolge nicht signifikanter Ergebnisse für einige Sektoren, wurde dieser Ansatz nicht gewählt.

Die AVEs von NTBs auf Indien's Exporte in die EU sind in den aggregierten Sektoren von der Größenordnung vergleichbar. Sie sind im Bereich Agrargüter und Nahrungsmittel sowie Textilien und Bekleidung mit 82% bzw. 19% geringer. Für sonstige Primärgüter und Industriegüter sind sie mit 24% und 39% leicht höher. Die AVEs von NTBs auf EFTA's Exporte in die EU sind auch hier erwartungsgemäß niedriger. Eine Ausnahme bilden die Sektoren Textilien und Dienstleistungen. Bei den einzelnen Agrar- und Nahrungsmittelsektoren gibt es eine starke Variation. Besonders hohe AVEs von NTBs auf Indien's Exporte in die EU sind bei Getränken und Tabak (1015%), Futtergetreide (660%) und bei Schweine und Geflügel (467%) zu finden. Reis sowie Schweine- und Geflügelfleisch weisen mit 43% bzw. 57% die geringsten AVEs auf. Überraschenderweise sind die AVEs von NTBs auf EFTA's Exporte in die EU in den meisten Sektoren höher. Sehr viel höhere AVEs von NTBs werden in den Sektoren Futtergetreide, Getränke und Tabak, sowie Ölsaaten implementiert. Andererseits erhebt die EU auf EFTA's Exporte von Schweinen und Geflügel, Rindfleisch sowie Schweine- und Geflügelfleisch sehr viel niedrigere AVEs von NTBs als gegenüber Indien. Zusammengefasst deuten die Ergebnisse auf teilweise sehr hohe AVEs von NTBs im Agrarbereich hin. Ein Vergleich mit anderen Studien (z. B. PHILIPPIDIS und SANJUÁN, 2007; WINCHESTER, 2009; CHANG und HAYAKAWA, 2010) zeigt, dass hohe AVEs bei Agrargütern und Nahrungsmitteln typisch sind.

In Anlehnung an WINCHESTER (2009) werden die existierenden Grenzbarrieren zwischen der EU und den EFTA Ländern als Normierung verwendet. Hierbei wird angenommen, dass die Effekte von NTBs zwischen EU und Norwegen und Schweiz niedrig sind, und dass ein erfolgreicher Abschluss des EU-Indien FTA zu einem ähnlich niedrigen Niveau an NTBs führen wird. Die AVEs der NTBs, die EUs Exporte nach Indien betreffen, werden berechnet durch Subtraktion von $AVE_{bEU/EFTA}$ von $AVE_{bEU/IND}$, wenn $AVE_{bEU/EFTA}$ geringer ist als $AVE_{bEU/IND}$. In gleicher Weise werden AVEs von NTBs berechnet, die Indiens Exporte in die EU betreffen. Wenn $AVE_{bEU/EFTA}$ größer ist als $AVE_{bEU/IND}$ und $AVE_{bEFTA/EU}$ größer ist als $AVE_{bIND/EU}$, wird angenommen, dass der Abschluss des FTA das Niveau der nicht-tarifären Protektion nicht ändert. Sind die Koeffizienten der Grenzdummyvariablen nicht signifikant, wird angenommen, dass kein Grenzeffekt vorliegt.

4 Simulationen mit dem GTAP-Modell

4.1 Modell und Daten

Die Simulationen in der vorliegenden Studie verwenden das komparativ statische, globale allgemeine Gleichgewichtsmodell GTAP. Die Grundstruktur des Standardmodells ist ausführlich in HERTEL (1997) dokumentiert und im Internet verfügbar.[12]

FRANCOIS (1999) entwickelte einen Ansatz, in dem NTBs als Eisberg-Transportkosten oder als Nettowohlfahrtsverlust modelliert werden, um die Doha-Runde der WTO-Verhandlungen zu analysieren. Dieser Ansatz wurde durch HERTEL et al. (2001) erweitert. Die Autoren stellen die Verbindung zwischen NTBs und CGE Modellierung her, indem NTBs als unbeobachtete, nicht explizit von der GTAP-Datenbasis berücksichtigte Handelskosten behandelt werden. Hierfür wird ein zusätzlicher effektiver Importpreis eingeführt, der eine Funktion aus den beobachteten Importpreisen und einem exogenen unbeobachteten technischem Koeffizienten ist (HERTEL et al., 2001: 13)

(2) $$pms^*_{irs} = pms_{irs} - ams_{irs}$$

pms^*_{irs} prozentuale Änderung des effektiven Importpreises von i aus r nach s

pms_{irs} prozentuale Änderung des Inlandspreises von i aus r nach s

ams_{irs} Importe i aus r nach s, erweitert durch technische Änderung

[12] Siehe www.gtap.org.

Die Senkung der Handelskosten eines bestimmten Exporteurs wird in einer Erhöhung des ams_{irs} unter der Annahme reflektiert, dass ams_{irs} im Anfangsgleichgewicht gleich Eins ist. Entsprechend dieses Ansatzes fällt der effektive Inlandspreis des von r nach s exportierten Guts i, der hierdurch die Abnahme der realen Ressourcenkosten reflektiert. Diese Methode zur Modellierung des Abbaus der NTBs in Form von sinkenden Handelskosten geht auf die Theorie der Eisberg-Transportkosten zurück, die ursprünglich durch SAMUELSON (1954) eingeführt wurde.

Durch Effizienzsteigerung und eine entsprechende Erhöhung des ams_{irs} wird die effektive Importmenge von Gut i aus der Region r nach Region s erhöht. Dies führt zu den folgenden Importnachfrage- und Importpreisgleichungen (HERTEL et al., 2001: 13):

(3) $$qxs_{irs} = -ams_{irs} + qim_{is} - \sigma^{i} \cdot \left(pms_{irs} - ams_{irs} - pim_{irs}\right)$$

(4) $$pim_{is} = \sum_r \theta_{irs} \cdot (pms_{irs} - ams_{irs})$$

qxs_{irs}	prozentuale Änderung der bilateralen Exporte von i aus r nach s
qim_{is}	prozentuale Änderung der Durchschnittsimporte von i nach s
pim_{irs}	prozentuale Änderung des Importpreises von i aus r nach s
pim_{is}	prozentuale Änderung des durchschnittlichen Importpreises von i nach s
σ^{i}	Substitutionselastizität zwischen den Importen von i
θ_{irs}	Anteil der Importe aus r an den Gesamtimporten von s zum Marktpreis

Entsprechend der Gleichungen (3) und (4) impliziert eine Erhöhung des ams_{irs}, dass die Importe von i aus der Region r nach s kompetitiver werden und Importe aus anderen Regionen substituieren. Zusätzlich zu den kostenerhöhenden Effekten, generieren NTBs einen Protektionseffekt, der durch Importzölle aufgefangen werden könnte. Sowohl ANDRIAMANANJARA et al. (2003) als auch FUGAZZA und MAUR (2008) bieten ausführliche Studien zum Vergleich dieser beiden Ansätze in regionalen bzw. globalen CGE Modellen an. Die Autoren betonen, dass die Anwendung des Importzoll-Ansatzes zur Modellierung von NTBs und der hierbei entstehenden Renten eine vorsichtige Interpretation der resultierenden Wohlfahrtseffekte erfordert. Mit der effizienzmäßigen Modellierung der NTBs werden insgesamt sehr hohe positive Wohlfahrtsgewinne quantifiziert, so dass sie nur bei geringeren Effizienzsteigerungen zu realistischen Ergebnissen führt.

In der vorliegenden Studie wird der Ansatz der Eisberg-Transportkosten angewendet. Die quantitative GTAP Analyse basiert auf Version 8 der GTAP-Datenbasis. Die 129 Länder und Regionen und 57 Sektoren werden zu einer 20x23 Datenbasis aggregiert. Hierbei werden Länder von potentiellen FTA und andere signifikante Handelspartner der EU und Indiens herausgehoben. Diese Sektoraggregation entspricht den Sektoren, die vorher in der Anwendung des Gravitationsmodells definiert wurden.

4.2 Szenarien und Ergebnisse

In diesem Abschnitt werden die Resultate der verschiedenen Optionen eines EU-Indien FTA diskutiert. Die Berechnungen basieren auf GEMPACK (HARRISON und PEARSON, 1996). Eine fixierte Handelsbilanz wird als makroökonomische Schließung in allen Szenarien verwendet.

Das Basisjahr 2007 der GTAP-Datenbasis impliziert ein aktuelleres politisches Umfeld. So ist das Multi-Fiber-Agreement bereits ausgelaufen (2005), die EU Erweiterung von 2004 und 2007 berücksichtigt und China ist seit 2007 ein Mitglied der WTO, das die vorgesehenen Verpflichtungen erfüllt. Allerdings erfordert die Analyse eines EU-Indien FTA die Implementierung laufender und kürzlich abgeschlossener FTA, welche die EU und Indien betreffen. Deshalb werden einige Prä-Experimente durchgeführt, die die ASEAN Free Trade Area (AFTA), die Südostasien FTA (SAFTA), das Indien-Sri Lanka-FTA, das EU-Korea-FTA und das EU-Südafrika-FTA (TDCA) berücksichtigt.

Neben Änderungen des politischen Umfelds sind makroökonomische Entwicklungen von Bedeutung für eine Volkswirtschaft. Daher werden Projektionen des globalen und regionalen BIP und der Faktorausstattung in das erweiterte GTAP Modell implementiert. Technischer Fortschritt wird durch das Modell endogen generiert und so die projizierten Wachstumsraten erreicht. Durch die Implementierung der zusätzlichen FTA und der Aktualisierung des makroökonomischen Umfelds wird eine Projektion bis zum Jahr 2015 durchgeführt. Hierbei wird angenommen, dass innerhalb dieser Zeitspanne das EU-Indien FTA vollständig abgeschlossen sein wird. Demgegenüber werden die WTO Verhandlungen aus den Simulationen ausgeschlossen.[13] Zusammenfassend ergeben sich drei Experimente für das EU-Indien FTA, die in Tabelle 2 aufgezeigt werden.

Tabelle 2: Politikszenarien zur Implementierung des EU-Indien FTA

	Zollkürzungen		NTBs	
	EU	Indien	Abbaurate	Normierung
EXP1	97%	97%	100%	EFTA - Normierung
EXP2	97%	97%	100%	keine Normierung
EXP3	97%	30%	100%	EFTA - Normierung

Tabelle 3 zeigt die Wohlfahrtsergebnisse der drei Experimente in Millionen US$ der GTAP-Datenbasis mit Hilfe der äquivalenten Variation (ÄV). Die erste Spalte zeigt die ÄV insgesamt, während die folgenden Spalten die Ergebnisse entsprechend der jeweiligen Schocks differenzieren. Folglich zeigen Spalte 2 bis 7 die Effekte der bilateralen Zollkürzungen im Agrar- und Nahrungsmittelsektor sowie im Industriesektor in der EU und Indien. Der zweite Teil der Tabelle 3 (Spalten 8 bis 15) repräsentieren die Effekte, die auf die Eliminierung der NTBs in der EU oder in Indien in unterschiedlichen Sektoren zurückzuführen sind.

Aus der ersten Spalte in Tabelle 3 ist es ersichtlich, dass die EU und Indien aus dem EU-Indien FTA profitieren. Die gesamten Wohlfahrtsgewinne der EU liegen zwischen 12 und 67 Mrd. US$. Im Vergleich dazu ist das Wohlfahrtsergebnis für Indien etwas niedriger im ersten Experiment und deutlich höher in den zwei anderen Experimenten. Es liegt im zweiten Experiment mit einer Zollkürzung von 97% und ohne Normierung der NTBs bei 85 Mrd. US$. Mit der asymmetrischen Zollkürzung im EXP3 ergibt sich ein Wohlfahrtsgewinn von 20 Mrd. US$, der im Vergleich zu EXP1 um 5 Mrd. US$ höher liegt (15 Mrd. US$). Die Zollkürzung in Indiens Industriesektor in der symmetrischen FTA führt zu einem Wohlfahrtsverlust von 6,1 bzw. 6,8 Mrd. US$, der nur teilweise durch den Wohlfahrtsgewinn aus der Zollkürzung im Agrar- und Nahrungsmittelsektor der indischen Ökonomie kompensiert wird. In EXP3 ergibt sich dagegen nur ein Wohlfahrtsverlust von 0,2 Mrd. US$ durch die Zollkürzung in Indiens Industriesektor, der vollständig durch den Wohlfahrtsgewinn aus der Zollkürzung im Agrar- und Nahrungsmittelsektor kompensiert wird. Grundsätzlich führt die Zollsenkung im indischen Industriesektor zu einem negativen Terms of Trade Effekt, der im EXP3 auf Grund der asymmetrischen Zollkürzung niedriger ausfällt. Die negativen Effekte werden jedoch von den positiven Allokationseffekten aufgehoben. Die meisten dieser Resultate sind bereits in der Literatur diskutiert. Interessanter sind die Ergebnisse im zweiten Teil der Tabelle 3, die sich auf die Eliminierung der NTBs beziehen. Auf den ersten Blick ist ersichtlich, dass das allgemeine Niveau dieser Wohlfahrtskomponente höher ist als die Effekte, die sich infolge der Zollkürzung ergeben. Dabei ist der Anteil der Eliminierung von NTBs an den Gesamtwohlfahrtseffekten für Indien in den ersten beiden Experimenten höher als für die EU.

[13] Hierfür gibt es zwei Gründe. Erstens ist aufgrund des mangelnden Fortschritts in den aktuellen WTO Verhandlungen eine fundierte Vermutung über den Zeitpunkt der Abschließung sehr schwierig. Zweitens wird die aktuelle GTAP-Datenbasis noch nicht mit der entsprechenden TASTE (Tariff Analytical and Simulation Tool for Economist) Funktion ergänzt, so dass die entsprechenden WTO Zollkürzungen auf der disaggregierten Ebene (HS6) berechnet werden können.

Dieser Anteil ist hauptsächlich auf die Eliminierung von NTBs im Industriesektor zurückzuführen. An zweiter Stelle folgt der Agrar- und Ernährungssektor. EXP2 bildet eine Ausnahme, da hier die Effekte der NTB-Eliminierung im Dienstleistungssektor auf Grund der fehlenden Normierung an Bedeutung gewonnen haben. Indien profitiert am meisten aus der eigenen NTB Eliminierung, wobei auch hier NTBs im Agrar- und Ernährungssektor eine wichtige Rolle spielen. Für die EU ist das Gegenteil zu beobachten. Die meisten Gewinne aus der Eliminierung von NTBs erzielt die EU wenn Indien die NTBs im Industriesektor abschafft. Da der Agrar- und Nahrungsmittelsektor für den Handel zwischen Indien und der EU bislang nur von geringerer Bedeutung ist, sind die mäßigen Effekte im Agrar- und Ernährungsbereich plausibel.

Tabelle 3: Veränderung der Wohlfahrt (Äquivalente Variation, Mio.US$)

		Bilateral Zollkürzung						Abbau der NTBs							
		EU			Indien			EU				Indien			
	Totale ÄV	NM & Ag	Indus-trie	Total	NM & Ag	Indus-trie	Total	NM & Ag	Indus-trie	Dienst-leistung	Total	NM & Ag	Indus-trie	Dienst-leistung	Total
	Experiment 1: FTA und NTBs														
EU	22202	112	-999	-886	826	9760	10586	305	2661	0	2967	349	7603	1589	9541
Indien	15088	368	2722	3090	1333	-6129	-4795	104	6047	0	6150	2823	5751	2072	10646
China	1417	30	-251	-220	-325	1242	918	9	-26	0	-17	-210	1480	-532	738
Japan	538	14	-6	8	-103	390	286	5	30	0	35	-71	441	-160	210
USA	855	3	6	10	-159	256	97	-6	196	0	190	-207	1045	-278	560
RestAsien	-1688	-11	-191	-202	-441	-747	-1189	-6	-96	0	-101	-126	-224	154	-195
LDC	-228	-4	-63	-67	45	-103	-58	1	-191	0	-189	36	-201	251	86
rWTOIC	-1209	9	-65	-56	-63	-302	-365	7	-400	0	-393	-14	-669	288	-395
rWTODC	-2645	-66	-577	-643	504	83	587	-5	-2314	0	-2320	435	-2600	1896	-269
Welt	34331	455	577	1032	1617	4450	6067	414	5907	0	6321	3015	12627	5279	20921
	Experiment 2: FTA und NTBs, keine Normierung														
EU	67041	116	-1727	-1611	1172	13438	14611	1507	11161	14468	27136	533	19093	7284	26910
Indien	85211	466	3871	4337	1373	-6776	-5403	856	41195	11356	53407	4037	17962	10833	32833
China	-561	33	-374	-341	-373	1446	1073	79	-3198	981	-2138	-301	3415	-2269	844
Japan	-91	15	-14	1	-118	438	320	32	-911	243	-636	-98	1009	-686	224
USA	-427	7	18	25	-192	325	133	25	-1710	324	-1361	-291	2344	-1277	775
RestAsien	-3364	-7	-245	-252	-548	-915	-1462	24	-903	-362	-1241	-200	-707	499	-409
LDC	-757	-2	-66	-69	26	-184	-158	-4	-348	-536	-888	30	-586	914	358
rWTOIC	-2364	13	-75	-62	-96	-513	-609	33	-467	-608	-1042	-38	-1708	1095	-651
rWTODC	-8450	-62	-674	-736	411	-819	-408	-139	-3670	-3983	-7792	494	-7018	7010	486
Welt	136237	578	715	1292	1657	6441	8097	2413	41150	21882	65445	4165	33801	23404	61370
	Experiment 3: asymmetrische FTA und NTBs														
EU	12471	120	-1001	-881	73	2389	2462	296	2449	0	2746	157	6281	1714	8151
Indien	20462	358	2718	3076	471	-163	308	101	5978	0	6079	2799	6275	1910	10983
China	811	31	-239	-208	-39	470	431	9	19	0	29	-149	1249	-540	559
Japan	351	14	-5	8	-13	148	136	5	35	0	40	-50	379	-163	166
USA	827	4	10	14	-36	194	158	-6	210	0	205	-154	890	-286	450
RestAsien	-699	-6	-169	-176	-42	-207	-249	-4	-67	0	-71	-103	-241	141	-204
LDC	-231	-3	-58	-62	5	-74	-69	2	-185	0	-183	18	-188	253	83
rWTOIC	-927	11	-56	-45	-8	-168	-176	7	-380	0	-373	-18	-596	280	-333
rWTODC	-3437	-57	-533	-590	70	-477	-407	-4	-2230	0	-2234	274	-2365	1885	-206
Welt	29627	470	667	1137	482	2113	2595	407	5831	0	6239	2774	11683	5194	19651

Quelle: Eigene Berechnungen.

5 Schlussfolgerung

Die vorliegende Studie analysiert die potenziellen Effekte eines EU-Indien FTA unter Berücksichtigung von Zöllen und NTBs. Der Fokus liegt auf dem Agrar- und Ernährungsbereich. Für die Analyse wurde die GTAP-Datenbasis und Poisson Regressionen von Gravitationsgleichungen zur Schätzung der AVEs der NTBs angewendet. Die Ergebnisse der ökonometrischen Schätzung verdeutlichen die Relevanz der grenzinduzierten Handelskosten im Agrarhandel zwischen der EU und Indien, das sich auf das hohe Niveau an NTBs zurückführen lässt. Indiens Exporte in die EU werden durch sehr hohe NTBs in den Sektoren Getränke und Tabak, Schweine und Geflügel behindert, während EU-Exporte nach Indien mit hohen NTBs in den Sektoren Futtergetreide, Schweine und Geflügel, sowie Getränke und Tabak, konfrontiert werden. Die geschätzten AVEs der NTBs werden unter der Annahme normiert, dass die Verhandlungen über ein EU-Indien FTA die NTBs im Agrarhandel auf ähnliche Niveaus reduzieren, die zwischen der EU und den EFTA Ländern vorherrschen. Allerdings sind die grenzinduzierten Handelskosten zwischen der EU und den EFTA Ländern teilweise immer noch sehr hoch und übersteigen die, die zwischen der EU und Indien vorherrschen. Im zweiten Schritt werden die AVEs in das CGE Modell GTAP implementiert und drei Experimente durchgeführt. Die Gesamtwohlfahrtseffekte aus diesen Experimenten verdeutlichen, dass EU und Indien aus dem EU-Indien FTA profitieren. Indiens Wohlfahrtsergebnis hängt hauptsächlich von der Höhe der Zollkürzung und von der Normierung der NTBs ab. Das Wohlfahrtsergebnis für Indien ist höher als in der EU, wenn eine asymmetrische Zollkürzung durchgeführt wird oder die NTBs nicht normiert werden. Die Effekte der Zollkürzungen sind insgesamt von geringerer Bedeutung als die Abschaffung von NTBs. Im Vergleich zu den bisherigen quantitativen Analysen eines Freihandelsabkommens zwischen der EU und Indien mit einem CGE Modell ist das Gesamtwohlfahrtsergebnis in dieser Studie für beide Handelsparteien höher, was eindeutig auf die Abschaffung von NTBs zurückzuführen ist. Dabei gewinnt Indien mehr durch die Eliminierung von NTBs als die EU. Der Abbau von NTBs im Agrar- und Nahrungsmittelsektor in Indien macht nach dem Industriesektor den zweithöchsten Anteil an den Gesamtwohlfahrtsgewinnen aus der Eliminierung von NTBs aus. Dies verdeutlicht die hohe Relevanz von NTBs im zukünftigen Handel von Agrargütern und Nahrungsmitteln für die indische Volkswirtschaft.

Die obige Analyse bedarf einer Qualifikation. Erstens, die Effekte von NTBs sind nicht direkt geschätzt worden. Neben den NTBs gibt es weitere Erklärungsfaktoren für den Grenzeffekt, so dass die Schätzungen hier eine Obergrenze bilden. Die Erweiterung der Spezifikation könnte dazu beitragen, die Effekte von NTBs stärker zu isolieren und nicht signifikante Grenzeffekte auszuschließen. Zweitens, die EU-EFTA normierten AVEs und insbesondere die nicht-normierten AVEs sind ambitioniert. Handelsbeziehungen zwischen Norwegen, Schweiz und den EU Mitgliedsländern entwickelten sich über eine lange Zeit. Demnach stellen die Schätzungen in dieser Studie langfristige Wohlfahrtseffekte des EU-Indien FTA dar. Schließlich muss bedacht werden, dass die Wohlfahrtseffekte geringer ausfallen würden, wenn die WTO Verhandlungen berücksichtigt worden wären. Allerdings, wie auch in WINCHESTER (2009) dargestellt, decken die Wohlfahrtseffekte einige wohlfahrtsverbessernde Aspekte nicht ab. Hierzu gehören die Realisation von Größeneffekten, dynamische Fortschritte durch Kapitalgewinn und Produktivitätsverbesserungen durch Technologietransfer. Diese Aspekte bieten interessante Möglichkeiten für weitere Forschungsarbeit.

