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Food standards: Modeling regulatory changes in trade impact assessments

Simulations with an extended structuralist computable general equilibrium (CGE) model

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This working paper at a glance

Is the harmonization of different food standards between countries in the context of free trade agreements exclusively positive, or is there a risk of high social costs for consumers? The harmonization of different national regulations plays an important role in contemporary trade policy. In this paper, the costs and benefits of harmonizing food safety regulations between the EU and the USA are estimated, using the ÖFSE Global Trade Model. The results show that the cost savings for companies due to the harmonization of regulatory standards are significantly lower than the associated negative effects on public health. Trade policy impact assessments must therefore take into account the social costs of regulation.

FORSCHUNGS-FÖRDERUNG

Kurztext
Ist die Angleichung unterschiedlicher Lebensmittelstandards zwischen Ländern im Kontext von Freihandelsabkommen ausschließlich positiv zu bewerten, oder besteht hier die Gefahr von Qualitätsverlusten mit hohen sozialen Kosten für die betroffene Bevölkerung? Die Angleichung unterschiedlicher nationaler Regulierungen spielt in der zeitgenössischen Handelspolitik eine wichtige Rolle. In diesem Working Paper werden die Kosten und Nutzen der Angleichung von Lebensmittelsicherheitsvorschriften zwischen der EU und den USA mithilfe des „ÖFSE Global Trade Model“ exemplarisch abgeschätzt. Die Ergebnisse zeigen, dass die Kostenersparnisse für Unternehmen aufgrund der Angleichung regulatorischer Standards deutlich geringer ausfallen als die damit einhergehenden negativen Effekte auf die öffentliche Gesundheit. Die handelspolitische Folgenabschätzung muss daher die gesellschaftlichen Kosten regulatorischer Qualitätsverluste systematisch berücksichtigen.

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Executive Summary

This working paper is part of a research project funded by the Hans Böckler Foundation that seeks to incorporate comprehensive effects of regulations in an economy-wide model for trade impact assessments (the ÖFSE global trade model). Regulations and standards cause trade costs and existing modeling approaches routinely focus on the estimation of potential gains from their removal. The omission of obviously existing economic benefits of regulation severely biases essentially all existing impact assessment models towards generating gains from "deep and comprehensive" free trade agreements (DCFTAs).

The problematic nature of this approach has been at the center of the controversy around Transatlantic Trade and Investment Partnership (TTIP) and the EU-Canada free trade agreement (CETA).

In the pursuit of ever freer global markets, free trade agreements (FTAs) have become an increasingly popular policy instrument. The World Trade Organization (WTO) reports that the number of active bilateral or regional FTAs has increased from around 50 in 1990 to 360 in 2023 (WTO 2024). Likewise, FTAs are at the center of the trade policy agenda of the European Union (EU). However, in contrast to traditional FTAs with their focus on tariff removal, the so-called new generation FTAs put the emphasis on the alignment and removal, respectively, of national regulations, or, in trade parlance, "behind-the-border measures" or "non-tariff barriers" (NTBs).

Thus, there is an increasing interconnection between trade liberalization and national policies and consequent macroeconomic, social and distributional as well as ecological effects. The content of DCFTAs potentially impacts core areas of national public policy, like health and consumer protection, labor standards or environmental regulations. The interlinkages between trade liberalization and regulatory change and their full economic and social effects are, however, not captured by prevailing trade impact assessment approaches.

Therefore, a deeper understanding based upon an alternative methodology is needed, which takes the full range of potential social costs and benefits of regulation into account and equips our macroeconomic model for trade impact assessment to provide a more realistic picture of DCFTA impacts on critical areas of public policy. Only on the basis of such an analysis can informed decisions about the appropriate design of these trade agreements be made.

The methodological challenge now consists precisely in identifying the nature of particular benefits of a regulation and in determining the scale and direction of its economic impact relative to its respective costs. To

narrow the scope, our project focuses on regulations that impact (i) human health and safety, as well as (ii) societal trust.

Based on the conceptual work done in two previous papers on the economic benefits and costs of regulation, as well as on the societal role of trust, along with the literature review on modeling the effects of regulation in economy-wide computable general equilibrium (CGE) models, we develop a simple structuralist CGE-model. This model is designed to capture the costs and benefits of various forms of regulatory alignment between countries.

The paper proceeds along the following lines. First, we provide a literature overview. Standard trade CGE models oversimplify NTBs, focusing on protection effects and struggling to capture their diverse nature. Trade-centered welfare analysis challenges the view of regulations solely as trade barriers but is limited to single-country partial equilibrium models. Yet, some CGE studies explore the economic impacts of climate change and air pollution on human health, offering insights into incorporating regulation costs and benefits into CGE models.