Literatur

ACHTERBOSCH, T., M. KUIPER und P. ROZA (2008): EU-India Free Trade Agreement: A Quantitative Assessment. Report No: 2008-059, Project code 20824. The Hague: LEI Wageningen.

ANDRIAMANANJARA, S., M. FERRANTINO und M. TSIGAS (2003): Alternative Approaches in Estimating the Economic Effects of Non-Tariff Measures: Results from Newly Quantified Measures. Working paper 2003-12-C. U.S. International Trade Commission.

ANDERSON, J.E. (1979): A theoretical foundation for the gravity equation. In: American Economic Review 69 (1): 106.

ANDERSON, J.E. und E.VAN WINCOOP (2003): Gravity with gravitas: a solution to the border puzzle. In: American Economic Review 93: 170-192.

BAIER, S. und J.H. BERGSTRAND (2009): Bonus vetus OLS: A simple method for approximating international trade-cost effects using the gravity equation. In: Journal of International Economics 77 (1): 77-85.

BURGER, M.; VAN OORT, F. und LINDERS, G.-J. (2009): On the Specification of the Gravity Model of Trade: Zeros, Excess Zeros and Zero-Inflated Estimation. In: Spatial Economic Analysis 4 (2): 167-190.

CHANG, K. und K. HAYAKAWA (2010): Border Barriers in Agricultural Trade and the Impact of their Elimination: Evidence from East Asia. In: The Developing Economies 48 (2): 232-246.

DECREUX, Y. und C. MITARITONNA (2007): Economic Impact of a Potential Free Trade Agreement between the European Union and India. Report by CEPII/CEMIN for the EU, Trade Specific Contract No: SI2.434.087. Brüssel: Europäische Kommission.

EU-KOMMISSION (2006): Global Europe – competing in the world. A contribution to the EU's Growth and Jobs Strategy. DG External Trade, Brüssel.

EU-KOMMISSION (2012): Trade. In: http://ec.europa.eu/trade/creating-opportunities/bilateral-relations/index_en.htm. Abruf: 29.02.2012.

FRANCOIS, J.F. (1999): Economic Effects of a New WTO Agreement Under the Millennium Round. Bericht an die Handelsdirektion der Europäischen Kommission.

FRANCOIS, J.F., H. NORBERG und A. PELKMANS-BALAOING (2008): Trade Impact Assessment of an EU-India Free Trade Agreement. Forschungsbericht an die Europäische Kommission. Institute for international and development economics (IIDE).

FUGAZZA, M. und J.-C. MAUR (2008): Non-Tariff Barriers in CGE Models: How Useful for Policy? In: Journal of Policy Modeling 30 (3): 475-490.

GTAP (2012): GTAP-Datenbasis Version 8, https://www.gtap.agecon.purdue.edu/databases/v8/default.asp

HARRISON, J.W. und K.R. PEARSON (1996): Computing Solutions for Large General Equilibrium Models using GEMPACK. In: Computational Economics 9: 83-127.

HERTEL, T.W. (Hrsg.) (1997): Global Trade Analysis. Modeling and Applications. New York.

HERTEL, T.W., T. Walmsley und K. Itakura (2001): Dynamic Effects of the New Age Free Trade Agreement between Japan and Singapore. In: Journal of Economic Integration 16 (4): 446-448.

MCCALLUM, J. (1995): National Borders matter: Canada-U.S. regional trade patterns. In: American Economic Review 85 (3): 615-623.

OLPER, A. und V. RAIMONDI (2008): Agricultural market integration in the OECD: A gravity-border effect approach. In: Food Policy 33: 165-175.

PHILIPPIDIS, G. und A.I. SANJUÁN (2007): An Analysis of Mercosur's regional trading agreements. In: World Economy 30: 504-531.

POLASKI, S.A., S. GANESH KUMAR, M.P. MCDONALD und S. ROBINSON (2008): India's Trade Policy Choices. Washington D.C: Carnegie Endowment for International Peace.

SAMUELSON, P.A. (1954): The transfer problem and transport costs II: Analysis of effects of trade impediments. In: The Economic Journal LXIV: 264-289.

WEI, S.J. (1996): Intra-national versus international trade: how stubborn are nations in global integration? Working Paper 5531. Cambridge, MA: National Bureau of Economics Research.

WELTBANK (2011): World Development Indicators. In: http://data.worldbank.org/. Abruf: 01.11.2011.

WINCHESTER N. (2009): Is there a dirty little secret? Non-tariff barriers and the gains from trade. In: Journal of Policy Modeling 31: 819-834.

6 Agriculture in the TTIP - A Joint Econometric-CGE Assessment

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Agriculture in the TTIP - A Joint Econometric-CGE Assessment

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Abstract

We examine the Transatlantic Trade and Investment Partnership (TTIP) between the European Union (EU) and the United States (US) considering detailed nontariff barriers (NTBs) in food and agriculture. We use the gravity model to estimate ad-valorem tariff equivalents (AVEs) of NTBs, which are based on integration levels negotiated by the TTIP partners in the past. We implement these AVEs into the Global Trade Analysis Project (GTAP) model to obtain economy-wide effects. We validate our results drawing on experience gained from past analyses of free trade areas. Simulation results indicate considerable gains for the EU and US that are predominantly driven by the reduction of NTBs, whereas third countries gain from spillover effects and are only moderately affected.

JEL classification: Q17, F15, D58, C21

Keywords: Transatlantic Trade and Investment Partnership; nontariff barriers; food and agricultural sector; gravity model; Global Trade Analysis Project

1 Introduction

Regionalism and the related ever-growing number of Free Trade Areas (FTAs) have become striking features of international trade in recent years. One of the most prominent FTAs is the currently negotiated Transatlantic Trade and Investment Partnership (TTIP) between the European Union (EU) and the United States (US), whose potential partners cover approximately half of the world's trade. The conclusion of the TTIP would thus lead to one of the biggest FTAs worldwide and might change the global trading system. There are many reasons why the EU and the US have gone forward with the negotiation of the TTIP. The most decisive factor in re-opening the trade talks in February 2013 was the obvious lack of progress in the Doha Round of the WTO negotiations since 2001, although the Bali Agreement of December 2013 has inspired new enthusiasm for the possible completion of the Doha Round. Other important reasons include the declining international competitiveness of many developed countries and the most recent global economic crisis. As a result, many developed countries established strong structural reforms, intensified the search for new partners in the world market and reinforced activities to stimulate existing trade relations. By opening up their markets to the respective TTIP partner for commodities, services and investments, the two giants of world trade are intent on enabling economic growth, creating jobs to boost their economies and keeping up with other global players, particularly the fast-growing emerging countries.

Whether the EU and the US might be successful in this endeavor is currently being controversially discussed, particularly in Europe but also in the US. This continuous debate has been triggered by the intention of the two partners to this FTA to not only reduce or abolish already-lowered tariffs but also to harmonize nontariff barriers (NTBs). Here, consumer and other nongovernmental organizations fear that the TTIP will lower safety and environmental standards. NTBs in the food and agricultural sector are regarded as playing an especially important role in the TTIP because European and American consumers seem to have very different and sometimes seemingly opposed attitudes toward food and how it should be produced. Two of the most obvious examples are the adverse attitude of European consumers to the use of genetically modified feed in livestock production and the reluctance of American consumers to consume cheese produced from raw milk. An agreement on the NTBs between the EU and the US might provide a starting point for a global set of standards, in which case the related spillover effects in third countries might contribute to reducing a possible trade-diverting effect of the TTIP.

Until now, there have been only a few publications providing quantitative analyses to support arguments for or against the TTIP. The results of these analyses indicate that the EU and the US would gain from a successful conclusion of the TTIP negotiations and that the major gain would result from the harmonization of EU and US NTBs and mutual recognition of production and testing procedures (e.g., CEPR, 2013; Felbermayr et al., 2013). To the best of our knowledge, there is only one study covering NTBs in the food and agricultural sector at a disaggregated level (Bureau et al., 2014); thus, extensive comparative analyses of the particularly important harmonization of the EU and US trade rules and regulations in the food and agricultural sector are not yet available. In this article, we make the following contributions. First, in contrast to the majority of the recent literature on this topic, we contribute to the understanding of the impact of reliable NTB reductions in detailed food and agricultural sectors. Second, in establishing possible liberalization scenarios for food and agriculture, we take advantage of new measures of the depth of various FTAs (Dür, Baccini, and Elsig, 2014) by working with a gravity-based econometric framework to link the depth of past FTAs to levels of liberalization in the food and agricultural sectors. This approach serves as the basis for a computable general equilibrium (CGE)-based prospective analysis of the TTIP. Finally, keeping concerns about CGE-based trade estimates in mind (Kehoe, 2005), we also compare our estimates to the outcomes from NAFTA.

2 Simulation Model-Based Assessments of Free Trade Areas

The question of whether FTAs are welfare gaining has been the subject of several articles after Viner (1950) published his influential analysis on trade creation and diversion. Since then, many authors have demonstrated that economic theory does not provide an unambiguous answer to this question. Among them are Lloyd and MacLaren (2004, p. 452ff.), who shed light on this question by providing an extended theoretical general equilibrium analysis. However, they also conclude that an ambiguity remains in the prediction of general equilibrium theory and suggest that CGE models are a natural vehicle to explore the economic effects of FTAs. Indeed, FTAs have for the most part been analyzed with the help of CGE models in the past. A survey analyzing the results of the substantial literature on this topic can be found in Lloyd and MacLaren (2004, p. 452ff.).[1]

Although CGE models have often been applied in the past to analyze this topic, very few articles have addressed the performance of this method. Hertel et al. (2003) consider this question by evaluating the likely outcome of the Free Trade Area of the Americas. The authors concentrate on the underlying parameters of the CGE models and note that CGE models are justifiably criticized for their lack of econometric foundation. Even if their estimated point elasticities are available, they might be based on deviating sector disaggregation or time periods that do not match. A systematically raising or lowering of elasticities in a sensitivity analysis therefore often fails to properly address the problem. Hertel et al. (2003) particularly note that the elasticity of substitution or so-called Armington elasticity is the key parameter to substitute among imports from different countries, thereby governing trade diversion and thus also welfare results. The authors are able to demonstrate that welfare results are far more sensitive to the Armington parameter than to all of the other parameters of the CGE model combined. Accordingly, they suggest building econometrically estimated confidence intervals around this particular parameter to enhance the quality of the CGE model results in an FTA analysis.

An additional important article in this context, written by (Lloyd and MacLaren, 2004), is based on a comparison of the available analyses of the FTA between the US and Australia. The authors also emphasize the importance of the Armington elasticity in analyzing FTAs and thereby support the suggestion of Hertel et al. (2003) to build confidence intervals for this key parameter. However, Lloyd and MacLaren (2004) extend this view by demonstrating that there might be a bias in trade diversion and the terms of trade effect due to the shortcomings of the Armington Assumption (Armington, 1969) together with the Constant Elasticity of Substitution (CES) function. Accordingly, they propose concentrating on national income and welfare effects in FTA analyses and advocate separating terms of trade effects from other effects in

[1] Plummer, Cheong, and Hamanaka (2010) provide a comprehensive menu of available methods for evaluating the impact of FTAs apart from the CGE models.

the welfare impact on third countries. Additionally, they state that up to the point of writing their article, estimates of tariff equivalents of NTBs had for the most part not been considered in FTA analyses. This includes rules of origin, which may serve to undermine liberalization commitments. Although rules of origin can be complex to model, the authors single them out because they assume their implementation in FTAs might lead to substantial additional administrative costs relative to welfare gains.

Kehoe (2005) provides an even more thorough evaluation of the performance of CGE modeling in FTA analyses. He systematically assesses three of the most prominent CGE models utilized to quantify the effect of the North American Free Trade Area (NAFTA). The analysis is built on relative measures to capture the development of trade flows after the implementation of NAFTA. Of particular importance is the increase in sectoral or total exports relative to the change in GDP. Using related statistical measures (e.g., the weighted correlation of data and the variance in the decomposition of change) to isolate the deviation between models' results and the actual statistics from 1999, the author is able to draw several significant conclusions for analyses of FTAs. Kehoe (2005) demonstrates that CGE models drastically underestimated the impact of NAFTA and failed to predict the absolute size of the increase in overall trade. In particular, the CGE models were not able to capture many of the sector details when employed to analyze NAFTA. Here, the results indicate that the highest relative increase in trade occurs in those sectors that have the smallest initial trade value, whereas previously larger sectors become less important. The CGE models, however, predicted exactly the opposite, which Kehoe (2005) mainly traces back to the CES function set up, low values of the elasticity of substitution and missing growth in productivity (see also Trefler, 2004, p. 887). In contrast, the CGE models delivered good results when predicting the increase in overall trade relative to GDP or quantifying the change in relative prices and quantities. It must be emphasized that Kehoe (2005) does not consider the effects of NTBs on the outcome of his evaluation.[2]

Plummer, Cheong, and Hamanaka (2010, p. 55) add to the discussion of the performance of CGE models in FTA analyses by arguing that productivity spillover is particularly important for the results of third countries in FTA analyses. However,

[2] At the time of writing, researchers were still mainly concerned with improving the tariff protection data in CGE models. The quantification of data on NTBs and their implementation in CGE models seemed to be an out-of-reach issue at that time.

they argue that the inclusion of endogenized productivity spillovers in CGE models is a very complicated operation, and none of the articles addressing it has succeeded so far. Similar to Lloyd and MacLaren (2004), they also emphasize that it is particularly difficult to model certain NTBs such as sanitary and phytosanitary measures, technical barriers or customs issues if they are included in an FTA. More recent analyses of FTAs largely include these trade costs of NTBs (e.g., Andriamananjara et al., 2004; Philippidis and Carrington, 2005; Fugazza and Maur, 2008; Engelbert, Bektasoglu, and Brockmeier, 2014). Here, the authors stress that the elasticity of substitution is not only important to determine changes in trade flows and welfare changes but also to quantify the magnitude of the NTBs.

What do we learn from these articles evaluating CGE-based analyses of FTAs? The public debate as well as the scope of the negotiations clearly indicates that it is essential to include NTBs in analyses of the TTIP. Therefore, we believe that it is of utmost importance to base the following analysis of the TTIP on an elasticity of substitution that we econometrically estimate using an exact match of the sector disaggregation of the CGE model and an appropriate time period. Additionally, we use our estimates of the elasticity of substitution and the related confidence interval to generate a distribution of the model's results when presenting absolute amounts or sectoral details. Taking the findings of Kehoe (2005) into account, we otherwise constrain our presentations of the simulation results to relative or percentage changes compared with initial values of macroeconomic variables such as GDP. Validating our analysis, we also evaluate the simulation results against the findings of Kehoe (2005) regarding the actual data after NAFTA came into force. In so doing, we believe that, of all of the concluded FTAs, NAFTA is most comparable to the TTIP, and the impact on the partner economies is therefore likely to be similar.

3 Estimations with the Gravity Model

Empirical analyses (CEPR, 2013; Felbermayr et al., 2013; Bureau et al., 2014) of the TTIP suggest that lowering trade costs through behind-the-border regulations and NTBs accounts for the majority of gains for the EU and US. Both are characterized by advanced regulatory systems that they consider essential to upholding their high standards for consumer, environmental, health and labor protections. Following ECORYS

(2009), our analysis does not judge whether a specific NTB is right or wrong or whether one system is better than the other. Instead, our article identifies NTBs through divergences in the regulatory systems that cause additional costs or limited access for foreign firms. This approach is also in accordance with the interests of the negotiating partners, who intend to keep their high standards but also to avoid unnecessary time and administrative costs by recognizing similarities in approval procedures, adjusting the wording of provisions to make it easier to comply with each other's existing rules, and making serious attempts to cooperate closely in designing new bilateral trading rules (European Commission, 2014a; USTR, 2014a).

There are several methods to combine the large variety of nontariff trade measures in one uniform metric. Many approaches are econometric, quantity-based methods and use trade data as the basis. One of the most influential studies on NTBs was performed by Kee, Nicita, and Olarreaga (2009). The authors use the United Nations Conference on Trade and Development (UNCTAD) Trade Analysis and Information System (TRAINS) database on NTBs and nonlinear regressions to estimate the importer-specific trade costs of NTBs at the HS-6 data level. The data are provided by the World Bank. Table 1 presents their estimated aggregated Ad Valorem Equivalents (AVEs) on NTBs for the EU and US for two non-food sectors and 16 food and agricultural sectors. In terms of non-food sectors, the US imposes nontariff restrictions in manufacturing and extraction that are equivalent to 18.37% and 137.44% tariffs, respectively. In contrast, the EU imposes much lower AVEs on NTBs in non-food sectors. The average AVEs on NTBs in agro-food sectors are 45% in the EU and 55% in the US. Both impose the highest AVEs on NTBs in the rice sector. These high AVEs can be explained by administrative burdens and inefficiencies in quantity and price measures, whereas technical regulations play only a minor role. In general, AVEs on NTBs in products of animal origin such as dairy and meat are higher than in plant-based products due to sanitary measures and other food safety regulations. Finally, Kee, Nicita, and Olarreaga (2009) find that the EU has a more homogenous structure in NTBs than the US.

The findings of Kee, Nicita, and Olarreaga (2009) in Table 1 present the estimated average level of nontariff protection currently existing in the EU and US. We assume that this level is the upper-bound level of NTBs for trade liberalization within an FTA. Given the experience of past negotiations on FTAs and the proposed course of action, it is likely that the EU and the US will not completely remove or harmonize existing bilateral NTBs within the TTIP. In our analysis, we therefore aim to quantify the level of NTB reduction that is oriented toward the historical actions of the two partners in the TTIP within an ex post study. In so doing, we use the gravity model and an indirect approach to estimate the trade costs of NTBs that can be considered reasonably likely to be reduced in a potential FTA between the EU and US. We apply an FTA variable that captures the trade effect of all of the policy instruments that are intended to reduce restrictive nontariff trade measures or to harmonize regulations and standards within FTAs on average (Chen and Novy, 2012).

Table 1: Estimated Aggregated Ad Valorem Equivalents (AVEs) on NTBs for the EU and US

	EU	US
Manufacturing	2.75	18.37
Extraction	1.32	137.44
Wheat	0.96	0.00
Cereal grains	53.33	114.23
Vegetables and fruits	38.67	35.81
Oil seeds	14.23	111.16
Plant based fibers	0.74	-
Crops	40.35	17.60
Cattle	58.38	61.03
Animal products	35.97	14.35
Vegetables oils and fats	33.92	5.96
Dairy	94.28	73.69
Rice	124.89	205.27
Sugar	46.37	-
Other food products	58.60	45.88
Beverages and tobacco	21.39	1.57
Cattle meat	47.99	51.77
Other meat	55.17	30.74

Source: Kee, Nicita, and Olarreaga (2009).

As a new feature, we introduce an FTA variable in our analysis that differentiates the depth and scope of agreed topics in the negotiations according to seven levels. Consequently, we can select the level of ambition in terms of reduction of nontariff trade measures and harmonization of regulations and standards in our experimental design. In the gravity modeling, we adopt the recent econometric developments. In particular, we account for endogenous FTAs and their effects on bilateral trade flows. Thereby, we follow the recent studies by Baier and Bergstrand (2002, 2007, 2009) and Egger et al. (2008, 2011). We adapt the two-stage procedure proposed by Greene (1994, 1997) by first using a probit regression to estimate the probability for each level of integration and to generate the inverse Mills ratios. In the second step, we use the predicted selectivity measures from the first stage in our gravity equation as regressors to correct for the potential endogeneity of FTAs (Winkelmann, 2008, p. 155). In doing so, we consider selection bias for depth in trade agreements (Egger and Francois, 2014).

3.1 Econometric Framework and Data

The gravity model has been used frequently to empirically analyze patterns of trade and the effects of trade agreements and barriers.[3] For our analysis, we implement the gravity-like equation developed by Anderson and van Wincoop (2003, 2004), which accounts for the general equilibrium effects of trade barriers. Their basic model explains bilateral trade by exporter production and importer consumption relative to global output. Trade is reduced by bilateral trade barriers and also by average trade barriers. The latter are known as multilateral resistance terms. Empirically, these average trade barriers can be fully controlled by importer- and exporter-specific dummy variables. Because bilateral trade frictions are not observable, they are defined as a function of observed trade costs factors. Generally, a set of geographical, political and cultural adjacency variables are included in the cost function. In addition to the FTA depth variable, we include two interaction terms between the FTA depth variable and the EU and US importer dummy variables to identify asymmetric peculiarities of EU and US trade agreements. The second-stage empirical specification reads as follows:

$$X_{ij} = \exp\Big(\alpha_i + \alpha_j + Z_{ij}^{'}\beta + \delta_1 FTAD_{ij} + \delta_2 FTAD_{i,EU} + \delta_3 FTAD_{i,USA} + \sum_{i=1}^{7} \gamma_k \hat{m}_{ij}^{k}\Big) \quad (1)$$

[3] See Anderson (2011) and Head and Mayer (2014) for a thorough review of the theoretical and empirical developments of the gravity model.

where X_{ij} is the value of trade from country i to country j, α_i is the fixed effect of the exporting country and α_j is the fixed effect of the importing country, accounting properly for general equilibrium effects. The vector $Z_{ij} = (1, Distance_{ij}, Contiguity_{ij}, \ldots)'$ contains a constant and all of the variables promoting or hindering trade except the FTA depth variable and the corresponding interactions with regional dummy variables. Furthermore, $\beta = (\beta_0, \beta_1, \beta_2, \ldots)'$ is a vector of the coefficients applying to the variables in Z_{ij}. The categorical variable $FTAD_{ij}$ ranges from zero to seven. It takes the value of zero if the two trade partners do not join the same FTA. A value that is greater than zero indicates an effective FTA between the two countries, whereby higher values indicate a deeper scope of the FTA. The variables $FTAD_{i,EU}$ and $FTAD_{i,US}$ represent the interaction terms between the FTA depth variable and the regional importer dummies. Thereby, the EU exhibits all integration levels within FTAs with the exception of the lowest level 1, and the US has only deeper FTAs (4, 6 and 7). The coefficient δ_1 identifies the average effect of a typical FTA, whereas δ_2 and δ_3 indicate EU and US behavioral deviations from the average FTA effect. Finally, m_{ij} is equal to the potential measure for endogeneity from the first-stage regression and γ is the corresponding coefficient.[4]

According to the theoretical derivation, we interpret the average FTA effect as $\delta_1 = (\sigma - 1) ln(1 + AVE_{FTAD})$. Here, σ is equal to the elasticity of substitution, and AVE_{FTAD} represents the trade cost equivalent of a typical FTA. We apply equation (1) to 16 individual food and agricultural sectors and ten manufacturing sectors (see Table A.1 in the Appendix).[5] The most important parameters for our analysis are the coefficients on the FTA depth variable and the interaction terms. In the second-stage estimation procedure, we apply the Poisson Pseudo Maximum Likelihood (PPML) estimator proposed by Santos Silva and Tenreyro (2006, 2011) to address the problems of zero trade flows[6] and heteroskedasticity in the trade data.

[4]Following Egger et al. (2011), we model the selection of FTA depth by a set of different characteristics. We consider geographical, cultural, historical and political affinity as well as the difference in economic size and the degree of networking between countries. The dependent variable is defined as a binary variable that takes the value of one if two countries belong to a common FTA in the corresponding integration level. We cover the most important FTAs, which are noted by the World Trade Organization. Detailed first-stage estimation results are available from the authors upon request.

[5]In estimating NTBs, we only use 16 of the 19 food and agricultural sectors from the simulations by combining the generally untraded sectors of paddy rice with processed rice, sugar cane and beets with sugar, and raw milk with dairy.

[6]Zero trade flows amount to 69.84% in agro-food and 41.79% in the non-food sectors.

We source data on bilateral imports at the GTAP level from the United Nations Commodity Trade Statistics database and the MFN applied tariff rates from the UNCTAD TRAINS database for 2010.[7] Due to unavailability of data, we reduce the number of regions to 114 regions. We also reduce the number of sectors to 16 food and agricultural sectors and ten manufacturing sectors.[8] Thereafter, our regression analysis includes 12769 observations for each sector.[9] The FTA depth variable is constructed using information from Dür, Baccini, and Elsig (2014). Data on contiguity, common language and colonial relationships are gathered by the Centre D'Etudes Prospectives et D'Informations Internationales (CEPII). Distances are the actual shipping distances taken from (Francois et al., 2013).[10] Political science variables on democratic and autocratic patterns of authority and regimes are taken from the Polity IV Project database.[11] GDP data are taken from the World Bank. We also include a measure of lagged trade network embeddedness taken from Francois and Rojas-Romagosa (2014). This measure is based on the number of common export partners shared by a given country pair and is motivated by evidence on the importance of network structures in economic relationships (Easley and Kleinberg, 2010; de Benedictis and Tajoli, 2011; Zouh, 2014).

3.2 Estimation Results

In Table 2, we display the PPML results for the primary agriculture and processed foods regressions. The Mills ratios are all negative, with two exceptions in the processed food regression. This result implies that unobservable factors favoring the creation of FTAs and their average scope are accompanied by unobservables that have a negative effect on trade (Egger et al., 2011, p. 125). However, the exogeneity for selectivity is rejected only for integration levels 1 and 6 in the primary agriculture regression and for integration level 6 in the processed food regression. Importantly, the joint significance

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[7]We use the tariff margin to consider the trade policy effect.

[8]Five non-food sectors are pooled over the individual manufacturing sectors. See Table A.1 in the Appendix for the detailed sector composition.

[9]Due to data unavailability, our data set includes 114 importing countries and 113 exporting countries. Missing data for other variables leads to unbalanced data sets.

[10]Missing values are replaced by distance information from CEPII.

[11]We replace missing data for the political science variable with mean values.

test for endogenous FTA depth selection reveals endogeneity, so we reject the hypothesis of exogeneity with p-values for the χ^2 statistic with a significance level lower than 0.05. Most of the coefficients have the expected signs and are statistically significant, confirming the results of the gravity literature. The elasticity of trade with respect to distance is negative and is only significant in the primary agriculture regression. Hence, if the distance between two countries increases by 1%, bilateral trade in primary agriculture decreases by 0.65%. The effects of contiguity and cultural adjacencies are positive and significantly influence agro-food trade. In contrast, political divergence does not have any significant effect.

Our expectations are that FTAs promote trade. Primary agricultural trade is expected to increase by 13% and trade in processed foods by 15% for countries trading within an FTA at the integration level of one. To obtain the regional specific deviations from the average effect, we take the cumulative effect by combining the typical FTA and the importer-specific FTA given the joint significance of the FTA depth variable and importer-specific dummy variables. Interestingly, the EU and the US deviate positively in primary agricultural trade and negatively in the processed food trade compared with the average FTA effect. If the EU is the importer in the FTA, primary agricultural trade is expected to increase by 16%; if the US is the importer, by 25%. Trade in processed food is expected to increase by 12% for the EU and by 5% for the US.

Table 3 reports point and interval estimates of disaggregated agro-food AVEs of NTBs for a modest FTA scenario using the elasticity of substitution σ from the sectoral estimations[12] and the FTA depth level of four.[13] In addition to point estimates, we assess the respective interval estimates. We calculate the interval estimates by considering the 95% confidence interval of the tariff elasticity and the point estimate of the FTA quantity effect. With respect to the existing diversity of the EU and the US in their attitudes within FTAs, we take into account the cumulative effect by combining the typical FTA effect and the importer-specific FTA effect, given the joint significance of the two parameters. In case the estimates are only individually significant, we take either the typical FTA quantity effect and conclude that EU and US agreements are not

[12] The substitution elasticity is equal to the absolute tariff coefficient plus one. In nine of 26 sectors, the estimate of the tariff elasticity is not significant. In these cases, we use the estimates from the pooled sector regressions.

[13] Non-food results on the AVEs of NTBs are not reported but are available from the authors upon request.

different compared with a typical FTA, or we take the importer-specific FTA quantity effects and conclude that EU and US agreements have an effect that is not observed in a typical FTA.[14]

Table 2: Second-Stage Estimation Results for Primary Agricultural and Processed Foods Trade

	Primary Agriculture		Processed Foods	
	Coefficient	Std. Error	Coefficient	Std. Error
ln(Tariff)	−2.197**	(0.959)	−0.545	(0.613)
ln(Distance)	−0.647***	(0.0727)	−0.598***	(0.0506)
Contiguity	0.618***	(0.130)	0.693***	(0.105)
Language	0.210*	(0.123)	0.377***	(0.111)
Colonizer	0.548***	(0.205)	0.497*	(0.298)
Colony	0.246	(0.184)	0.365***	(0.109)
Policy	−0.277	(0.546)	0.556	(0.453)
$FTAD$	0.118***	(0.0438)	0.143***	(0.0295)
$FTAD_{i,EU}$	0.0288	(0.0376)	−0.0307	(0.0275)
$FTAD_{i,US}$	0.109**	(0.0451)	−0.0943**	(0.0479)
$\hat{m}_1$	−0.267**	(0.122)	−0.250	(0.252)
$\hat{m}_2$	−0.125	(0.0940)	0.0123	(0.0820)
$\hat{m}_3$	−0.0555	(0.0894)	−0.0359	(0.0857)
$\hat{m}_4$	−0.0623	(0.0835)	−0.00154	(0.0775)
$\hat{m}_5$	−0.335	(0.280)	0.140	(0.191)
$\hat{m}_6$	−0.445**	(0.175)	−0.270**	(0.121)
$\hat{m}_7$	0.0361	(0.167)	0.00903	(0.122)
N	11053		11070	
R^2	0.836		0.803	
χ^2-*stat*	18.60		14.41	
p-value of χ^2	0.00954		0.0444	

Note: Importer and exporter fixed effects are not reported. Asterisks (*), (**) and (***) denote significance at the 10%, 5% and 1% levels, respectively. "χ^2-*stat*" and "*p-value* of χ^2" refer to a test of joint significance of Mills ratios to assess endogeneity.
Source: Authors' calculations.

[14] In cases in which both the cumulative and the individual effects are not significant, we consider the average effect from the pooled agro-food sector regression.

Table 3: Point and Interval Estimates for AVEs of NTBs in Disaggregated Agro-Food Sectors and the Average Non-Agro-Food Sector

	US to EU			EU to US		
	LB	MV	UB	LB	MV	UB
Non-agro-food	1.3	1.9	3.4	1.6	2.3	4.2
Wheat	71.4	95.5	142.6	0.0	0.0	0.0
Cereal grains nec.	6.7	8.4	11.3	113.0	156.2	246.8
Crops nec.	22.4	28.6	39.5	33.9	43.8	61.7
Oil seeds	31.3	40.3	56.5	114.1	157.9	249.8
Vegetable & fruit	17.8	22.6	30.9	57.9	76.5	111.9
Other animal products	22.4	28.6	39.5	33.9	43.8	61.7
Sugar	4.0	6.4	15.9	8.3	13.4	34.9
Vegetable oil & fat	22.4	28.6	39.5	33.9	43.8	61.7
Processed rice	7.1	11.2	26.0	0.0	0.0	0.0
Beef	49.0	64.2	92.7	299.1	459.4	873.7
Dairy products	90.5	122.9	188.6	23.2	29.6	40.9
Other meat nec.	48.1	63.1	90.8	30.3	39	54.6
Other food products	3.3	4.4	6.8	0.2	0.3	0.4
Beverages & tobacco	6.6	9.9	19.8	12.7	19.3	39.9

Note: LB = Lower Bound; MV = Mean Value; UB = Upper Bound.
Source: Authors' calculations.

In terms of non-food sectors, the EU is expected to reduce NTBs against US exports equivalent to a 1.86% tariff on average. US willingness to reduce NTBs is estimated to be slightly higher, at 2.28% on average. In contrast, reducible trade costs caused by NTBs in the agro-food sectors are much higher. The EU is expected to greatly reduce NTBs in animal-based products such as other meat (64%), beef (63%) and dairy (123%). However, in the wheat sector (96%), the EU is assumed to issue regulatory convergence. In addition, the US is anticipated to reduce NTBs mainly in beef (459%), but NTB reduction is also considerable in oil seeds and cereal. According to our empirical results, the US does not consider regulatory convergence in two sectors (wheat and processed rice). In contrast, we estimate EU regulatory convergence in all sectors, but concessions in sugar, other food products and cereal grains are not important. The US is not expected to negotiate regulatory divergence in its FTAs in other food products. We estimate the most regulatory compliance in the beef and other meat sectors and anticipate the least compliance in other food products, processed rice and sugar. The EU and the US are estimated to have different compliance attitudes in terms of scope. The greatest differences are in the beef, cereal grains and oil seeds sectors. The marginal concessions and sector exclusions fit with the differentiated special treatment in agricultural agreements across countries. Specifically, such exclusions comply with the previous behavior of the EU and US in FTA negotiations, where particularly sensitive sectors such as sugar, rice and dairy are left out or treated specially, mainly as a result of historical reasons and political sensitivity (European Commission, 2014b; USTR, 2014b).[15]

4 Extension of the GTAP Model

The simulations in this article build on the GTAP framework. The standard version of the GTAP model is a comparative, static, multi-region general equilibrium model that provides a detailed representation of the economy, including the linkages between the farming, agribusiness, industrial and service sectors of the economy. Outstanding characteristics of this standard GTAP model are the non-homothetic constant difference of elasticity preferences of the private household and the explicit inclusion of international trade and transport margins and a global banking sector. Trade flows draw on bilateral matrices and are based on the Armington assumption (Armington, 1969). Price wedges represent all policy interventions. Additional features of the standard GTAP model are perfect competition in all markets and the profit- and utility-maximizing behavior of producers and consumers. The standard GTAP model and database is well documented by Hertel (1997) and is available on the Internet.

The standard GTAP framework does not take NTBs into account. To incorporate our estimated NTBs in the analysis of the TTIP, we extend the GTAP model and augment the GTAP database. There are several ways that NTBs can be covered in the equation system of a CGE model. All of these approaches are based on the assumption that NTBs limit trade, thereby creating an artificial scarcity and a related higher import price. The resulting wedges between the world market and domestic prices are the key inputs used in the empirical analysis of NTBs. They can be incorporated into the CGE model as tariff equivalents beyond the actual tariffs, as export tax equivalents or

[15] Examples of EU and US FTAs excluding individual agro-food sectors from full liberalization are the EU-Mexico FTA, the EU-Korea FTA, the US-Australia FTA and the US-Canada trade arrangements.

as efficiency losses with the help of the so-called "sand in the wheel" or "iceberg cost" approach (Andriamananjara, Ferrantino, and Tsigas, 2003, p. 3).

Following CEPR (2013, p. 16), we differentiate between two types of NTBs in our analysis, namely, "costs" and "rents" and associate them with either one of the approaches to incorporate NTBs in the CGE models noted above. Costs of NTBs are induced by regulations that increase the resources used to conduct the business. An example is a regulation that requires expansive reconfigurations of products for export. To cover these resource-wasting costs of NTBs, we employ an approach originally developed by Francois (1999, 2001) and extended by Hertel, Walmsley, and Itakura (2001) that treats NTB-related costs as unobserved trade costs not explicitly covered by the GTAP database.

In contrast, NTBs generate rents when market access is restricted, prices are increased due to induced market power and additional mark-ups (higher prices) accrue to firms (CEPR, 2013, p. 16). To integrate these rents of NTBs into the GTAP model, we follow the approach of Urban, Jensen, and Brockmeier (2014, p. 15ff.), which was initially elaborated for domestic support, and adapt it to the import rents in the GTAP model. In so doing, we supplement the GTAP model structure with a tariff equivalent that allows for an additional rent above the tariff revenues. This procedure enables us to differentiate between tariff-related and rent-creating policy instruments.

Costs and rents of NTBs cause different economic impacts in terms of changing market concentration and economic power. Both types of NTBs and their corresponding integration into the CGE models affect the terms of trade in a similar way but exhibit different welfare effects. NTB-related costs involve the wasting of resources and hence efficiency and welfare losses but do not exhibit trade diversion effects. In contrast, NTB-related rents imply a redistribution of welfare between consumers and producers in addition to the efficiency losses and give rise to trade-diverting effects (Andriamananjara, Ferrantino, and Tsigas, 2003, p. 4; Schiff and Winters, 2003, p. 57; Fugazza and Maur, 2008, p. 485; CEPR, 2013, p. 16).

5 Simulations of the Transatlantic Trade and Investment Partnership

In recent years, international trade negotiations as well as agricultural trade reforms have lowered tariff levels but also smoothed out tariff peaks between the EU and the US. In 2009, EU imports of food and agricultural products from the US faced an average tariff of 4.9%, whereas the average EU import tariff for US industrial sector exports amounted to a very low 1.18%. The average US tariffs for EU agro-food and manufacturing exports are also very moderate, at only 3.22% and 1.55%, respectively (TRAINS, 2014).

The situation slightly changes when tariffs in the food and agricultural sector are considered at a detailed product level. Table 4 presents the bilateral tariffs between the EU and the US for food and agricultural products at the most disaggregated sector level of the GTAP database (version 9, 2014). In general, the EU tariffs are higher than the US tariffs for all food and agricultural markets. The EU's highest tariffs are on US exports of beef (65%), dairy (47%), processed rice (21%) and pork and poultry (other meat nec., 38%). However, US tariffs are highest on EU exports of sugar (13%), dairy (12%), other food products (4%) and processed rice (4%).

Table 4: Bilateral Tariffs of the Agricultural and Food Sectors, 2011, %

	EU	US
Wheat	11.8	1.4
Cereal grains nec.	1.4	0.1
Crops nec.	6.4	3.2
Oil seeds	0.0	0.0
Vegetable & fruit	2.9	2.1
Other animal products	2.0	0.5
Vegetable oil & fat	2.8	1.4
Processed rice	21.0	4.3
Beef	65.3	1.4
Dairy products	47.3	11.6
Other meat nec.	14.0	0.8
Other food products	13.3	4.4
Beverages & tobacco	5.9	0.8

Source: GTAP database, version 9, 2014.

The AVE estimates presented in Table 2 are used to integrate the costs and rents of NTBs into the GTAP database. Currently, only ECORYS (2009) provides information on rents and costs in the food and agricultural sectors of the EU and the US. They identify a cost share for the food and agricultural sector that amounts to 69% and 64% for the EU and the US, respectively. The remaining 31% (EU) and 36% (US) are attributed to rents of NTBs. For the non-food sectors, we also draw on the analysis provided by ECORYS (2009) and allocate an average share of 56.3% (EU) and 59.8% (US) to the costs of NTBs, while the remaining gap is distributed to the respective rents of NTBs.

In line with Fox et al. (2003), OECD (2009) and CEPR (2013), we implement the rents of NTBs in the GTAP database using the Altertax procedure (see Malcom, 1998). Because rents mainly accrue to importer interest in the food and agricultural sector, we assume that all rents of NTBs are established on the import side. Applying the information from ECORYS (2009) presented above to the AVE estimates given in Table 3, we derive the breakdown of bilateral rents and costs of NTBs for the food and agricultural sectors presented in Table 5. Using the mean value and the upper and lower bounds of our econometric estimates, we thereby establish a base for our confidence interval in the following simulations.

In accordance with (CEPR, 2013, p. 28), we take direct and indirect spillover effects for third countries into account. A direct spillover effect enables third countries to take advantage of improved market access to the EU and the US. Here, we assume that the direct spillover effect is equal to 0% to 10% of the estimated NTBs between the EU and the US, depending on the intensity of trade relations with the third country. An indirect spillover effect captures the improved access of the EU and the US to the markets of third countries, which is assumed to be equal to 1% of the direct spillover effect. Finally, we also assume a trade-promoting effect of the TTIP between third countries of 0.01%.

Table 5: Bilateral Rents and Costs of NTBs of the Food and Agricultural Sectors, 2010, %

	Rents						**Costs**					
	US to EU			**EU to US**			**US to EU**			**EU to US**		
	LB	MV	UB	LB	MV	UB	LB	MV	UB	LB	MV	UB
Wheat	22	30	44	0	0	0	49	66	98	0	0	0
Cereal grains nec.	2	3	4	41	56	89	5	6	8	72	100	158
Crops nec.	7	9	12	12	16	22	15	20	27	22	28	40
Oil seeds	10	13	18	41	57	90	22	28	39	73	101	160
Vegetable & fruit	6	7	10	21	28	40	12	16	21	37	49	72
Other animal products	7	9	12	12	16	22	15	20	27	22	28	39
Sugar	1	2	5	3	5	13	3	4	11	5	9	22
Vegetable oil & fat	7	9	12	12	16	22	15	20	27	22	28	39
Processed rice	2	3	8	0	0	0	5	8	18	0	0	0
Beef	15	20	29	108	165	315	34	44	64	191	294	559
Dairy products	28	38	58	8	11	15	62	85	130	15	19	26
Other meat nec.	15	20	28	11	14	20	33	44	63	19	25	35
Other food products	1	1	2	0	0	0	2	3	5	0	0	0
Beverages & tobacco	2	3	6	5	7	14	5	7	14	8	12	26

Note: LB = Lower Bound; MV = Mean Value; UB = Upper Bound.
Source: Authors' calculations based on Table 2 and ECORYS (2009).

5.1 Pre-Simulations and Scenarios

Simulations in this article are based on the GTAP framework. We use version 9 of the GTAP database with a base year of 2011. This database is aggregated into 31 sectors and 20 regions. Thereby, we single out major trading partners and other countries currently involved in FTAs with the EU and the US. Given the focus of the analysis, we keep the most detailed information from the GTAP database for the food and agricultural sector. For the nonagricultural part of the economy, we differentiate between several manufacturing and service sectors[16] (see Table A.1 in the Appendix). The resulting sector disaggregation also matches the predefined sectors in the gravity model approach.

Using the bilateral rents and costs based on the mean value and the upper and lower bounds of our econometric estimates (see Table 5) as well as the related econometric estimates of the elasticity of substitution, we build the starting point of our confidence interval by projecting three different baselines from the benchmark year 2011 to the year 2020. In each baseline, we consider identical changes to the political and economic environment. To update the political situation, we simulate EU enlargement to include Croatia (2013). The economy-wide levels of macroeconomic variables are updated according to developments based on factor endowment and population in each country and region to the year 2020 for each baseline. Thereby, the GTAP model endogenously generates the value of the technical change parameter necessary to reach the projected growth rates of the prevailing economies. The three different baselines are compared with a scenario in which we completely abolish tariffs and reduce all of the costs and rents of NTBs between the EU and the US. The scenario is also conducted with values for the elasticity of substitution, which are calculated with the help of the mean value and the upper and lower bounds of our estimates (see table 3). Additionally, we assume that changes in the political and economic environment will be completely implemented within the given time period. Such changes include the previously noted change in tariffs and NTBs of the EU and the US and also the resulting spillover effects in third countries.

[16] In the simulations of the TTIP, we also consider reductions of NTBs in services sectors. Information on the AVEs of NTBs for services is taken from CEPR (2013).

5.2 Simulation Results

In this section, we discuss the results of the policy simulations. In presenting the results, we focus on the trade and welfare effects. The results are presented in millions of US$. The simulations are performed using GEMPACK (version 11.0) and RunGTAP (Harrison and Pearson, 1996). A fixed trade balance is adopted as the macroeconomic closure in the policy simulations.

5.2.1 Trade

The EU and the US are linked through intensive trade relations with each other but also with other trade partners. The partners in the TTIP account for over half of worldwide GDP and nearly one-third of world trade. Tables 6 and 7 display the trading partners of the EU and the US in the base year 2011, after our projections in the year 2020 and after the TTIP is implemented, respectively. We use exports to illustrate the trade relations but also observe the import side to ascertain that there is no deviating situation. Both tables differentiate according to the share of the trading partner in total exports and in food and agricultural exports. Trading partners importing less than 1% of the total exports of the EU and the US are aggregated in the Rest of the World (ROW).

The numbers in Table 6 indicate that the EU trades for the most part with itself. Intra-EU trade covers approximately 60% of total EU exports and approximately 75% of total EU agro-food trade in the base year. The US is the most important trading partner for total exports outside the EU. EU agro-food exports go mainly to high-income countries (HIC) and North Africa, whereas the US is the third most important partner. Up to the year 2020, the intra-EU trade becomes slightly less important. The TTIP increases the importance of the US, whereas other trading partners of the EU, particularly HIC and North America, become to some extent less important. However, for most of the third countries, we hardly observe any change of importance.

The US total exports as well as agro-food exports are more evenly distributed among the trading partners. Although much of the total US exports goes to the EU as well, the NAFTA partner as well as HIC, Japan and China are also important trading partners. For the US agro-food exports, the NAFTA partners, HIC, Japan and China are even

Table 6: Trading Partners of the EU, %

	Total EU exports			EU food and agricultural exports		
	2011	2020	2020+TTIP	2011	2020	2020+TTIP
EU	60.7	58.9	56.1	75.8	70.8	69.0
USA	7.9	8.6	12.8	2.2	2.4	4.4
HIC	6.6	6.7	6.4	4.1	4.7	4.6
China	3.5	3.4	3.2	1.0	2.1	2.1
North Africa	2.3	2.6	2.5	3.3	4.1	4.0
Japan	1.6	1.5	1.5	1.1	1.0	1.0
Rest of Asia	1.5	1.7	1.6	0.8	1.1	1.1
East Europe	1.0	1.1	1.1	1.3	1.3	1.3
Turkey	1.5	1.6	1.5	0.8	0.9	0.9
India	1.2	1.4	1.3	0.1	0.3	0.3
ROW	12.2	12.6	12.0	9.3	11.3	11.2

Note: High Income Countries (HIC); Rest of the World (ROW); please refer to Table A.1 in the Appendix.
Source: Authors' calculations based on the GTAP framework and own econometric estimates.