Second, we propose an approach to integrate the costs and benefits of NTBs in the ÖFSE model. This includes border costs and labor productivity changes linked to regulatory compliance on the cost side. On the benefit side, we account for consumption shifts from health expenditures, labor productivity changes from illnesses and mortality, as well as—new and complementary—the impact of changes in generalized trust on investment.

Third, we show how to connect these items to specific variables (or associated parameters) in the ÖFSE model and estimate magnitudes of shocks for the case of changes in food safety regulations. And, finally and fourth, we simulate the model on the basis of carefully crafted scenarios that reflect possible outcomes of cross-border regulatory liberalization negotiations in a DCFTA.

Clearly, results depend on the magnitude of implemented shocks and the specific structure of various scenarios. However, across all scenarios, simulation results highlight that it is highly plausible that at least one country faces adverse consequences from regulatory adjustments.

The novel inclusion of trust in domestically legitimated regulation as a positive and causal factor in economic activity requires further work and critical scrutiny. We emphasize that our overall conclusion—that benefits of regulations tend to clearly exceed their costs, and that cross-border deregulation in DCFTAs carries significant economic risk—does not depend on the inclusion of trust.

Corroborated by sensitivity analysis, our robust bottom line is that deregulation across borders within a DCFTA can lead to losses of benefits associated with regulation that plausibly dominate any corresponding reduction in (trade) costs. Thus, our findings indicate that the far and wide reach of DCFTAs into national regulatory systems deserves further scrutiny.

Zusammenfassung

Dieses Arbeitspapier ist Teil eines von der Hans-Böckler-Stiftung geförderten Forschungsprojekts, das darauf abzielt, umfassende Auswirkungen von Regulierungen in ein makroökonomisches Modell für Handelsfolgenabschätzungen einzubeziehen (das ÖFSE Global Trade Model). Regulierungen und Standards verursachen Handelskosten, und bestehende Modellierungsansätze konzentrieren sich routinemäßig auf die Abschätzung potenzieller Gewinne aus deren Beseitigung. Die Nichtberücksichtigung der offensichtlich vorhandenen wirtschaftlichen Vorteile von Regulierungen führt dazu, dass praktisch alle bestehenden Modelle zur Folgenabschätzung auf die Erzielung von Gewinnen aus „tiefgreifenden und umfassenden" Freihandelsabkommen (DCFTAs) ausgerichtet sind.

Die Problematik dieses Ansatzes stand im Mittelpunkt der Kontroverse um die Transatlantische Handels- und Investitionspartnerschaft (TTIP) und das Freihandelsabkommen zwischen der EU und Kanada (CETA).

Im Streben nach immer freieren globalen Märkten sind Freihandelsabkommen (FTAs) zu einem immer beliebteren politischen Instrument geworden. Die Welthandelsorganisation (WTO) berichtet, dass die Zahl der aktiven bilateralen oder regionalen Freihandelsabkommen von etwa 50 im Jahr 1990 auf 360 im Jahr 2023 gestiegen ist (WTO 2024). Auch auf der handelspolitischen Agenda der EU stehen Freihandelsabkommen im Mittelpunkt.

Im Gegensatz zu den traditionellen Freihandelsabkommen, die sich auf die Beseitigung von Zöllen konzentrieren, legen die Freihandelsabkommen der so genannten neuen Generation den Schwerpunkt auf die Angleichung bzw. Beseitigung nationaler Vorschriften oder, wie es im Handelsjargon heißt, „Maßnahmen hinter der Grenze" oder „nichttarifäre Handelshemmnisse" (NTBs).

Es besteht also eine zunehmende Verbindung zwischen der Handelsliberalisierung und der nationalen Politik und den daraus resultierenden makroökonomischen, sozialen und verteilungspolitischen sowie ökologischen Auswirkungen. Der Inhalt von DCFTAs wirkt sich potenziell auf Kernbereiche der nationalen Politik aus, wie Gesundheits- und Verbraucherschutz, Arbeitsstandards oder Umweltvorschriften. Die Verflechtungen zwischen Handelsliberalisierung und regulatorischem Wandel sowie deren umfassende wirtschaftliche und soziale Auswirkungen werden jedoch von den vorherrschenden Ansätzen der Handelsfolgenabschätzung nicht erfasst.

Daher ist ein tieferes Verständnis auf der Grundlage einer alternativen Methodik erforderlich, die das gesamte Spektrum potenzieller sozialer

Kosten und Vorteile von Regulierung berücksichtigt und unser makroökonomisches Modell für die Handelsfolgenabschätzung in die Lage versetzt, ein realistischeres Bild der Auswirkungen des DCFTA auf kritische Bereiche der öffentlichen Politik zu vermitteln. Nur auf der Grundlage einer solchen Analyse können fundierte Entscheidungen über die angemessene Gestaltung dieser Handelsabkommen getroffen werden.