Table 7: Trading Partners of the US, %

	Total trade			Food and agricultural trade		
	2011	2020	2020+TTIP	2011	2020	2020+TTIP
EU	23.8	21.9	31.7	7.4	5.4	13.3
Canada	14.5	14.9	12.9	11.5	10.0	9.2
Mexico	9.8	10.2	8.9	12.4	11.6	10.7
HIC	9.0	8.5	7.5	5.8	5.4	5.0
Japan	6.3	5.9	5.1	12.2	9.7	8.9
China	7.8	8.8	7.7	15.4	20.3	18.6
Korea	3.7	3.7	3.2	5.2	5.0	4.6
Rest of Asia	3.6	4.0	3.5	6.1	7.2	6.6
Central America	2.1	2.2	2.0	3.7	3.6	3.3
North Africa	2.2	2.4	2.1	5.1	5.1	4.6
Brazil	2.2	2.1	1.9	0.5	0.5	0.4
India	1.7	2.1	1.8	0.5	1.2	1.1
ROW	13.3	13.3	11.7	14.1	15.0	13.7

Note: High Income Countries (HIC); Rest of the World (ROW); please refer to Table A.1 in the Appendix.
Source: Authors' calculations based on the GTAP framework and own econometric estimates.

more important. EU demand for US exports is slightly decreasing by 2020, but because of the TTIP, the EU is regaining importance and particularly the NAFTA partners lose market shares. A similar situation is given for agro-food trade, but here, China is still the most important partner after the TTIP is in place.

Tables 6 and 7 suggest that third countries are not substantially affected by the TTIP, but the tables do not provide information on all countries or on bilateral trade. In Tables 8 and 9, we therefore supply a matrix covering the bilateral percentage of exports relative to the prevailing countries' GDP, which, as discussed above, have proven to be close to the actual data after the implementation of NAFTA. We adapt the variable calculated by Kehoe (2005, p. 353) according to equation (2) so that n is summed over total trade in Table 8 or over food and agricultural trade in Table 9.

In both tables, s and r represent the source and destination of exports ($VXWD_{nsr}$), respectively:

$$EXPtoGDP_{sr} = \left(\frac{\sum_n VXWD^1_{nsr}}{GDP^1_r} \Big/ \frac{\sum_n VXWD^0_{nsr}}{GDP^0_r} - 1 \right) \times 100 \qquad (2)$$

To ease the interpretation of the results in Tables 8 and 9, we indicate in bold the trading partners with which the trade of the EU or the US is greater than 1% of total trade or of food and agricultural trade, and we highlight cells with negative values in grey.

As expected, we observe the highest increase of exports relative to GDP between the partners of the TTIP. This increase in trade is more pronounced in the food and agricultural sector and more noticeable for EU exports to the US, for which the initial share of the total exports and food and agricultural exports of the EU to the US is smaller than the corresponding trade flow from the US to the EU. Additionally, EU exports relative to GDP to third countries mainly increase, whereas third country total exports relative to GDP to the EU mainly decrease. The opposite development can be observed for the US. In other words, the EU enhances its supply to the US but also to other countries, whereas the US is only able to enlarge its supply to the

EU by decreasing its exports to third countries. A similar pattern, although not as pronounced, is shown for food and agricultural exports in Table 9.

A decrease of exports relative to GDP occurs more often when only the food and agricultural sector is considered. Obviously, the spillover effect increases non-agro-food trade with and between third countries, and this effect outweighs the mainly negative development in the agro-food sector. The decreasing effect in the food and agricultural sectors of most third countries is accompanied by a greater increase in trade between the TTIP partners and can be traced back to the higher NTBs in the food and agricultural sector (see Table 3).

In general, the trade effect for third countries is rather moderate. None of the positive or negative percentage changes in exports relative to GDP in third countries is greater than 2% for total exports or greater than 7% for food and agricultural exports. Those countries whose initial trade with the EU and/or the US is initially of a lower magnitude particularly experience only minor effects. Additionally, trade between third countries is not affected considerably and in many cases increases.

Table 8: Bilateral Exports relative to GDP due to the TTIP Implementation, %

⇐Importer / Exporter⇒	EU	US	Canada	Japan	Korea	HIC	China	India	Brazil	Mexico	Turkey	Central America	East Europe	North Africa	Rest of Asia	Rest of Mercosur	Bangladesh	Mozambique	Rest of LDC	ROW
EU	**−2.02**	**64.82**	1.92	**1.39**	0.88	**1.20**	**0.24**	0.52	−0.14	1.76	**0.22**	0.89	**0.58**	**0.63**	**−0.28**	−0.61	0.36	0.24	−0.89	**−0.05**
US	**33.45**	0.00	**−0.81**	**−2.09**	**−0.87**	**−0.46**	**−1.67**	**−1.64**	**−2.00**	**−0.69**	−1.24	**−1.21**	−0.36	**−0.65**	**−1.25**	−1.08	−1.21	−0.88	−0.89	**−0.10**
Canada	−0.38	**0.43**	0.00	0.38	0.38	0.29	0.21	0.36	0.18	0.26	0.19	0.29	0.20	0.39	0.14	−0.06	0.06	0.25	0.62	0.30
Japan	**−0.43**	**0.88**	0.22	0.00	0.29	−0.07	0.24	0.38	0.30	0.97	0.29	0.47	0.21	0.13	0.08	0.39	−0.01	0.25	0.39	0.14
Korea	−0.31	**0.87**	0.39	0.46	0.00	0.10	0.34	0.43	0.42	0.68	0.26	0.56	0.20	0.13	0.21	0.50	0.05	0.03	0.41	0.19
HIC	**−0.98**	**1.46**	0.58	0.73	0.42	0.06	0.62	0.39	0.42	1.28	0.11	0.61	0.17	0.10	0.36	0.42	0.24	0.08	0.42	0.20
China	**−1.04**	**0.52**	−0.04	0.26	−0.02	−0.44	0.00	0.22	0.37	0.23	0.23	0.31	0.12	−0.18	−0.05	0.34	−0.01	0.30	0.39	0.04
India	**−0.27**	**0.79**	0.29	0.64	0.54	0.14	0.56	0.00	0.33	0.17	0.26	0.44	0.10	−0.08	0.28	0.26	0.03	0.00	0.33	0.13
Brazil	−0.34	**0.94**	0.48	0.66	0.53	0.37	0.62	0.40	0.00	1.47	0.24	0.52	0.13	0.20	0.50	0.04	0.10	0.27	0.50	0.30
Mexico	−0.29	**0.51**	0.15	0.40	0.37	0.35	0.30	0.28	−0.77	0.00	0.29	0.24	0.21	0.41	0.20	−0.33	−0.24	0.42	0.49	0.35
Turkey	**−0.34**	0.97	0.46	0.72	0.66	0.46	1.04	0.69	0.51	1.27	0.00	0.72	0.16	0.14	0.80	0.39	0.43	0.28	0.60	0.43
Central America	−0.10	0.83	0.49	0.66	0.56	0.43	0.50	0.46	0.11	0.71	0.34	0.04	0.24	0.29	0.49	0.21	0.26	0.30	0.55	0.34
East Europe	**−0.20**	0.97	0.58	0.69	0.62	0.47	0.92	0.66	0.63	0.89	0.30	0.68	0.13	0.47	0.77	0.50	0.44	0.32	0.62	0.39
North Africa	**−0.44**	**1.05**	0.49	0.72	0.66	0.41	0.96	0.58	0.50	0.92	0.02	0.66	0.12	0.12	0.71	0.30	0.41	0.33	0.53	0.34
Rest of Asia	**−0.51**	**1.13**	0.42	0.45	0.26	−0.27	0.29	0.05	0.10	0.91	0.16	0.46	0.10	0.08	0.06	0.08	0.04	0.07	0.22	0.13
Rest of Mercosur	−0.09	0.87	0.53	0.67	0.58	0.46	0.63	0.57	0.00	1.33	0.34	0.60	0.25	0.46	0.59	0.11	0.39	0.31	0.60	0.48
Bangladesh	0.00	0.79	0.47	0.67	0.59	0.46	0.65	0.45	0.46	0.73	0.40	0.64	0.26	0.47	0.55	0.33	0.00	0.34	0.56	0.51
Mozambique	0.01	0.82	0.52	0.67	0.60	0.49	0.71	0.61	0.64	0.74	0.42	0.64	0.27	0.52	0.71	0.44	0.61	0.00	0.62	0.53
Rest of LDC	−0.20	0.85	0.52	0.66	0.55	0.44	0.63	0.37	0.40	0.75	0.15	0.62	0.22	0.25	0.45	0.64	0.21	−0.34	0.11	0.23
ROW	**−1.14**	**1.29**	0.45	0.67	0.59	0.17	0.69	0.24	0.31	1.60	−0.25	0.66	−0.37	0.00	0.49	0.29	0.13	−0.07	0.04	0.09

Note: High Income Countries (HIC); Rest of the World (ROW); Please refer to Table A.1 in the Appendix for more detail; Bold values indicate trading partners to which the EU or the US export more than 1% of total food and agricultural exports or from which the EU or the US import more than 1% or total food and agricultural imports (compare also Tables 6 and 7). Cells highlighted in grey represent negative values.

Source: Authors' calculations based on the GTAP framework and own econometric estimates.

Table 9: Bilateral Food and Agricultural Exports relative to GDP due to the TTIP Implementation, %

⇐Importer / Exporter⇒	EU	US	Canada	Japan	Korea	HIC	China	India	Brazil	Mexico	Turkey	Central America	East Europe	North Africa	Rest of Asia	Rest of Mercosur	Bangladesh	Mozambique	Rest of LDC	ROW
EU	**−1.90**	**188.48**	0.86	**0.89**	1.09	**2.30**	**0.00**	**−1.57**	−0.65	0.36	**−0.13**	−0.22	**0.07**	**0.13**	**−1.16**	−2.25	−0.24	−0.02	−1.18	**−0.29**
US	**98.56**	0.00	**0.94**	**−1.46**	**−0.93**	7.33	**−1.79**	**−2.65**	**−4.73**	**1.72**	−1.19	**−2.68**	−3.11	**−3.03**	**−3.41**	−0.86	−2.39	−4.13	−6.00	**−2.63**
Canada	−1.00	**0.33**	0.00	−0.52	−0.44	−0.49	−0.33	−0.39	−0.66	−0.30	−0.36	0.40	−0.84	−0.47	−0.30	−0.13	−0.63	−0.13	−0.12	−0.36
Japan	**−0.65**	**0.26**	0.10	0.00	−0.07	−0.26	0.02	−0.01	−0.11	0.00	−0.38	0.57	−0.43	−0.33	0.03	0.17	−0.21	−0.26	−0.01	−0.23
Korea	−0.56	**0.05**	0.34	−0.11	0.00	−0.18	0.08	−0.17	−0.06	0.17	−0.56	0.65	−0.33	−0.33	−0.03	−0.03	−0.25	−1.30	−0.11	−0.27
HIC	**−0.25**	**0.26**	0.07	0.17	0.30	−0.13	0.22	−0.01	0.07	0.31	−0.31	0.60	−0.36	−0.21	0.18	0.09	0.09	−0.33	−0.01	−0.11
China	**−0.58**	**−0.02**	−0.15	−0.15	−0.18	−0.37	0.00	0.02	0.15	0.20	−0.41	0.79	−0.51	−0.32	0.05	0.36	0.06	0.08	0.09	−0.27
India	**0.02**	**0.22**	−0.41	−0.17	−0.14	−0.30	0.00	0.00	−0.03	0.03	−0.41	0.54	−0.45	−0.34	0.01	0.08	−0.13	−0.10	−0.01	−0.12
Brazil	−0.52	**0.06**	−0.33	−0.21	−0.14	−0.52	−0.05	−0.22	0.00	0.12	−0.52	0.12	−0.66	−0.46	−0.06	0.01	−0.16	−0.30	−0.16	−0.32
Mexico	−0.91	**0.24**	0.18	−0.53	−0.59	−0.66	−0.40	−0.20	−0.33	0.00	−0.54	0.08	−0.65	−0.44	−0.30	0.01	−0.73	−0.49	−0.26	−0.29
Turkey	**−0.08**	−0.46	−0.32	0.34	0.19	−0.26	0.13	−0.09	−0.01	0.25	0.00	0.49	−0.37	−0.21	0.22	0.12	−0.31	−0.38	−0.22	−0.02
Central America	−0.49	**−0.29**	−0.05	−0.57	−0.43	−0.66	−0.45	−0.59	−0.07	−0.13	−0.83	−0.17	−0.54	−0.87	−0.26	−0.11	−0.49	−1.18	−0.61	−0.65
East Europe	**−0.37**	0.76	0.37	0.47	0.46	0.10	0.46	0.09	0.35	0.39	−0.27	1.11	−0.27	−0.14	0.13	0.32	0.18	0.00	0.22	0.14
North Africa	**−0.15**	**−0.44**	−0.23	0.22	0.35	−0.20	0.28	0.14	0.49	−0.06	−0.26	0.64	−0.27	−0.19	0.19	0.24	0.09	0.07	0.11	−0.04
Rest of Asia	**−0.92**	**−0.17**	0.16	−0.18	−0.18	0.16	−0.17	−0.26	−0.26	0.20	−0.62	0.63	−0.78	−0.50	−0.17	−0.14	−0.22	−0.26	−0.12	−0.47
Rest of Mercosur	−0.89	0.42	−0.38	−0.50	−0.27	−0.70	−0.19	−0.43	−0.34	0.21	−0.77	0.67	−0.92	−0.69	−0.20	0.21	−0.49	−0.64	−0.38	−0.48
Bangladesh	−0.48	−0.31	−0.24	−0.05	0.10	−0.22	0.07	−0.03	0.02	−0.05	−0.30	0.73	−0.04	−0.25	0.27	0.09	0.00	−0.07	0.03	−0.19
Mozambique	0.00	−1.20	0.26	0.13	0.32	0.17	0.25	−0.03	0.30	0.59	−0.14	0.56	−0.43	−0.04	0.44	0.40	0.24	0.00	−0.08	−0.05
Rest of LDC	−0.53	−0.90	−0.28	−0.35	−0.05	−0.36	0.10	−0.06	0.21	−0.25	−0.39	0.36	−0.52	−0.52	0.22	0.90	−0.10	−0.32	−0.08	−0.41
ROW	**−0.54**	**−0.25**	−0.04	−0.27	0.12	−0.25	0.11	0.02	0.17	0.38	−0.30	0.54	−0.45	−0.27	0.16	0.24	−0.06	−0.38	0.01	−0.11

Note: High Income Countries (HIC); Rest of the World (ROW); Please refer to Table A.1 in the Appendix for more detail; Bold values indicate trading partners to which the EU or the US export more than 1% of total food and agricultural exports or from which the EU or the US import more than 1% or total food and agricultural imports (compare also Tables 6 and 7). Cells highlighted in grey represent negative values.

Source: Authors' calculations based on the GTAP framework and own econometric estimates.

Bangladesh, Mozambique and the rest of the Least Developed Countries (LDCs) are only able to increase total exports relative to GDP to the US, whereas we mainly observe a decrease for other trade with the TTIP partners. However, due to the spillover effects, the LDCs are able to increase their trade with other third countries, although we only assume that they have the resources to indirectly adapt to the EU-US standard and are thus not able to gain from their own spillover effects.

In Tables 10 and 11, we provide a sectoral breakdown of the bilateral trade in the agro-food sector between the EU and the US. We report the share of the individual sectors in total food and agricultural trade in the base year of 2011, after our projections in the year 2020 and after the TTIP is implemented, respectively. For each trading partner, we present the development of the most important sectors, whereas sectors with shares of less than 1% are aggregated in a sector called "Other agro-food sectors."

Table 10: Share of Agro-Food Sectors in EU Total Agricultural and Food Exports to the US, %

	2011	2020	2020+TTIP
Other food products	54.81	54.20	35.97
Dairy products	13.01	12.25	17.72
Vegetable oil & fat	9.77	9.24	9.5
Crops nec.	8.17	9.97	10.97
Other meat nec.	5.31	4.89	5.06
Vegetable & fruit	3.58	4.14	6.96
Beef	0.49	0.46	6.87
Cereal grains nec.	0.26	0.28	0.95
Wheat	0.24	0.29	0.17
Oil seeds	0.11	0.13	0.46
Sugar	0.19	0.18	2.19
Other agro-food sectors	4.06	3.97	3.08

Note: Please refer to Table A.1 in the Appendix for more detail; cells highlighted in grey represent sectors with increasing importance compared with 2020.
Source: Authors' calculations based on the GTAP framework and own econometric estimates.

In the year 2011, EU exports to the US are dominated by other food products (55%). Less important, though still covering approximately 13%, 10% and 8% of total agro-food trade, are dairy products, vegetable oil and fats, and crops nec., respectively. This situation does not change considerably in our projections to the year 2020. The structure of US agro-food exports to the EU is more evenly distributed. In 2011, a high share of the US exports to the EU is also given for other food products (28%), but exports of vegetables and fruits (22%) as well as oil seeds (13%) are comparably important. Crops, wheat and cereal grains take up a share of 7% to 8%. Analogously to the EU, we do not observe a major change in the US export structure to the EU in the year 2020.

Table 11: Share of Agro-Food Sectors in Total US Agricultural and Food Exports to the EU, %

	2011	2020	2020+TTIP
Other food products	27.72	34.62	30.05
Vegetable & fruit	21.70	20.86	12.48
Oil seeds	13.13	13.59	9.36
Crops nec.	8.48	6.65	4.93
Wheat	7.65	3.88	6.81
Cereal grains nec.	6.98	4.83	2.20
Other meat nec.	2.64	2.43	3.54
Vegetable oil & fat	2.19	3.66	2.40
Dairy products	1.33	1.16	6.55
Beef	0.93	2.04	8.66
Processed rice	0.32	0.74	6.87
Other agro-food sectors	6.91	5.54	6.16

Note: Please refer to Table A.1 in the Appendix for more detail; cells highlighted in grey represent sectors with increasing importance compared with 2020.
Source: Authors' calculations based on the GTAP framework and own econometric estimates.

According to the findings of Kehoe (2005), we evaluate our analysis by comparing the results in the year 2020 with the data after the TTIP has been implemented. In so doing, we highlight the sectors in Tables 10 and 11 in grey that are gaining in importance compared with the pre-TTIP situation in 2020. Table 10 indicates that the most important EU export sector to the US, comprising other food products, becomes noticeably less important after the implementation of the TTIP, whereas we observe an increase in the EU export shares for the majority of the other sectors. For the US, we report a decrease in importance for the four initially most important sectors. In contrast, the other, initially not notable sectors mainly gain in importance. We therefore believe that our simulation results significantly resemble the development shown in the actual data after the implementation of NAFTA, and we are more confident in presenting these more detailed results at the sector level for selected products.

5.2.2 Welfare

In Table 12, we depict the welfare changes, given as Equivalent Variation (EV). Following Hertel et al. (2003), we present the mean value of the EV as well as the upper and lower bounds in the first three columns of Table 12 to provide insight into the distribution of the welfare results. We also decompose the mean value of the EV in Table 12. Accordingly, columns 3 to 6 present the decomposition related to policy instruments. To ease the interpretation, we again highlight negative values in grey in Table 12.

The world gains approximately 100 billion US$ due to the implementation of the TTIP. A majority of this welfare gain accrues to the TTIP partner, and the increase is slightly higher for the EU. Welfare gains can mainly be attributed to the harmonization of NTBs (columns 5 and 6 in Table 12). However, we assume the share of the welfare effect due to the costs of NTBs in total welfare to be lower because our applied econometric approach enables us to only capture the integration level that the TTIP partners have negotiated in the past. We would observe a much higher share for the costs of NTBs here if we were implementing the overall possible harmonization level. The abolishment of tariffs between the partners of the TTIP only plays a minor role. Accordingly, we also observe the highest gains in the EU and the US.

The NAFTA and Mercosur countries as well as most of the countries in Central America exhibit slight decreases in their welfare resulting from the trade-diverting effect of the TTIP. Column 4 shows that this effect largely stems from the elimination of tariffs between the EU and the US, and the harmonization of the NTBs and the spillover effect has a positive effect on the welfare of these countries. A similar effect is shown for the main trading partners of the EU. Here, the HIC countries, Eastern Europe, North Africa, Japan and China exhibit a similar pattern. We observe only marginal welfare effects for Bangladesh and Mozambique, but the rest of the LDCs face a welfare loss of approximately 0.2 billion US$. Using the decomposition of the result, we are able to identify the harmonization of NTBs as the main reason for this welfare loss in the LDCs (column 6 in Table 12). Assuming that LDC countries are only indirectly able to adapt to the EU-US set of rules and standards after the TTIP is in place, they are not able to compensate for the loss due to trade diversion by the welfare gain resulting from the spillover effect.

In general, the welfare effect for third countries is also rather moderate. None of the positive or negative changes is greater than 0.1 billion US$. In accordance with Plummer, Cheong, and Hamanaka (2010), we must emphasize that the spillover effect is of particular importance for the results of third countries in the TTIP analysis.

Table 12: Change in Welfare (EV, billion US$)

	Total EV (Confidence interval)			Decomposition of EV (MV) according to		
	(1) LB	(2) MV	(3) UB	(4) Tariffs	(5) Rents	(6) Costs
World	89.26	96.57	118.04	3.64	10.43	82.5
EU	46.78	53.61	72.54	1.61	11.57	40.44
US	44.46	44.66	49.05	5.27	−0.28	39.68
Canada	0.31	0.44	0.64	−0.22	−0.08	0.75
Japan	−0.28	−0.14	0.31	−0.33	−0.2	0.38
Korea	−0.27	−0.12	0.22	−0.20	−0.15	0.23
HIC	0.61	0.75	1.07	−0.17	−0.22	1.15
China	−1.11	−0.72	−0.43	−1.07	0.22	0.13
India	−0.30	−0.13	0.21	−0.24	0.02	0.08
Brazil	−0.03	−0.04	−0.05	−0.10	0.02	0.03
Mexico	−0.06	−0.07	−0.22	−0.18	−0.27	0.38
Turkey	0.02	0.09	0.3	−0.12	0.01	0.20
Central America	−0.11	−0.10	−0.05	−0.04	−0.04	−0.03
East Europe	0.03	0.05	0.16	−0.01	−0.04	0.10
North Africa	0.16	0.09	−0.3	−0.06	−0.05	0.20
Rest of Asia	−0.45	−0.47	−0.53	−0.18	−0.10	−0.19
Rest of Mercosur	−0.10	−0.12	−0.13	−0.03	−0.01	−0.07
Bangladesh	0.00	0.00	−0.01	−0.02	0.03	−0.01
Mozambique	0.00	0.00	0.00	0.00	0.00	0.00
Rest of LDC	−0.12	−0.22	−0.66	−0.04	0.02	−0.20
ROW	−0.28	−0.98	−4.00	−0.23	−0.02	−0.73

Note: LB = Lower Bound; MV = Mean Value; UB = Upper Bound; Please refer to Table A.1 in the Appendix for more detail; cells highlighted in grey represent negative values.

Source: Authors' calculations based on the GTAP framework and own econometric estimates.

6 Conclusion

Our analysis of the implications of the TTIP for food and agriculture is based on econometrically estimated NTB rents and costs and an extended GTAP framework. We consider NTB rents and costs economy-wide but particularly for disaggregated food and agricultural sectors, taking into account the integration levels negotiated by the TTIP partners in the past. We implement these AVEs into the GTAP model to obtain economy-wide effects. We validate our results by drawing on experiences gained from past analyses of FTAs.

Gravity results indicate differentiated treatment in the reduction of NTBs in the agro-food sectors. Whereas some sectors are estimated to be excluded from the TTIP, other sectors experience great regulatory convergence. The EU and the US are expected to significantly reduce NTBs in animal-based products such as beef and other meat. In contrast, concessions in sugar, other food products and cereal grains are estimated to not be important. This outcome fits with the previous behavior of the EU and US in FTA negotiations, leaving out or providing special treatment to specific sensitive sectors as a result of historical reasons and political sensitivities.

Subsequent policy simulation results indicate a strong increase in trade between the EU and the US. Low trade-diverting effects are predominantly observed for the main trading partners of the EU and the US, namely, the NAFTA and Mercosur countries as well as North Africa, China and Japan. A decrease in exports relative to GDP occurs more often when only the food and agricultural sector is considered. Obviously, spillover effects increase non-agro-food trade with and between third countries, and this effect outweighs the primarily negative development in the agro-food sector. The decreasing effect in the food and agricultural sectors of the majority of third countries is accompanied by a greater increase in trade between the TTIP partners and can be traced back to the higher NTBs in the food and agricultural sector (see Table 3). In accordance with Kehoe (2005), sectors with initially low trade volumes thereby exhibit the largest relative increase in trade, whereas previously larger sectors become less important in the EU and the US.

Finally, simulation results indicate considerable gains for the EU and the US that are mainly driven by the reduction in NTBs, whereas third countries gain from the spillover effects and are only moderately affected. In general, NTBs are much more important than tariffs for trade effects but also for welfare effects. However, we assume the share of the welfare effect due to the costs of NTBs in total welfare to be lower because our applied econometric approach enables us to only capture the integration level that the TTIP partners have negotiated in the past. Welfare effects for high- and middle-income third countries are primarily positive, whereas LDCs exhibit negative welfare effects, predominantly because we assume that LDCs are less likely to be able to adapt to the EU-US set of rules.

Appendix

Table A1: Regional and Sectoral Aggregation

	Regions		Sectors
1	European Union Austria, Belgium, Denmark, Finland, France, Germany, Ireland, United Kingdom, Greece, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, Czech Republic, Hungary, Malta, Poland, Slovakia, Slovenia, Estonia, Latvia, Lithuania, Cyprus, Romania, Bulgaria, Croatia	1	Paddy rice
2	United States of America	2	Wheat
3	Canada	3	Cereal grains nec.
4	Japan	4	Vegetables, fruits, nuts
5	Korea	5	Oil seeds
6	High Income Countries Australia, New Zealand, Hong Kong, Taiwan, Singapore, Switzerland, Norway, Rest of EFTA	6	Sugar cane, sugar beet
7	China	7	Plant-based fibers
8	India	8	Crops nec.
9	Brazil	9	Cattle
10	Mexico	10	Other animal products nec.
11	Turkey	11	Raw milk
12	Central America Costa Rica, Guatemala, Honduras, Nicaragua, Panama, El Salvador, Rest of Central America, Dominican Republic, Jamaica, Puerto Rico, Trinidad and Tobago, Caribbean	12	Wool
13	East Europe Albania, Belarus, Ukraine, Rest of Eastern Europe, Rest of Europe	13	Sugar
14	North Africa Israel, Rest of Western Asia, Egypt, Morocco, Tunisia, Rest of North Africa	14	Processed rice

Continued on next page

Table A1 – continued from previous page

	Regions		Sectors
15	Association of Southeast Asian Nations Indonesia, Malaysia, Philippines, Thailand, Vietnam	15	Dairy
16	Mercosur Argentina, Paraguay, Uruguay	16	Cattle meat
17	Bangladesh	17	Other meat nec.
18	Mozambique	18	Vegetable oils and fats
19	Least Developed Countries Rest of East Asia, Brunei Darussalam, Cambodia, Lao People's Democratic Republic, Rest of Southeast Asia, Nepal, Rest of South Asia, Benin, Burkina Faso, Guinea, Senegal, Togo, Rest of Western Africa, Central Africa, South Central Africa, Ethiopia, Madagascar, Malawi, Rwanda, Tanzania, Uganda, Rest of Eastern Africa	19	Other food products
20	Rest of the World Rest of Oceania, Mongolia, Pakistan, Sri Lanka, Rest of North America, Bolivia, Chile, Colombia, Ecuador, Peru, Venezuela, Rest of South America, Russian Federation, Kazakhstan, Kyrgyzstan, Rest of Former Soviet Union, Armenia, Azerbaijan, Georgia, Bahrain, Islamic Republic of Iran, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Cameroon, Cote d'Ivoire, Ghana, Nigeria, Kenya, Mauritius, Zambia, Zimbabwe, Botswana, Namibia, South Africa, Rest of South African Customs Union, Rest of the World	20	Beverages and tobacco
		21	Other primary sectors Wool, Forestry, Fishing, Minerals nec.
		22	Other primary energy Coal, Oil, Gas
		23	Chemicals

Continued on next page

Table A1 – continued from previous page

Regions		Sectors
	24	Electrical machinery
	25	Motor vehicles
	26	Other transport equipment
	27	Other machinery
	28	Metals and metal products
		Ferrous metals, Metals nec., Metal products
	29	Wood and paper products
		Wood products, Paper products, Publishing
	30	Other manufactures
		Textiles, Wearing apparel, Leather products, Mineral products nec., Manufactures nec., Petroleum, Coal products
	31	Water transport
	32	Air transport
	33	Finance
	34	Insurance
	35	Business services
	36	Communications
	37	Construction
	38	Personal services
	39	Other services
		Electricity, Gas manufacture, Distribution, Water, Trade, Transport nec., Public administration, Defense, Health, Education, Dwellings

Source: GTAP database, version 9, 2014

References

Anderson, J. E. (2011), The Gravity Model, *Annual Review of Economics* 3, pp. 133–160.

Anderson, J. E. and van Wincoop, E. (2003), Gravity with Gravitas: A Solution to the Border Puzzle, *American Economic Review* 93, pp. 170–192.

Anderson, J. E. and van Wincoop, E. (2004), Trade Costs, *Journal of Economic Literature* 42, pp. 691–751.

Andriamananjara, S., Ferrantino, M.J., and Tsigas, M. (2003), Alternative Approaches in Estimating the Economic Effects of Non-Tariff Measures: Results from Newly Quantified Measures, Working paper. Office of Economics Working Paper. U.S. International Trade Commission. 2003-12-C.

Andriamananjara, S., Dean, J.M., Feinberg, R., Ferrantino, M.J., Ludema, R., and Tsigas, M. (2004), The Effects of Non-Tariff Measures on Prices, Trade, and Welfare: CGE Implementation of Policy-Based Price Comparisons, Working paper. Office of Economics Working Paper. U.S. International Trade Commission. 2004-04-A.

Armington, P. (1969), A Theory of Demand for Products Distinguished by Place of Origin, *International Monetary Fund Staff Papers* 16, pp. 159–178.

Baier, S.L. and Bergstrand, J.H. (2002), On the Endogeneity of International Trade Flows and Free Trade Agreements. University of Notre Dame.

Baier, S.L. and Bergstrand, J.H. (2007), Do Free Trade Agreements Actually Increase Members' International Trade?, *Journal of International Economics* 71, pp. 72–95.

Baier, S.L. and Bergstrand, J.H. (2009), Estimating the Effects of Free Trade Agreements on International Trade Flows using Matching Econometrics, *Journal of International Economics* 77(1), pp. 63–76.

Bureau, J.C., Disdier, A-C., Emlinger, C., Fouré, J., Felbermayr, G., Fontagné, L. and Jean, S. (2014), Risks and Opportunities for the EU Agri-Food Sector in a Possible EU-US Trade Agreement, Directorate-General for Internal Policies. Policy Department. Structural and Cohesion Policies. Agriculture and Rural Development. European Parliament.

CEPR (2013), Reducing Transatlantic Barriers to Trade and Investment. An Economic Assessment, Final Project Report. Prepared Under Implementing Framework Contract TRADE10/A2/A16.

Chen, N. and Novy, D. (2012), On the Measurement of Trade Costs: Direct Vs. Indirect Approaches to Quantifying Standards and Technical Regulations, *World Trade Review* 11(3), pp. 401–414.

de Benedictis, L. and Tajoli, L. (2011), The World Trade Network, *World Economy* 34(8), pp. 1417–1454.

Dür, A., Baccini, L., and Elsig, M. (2014), The Design of International Trade Agreements: Introducing a New Dataset, *Review of International Organizations* 9(3), pp. 353–375.

Easley, D. and Kleinberg, J. (2010), *Networks, Crowds, and Markets: Reasoning about a Highly Connected Worl*, Cambridge: Cambridge University Press.

ECORYS (2009), Non-Tariff Measures in EU-US Trade and Investment - an Economic Analysis, Report to the European Commission, Directorate-General for Trade OJ 2007/S 180-219493.

Egger, H., Egger, P., and Greenaway, D. (2008), The Trade Structure Effects of Endogenous Regional Trade Agreements, *Journal of International Economics* 74(2), pp. 278–298.

Egger, P. and Francois, J.F. (2014), The Effect of FTAs on NTMs with Selection Bias for Depth of Trade Agreements, Working paper.

Egger, P., Larch, M., Staub, K.E. and Winkelmann, R. (2011), The Trade Effects of Endogenous Preferential Trade Agreements, *American Economic Journal: Economic Policy* 3(3), pp. 113–143.

Engelbert, T., Bektasoglu, B., and Brockmeier, M. (2014), Moving Toward the EU or the Middle East? An Assessment of Alternative Turkish Foreign Policies Utilizing the GTAP Framework, *Food Policy* 47, pp. 46–61.

European Commission (2014a), In Focus: Transatlantic Trade and Investment Partnership (TTIP). URL `http://ec.europa.eu/trade/policy/in-focus/ttip/`, accessed 15 June 2014.

European Commission (2014b), Agreements. URL http://ec.europa.eu/trade/policy/countries-and-regions/agreements/, accessed 10 September 2014.

Felbermayr, G., Larch, M., Flach, L., Yalcin, E., Benz, S. and Krüger, F. (2013), Dimensionen und Effekte eines transatlantischen Freihandelsabkommen. URL http://www.cesifo-group.de/portal/pls/portal/ifo_applications.switches.DocLinkIfoD L?getDoc =ifosd_2013_04_3.pdf, accessed 30 June 2013.

Fox, A., Francois, J.F., and Londono-Kent, P. (2003), Measuring Border Crossing Costs and their Impact on Trade Flows: The United States-Mexican Trucking Case, GTAP resource 1282. URL https://www.gtap.agecon.purdue.edu/resources/download/1492.pdf, accessed May 2014.

Francois, J.F. (1999), Economic Effects of a New WTO Agreement Under the Millennium Round, Report to the European Commission Trade Directorate.

Francois, J.F. (2001), *The Next WTO Round: North-South Stakes in New Market Access Negotiations*, Centre for International Economic Studies, Adelaide.

Francois, J.F. and Rojas-Romagosa, H. (2014), Melting Ice Caps and the Economic Impact of Opening the Northern Sea Route, CPB discussion paper. URL http://www.cpb.nl/en/publications, accessed 15 September 2014.

Francois, J.F., Rojas-Romagosa, H., and Vasilache-Freudenthal, A. (2013), Melting Ice Caps and the Economic Impact of the Northern Sea Shipping Lanes, GTAP Resource 4222. URL https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=4222, accessed September 2014.

Fugazza, M. and Maur, J.C. (2008), Non-Tariff Barriers in CGE Models: How Useful for Policy?, *Journal of Policy Modeling* 30, pp. 475–490.

Greene, W.H. (1994), Accounting for Excess of Zeros and Sample Selection in Poisson and Negative Binomial Regression Models, Discussion Paper EC-94-10. Department of Economics, New York University.

Greene, W.H. (1997), FIML Estimation of Sample Selection Models for Count Data, Discussion Paper EC-97-02. Department of Economics, Stern School of Business, New York University.

Harrison, J.W. and Pearson, K.P. (1996), Computing solutions for large general equilibrium models using GEMPACK, *Computational Economics* 9, pp. 83–127.

Head, K. and Mayer, T. (2014), Gravity Equations: Workhorse, Toolkit, and Cookbook, in E. Helpman, K. Rogoff, and G. Gopinath (eds.), *Handbook of International Economics*, NorthHolland, pp. 131–195.

Hertel, T. W. (ed.) (1997), *Global trade analysis. Modeling and applications.*, Cambridge University Press.

Hertel, T.W., Walmsley, T., and Itakura, K. (2001), Dynamic Effect of the 'New Age' Free Trade Agreement between Japan and Singapore, *Journal of Economic Integration* 16(4), pp. 446–484.

Hertel, T.W., Hummels, D., Ivanic, M. and Keeney, R. (2003), How Confident can we be in CGE-Based Assessments of Free Trade Agreements?, GTAP Resource 1283. URL https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=1283,accessed 15 May 2014.

Kee, H.L., Nicita, A., and Olarreaga, M. (2009), Estimating Trade Restrictiveness Indices, *Economic Journal* 119(534), pp. 172–199.

Kehoe, T.J. (2005), An Evaluation of the Performance of Applied General Equilibrium Models on the Impact of NAFTA, in T.J. Kehoe, T.N. Srinivasan, and J. Whalley (eds.), *Frontiers in Applied General Equilibrium Modeling*, Cambridge University Press, pp. 341–378.

Lloyd, P.J. and MacLaren, D. (2004), Gains and Losses from Regional Trading Agreements: A Survey, *Economic Record* 80(251), pp. 445–467.

Malcom, G. (1998), Adjusting Tax Rates in the GTAP Data Base, GTAP Technical Paper No. 12. URL https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=315, accessed 15 May 2014.

OECD (2009), Overcoming Border Bottlenecks. The Costs and Benefits of Trade Facilitation, OECD Trade Policy Studies. URL http://www.oecd.org/tad/facilitation/overcomingborderbottlenecksthecostsandbenefitsoftradefacilitation.html, accessed 15 May 2014.

Philippidis, G. and Carrington, A. (2005), European Enlargement and Single Market Accession: A Mistreated Issue, *Journal of Economic Integration* 20(3), pp. 543–566.

Plummer, M.G., Cheong, D., and Hamanaka, S. (2010), Methodology for Impact Assessment of Free Trade Agreemensts. URL http://aric.adb.org/pdf/FTA_Impact_Assessment.pdf, accessed 15 May 2014.

Santos Silva, J.M.C. and Tenreyro, S. (2006), The Log of Gravity, *The Review of Economics and Statistics* 88(4), pp. 641–658.

Santos Silva, J.M.C. and Tenreyro, S. (2011), Poisson: Some Convergence Issues, *Stata Journal* 11(2), pp. 207–212.

Schiff, M. and Winters, L.A. (2003), Regional Integration and Development. URL http://siteresources.worldbank.org/BRAZILINPOREXTN/Resources/3817166-1185895645304/4044168-1186324101142/12RegionalIntegrationFull.pdf, accessed 15 May 2014.

TRAINS (2014), Database. URL http://wits.worldbank.org/Default.aspx, accessed 10 September 2014.

Trefler, D. (2004), The Long and Short of the Canada-U.S. Free Trade Agreement, *American Economic Review* 94(4), pp. 870–895.

Urban, K., Jensen, H.G., and Brockmeier, M. (2014), Extending the GTAP Data Base and Model to Cover Domestic Support Issues using the EU as Example, GTAP Technical Paper 35. URL https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=4569, accessed 15 June 2014.

USTR (2014a), Office of the United States Trade Representative. Executive Office of the President. U.S. Objectives, U.S. Benefits In the Transatlantic Trade and In-vestment Partnership: A Detailed View. Factsheet March 2014. URL http://www.ustr.gov/about-us/press-office/press-releases/2014/March/US

-Objectives-US-Benefits-In-the-TTIP-a-Detailed-View, accessed 10 June 2014.

USTR (2014b), Office of the United States Trade Representative. Executive Office of the President. Free Trade Agreements. URL http://www.ustr.gov/trade-agreements/free-trade-agreements, accessed 15 September 2014.

Viner, J. (1950), *The Customs Union Issue*, New York: Carnegie Endowment.

Winkelmann, R. (2008), *Econometric Analysis of Count Data*, Springer-Verlag Berlin Heidelberg.

Zouh, M. (2014), Intensification of Geo-Cultural Homophily in Global Trade: Evidence from the Gravity Model, *Social Science Research* 40(1), pp. 193–209.

7 The Effect of Aggregation Bias: An NTB Modeling Analysis of Turkey's Agro-Food Trade with the EU

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The Effect of Aggregation Bias: An NTB-Modeling Analysis of Turkey's Agro-Food Trade with the EU

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Abstract

We explore how different data aggregation levels affect the gravity estimates of non-tariff barriers (NTBs) in the agro-food sector, and we examine their related impacts on policy simulations of an expansion to the European Union (EU) that would include Turkey. We calculate two sets of ad valorem equivalents (AVEs) of NTBs using the gravity approach to disaggregated and aggregated Central Product Classification data for 15 Global Trade Analysis Project (GTAP) agro-food sectors. We find that the AVEs of NTBs vary substantially across products and that using aggregated data primarily leads to an overestimation of the effects of NTBs. In a second step, we incorporate the AVEs of NTBs into the GTAP model to evaluate Turkey's EU membership and conclude that aggregation bias has considerable effects on both the estimation of NTBs and on the general equilibrium simulation results. Utilizing aggregated data leads to an overestimation of the trade costs of NTBs and, hence, to an overestimation of trade and welfare effects.

JEL classification: D58; F15; Q17

Keywords: aggregation bias; gravity estimates; non-tariff barriers; computable general equilibrium modeling; Global Trade Analysis Project

1 Introduction

Multilateral negotiations on trade liberalization and the increasing number of economic integration agreements have led to a low level of tariffs worldwide. Consequently, the number and importance of non-tariff barriers (NTBs) to trade has risen, and the plethora of different NTBs makes their regulation at the multilateral level almost impossible. Another potential framework to negotiate the reduction of NTBs might be bilateral and regional trade agreements (RTAs). Thus, a reduction in NTBs needs to be taken into account, particularly in the analysis of RTAs. Recent literature shows that NTB reduction has a greater impact on welfare results than reduced tariffs in most RTAs (e.g., Engelbert et al., 2014; Lejour et al., 2001). RTAs are negotiated at a very detailed product level, whereas most empirical studies only consider the aggregated sector level. Against this background, this article analyzes the effects of different aggregation levels on econometric estimates of the trade costs of NTBs and their related impact on the policy simulations of Turkey's potential membership to the European Union (EU). In our analysis, we consider the importance of the food and agricultural trade between Turkey and the EU and the high NTBs imposed on this sector.

Aggregation bias is well-recognized and apparent in the gravity estimates used to quantify NTBs (e.g., Agostino et al., 2007; Anderson and van Wincoop, 2004; Anderson, 2009; Cipollina and Salvatici, 2012; French, 2012; Haveman and Thrusby, 1999; Haveman et al., 2003; Hillberry, 2002; Hillberry and Hummels, 2003). Authors argue that inferences about trade costs from the literature are limited and misleading due to highly aggregated data and the different effects of trade policies across products. These authors agree that the impacts of trade barriers can only be separated and compared at a sectoral level if disaggregated data are used. However, to the best of our knowledge, none of the existing studies offer gravity estimates at a very detailed agro-food product level, nor do existing studies offer a combination of econometric estimates of NTBs at different aggregation levels and their use in a CGE model.

We calculate two sets of ad valorem equivalents (AVEs) of NTBs using the gravity approach to disaggregated and aggregated Central Product Classification (CPC) data for 15 Global Trade Analysis Project (GTAP) agro-food sectors. We compare the disaggregated CPC pooled gravity results with the aggregated gravity results to reveal the impact of the level of data aggregation on the magnitude of trade costs caused by NTBs. Subsequently, we incorporate the AVEs of NTBs estimated at different aggregation levels into the GTAP model to simulate the EU's expansion to include Turkey. We run two experiments, which differ in terms of the NTBs resulting from the different gravity aggregation estimates, to show the impact of aggregation bias on the simulation results. Hence, our article contributes to the literature by revealing the impact of data aggregation on the estimation of NTBs and its related effect on policy simulation results.

Our analysis is divided into two parts. In the first part, we use the gravity approach to estimate the AVEs of NTBs using disaggregated and aggregated data. In the second part, we incorporate these AVEs, which are calculated at different aggregation levels, into the GTAP framework to expose the aggregation bias that is transferred from the gravity estimates to the CGE analysis. We focus on the extent of aggregation bias and the differences between the results of experiments that are either run using the AVEs of NTBs from the disaggregated gravity estimates or those from the aggregated gravity estimates.

2 Gravity Modeling

The measurement of the effects of NTBs at different levels of aggregation is based on an ex post study using the gravity approach. The gravity model has become a strong empirical tool for analyzing patterns of trade flows, regional agreements, and the effects of trade frictions. Due to its broad theoretical justification and strong explanatory power, it is also recognized as a useful tool for identifying and quantifying the trade costs of NTBs.[1] For our analysis, we adopt the gravity-like equation of Anderson and van Wincoop (2003, 2004). Their specification is based on the Armington model and takes into account the general equilibrium effects of trade barriers. In its basic formulation, imports depend on the output of the exporting country and the consumption of the importing country relative to world output. Bilateral trade is lowered by bilateral and multilateral trade barriers as governed by the elasticity of substitution. Multilateral trade barriers, also known as multilateral resistance terms, represent the average trade barriers (Anderson and van Wincoop, 2003). The multilateral resistance terms are

[1] See Anderson (2011) and Head and Mayer (2014) for a thorough review on the theoretical and empirical developments of the gravity model.

econometrically captured by country-specific dummies or by country-time-fixed effects in a panel data framework (Anderson and van Wincoop, 2003; Feenstra, 2004).[2] Bilateral trade barriers are unobservable, but they can be approximated by a trade cost function using observable trade cost proxies.