Die methodische Herausforderung besteht nun genau darin, die besonderen Vorteile einer Regulierung zu ermitteln und das Ausmaß und die Richtung ihrer wirtschaftlichen Auswirkungen im Verhältnis zu ihren jeweiligen Kosten zu bestimmen. Um den Anwendungsbereich einzugrenzen, konzentriert sich unser Projekt auf Regelungen, die (i) die menschliche Gesundheit und Sicherheit sowie (ii) das gesellschaftliche Vertrauen beeinflussen.

Auf der Grundlage der konzeptionellen Arbeit, die in zwei früheren Papieren zu den wirtschaftlichen Vorteilen und Kosten der Regulierung sowie zur gesellschaftlichen Rolle des Vertrauens geleistet wurde, und auf Basis einer Literaturübersicht über den Stand der Modellierung der Auswirkungen von Regulierung in gesamtwirtschaftlichen CGE-Modellen (CGE: computable general equilibrium) entwickeln wir in diesem Arbeitspapier ein einfaches strukturalistisches CGE-Modell. Mit diesem modellieren wir in Folge die Kosten und Vorteile verschiedener Formen der Angleichung der Rechtsvorschriften zwischen Ländern.

Das Papier geht dabei wie folgt vor. Zunächst wird ein Überblick über die Literatur gegeben. Standard-CGE-Modelle für den Handel vereinfachen NTBs zu stark, indem sie sich auf die handelshemmende Wirkung unterschiedlicher regulatorischer Standards konzentrieren und deren vielfältige Natur nicht adäquat erfassen. Die handelszentrierte Wohlfahrtsanalyse stellt die Betrachtung von Regulierungen ausschließlich als Handelshemmnisse zwar in Frage, beschränkt sich jedoch auf partielle Ein-Länder-Gleichgewichtsmodelle. Einige CGE-Studien untersuchen die wirtschaftlichen Auswirkungen des Klimawandels und der Luftverschmutzung auf die menschliche Gesundheit, was nützliche Einblicke in die Einbeziehung von Regulierungskosten und -nutzen in CGE-Modelle bietet.

Zweitens schlagen wir einen Ansatz vor, um die Kosten und Vorteile von nichttarifären Handelshemmnissen in das ÖFSE-Modell zu integrieren. Dies fokussiert auf die Regulierungskosten an der Grenze und auf Veränderungen der Arbeitsproduktivität, die mit der Einhaltung von Vorschriften auf der Kostenseite verbunden sind. Auf der Nutzenseite berücksichtigen wir Konsumverschiebungen aufgrund von Gesundheitsausgaben, Veränderungen der Arbeitsproduktivität aufgrund von Krankheiten und Sterblichkeit sowie – neu und ergänzend – die Auswirkungen von Veränderungen des allgemeinen Vertrauens auf Investitionen.

Drittens begründen wir, wie diese Elemente mit spezifischen Variablen (oder zugehörigen Parametern) im ÖFSE-Modell verbunden werden können, und schätzen die Größenordnungen der Schocks für den Fall von Änderungen der Lebensmittelsicherheitsvorschriften. Und schließlich und viertens simulieren wir das Modell auf der Grundlage sorgfältig ausgearbeiteter Szenarien, die mögliche Ergebnisse von Verhandlungen über die grenzüberschreitende Liberalisierung von Vorschriften in einem DCFTA widerspiegeln.

Die Ergebnisse hängen natürlich von der Größenordnung der implementierten Schocks und der spezifischen Struktur der verschiedenen Szenarien ab. Die Simulationsergebnisse zeigen jedoch für alle Szenarien, dass es höchst plausibel ist, dass mindestens ein Land mit negativen Folgen aufgrund handelsinduzierter regulatorischer Anpassungen konfrontiert wird.

Die innovative Berücksichtigung von Vertrauen als positiver und kausaler Faktor für nationale Wirtschaftstätigkeit erfordert weiterführende und kritische Forschung. Wir betonen jedoch, dass unsere allgemeine Schlussfolgerung - dass der Nutzen von Regulierungen ihre Kosten tendenziell deutlich übersteigt und dass die grenzüberschreitende Deregulierung in DCFTAs ein erhebliches wirtschaftliches Risiko birgt - nicht von der Einbeziehung von Vertrauen abhängt.