2.1 Identification Strategy and Data

To identify the effects of NTBs, we use an implicit measure that we integrate into our trade cost function. RTA variables serve as instruments to isolate the measures that aim to eliminate unnecessary and restrictive non-tariff measures, to reduce regulatory divergence and to harmonize standards or regulations within a region on average (Chen and Novy, 2012). In the analysis of Turkey's potential accession to the EU, we apply a variable to the EU trade bloc to quantify the positive effects of regulatory convergence and the reduction in NTBs that occur in the integration process.[3] We compare existing trade levels under the European economic integration to a hypothesized, counterfactual trade level in the absence of the EU. We draw inferences about the trade costs of NTBs using the theoretical model structure based on the missing trade in the absence of the EU. Applying this approach allows us to calculate a consistently aggregated measure that identifies all NTB-induced trade costs at the sector or product level, which can be realistically eliminated within the EU integration process.

We use a panel data framework to obtain the most reliable estimate of the average expected effect of the European integration process (Baier and Bergstrand, 2007; Magee, 2008; Raimondi et al., 2012), but there are different specifications of the panel gravity equation (compare Baldwin and Taglioni, 2006; Egger and Pfaffermayr, 2003; Micco et al., 2003; Stack, 2009; Sun and Reed, 2010). For our analysis, we choose the panel structure with time-fixed and bilateral fixed effects. Accordingly, we use a panel data estimation strategy in which all time-invariant country-pair factors, such as distance, sharing a common border or common language, a colonial relationship, and other ties that are constant over time, are captured by the country-pair individual heterogeneity term. The intercept is also absorbed, so it has to be removed from the equation.

[2] Alternatively, multilateral trade barriers can be approximated using Baier and Bergstrand (2009) method.

[3] By using this identification strategy, we assume a wide-ranging notion of NTBs. We are not able to identify individual measures and so can only quantify the overall effects of the NTBs on trade.

Hence, only time-variant characteristics enter the fixed-effects model. As controls, we include several variables to capture changes in economic and political characteristics as well as trade policies. We use the Poisson fixed effects model to estimate the gravity equation (Palmgren, 1981; Hausman et al., 1984). This estimation is accomplished through a multiplicative form incorporating trade flows in levels, and we thereby address the problem of zero bilateral trade flows. The evaluation of the parameters is based on the conditional quasi-maximum likelihood (Anderson, 1970).[4] We infer from robust standard errors to properly account for heteroskedasticity which is typical of trade data (Santos Silva and Tenreyro, 2006). The conditional fixed-effects Poisson regression technique is pursued to estimate the following empirical specification that differs according to the degree of data aggregation:

$$X^k_{ij,t} = \exp\Big(\alpha_{ij} + \alpha_t + \beta_1 sGDP_{ij,t} + \beta_2 dGDPpc_{ij,t} + \beta_3 dPopDensity_{ij,t} + \beta_4 dPolicy_{ij,t} + \beta_5 lnTariff^k_{ij,t} + \beta_6 EU_{ij,t} + \beta_7 RTA_{ij,t}\Big) + \epsilon^k_{ij,t} \quad (1)$$

Here, the similarity in the terms for economic size ($sGDP_{ij,t}$) for each country pair is derived from the two countries' share of GDP[5], and the difference in terms of relative factor endowments ($dGDPpc_{ij,t}$) for each country pair is derived from the absolute difference in the GDP per capita[6] (Helpman, 1987; Stack, 2009). In the same way, differences in population density ($dPopDensity_{ij,t}$) and political structure ($dPolicy_{ij,t}$) are obtained. The variable $lnTariff^k_{ij,t}$ is equal to one plus the ad valorem tariff equivalent of country i on the exports of country j in year t and sector k. The variable

[4] An alternative and equivalent method that would yield identical estimates would be to use a conventional Poisson regression by maximum likelihood including dummy variables for all country pairs and years to directly estimate the fixed effects. For convenience, we choose the conditional maximization of the likelihood.

[5] The formula to compute the similarity between two countries in terms of economic size ($sGDP_{ij,t}$) is $ln\Big[1 - \Big(GDP_{i,t}/(GDP_{i,t} + GDP_{j,t})\Big)^2 - \Big(GDP_{j,t}/(GDP_{i,t} + GDP_{j,t})\Big)^2\Big]$.

[6] The formula to compute the difference between two countries in terms of factor endowments ($dGDPpc_{ij,t}$) is $abs\Big(ln(GDPpc_{i,t}) - ln(GDPpc_{j,t})\Big)$ where $GDPpc$ is the GDP per capita.

$EU_{ij,t}$ is equal to one if countries i and j are both members of the EU and zero otherwise. The dummy variable $RTA_{ij,t}$ is set to unity if both countries belong to the same RTA and to zero otherwise. The EU and RTA dummies account for the regional non-tariff preferences. The corresponding regression parameters are denoted by β_1 to β_7, and the fixed effects control for time-invariant bilateral factors (α_{ij}) and time-specific macroeconomic shocks affecting global trade flows (α_t). Finally, $\epsilon^k_{ij,t}$ is an error term.

To estimate Equation (1) and to compute the tariff cost equivalent of NTBs, we source annual data on bilateral trade flows for 157 CPC products[7] at the most disaggregated level from the United Nations Commodity Trade Statistics (UN COMTRADE) database.[8] Bilateral tariffs come from the UNCTAD TRAINS database using the World Integrated Trade Solution application software. Information on GDP and GDP per capita, population and land area is taken from the World Bank. The source of the political variable is the Polity IV project (CSP, 2014). Finally, the binary RTA variable is taken from de Sousa (2014). Our panel set covers the period from 1988 to 2011. The most important parameters of our analysis are the ones for tariffs and EU membership, and we expect tariffs to have a negative effect on trade and EU membership to have a trade-enhancing effect. In the regressions at the aggregated data level, we assume an upward bias over tariffs and EU membership that probably distorts the size of the estimates of tariff elasticity and economic integration compared to disaggregated data-level regressions. In the CPC product-level regressions, we anticipate high variation in the effects of tariffs and economic integration across products.

2.2 Empirical Results

We apply the two-way fixed effects Poisson model to the trade data of 157 CPC products for 15 GTAP agro-food sectors at the aggregated and pooled levels. In addition, we obtain estimates at each CPC product level to compare product line estimates to sector estimates and thus reveal the aggregation differences in the estimates. Table 1 shows

[7]Table 2 shows the number of CPC sectors mapped to each food and agricultural GTAP sector. The complete and detailed listing of CPC sectors by GTAP sector is available at https://www.gtap.agecon.purdue.edu/databases/contribute/concordinfo.asp.

[8]Trade flows that are recorded as missing, and countries that do not report any trade statistics are omitted from the dataset.

the parameter estimates for the vegetables, fruits and nuts sector.[9] We only present and discuss the results of this sector in detail because it is important to the trade between the EU and Turkey and exhibits substantially relevant NTBs. Vegetables, fruits and nuts are highly affected by sanitary and phytosanitary measures and other food safety standards to which consumers are sensitive. Column 1 shows the estimates for the vegetables, fruits and nuts sector at the aggregated level, and column 2 shows the estimates from the disaggregated CPC pooled gravity regression. The subsequent columns display the gravity results for the corresponding individual disaggregated CPC products. Thereby, columns 3 to 6 represent vegetables, and columns 7 to 12 represent fruits.

Most control variables have the expected signs and are statistically significant. As expected, differences between countries in terms of factor endowments, population density and policies, as identified by the variables $dGDPpc_{ij,t}$, $dPopDensity_{ij,t}$ and $dPolicy_{ij,t}$, respectively, tend to decrease bilateral trade. Instead, the estimates of similarity in economic size, as captured by the variable $sGDP_{ij,t}$, are mixed in terms of having the correct sign. When the parameter shows the correct sign, it is not significant. In contrast, the effects of tariffs are consistent with our expectations and are highly significant. If the tariff increases by 1%, the trade of vegetables, fruits and nuts decreases by 3.1% in the aggregated version and by 2.3% in the disaggregated version. Considering the results from the product-level gravity approach, the tariff elasticity varies greatly from 0.8% to 4.8%.[10]

Economic integration agreements have a positive effect on trade. Trade between two countries that join the same RTA is expected to increase by 114.9% with the aggregated data and by 71.4% with the disaggregated data. In terms of the product-level results, trade is expected to increase somewhere between 23.4% (dried leguminous vegetables) and 103.2% (other vegetables, fresh or chilled).[11]

[9] Detailed regression results for the other sectors are available from the authors on request.

[10] The interpretation of the parameters using log-transformed variables in the exponential function is identical to the interpretation using log-log equations; they are interpreted as elasticities.

[11] The interpretation of the parameter associated with the economic integration dummy variables is standard for semi-logarithmic equations. For example, if we assume the coefficient estimated for the RTA in the aggregated version is $b_{RTA} = 0.765$, then two countries joining the same RTA will trade an extra $\Big(\exp(b_{RTA}) - 1\Big) \times 100 = \Big(\exp(0.765) - 1\Big) \times 100 = 114.9\%$ relative to the amount traded between two non-RTA countries.

Table 1: Estimation Results (Dependent Variable: Imports)

	Sector Level		Product Level									
	(1) Vegetables, fruits, nuts agg	(2) Vegetables, fruits, nuts disagg	(3) Potatoes	(4) Dried leguminous vegetables	(5) Other vegetables, fresh or chilled	(6) Edible roots and tubers	(7) Dates, figs, bananas, coconuts, etc.	(8) Citrus fruit, fresh or dried	(9) Grapes, fresh or dried	(10) Other fruit, fresh	(11) Other fruit, dried	(12) Other nuts
lnTariff	-3.091***	-2.279**	-0.811***	-0.954***	-4.490***	-4.620*	-3.705***	-4.823***	-1.941***	-4.064***	-3.573***	-4.073**
	(1.168)	(1.045)	(0.163)	(0.192)	(0.788)	(2.413)	(0.637)	(1.632)	(0.593)	(1.064)	(1.041)	(1.681)
EU	1.617***	1.072***	0.591*	-0.178	1.570***	0.629	2.882***	0.790***	1.304***	1.309***	1.161***	0.824***
	(0.135)	(0.120)	(0.321)	(0.357)	(0.168)	(0.738)	(0.279)	(0.191)	(0.161)	(0.179)	(0.312)	(0.241)
RTA	0.765***	0.539***	0.381**	0.215*	0.709***	0.489*	0.447***	0.311**	0.635***	0.661***	0.417***	0.0732
	(0.0751)	(0.0666)	(0.183)	(0.125)	(0.113)	(0.271)	(0.0834)	(0.142)	(0.0960)	(0.0763)	(0.122)	(0.227)
sGDP	0.135	-0.127	-0.140	-0.320	0.221	-1.099***	0.242	0.239	-0.490**	-0.193	-0.126	0.121
	(0.124)	(0.128)	(0.333)	(0.224)	(0.166)	(0.335)	(0.198)	(0.248)	(0.235)	(0.162)	(0.159)	(0.232)
dGDPpc	-0.599***	-0.660***	-0.660**	-0.705***	-0.567***	-1.245***	-0.139	-0.331*	-0.870***	-0.751***	-0.901***	-0.630**
	(0.104)	(0.107)	(0.321)	(0.172)	(0.126)	(0.233)	(0.193)	(0.184)	(0.192)	(0.128)	(0.176)	(0.288)
dPopDensity	-0.459	-0.598*	-0.580	-0.714	-1.329**	-7.831***	-0.452	0.957	0.979	-0.762	-0.885	0.683
	(0.374)	(0.332)	(1.090)	(0.776)	(0.590)	(2.715)	(0.437)	(0.762)	(0.850)	(0.540)	(0.737)	(0.895)
dPolity	-0.0539***	-0.0322***	-0.0299	-0.0252**	-0.0334**	-0.0193	-0.0433***	-0.0282	-0.0635***	-0.0167	0.00408	-0.0155
	(0.0120)	(0.0107)	(0.0316)	(0.0117)	(0.0156)	(0.0155)	(0.0116)	(0.0286)	(0.0207)	(0.0186)	(0.0101)	(0.0173)
Obs.	91094	251572	11686	27812	36525	10213	38078	20785	19229	34708	21059	22310
AVEs of NTBs (%)	68.73	60.06	107.24	25.28	41.86	11.16	117.68	17.80	95.78	38.0	38.39	22.42

Note: Standard errors are reported in parentheses. Asterisks (*), (**) and (***) denote significance at the 10%, 5% and 1% levels, respectively.

Source: Authors' calculations.

As expected, deeper trade integration increases trade even more, and EU membership is expected to increase the trade of vegetables, fruits and nuts by 403.8% if considering the aggregated data and by 192.1% if considering the disaggregated data. In the product-level estimations, the positive trade effects of EU membership are greater for some products (e.g., dates, figs, bananas, coconuts, Brazil and cashew nuts, pineapples, and avocados (1,685%)) and lower for others (e.g., potatoes (80.6%)). In two sectors (shelled, dried leguminous vegetables and edible roots and tubers with high starch or inulin content), EU membership does not have a significant effect on trade.

In terms of aggregation bias, the effect of EU membership is significantly lower using disaggregated data compared to the result using aggregated data. This notion is not applicable to all regressions and trade policy variables because there is an overlap between the confidence intervals of the disaggregated gravity and aggregated gravity results. Nonetheless, we can conclude that for some sectors (vegetables, fruits, and nuts, crops; dairy; other food products; beverages and tobacco) there is a significant overestimation of trade policy effects using aggregated data. This result is in accordance with those of other authors using aggregated data in gravity modeling (e.g., French, 2012; Hillberry, 2002).

Following the structure of the theoretical gravity model, the parameters of the economic integration variables are interpreted as $\hat{\beta}_6 = (\sigma - 1)\, lnb_{EU}$ and $\hat{\beta}_7 = (\sigma - 1)\, lnb_{RTA}$, where σ is the elasticity of substitution between goods[12] and $b_{EU} - 1$ and $b_{RTA} - 1$ are the tariff cost equivalents of the EU NTBs and a typical RTA.[13] Accordingly, the last row of Table 1 displays the tariff cost equivalents of NTBs. In terms of the aggregated gravity result, EU membership leads to a reduction in NTBs or regulatory divergence in vegetables, fruits and nuts equivalent to a 68.7% tariff for both countries. Considering the CPC-pooled regression results, the trade-enhancing effect for the vegetables, fruits and nuts sector that results from Turkey's membership in the EU amounts to only

[12] The substitution elasticity is equal to the absolute tariff coefficient resulting from sectoral or product estimations plus 1. When the tariff elasticity estimate is not significant, we take the GTAP elasticity of substitution for the sector-level calculations or the average tariff elasticity from the remaining significant estimates in the GTAP sector group for the product-level calculations.

[13] Whenever the EU dummy coefficient is not significant, we consider the typical RTA quantity effect to calculate the trade costs of NTBs. In that way, we assume that the effect of EU membership does not differ from a typical RTA effect. However, there are also some cases in which both economic integration variables are not significant or have the incorrect sign. In these cases, we assume that Turkey's EU membership will not have any effects on the reduction of NTBs in the respective sectors.

60.06%. This reflects the overestimation effect of using highly aggregated data to estimate the effects of NTBs.

The results of the CPC product-level gravity approach reveals that the most regulatory convergence occurs in the dates, figs, bananas, coconuts, Brazil and cashew nuts, pineapples, and avocados sector (117.7%). The least regulatory compliance occurs in the edible roots and tubers with high starch or inulin content sector (11.2%). The results on AVEs of NTBs are very sensitive to the elasticity of substitution (e.g., Obstfeld and Rogoff, 2001; Raimondi and Olper, 2011). In general, the lower the elasticity of substitution, the greater the AVEs of NTBs will be. Thus, even low levels of non-tariff protection can have large trade-hindering effects if the substitution elasticity is sufficiently low. This issue also applies to our estimates of tariff elasticity and explains the high AVEs of NTBs for some disaggregated CPC-level products.

To compare the CPC product-level results to the sector-level results, we aggregate the results of the product-level gravity approach on AVEs to the sector level and weight them by their relative importance using trade quantities as weights.[14] Specifically, we utilize the weights according to the bilateral trade structure of the EU and Turkey for each sector. This approach leads to asymmetric AVEs of NTBs for the EU and Turkey.

Table 2 exhibits aggregated, disaggregated and re-aggregated AVEs of NTBs that the EU and Turkey are expected to decrease during the process of Turkey's integration into the EU. In addition, we present the number of CPC sectors mapped to each GTAP-level sector and the variation coefficient of AVEs of NTBs from the CPC product-level gravity regressions. In the wheat and processed rice sectors, there is only one corresponding CPC sector leading to equal AVEs of NTBs for all gravity versions. Consequently, there is also no variation at the CPC level across products. In line with other studies (e.g., Anderson and van Wincoop, 2004), there is high variation across products. We observe high variation coefficients in the sectors of other meat, other animal products and plant-based fibers with variation coefficients of 188%, 130% and 122%, respectively. The lowest variation is found in the oil seeds (22%), sugar (50%),

[14] Applying trade weights to the aggregation method is atheoretic and might considerably bias the measurement of trade restrictiveness due to NTBs. Anderson and Neary (1996, 2003) propose theoretic aggregation by using the idea of uniform tariff equivalents. However, this theory-based aggregation method requires large and mostly unavailable quantities of data, so we rely on the standard procedure. We are aware that most restrictive NTBs enter into the overall average with relatively low weights and vice versa (Laird and Yeats, 1988).

and vegetable oils and fats (64%) sectors. Turning to the results of the aggregated gravity approach to estimate the AVEs of NTBs, the trade of plant-based fibers is expected to face relatively low non-tariff compliance. The very high trade costs caused by NTBs are expected to decrease in beverages and tobacco, wheat, and cereal grains. The order is similar when considering the pooled CPC-disaggregated gravity regression results on AVEs of NTBs, although the magnitude is much lower. The EU and Turkey are assumed to only marginally reduce trade costs in the crop and sugar sectors. Instead, the two parties are expected to achieve the most regulatory compliance in the wheat, beverages and tobacco, other food products and cereal grains sectors. With one exception, namely, other food products, all gravity results on the AVEs of NTBs using aggregated data are higher than those obtained using disaggregated data. This result again confirms our previous assumption that estimates from aggregated data regressions will overestimate the effect of EU membership.

Table 2: Aggregated, Disaggregated and Re-aggregated AVEs of NTBs (%)

Sector	CPC sectors (No.)	Variation coefficient (%)	Aggregated AVEs EU/TUR	Disaggregated AVEs EU/TUR	Re-aggregated AVEs TUR⟶EU	EU⟶TUR
Wheat	1	-	315.17	315.17	315.17	315.17
Cereal grain	4	76.75	291.89	140.94	98.08	86.15
Vegetables, fruits and nuts	10	77.01	68.73	60.06	47.07	47.75
Oil seeds	5	22.32	40.86	26.64	17.75	19.42
Plant-based fibers	3	122.45	8.52	0.00	0.00	0.03
Crops	14	113.51	101.77	13.86	43.34	32.75
Other animal products	10	130.14	122.28	78.38	13.45	1.41
Cattle meat	9	91.41	88.62	35.02	127.25	48.01
Other meat	9	188.00	116.95	104.62	21.39	19.52
Vegetables oils and fats	11	64.08	52.66	29.95	30.62	29.35
Dairy	11	113.91	84.14	56.98	102.70	137.30
Processed rice	1	-	50.14	50.14	50.14	50.14
Sugar	4	49.58	42.52	28.96	125.00	135.73
Other food products	52	95.19	49.26	148.99	41.49	37.52
Beverages and tobacco	13	113.15	541.97	156.00	60.56	183.96

Source: Authors' calculation.

According to the trade-weighted results, the EU and Turkey show the greatest deviation in terms of reduced NTBs in the beverages and tobacco, dairy and sugar sectors, in which Turkey is expected to reduce NTBs more strongly than the EU. Additionally, in the cattle meat, other animal products, cereal grains and crops sectors, there are large deviations. Here, the EU is willing to reduce NTBs to a higher degree than Turkey.

Not shown in Table 2 but important nonetheless, is the average AVE of NTBs across all 15 sectors, which decreases greatly from the aggregated version (131.7%) to the disaggregated version (83.1%) and even more in the re-aggregated version (72.9% for the EU and 76.3% for Turkey). Hence, the overestimation effect ranges between 60 and 80 percentage points. Considering the sectoral differences between the aggregated and disaggregated gravity estimation results, there is a bias of between 11 and 635 percentage points. In the same way, the variation in the average AVEs of NTBs across sectors decreases substantially.

3 Simulations with the Global Trade Analysis Project (GTAP) Framework

We analyze the effects of the aggregation bias of the gravity estimates on the policy simulation results with the help of the GTAP model, which is a comparative, static, multi-region general equilibrium model. The standard GTAP model provides a detailed representation of the economy, including the linkages between the farming, agribusiness, industrial and service sectors. The use of the non-homothetic, constant difference of elasticity to handle private household preferences, the explicit treatment of international trade and transport margins and the inclusion of the global banking sector are innovative features of the GTAP model. Trade is represented by bilateral matrices based on the Armington assumption. Additional features of the standard GTAP model are in perfect competition in all markets and the profit- and utility-maximizing behavior of producers and consumers. All policy interventions are represented by price wedges. The framework of the standard GTAP model is well-documented in Hertel (1997) and is available on the Internet.[15]

3.1 Incorporation of NTBs into the GTAP Model

NTBs are not considered in the standard GTAP model. However, they can be modeled using several methods, namely, as export taxes or import tariffs or as efficiency losses depending on the policies with which they are related. In the cases in which trade

[15]See https://www.gtap.org.

barriers generate rents, they can be implemented into the CGE model as import tariffs or export taxes. When NTBs only cause efficiency losses and thus increase the cost of production, an efficiency approach can be used (compare Francois, 1999, 2001). Several authors employ a combination of both NTB-modeling approaches to account for the different effects of trade barriers (Andriamananjara et al., 2003, 2004; CEPR, 2013; Fox et al., 2003; Fugazza and Maur, 2008; Walkenhorst and Yasui, 2005). With the efficiency approach, the removal of trade costs is reflected as an increase in technology by introducing an additional effective import price that is a function of the observed import price and an exogenous unobserved technical coefficient (Francois, 1999, 2001; Hertel et al., 2001, p. 13). The efficiency approach to modeling NTBs is also referred to as the "sand in the wheels" of trade or the "iceberg cost approach". Alternatively, rent-creating NTBs are incorporated into the GTAP model using the import-tariff or export-tax approach. Hence, a change in import tariffs or export taxes is simulated to account for the protection effect of NTBs. The "Altertax" program in the GTAP model enables users to implement NTBs as additional duties to the initial GTAP duties. Therefore, the partial or complete removal of import tariffs and/or export taxes reflects the effects of trade costs (Andriamananjara et al., 2003; Fox et al., 2003; Walkenhorst and Yasui, 2005).

3.2 Experimental Design

In this article, we employ version 8 of the GTAP database. We combine the original 134 countries and regions and the original 57 sectors into a 23-sector, 10-region aggregation. We keep food and agricultural sectors separate and group non-food sectors into extraction, manufacturing and services. In the regional mapping, we single out the main country groups. Our sector and region aggregations are highlighted in Table A1 in the Appendix.

The base year in version 8 of the GTAP database is 2007. We move the GTAP framework to 2020 because we assume that Turkey's membership in the EU will be concluded by then. Croatia's membership in the EU is established after 2007. With the help of a pre-experiment, we model the enlargement of the EU to include Croatia, and we include exogenous projections of GDP, population, technical progress and growth in factor endowments to incorporate economic developments until 2020. We source the data for the corresponding shocks from the Centre d'Etudes Prospectives et d'Informations Internationales, the UN and the World Bank. We disregard Turkey's free trade agreements (FTAs) after 2007 since Turkey would have to withdraw from any FTAs with third-party nations on its membership in the EU (European Commission, 2014a; Turkish Undersecretariat of Foreign Trade, 2014).

We then run two experiments using the AVEs of NTBs, which are calculated at different aggregation levels, namely, by using the AVEs of NTBs from the aggregated gravity approach (EXP1) and those from the disaggregated gravity approach (EXP2).[16] We consider the bilateral import tariffs and export subsidies between Turkey and the EU and Turkey's adaptation of the EU Customs Union's tariff level after becoming an EU member. In modeling the NTBs, we take the predominance of technical NTBs in the food and agricultural sectors into account by assuming that 75% of NTBs to the agro-food trade are technical NTBs. Hence, we model them using the efficiency approach.[17] The remaining 25% are assumed to be rent-creating NTBs, so they are implemented in the GTAP model by employing the import tariff modeling technique.[18] We also assume 1% of trade facilitation in non-food sectors due to our focus on the agro-food sector (Engelbert et al., 2014; Francois, 2007).

3.3 Simulation Results: Welfare and Trade Effects

This section discusses the results of two experiments, EXP1 and EXP2, and we focus on the welfare and trade balance effects. We use the NTBs estimated with the gravity approach based either on aggregated data or disaggregated data to reveal the effect of different data aggregation levels on the policy simulation results. We present our re-

[16] We do not consider the re-aggregated AVEs of NTBs in our policy CGE experiment because of the additional aggregation bias we incorporate through the atheoretic trade weighting.

[17] An inspection of NTBs to trade between Turkey and the EU show that especially in the food and agriculture sector, the most frequent trade barriers are technical. They are imposed for food safety reasons, such as labeling, maximum residual limits, pesticide use, and genetically modified content. The remaining frequent NTBs are rent-creating and include quantitative restrictions as well as non-automatic and import licenses (European Commission, 2014b; RASFF, 2013; Önen, 2008; Özdemir, 2008; Teknik Engel, 2014). The predominance of technical NTBs, especially in the agro-food sector, is also common in the literature (Andriamananjara et al., 2003; Fugazza and Maur, 2008).

[18] We only use efficiency and import tariff modeling of NTBs. We disregard export tax modeling since NTBs that are related to export prices, such as quantitative export restrictions, are not common in trade between Turkey and the EU except for the export restrictions on copper scrap (European Commission, 2014c).

sults in millions of 2007 US$. GEMPACK (version 11.0) and RunGTAP (Harrison and Pearson, 1996) are used to perform the simulations. We adopt a fixed trade balance as macroeconomic closure in the enlargement simulations. In Table 3, we present the welfare results of Turkey's potential membership in the EU. The simulation results in the first part of the table are based on the experiment using the aggregated data in the gravity estimation, whereas the second part of Table 3 displays the simulation results using the disaggregated data in the gravity estimation. The welfare results are also differentiated according to the gains that result from the reduction of NTBs or the removal of tariffs. We consider our first experiment, EXP1, as our reference situation. In the third part of the table, we therefore present the absolute and percentage deviations of EXP2 from EXP1. The percentage deviations are denoted in parentheses.

Table 3: Welfare Results of the Enlargement Experiments (million US$)

	Turkey	EU	MENA	Asia	NorthAm	LatinAm	Oceania	SSA	ROW
EXP1 (NTBs from aggregated gravity estimates)									
Total	6548	5867	629	-329	-468	-247	8	306	502
Tariffs	893	622	705	-422	179	358	36	187	749
NTBs	5655	5245	-262	247	-255	-356	-46	-27	-349
EXP2 (NTBs from disaggregated gravity estimates)									
Total	5200	5485	452	-117	-221	-44	28	210	442
Tariffs	898	484	630	-33	255	200	53	157	755
NTBs	4302	5001	-359	249	-86	-292	-53	-63	-404
EXP1 - EXP2									
Total	1348	382	177	-212	-247	-203	-20	96	60
	(21)	(7)	(28)	(64)	(53)	(82)	(-250)	(31)	(12)
Tariffs	-5	138	75	-389	-76	158	-17	30	-6
	(-1)	(22)	(11)	(92)	(-42)	(44)	(-47)	(16)	(-1)
NTBs	1353	244	97	-2	-169	-64	7	36	55
	(24)	(5)	(-37)	(-1)	(66)	(-18)	(-13)	(-133)	(-16)

Note: The numbers in brackets are the percentage deviations of EXP1 from EXP2. For instance, the percentage change in Turkey's total welfare level between EXP1 and EXP2 is equal to 21%.
Source: Authors' calculations.

As expected, Turkey's inclusion in the EU results in unambiguous gains for both Turkey and the EU in both experiments. Turkey's total welfare gain amounts to 6.55 billion US$ in the first experiment whereas 5.87 billion US$ accrue to the EU. In EXP2, in which NTBs from the disaggregated gravity estimates are used, the welfare gains for Turkey and the EU are more limited but remain considerable (5.20 billion US$ and 5.49 billion US$, respectively). In EXP1, 0.89 billion US$ of welfare gain accrue to Turkey due to the bilateral removal of import tariffs between Turkey and the EU, and Turkey's adaptation of the EU Customs Union's tariff level after becoming an EU member. The remaining 5.66 billion US$ stem from the reduction in NTBs. The greater welfare effects through the elimination of NTBs, as opposed to the abolition of tariffs, also applies to the EU (5.25 billion US$ vs. 0.62 billion US$). Similar welfare effects are observed in EXP2, in which the gains stemming from NTB reduction outweigh the gains resulting from bilateral tariff removal. Hence, the welfare effect of the removal of NTBs amounts to 4.30 billion US$ for Turkey and 5.00 billion US$ for the EU. Including Turkey in the EU also has welfare impacts on other countries. Asia in EXP1 and Latin America in EXP2 experience welfare losses due to the decrease in their agro-food imports to the EU. In both experiments, the overall welfare level of the Middle East and North Africa (MENA) and the Rest of the World (ROW) increase considerably. In both cases, those welfare gains can be predominantly traced to Turkey's adaptation of the EU Customs Union's tariff level.

As presented in Table 3, the transfer of aggregation bias from the econometric estimations to the GTAP level simulations creates differences between the welfare results of the two experiments. Using gravity estimates based on aggregated data results in higher welfare gains for both Turkey and the EU. However, especially for Turkey, deviations across experiments are higher (6.55 billion US$ vs. 5.20 billion US$ for Turkey and 5.87 billion US$ vs. 5.49 billion US$ for the EU). Higher differences between EXP1 and EXP2 for Turkey can be traced back to the predominance of the higher AVEs of NTBs in the gravity estimates using aggregated data (compare Table 1 and Table 2). Using EXP1 as our reference situation, total welfare effects deviate by 21% for Turkey and by 7% for the EU. For Turkey, the deviation across experiments that resulted from the reduction in NTBs (24%) is higher than the deviation due to the removal of tariffs (-1%). In contrast, the difference in welfare gains between EXP1 and EXP2 caused by NTB reduction for the EU is not highly pronounced (5%).

In Table 4, we present the impact of Turkey's membership in the EU focusing on the trade balance of the total agro-food sector and the 16 individual food and agricultural products. The first part of the table shows changes in the trade balance when NTBs stem from gravity estimates using aggregated data (EXP1). The second part demonstrates the effects of tariff and NTB reduction between Turkey and the EU when NTBs from the disaggregated gravity estimates are used (EXP2). The third part exhibits the absolute and percentage changes of EXP2 from the reference situation, EXP1.

Table 4: Trade Balance Results of Enlargement Experiments (million US$)

	EXP1 NTBs from aggregated gravity estimates			**EXP2** NTBs from disaggregated gravity estimates			**EXP1 - EXP2**		
	Turkey	EU	ROW	Turkey	EU	ROW	Turkey	EU	ROW
Agro-food products	1598	-2350	-911	-162	-1856	897	1760	-494	-1808
							(110)	(21)	(198)
Wheat	-596	308	249	-559	277	245	-37	31	4
							(6)	(10)	(2)
Cereal grain	-478	306	136	-481	260	186	3	46	-50
							(-1)	(15)	(-37)
Paddy rice	-1	-10	10	-1	-10	11	0	0	-1
							(0)	(0)	(-10)
Vegetables, fruit and nuts	2412	-2621	-188	1838	-1808	-287	574	-813	99
							(24)	(31)	(-53)
Oil seeds	-44	438	-408	-45	324	-293	1	114	-115
							(-2)	(26)	(28)
Plant-based fibers	119	-8	-105	45	8	-54	74	-16	-51
							(62)	(200)	(49)
Crops	-32	45	-71	-578	-104	572	546	149	-643
							(-1706)	(331)	(906)
Other animal products	-272	332	-87	-195	254	-80	-77	78	-7
							(28)	(23)	(8)
Vegetable oils and fats	117	-444	229	-55	-466	412	172	22	-183
							(147)	(-5)	(-80)
Dairy	-2354	1617	593	-1526	963	465	-828	654	128
							(35)	(40)	(22)
Processed rice	-140	144	-21	-131	131	-17	-9	13	-4
							(6)	(9)	(19)
Sugar	1712	-1085	-669	1505	-894	-659	207	-191	-10
							(12)	(18)	(1)
Other food products	2156	-2180	-688	1358	-1389	-257	798	-791	-431
							(37)	(36)	(63)
Beverages and tobacco	-553	545	-68	-377	390	-70	-176	155	2
							(32)	(28)	(-3)
Cattle meat	-287	103	185	-864	120	720	577	-17	-535
							(-201)	(-17)	(-289)
Other meat	-161	160	-8	-96	88	3	-65	72	-11
							(40)	(45)	(138)

Note: The numbers in brackets are the percentage deviations of EXP1 from EXP2. For instance, the percentage change difference in Turkey's agro-food trade balance between EXP1 and EXP2 is equal to 110%.
Originally, we differentiated between Switzerland, Norway, Croatia, Rest of EFTA, Rest of Eastern Europe, Rest of Europe, Belarus, Russian Federation, Ukraine, Kazakhstan, Kyrgyzstan, Armenia, Azerbaijan, Rest of Former Soviet Union, and Rest of the World (compare Table A1 in the Appendix). To simplify, we aggregated all regions other than Turkey and the EU to ROW to present the results.
Source: Authors' calculations.

The aggregation level used to estimate NTBs with the gravity approach has different trade balance effects on Turkey, the EU, and the ROW. For instance, the results of EXP1 indicate that Turkey's membership in the EU causes an increase in Turkey's agro-food trade balance by 1.60 billion US$ when the aggregated gravity estimates are used to estimate the AVEs of NTBs. However, Turkey's agro-food trade balance decreases by 0.16 billion US$ according to the results of EXP2. Hence, the deviation between EXP1 and EXP2 amounts to 110%. The same effect of aggregation bias, and thus a deviation of 21%, is also observed for the EU agro-food trade balance. EU agro-food imports relative to exports decrease by 2.35 billion US$ in EXP1, whereas this decrease is smaller and is equal to 1.86 billion US$ in EXP2. As expected, Turkey's inclusion in the EU also has effects on other economies, but the direction and magnitude of the effect again differ according to the aggregation level that is used to estimate the AVEs of NTBs. For example, Turkey's membership to the EU has a negative effect on the ROW agro-food trade balance when NTBs from aggregated gravity estimates are used. However, the ROW trade balance in the food and agricultural sector increases when NTBs from gravity estimates using disaggregated data are input in the GTAP model. Here, the deviation amounts to 198%.

At the product level, the greatest changes to Turkey's and EU's agro-food trade balance are observed in the vegetables, fruits and nuts, dairy and other food products sectors in both experiments. The changes in the trade balance of the separate food and agricultural sectors also drive the results for the total trade of food and agricultural products. This is particularly true for vegetables, fruits and nuts as well as other food products, which are highly exported from Turkey to the EU (GTAP database, version 8); NTBs are most frequently imposed in these sectors (European Commission, 2014b; RASFF, 2013; Önen, 2008; Özdemir, 2008; Teknik Engel, 2014). Following Turkey's membership in the EU, the imports of dairy products from the EU to Turkey increase and result in a rise in the EU dairy trade balance.

For EXP1, the largest increase, 2.41 billion US$, in Turkey's agro-food trade balance occurs in the vegetables, fruits and nuts sector. Remarkably, the increase in other food exports from Turkey is relative to its imports by 2.16 billion US$. In accordance with the relative increase in Turkey's exports of vegetables, fruits and nuts as well as other food products in EXP1, the EU trade balance in these sectors decreases by 2.62 billion US$ and 2.18 billion US$, respectively. For the EU, the highest increase in the agro-food trade balance occurs in dairy products (1.16 billion US$) accompanied by a decrease in Turkey's trade balance (2.35 billion US$). However, using the NTBs from the disaggregated gravity estimates leads to lower changes in the trade balances of Turkey and the EU for the vegetables, fruits and nuts, dairy and other food products sectors. In EXP2, Turkey's trade balance of the vegetables, fruits and nuts sector increases by only 1.83 billion US$, which corresponds to a deviation of 24% from the results of EXP1. The increase in the trade balance in other food products amounts to 1.36 billion US$ for Turkey in EXP2, so the deviation between EXP1 and EXP2 equals 37%. For dairy products, we calculate the EU trade balance changes in EXP2 to be equal to 0.96 billion US$, resulting in a deviation of 40% between EXP1 and EXP2. These differences clearly reveal the effects of aggregation bias, which stems from the econometric estimates of trade costs at different data aggregation levels and is particularly prominent in those two sectors. For instance, the AVE of NTBs for dairy products is estimated to be 84.14% with the aggregated gravity estimates, whereas the number equals 56.98% when disaggregated gravity estimates are used (compare Table 2). We also observe similar differences in the AVEs of NTBs for the vegetables, fruits and nuts sector (68.73% in EXP1 vs. 60.06% in EXP2). The only exception occurs in the other food products sector, in which the estimated AVE of NTBs is lower in the gravity estimates using aggregated data, but the reduction of the NTBs in this sector results in higher changes in the trade balance in EXP2.

The predominant assumption of aggregation bias in the CGE analysis is that a higher degree of sector disaggregation results in larger trade and welfare effects in the simulations performed with CGE models (e.g., Brockmeier and Bektasoglu, 2014; Charteris and Winchester, 2010; Grant et al., 2007, 2008; Narayanan et al., 2010a,b). However, in previous studies, NTBs are not considered, and the AVEs of NTBs that are calculated at different aggregation levels are not compared. In our analysis, the overestimation of the CGE model traces back to the aggregation bias occurring in the estimates of AVEs of NTBs. As demonstrated by several authors, it is common to observe the overestimation effects of gravity estimates on trade costs using aggregated data (e.g., French, 2012; Hillberry, 2002; Hillberry and Hummels, 2003). Because we use the exact same structure of the GTAP database in both experiments and only change the implemented AVEs of NTBs between our experiments, we observe the pure effects of aggregation bias from the gravity estimates in our results. Hence, our analysis is not comparable to existing studies analyzing the effect of data aggregation levels in CGE models.

4 Concluding Remarks

In this article, we focus on the importance of NTBs in the analysis of RTAs and the effect of aggregation bias on the estimation of the AVEs of NTBs. We explore the impact of different data aggregation levels on the estimation of the trade costs of NTBs. In addition, we reveal how the aggregation bias from the econometric estimates is transferred to the GTAP framework and thus affects the results of policy simulations analyzing Turkey's membership to the EU. In our analysis, we focus on food and agriculture. First, we infer the trade costs of NTBs for 15 aggregated GTAP sectors using the gravity approach and state-of-the-art econometrics. We apply the gravity model to aggregated and disaggregated data. We choose a model specification in which we capture all policy measures that reduce regulatory divergence and eliminate unnecessary restrictive NTBs in the European integration using a binary variable. We convert the missing trade in the absence of EU membership into a tariff equivalent using the theoretical model structure.

Our results show that AVEs of NTBs vary substantially across sectors, particularly when using disaggregated data. In addition, the AVEs of NTBs are significantly higher for some sectors when using aggregated data, indicating the overestimation effect of applying trade policies at the aggregated level. Considering average values, the AVEs of NTBs resulting from aggregated gravity estimations are approximately 60 percentage points higher than the AVEs of NTBs resulting from disaggregated gravity estimations. In terms of sectoral differences, the overestimation ranges from 11 to 635 percentage points.

Secondly, we incorporate the estimated AVEs of NTBs into the GTAP framework by using the efficiency and import tariff modeling approaches. In our experiments, we use both the disaggregated and the aggregated gravity estimates to reveal the extent to which the policy simulation results differ when different aggregation levels are used to estimate the AVEs of NTBs. The results of our two experiments show that Turkey's membership in the EU results in unambiguous welfare gains for both Turkey and the EU in both experiments. However, there are considerable differences between the experiments using NTBs from either aggregated gravity estimates (EXP1) or from disaggregated gravity estimates (EXP2). The deviations of EXP2 from EXP1 amount to 21% and 7% for Turkey's and the EU's welfare gains, respectively. Similar effects of aggregation bias are also observed in the trade balance results. The deviations between experiments for the agro-food trade balance of Turkey and the EU are equal to 110% and 21%, respectively. At the product level, the greatest differences between the results of the two experiments are observed in the trade balance of the vegetables, fruits and nuts, dairy and other food products sectors. This effect of aggregation bias clearly results from the predominance of higher levels of AVEs of NTBs obtained using aggregated data to the gravity approach. Therefore, using highly aggregated data to estimate the effects of NTBs predominantly results in an overestimation of trade costs. The effect of aggregation bias that already occurs in gravity estimations is then transferred to CGE simulations. Hence, we also obtain deviating results in the policy simulation conducted with the GTAP framework, which is especially observed at the sector level when different data aggregation levels are used to estimate the AVEs of NTBs.

In this article, we are able to confirm the importance of NTBs in the analysis of RTAs. Our results show that the welfare gains from the reduction of NTBs outweigh the gains from the elimination of import tariffs and export subsidies. Hence, the consideration of NTBs in trade policy analysis should not be disregarded. Second, we conclude that the aggregation level of the data influences the outcome of the estimation of the AVEs of NTBs considerably. The implementation of different values of estimated trade costs into the GTAP model directly affects policy simulation results. Consequently, researchers and policy makers should be aware of aggregation bias in the in-depth analysis of trade policies and be cautious when finding a compromise between spending resources to gather disaggregated data and inaccurate results.

Appendix

Table A1: Regional and Sectoral Aggregation

	Regions		Sectors
1	Turkey	1	Paddy rice
2	European Union Austria, Belgium, Denmark, Finland, France, Germany, Ireland, United Kingdom, Greece, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, Czech Republic, Hungary, Malta, Poland, Slovakia, Slovenia, Estonia, Latvia, Lithuania, Cyprus, Romania, Bulgaria	2	Wheat
3	Croatia	3	Cereal grains
4	Middle East and North Africa Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Egypt, Morocco, Tunisia, Islamic Republic of Iran, Israel, Rest of North Africa, Rest of Western Asia	4	Vegetables, fruit and nuts
5	Asia China, Hong Kong, Japan, Korea, Mongolia, Taiwan, Cambodia, Indonesia, People's Democratic Republic of Lao, Malaysia, Philippines, Singapore, Thailand, Vietnam, Bangladesh, India, Nepal, Pakistan, Sri Lanka, Rest of South Asia, Rest of Southeast Asia	5	Oil seeds
6	North America Canada, United States of America, Mexico, Rest of North America	6	Sugar cane, sugar beet
7	Latin America Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela, Costa Rica, Guatemala, Honduras, Nicaragua, Panama, El Salvador, Caribbean, Rest of South America, Rest of Central America	7	Plant-based fibers

Continued on next page

Table A1 – continued from previous page

	Regions		Sectors
8	Oceania	8	Crops
	Australia, New Zealand, Rest of Oceania		
9	Sub-Saharan Africa	9	Cattle
	Cameroon, Cote d'Ivoire, Ghana, Nigeria, Senegal, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Tanzania, Uganda, Zambia, Zimbabwe, Botswana, Namibia, South Africa, Rest of African Customs Union, South Central Africa, Rest of Eastern Africa, Rest of Western Africa, Central Africa		
10	Rest of the World	10	Other animal products
	Switzerland, Norway, Rest of EFTA, Rest of Eastern Europe, Rest of Europe, Belarus, Russian Federation, Ukraine, Kazakhstan, Kyrgyzstan, Armenia, Azerbaijan, Rest of Former Soviet Union, Rest of the World		
		11	Raw milk
		12	Wool
		13	Sugar
		14	Processed rice
		15	Dairy
		16	Cattle meat
		17	Other meat
		18	Vegetable oils and fats
		19	Other food products
		20	Beverages and tobacco
		21	Extraction
			Forestry, Fishing, Coal, Oil, Gas, Minerals not elsewhere specified (nec)

Continued on next page

Table A1 – continued from previous page

Regions		Sectors
	22	Manufacturing
		Textiles, Wearing apparel, Leather products, Wood products, Paper products, Publishing, Metal products, Motor vehicles and parts, Transport equipment nec, Petroleum, Coal products, Chemical, Rubber, Plastic products, Mineral products nec, Ferrous metals, Metals nec, Electronic equipment, Machinery and equipment nec
	23	Services
		Electricity, Gas manufacture, distribution, Water, Construction, Trade, Transport nec, Water transport, Air transport, Communication, Financial services nec, Insurance, Business services nec, Recreational and other services, Public Administration, Defense, Health, Education, Dwellings

Source: GTAP database, version 9, 2014

References

Agostino, M.R., Aiello, F., and Cardamone, P. (2007), Analysing the impact of trade preferences in gravity Models. Does aggregation matter?, TRADEAG Working Paper, 07/4.

Anderson, E. B. (1970), Asymptotic properties of conditional maximum likelihood estimators., *Journal of the Royal Statistical Society* B(32), pp. 283–301.

Anderson, J. and Neary, P. (1996), A new approach to evaluating trade policy, *Review of Economic Studies* 63(1), pp. 107–125.

Anderson, J. and Neary, P. (2003), The Mercantilist index of trade policy, *International Economic Review* 44(2), pp. 627–649.

Anderson, J. E. (2009), Consistent Trade Policy Aggregation, *International Economic Review* 50(3), pp. 903–927.

Anderson, J. E. (2011), The Gravity Model, *Annual Review of Economics* 3, pp. 133–160.

Anderson, J. E. and van Wincoop, E. (2003), Gravity with Gravitas: A Solution to the Border Puzzle, *American Economic Review* 93, pp. 170–192.

Anderson, J. E. and van Wincoop, E. (2004), Trade Costs, *Journal of Economic Literature* 42, pp. 691–751.

Andriamananjara, S., Ferrantino, M.J., and Tsigas, M. (2003), Alternative Approaches in Estimating the Economic Effects of Non-Tariff Measures: Results from Newly Quantified Measures, Working paper. Office of Economics Working Paper. U.S. International Trade Commission. 2003-12-C.

Andriamananjara, S., Dean, J.M., Feinberg, R., Ferrantino, M.J., Ludema, R., and Tsigas, M. (2004), The Effects of Non-Tariff Measures on Prices, Trade, and Welfare: CGE Implementation of Policy-Based Price Comparisons, Working paper. Office of Economics Working Paper. U.S. International Trade Commission. 2004-04-A.

Baier, S.L. and Bergstrand, J.H. (2007), Do Free Trade Agreements Actually Increase Members' International Trade?, *Journal of International Economics* 71, pp. 72–95.

Baier, S.L. and Bergstrand, J.H. (2009), Estimating the Effects of Free Trade Agreements on International Trade Flows using Matching Econometrics, *Journal of International Economics* 77(1), pp. 63–76.

Baldwin, R.E. and Taglioni, D. (2006), Gravity for dummies and dummies for gravity equations, NBER Working Paper, 12516.

Brockmeier, M. and Bektasoglu, B. (2014), Model structure or data aggregation level: Which leads to greater bias of results?, *Economic Modelling* 38, pp. 238–245.

CEPR (2013), Reducing Transatlantic Barriers to Trade and Investment. An Economic Assessment, Final Project Report. Prepared Under Implementing Framework Contract TRADE10/A2/A16.

Charteris, A. and Winchester, N. (2010), Dairy disaggregation and joint production in an economy-wide model, *The Australian Journal of Agricultural and Resource Economics* 54(4), pp. 491–507.

Chen, N. and Novy, D. (2012), On the Measurement of Trade Costs: Direct Vs. Indirect Approaches to Quantifying Standards and Technical Regulations, *World Trade Review* 11(3), pp. 401–414.

Cipollina, M. and Salvatici, L. (2012), Hands-on gravity estimation with STATA. Version 1., AGRODEP Technical Note TN-05.

CSP (2014), Center for Systemic Peace. INSCR Data Page. URL `http://www.systemicpeace.org/inscrdata.html.`, accessed 05 November 2014.

de Sousa, J. (2014), International economics data and programs. URL `http://jdesousa.univ.free.fr/data/rta/rta_faq.htm`, accessed 15 August 2014.

Egger, P. and Pfaffermayr, M. (2003), The proper panel econometric specification of the gravity equation: A three-way model with bilateral interaction effects, *Empirical Economics* 28(3), pp. 571–580.

Engelbert, T., Bektasoglu, B., and Brockmeier, M. (2014), Moving Toward the EU or the Middle East? An Assessment of Alternative Turkish Foreign Policies Utilizing the GTAP Framework, *Food Policy* 47, pp. 46–61.

European Commission (2014a), Accession treaty: Treaty concerning the accession of the Republic of Croatia. URL `http://www.hnb.hr/medjunarodna_suradnja/dokumenti/e-ugovor-o-pristupanju-rh-europskoj-uniji.pdf.`, accessed 14 June 2014.

European Commission (2014b), Technical barriers to trade notification database. URL `http://ec.europa.eu/enterprise/tbt/index.cfm?fuseaction=Search.viewMenu&dspLang=EN`, accessed 05 June 2014.

European Commission (2014c), Trade: Market access database. URL `http://madb.europa.eu/madb/barriers_details.htm?barrier_id=115408&version=1`, accessed 07 August 2014.

Feenstra, R. C. (2004), *Advanced International Trade: Theory and Evidence*, Princeton, NJ: Princeton University Press.

Fox, A., Francois, J.F., and Londono-Kent, P. (2003), Measuring Border Crossing Costs and their Impact on Trade Flows: The United States-Mexican Trucking Case, GTAP resource 1282. URL `https://www.gtap.agecon.purdue.edu/resources/download/1492.pdf`.

Francois, J. F. (2007), Economic Impact of a Potential Free Trade Agreement between the European Union and South Korea, Copenhagen Economics.

Francois, J.F. (1999), Economic Effects of a New WTO Agreement Under the Millennium Round, Report to the European Commission Trade Directorate.

Francois, J.F. (2001), *The Next WTO Round: North-South Stakes in New Market Access Negotiations*, Centre for International Economic Studies, Adelaide.

French, S. (2012), The Composition of Exports and Gravity, Working Paper. School of Economics. University of New South Wales.

Fugazza, M. and Maur, J.C. (2008), Non-Tariff Barriers in CGE Models: How Useful for Policy?, *Journal of Policy Modeling* 30, pp. 475–490.

Grant, J.H., Hertel, T.W., and Rutherford, T.F. (2007), Tariff line analysis of U.S. and international dairy protection, *Agricultural Economics* 37(1), pp. 271–280.

Grant, J.H., Hertel, T.W., and Rutherford, T.F. (2008), Dairy TRQ liberalization:

Contrasting bilateral and most favored nation reform options., Paper presented at the 11th Annual Conference on Global Economic Analysis, Helsinki, 12-14 June.

Harrison, J.W. and Pearson, K.P. (1996), Computing solutions for large general equilibrium models using GEMPACK, *Computational Economics* 9, pp. 83–127.

Hausman, J., Hall, B.H., and Grilichers, Z. (1984), Econometric Models for Count Data with an Application to the Patents-R&D Relationship, *Econometrica* 52(4), pp. 909–938.

Haveman, J.D., Nair-Reichert, U., and Thrusby, J.G. (2003), How Effective are Trade Barriers? An Empirical Analysis of Trade Reduction, Diversion, and Compression, *The Review of Economics and Statistics* 85(2), pp. 480–485.

Haveman, J.D. and Thrusby, J. G. (1999), The Impact of Tariff and Non-Tariff Barriers to Trade in Agricultural Commodities: A Disaggregated Approach, Purdue CIBER Working Papers. Paper 143.

Head, K. and Mayer, T. (2014), Gravity Equations: Workhorse, Toolkit, and Cookbook, in E. Helpman, K. Rogoff, and G. Gopinath (eds.), *Handbook of International Economics*, NorthHolland, pp. 131–195.

Helpman, E. (1987), Imperfect Competition and International Trade: Evidence from fourteen industrialized countries, *Journal of the Japanese and International Economies* 1, pp. 62–81.

Hertel, T. W. (ed.) (1997), *Global trade analysis. Modeling and applications.*, Cambridge University Press.

Hertel, T.W., Walmsley, T., and Itakura, K. (2001), Dynamic Effect of the 'New Age' Free Trade Agreement between Japan and Singapore, *Journal of Economic Integration* 16(4), pp. 446–484.

Hillberry, R. and Hummels, D. (2003), Intranational Home Bias: Some Explanations, *The Review of Economics and Statistics* 85(4), pp. 1089–1092.

Hillberry, R. H. (2002), Aggregation bias, compositional change, and the border effect, *Canadian Journal of Economics* 35(3), pp. 517–530.

Laird, S. and Yeats, A. (1988), A Note on the aggregation bias in current procedures for the measurement of trade barriers, *Bulletin of Economic Research* 40(2), pp. 133–143.

Lejour, A. M., Mooij, A. R., and Nahuis, R. (2001), EU Enlargement: Economic implications for countries and industries?, CESIFO Working Paper 585.

Magee, C. (2008), New Measures of Trade Creation and Trade Diversion, *Journal of International Economics* 75(2), pp. 349–362.

Micco, A., Stein, E., and Ordonez, G. (2003), The currency union effect on trade: Early evidence from EMU, *Economic Policy* 18(37), pp. 316–356.

Narayanan, B.G., Hertel, T.W., and Horridge, J.M. (2010a), Disaggregated data and trade policy analysis: The value of linking partial and general equilibrium models, *Economic Modelling* 27(3), pp. 755–766.

Narayanan, B.G., Hertel, T.W., and Horridge, J.M. (2010b), Linking partial and general equilibrium models: A GTAP application Using TASTE, GTAP Technical Paper No. 29, Center for Global Trade Analysis, Purdue University, West Lafayette.

Obstfeld, M. and Rogoff, K. (2001), The six major puzzles in international macroeconomics: Is there a common cause?, in B.S. Bernake and Rogoff K (eds.), *NBER Macroeconomics Annual 2000*, MIT Press, vol. 15.

Önen, E. (2008), DTÖ yükümlülükleri kapsaminda Türkiye ile Avrupa Birligi arasindaki tarim ürünleri ticareti ve bu ticarette önem arz eden tarife disi engeller, AB Uzmanlik Tezi, T.C. Tarim ve Köyisleri Bakanligi, Dis Iliskiler ve Avrupa Birligi Koordinasyon Dairesi Baskanligi, Ankara.

Özdemir, S. (2008), Türkiye'nin Avrupa Birligi ülkelerine yas meyve-sebze ihracati ve Avrupa Birligi Cevre Politikalarindan kaynaklanan teknik engeller., MS Thesis, Çukurova Üniversitesi, Fen Bilimleri Enstitüsü, Tarim Ekonomisi Anabilim Dali, Adana.

Palmgren, J. (1981), The Fisher information matrix for log-linear models arguing conditionally in observed explanatory variables., *Biometrika* 68, pp. 563–566.

Raimondi, V. and Olper, A. (2011), Trade elasticity, gravity and trade liberalisation: Evidence from the food industry, *Journal of Agricultural Economics* 62(3), pp. 525–550.

Raimondi, V., Scoppola, M., and Olper, A. (2012), Preference erosion and the developing countries exports to the EU: a dynamic panel gravity approach, *Review of World Economics* 148, pp. 707–732.

RASFF (2013), The Rapid Alert System for Food and Feed: 2013 Preliminary Annual Report. URL `http://ec.europa.eu/food/safety/rasff/index_en.htm`, accessed 15 May 2014.

Santos Silva, J.M.C. and Tenreyro, S. (2006), The Log of Gravity, *The Review of Economics and Statistics* 88(4), pp. 641–658.

Stack, M. M. (2009), Regional integration and trade: Controlling for varying degrees of heterogeneity in the gravity model, *The World Economy* 32(5), pp. 772–789.

Sun, L and Reed, M.R. (2010), Impacts of free trade agreements on agricultural trade creation and trade diversion, *American Journal of Agricultural Economics* 92(5), pp. 1351–1363.

Teknik Engel (2014), Bildirim veritaban? URL `http://www.teknikengel.gov.tr/index.cfm?actio n=arama`, accessed 12 April 2014.

Turkish Undersecretariat of Foreign Trade (2014), Trade agreements: Turkey's free trade agreements. URL `http://www.economy.gov.tr/index.cfm?sayfa=tradeagreements&bolum=fta&region=0`, accessed 14 July 2014.

Walkenhorst, P. and Yasui, T. (2005), Benefits of trade facilitation: A quantitative assessment, in P. Dee and M. Ferrantino (eds.), *Quantitative measures for assessing the effect of non-tariff measures and trade facilitation*, Singapore: World Scientific Ltd.

8 Conclusion

With the reduction of tariff barriers due to multilateral trade liberalization agreements under the GATT and the successor WTO, NTBs and regulatory divergence across countries have gained in importance in governing and influencing international trade. Of this, food and agricultural trade is mainly affected by NTBs due to political and historical reasons and consumer safety issues. While past trade negotiations were dominated by the scope and progress of tariff reductions, in recent times, policymakers have been concerned about the plurality of NTBs across borders limiting the evolvement and expansion of commercial exchange. Hence, NTBs have become a priority topic of trade policy agendas. Because agreements on NTBs at the multilateral level are a tedious and resource-intensive process, bilateral or regional trade liberalization through reduction of NTBs appear more promising. The more similar countries are in terms of economic development, investment structures, political ties and cultural affinity that negotiate for an FTA, the more likely they succeed in agreeing on reduction of NTBs and regulatory convergence. However, empirical prospective analyses on the potential effects of FTAs considering detailed agro-food sectors and allowing for simultaneous reductions of tariffs and NTBs are rare to find in the literature.

This cumulative dissertation includes six articles that address two critical issues in international agricultural economics research, namely, the effects of NTBs and the assessment of FTAs by explicitly considering the reduction of NTBs in agro-food sectors. In addition to the economics research questions, methodological objectives with respect to the econometric approach and the CGE modeling are also followed.

The first two articles present a literature review about NTBs, their prevalence and evolution over time. The following articles assess the importance of NTBs in the outcome of FTA policy simulations by relying on the connection of the gravity model of trade and the CGE model GTAP. The focus is on detailed food and agricultural trade.

The first article provides an overview of NTBs and reviews the methods to identify and quantify the effects of NTBs. The article also proposes an idea of how to further extend the comprehensive analysis of NTBs by suggesting alternative indices and combining different approaches. Based on the calculation of frequency and coverage ratios utilizing the most comprehensive database on NTBs, the conclusion can be drawn that there is a high prevalence of NTBs in food and agriculture. Particularly, South American countries, Australia, Canada and the US dominate the application of NTBs worldwide. However, the results must be interpreted with caution because they strongly depend on the quality of the data. Because most NTBs are independent from multilateral commitments, there are no strict rules in reporting implemented NTBs, so the results are an indication of the reporting behavior of countries. In addition, the inventory approach gives no degree of the restrictiveness of NTBs. Nevertheless, the approach might offer a starting point for further thorough analysis of NTBs.

The second article extends the analysis of NTBs. It also elaborates WTO's approach in regulating NTBs and their role during the recent economic crisis. Direct proxies of NTBs are incorporated into a gravity-like equation in a panel setting to investigate the evolution over time and the restrictiveness on agro-food trade. The differentiation between effects on imports and exports across different income level groups of countries reveals considerable distinctions. Based on descriptive data analysis and estimation results, an increase in NTBs and a significant trade-hindering effect can be observed. Consequently, the empirical analysis confirms the high relevance of NTBs in agro-food trade. However, the outcome depends on the proxies that entered the model so that the magnitude and significance of the negative effect strongly varies from one proxy to the other. Hence, there is still need for more comprehensiveness and quality of data with respect to NTBs to better isolate their effects on trade. Indeed, there are international efforts to increase the availability and quality of information for NTBs. These efforts have once again been intensified as the consequence of the recent economic crisis. During the crisis, governments retreated in implementing protectionist measures including a wide range of NTBs to protect domestic industries and consumers. Though meant as short-term solutions, many countries have kept the measures or reset them only slowly, especially in sensitive sectors such as the agro-food sector. The databases on NTBs are meant to provide clarity and transparency; however, different objects and aims of the corresponding organizations and methodological differences in the identification and collection of data make the comparison and usability very difficult. Increased cooperation and coordination among organizations and agreement on methodological and systematic data issues would increase the conceptual clarity and definiteness of the effects of NTBs in the future.

The following two articles further expand the assessment of NTBs by evaluating their role in the outcome of FTA policy simulations. In doing so, a two-step approach is employed. In the first step, the theory-consistent gravity border effect approach is applied to indirectly estimate the effects of NTBs in detailed agro-food sectors and to calculate AVEs of NTBs with the help of the elasticity of substitution. In the second step, the econometric results on NTBs enter the GTAP model. While the third article assesses the potential impacts of Turkey's membership in either the EU or GAFTA, the fourth article offers an affirmed analysis by assessing the EU-India FTA. To consider the level of NTBs that is realistically reducible in the FTA analyses, NTBs are benchmarked to the integration level of comparable FTAs. NTBs are modeled as efficiency losses due to the focus on detailed agro-food sectors and the predominance of technical NTBs in these sectors. With respect to the research questions, both empirical analyses reveal that welfare gains from lowering NTBs are of considerable importance and would generally be greater than the gains stemming from the elimination of tariffs. The reduction of NTBs in the agro-food sector accounts for the highest proportion of the welfare gains coming from the reduction of NTBs. Hence, both articles conclude that the inclusion of NTBs in the evaluation of FTAs is essential and that detailed agro-food sectors have to be considered in the analysis. Furthermore, the analyses point out that the elasticity of substitution crucially influences the magnitude of AVEs of NTBs.

The fifth article takes up the outcomes of the previous articles but considers methodological advancements when analyzing the TTIP between the EU and US. In gravity modeling, a different strategy to identify NTBs is pursued. A categorical FTA variable enters the gravity equation that differentiates the depth and scope of agreed topics in the negotiations according to seven levels of the FTA partners in the past. Consequently, ambitiousness in terms of reduction of NTBs and harmonization of regulations and standards can be selected. Particular consideration is given to the correction of endogeneity that results from selection bias. Assuming a mean integration level, TTIP simulations are conducted using the GTAP model. In contrast to the two previous articles, the analysis in this paper applies both NTB modeling techniques by differentiating between resource-wasting NTBs and rent-generating NTBs. Thereby, rents of NTBs are completely established on the importer side. The division is based on existing cost and rent shares for NTBs between the EU and US. It also considers carefully elaborated spillover effects for third countries. Since the elasticity of substitution not only governs the magnitude of AVEs of NTBs but also critically determines trade diversion and welfare effects in CGE modeling, the analysis is based on the econometric obtained elasticity of substitution derived from the gravity model. The analysis also includes the related confidence intervals to generate a distribution of the model's results. Simulation results show considerable gains for the EU and US that are predominantly driven by the reduction of NTBs. At this, resource-wasting NTBs weigh much heavier in the overall large, positive welfare gains than rent-generating NTBs. Third countries are only moderately affected because spillover effects caused by regulatory convergence between FTA partners outweigh the negative trade-diverting effects. Finally, employing estimated elasticity of substitution and the corresponding interval estimates enhances the confidence of the FTA policy analysis.

Finally, the sixth article analyzes the question of whether gravity estimates of NTBs in the agro-food sector are affected by different data aggregation levels and whether this would have an influence on policy simulations. AVEs of NTBs are calculated using the gravity model and the FTA dummy approach to disaggregated and aggregated data for 15 GTAP agro-food sectors. Subsequently, the GTAP model is employed to perform two experiments of an expansion to the EU that would include Turkey, which vary by the integrated AVEs of NTBs. In NTB modeling, the efficiency and import tariff approach are applied by assuming that the majority of NTBs are resource-wasting NTBs and that rent-creating NTBs make up only a small portion of total NTBs. Econometric results suggest a high variation of NTBs across the detailed sectors. AVEs of NTBs that are obtained with aggregated data are primarily higher than the ones obtained with disaggregated data. The incorporation of NTBs, which are estimated at different data aggregation levels, for liberalization scenarios leads to diverse simulation results. Hence, the aggregation level has a noticeable effect on the outcome of gravity estimates and on simulation results. Results in terms of differentiation of alternative types of NTBs confirm the outcome of the previous study that resource-wasting NTBs predominate the positive welfare outcome.

The empirical analyses included in this thesis illustrate and reaffirm the high prevalence and relevance of NTBs in the international agricultural trade. AVEs of NTBs exceed tariffs and, hence, point to the necessity of including NTBs for sound policy analyses. NTBs considerably determine the outcome of FTA policy simulations. Importantly, the consideration of detailed agro-food sectors matters for the overall results. The efficiency approach results in higher welfare gains than the import tariff approach to model NTBs. Both types of NTBs affect the terms of trade in a similar way, but resource-wasting NTBs do not exhibit trade diversion effects in a traditional Vinerian sense. Thus, in contrast to tariffs and rent-generating NTBs, reducing NTB-related costs represents a real resource saving and hence dominate the high welfare gains. Consequently, the distinction of alternative types of NTBs for modeling NTBs in CGE applications is important because of the differentiated effects on welfare analysis. By considering spillover effects, third countries are also exempted from NTB-related costs. This, in total, lowers the negative trade-diverting effects caused by reducing rent-generating measures and is a benefit for the total welfare outcome. That is why spillover effects are of particular importance for the results of FTA policy simulations.

With respect to methodological issues in the econometric approach, the theory-consistent gravity model proves to be a strong empirical tool to measure the effects of NTBs and derive AVEs. Because of the limitations of high-quality direct measures for NTBs so far, the applied identification strategies enable one to indirectly obtain the effects of NTBs and to join them in one metric. The application of Poisson fixed-effects estimators proves to be qualified. Appropriate correction methods for endogeneity and other unobserved heterogeneity assure unbiased estimation results. The use of different specifications of the gravity model supports the stability of the results. To avoid aggregation bias, the gravity model is adaptable to disaggregated data. The presented analyses show that the correct econometric application of the gravity model is insofar important that it also offers estimates on the elasticity of substitution. Because the magnitude of AVEs of NTBs is highly sensitive to the chosen elasticity of substitution, this behavioral parameter needs also special consideration in the analysis. Accordingly, taking the gravity estimates of the elasticity of substitution from the same estimation procedure as the results for NTBs, offers the highest consistency in calculating AVEs of NTBs. The joint econometric-CGE approach offers an appropriate and comprehensive framework for evaluating the effects of the reduction of NTBs in the process of economic integration. A perfect match of data in the econometric application and CGE policy analysis assures the reliability and performance of the joint approach. Extending the CGE model and augmenting the database with econometric estimates in terms of AVEs of NTBs and the elasticity of substitution enhance the level of detail and quality of CGE-based assessments of FTAs. The reliability of the results is further increased by considering the most disaggregated data level.

Future research analyses might apply even more disaggregated data and consider direct measures of NTBs. This approach would take even better account of the discrepancy between the level of real trade policy negotiations on NTBs and the level of trade models and allow more detailed and accurate separation between different types of NTBs. In doing this, information from newly emerging databases on NTBs can be utilized. To conduct CGE policy analyses, theory-based aggregation methods, such as the calculation of the welfare-equivalent Trade Restrictiveness Index and of the import-equivalent Mercantilist Trade Restrictiveness Index, could be applied to consistently obtain AVEs of NTBs at the CGE sector level. Finally, it is to be kept in mind that model-based analyses play an important role in the assessment of policies. With decreasing tariffs the demand for information about the impacts of NTBs increases. Hence, the composite-method approach that was selected for this thesis can meet these information needs and generally contributes to better policy impact analysis. The joint econometric-CGE analysis can be transferred to the prospective assessment of other deep FTAs. To take yet another step forward in this connection, the econometric method that was selected for this thesis could be used to construct a detailed database of AVEs of NTBs for the CGE framework that can be connected with a module that is able to reduce the AVEs of NTBs and to aggregate the AVEs to the desired CGE sector level. This would also enable one to conduct reliable plurilateral and multilateral liberalization scenarios by considering NTBs. In addition, the econometric method might contribute to the literature that tries to meet the challenge in selecting the correct elasticity of substitution for trade policy analysis. It could enable a structural consistent estimation of sector- and region-specific elasticities of substitution that can be incorporated into the CGE database to replace the region-generic parameter. In summary, augmenting the behavioral parameter file with detailed estimated elasticities of substitution and considering detailed AVEs of NTBs in the CGE framework would allow one to perform proposed policy changes ex-ante more precise and reliable.