Bestätigt durch Sensitivitätsanalysen lautet unser robustes Fazit, dass die grenzüberschreitende Deregulierung innerhalb eines DCFTA zu Verlusten bei den mit der Regulierung verbundenen sozialen Vorteilen führen kann, die plausiblerweise jede entsprechende Reduzierung der (Handels-)Kosten überwiegen. Unsere Ergebnisse deuten also darauf hin, dass regulatorische Angleichung im Kontext von (bilateralen) Freihandelsabkommen nicht automatisch soziale Vorteile mit sich bringt, sondern jeweils einer genauen Untersuchung bedürfen.

1 Introduction

Non-tariff barriers (NTBs) are policy instruments distinct from import tariffs that can affect import quantities or prices, or both. As import tariffs have come under greater discipline since the early 1990s, NTBs are at the heart of negotiations on deep and comprehensive free trade agreements (DCFTAs) since the late 2000s.

These policies encompass a broad range of technical and non-technical measures applied to both imports and exports, such as standards, fees, quotas, voluntary export restraints, licenses, subsidies, competition measures, rules of origin, intellectual property regulations, among others (UNCTAD 2012).

However, regulatory impacts on trade have been defined more comprehensively including "border measures (customs procedures, etc.) as well as behind-the-border measures flowing from domestic laws, regulations and practices. […] In other words, non-tariff barriers and regulatory divergence are restrictions to trade in goods, services and investment at the federal or (member) state level." (Berden et al. 2009: xiii)

NTBs are indeed commonly concomitants of national regulations. These underlying regulations and standards are not generally targeted to affect trade, but have other policy objectives, such as consumer safety and health or environmental protection and are "a way of bringing the outcomes of a decentralized market economy more closely into line with social objectives that may not otherwise be achieved" (Maur/Shepherd 2011: 198).

Regulations, therefore, provide societal benefits that typically exceed the costs of compliance, an aspect frequently assessed in monetary terms using cost-benefit analysis (CBA).

Moreover, regulations and standards are linked to the issue of trust.[1] Theoretical research and empirical evidence suggest that generalized trust and enforcement mechanisms can complement each other over time and facilitate cooperation for the sake of economic growth as well as other socially desirable activities. Importantly, it can be argued that generalized trust is easier to maintain in organically "homegrown" and democratically legitimated systems of enforcement that tend to be superior to externally imposed structures.

While social objectives of regulations are "acknowledged in passing" in the literature on NTBs in standard trade CGE models, they are "not given

1 Standard CBA approaches and the linkages between trust, regulation and trade are assessed in two working papers as part of this project (see von Arnim / Tröster / Raza 2024 and Tröster / von Arnim / Raza 2024).

full due in quantitative analyses of NTB reductions. Where consumers (a.k.a. voters) in the United States and the EU place different values on such objectives, we need to be careful not to assume that identified barriers are not offset by benefits" (Berden/Francois 2015: 3). However, the methodologies applied in trade policy impact assessments focus only on the protection effects of NTBs and disregard the compliance cost for companies and the social benefits they provide (Fugazza/Maur 2008).[2]

In summary, adjustments to national regulations due to free trade agreements can impact trade costs, but can simultaneously influence benefits, compliance costs, and generalized trust. A priori, the net effects of these adjustments remain uncertain. The present study seeks to make first steps towards a more comprehensive and balanced approach in the modeling of costs as well as benefits of NTBs in trade impact assessments.

Using a three country-three sector version of the ÖFSE trade model, a structuralist computable general equilibrium (CGE) model, we illustrate in carefully designed scenarios that deregulation across borders within a DCFTA can lead to losses of benefits associated with regulation that plausibly dominate any corresponding reduction in (trade) costs. Thus, our findings indicate that the far and wide reach of DCFTAs into national regulatory systems deserves further scrutiny.

The paper proceeds as follows. The following Chapter 2 presents an overview on three important strands in the literature on NTBs, which demonstrates the overall scarcity of trade impact assessments that incorporate benefits from regulations in a comprehensive manner. In Chapter 3, we provide a summary of the ŐFSE Global Trade Model. This is a structuralist CGE model, which does not rely on unrealistic neoclassical closures.

Chapter 4 explains our general approach to simulating costs and benefits of deregulation under DCFTAs in this framework. Two aspects are critical here. First, we discuss how to categorize the costs and benefits of regulation in general, and how these can be captured in a simulation exercise. Second, we detail modes of cross-border regulatory adjustment. The various forms such regulatory liberalization can take are critically important for careful scenario design.

Chapter 5 defines a set of specific scenarios and presents simulation results, based on a three country-three sector version of the ŐFSE model. Additionally, we present sensitivity analyses. Chapter 6 offers our conclusions.

2 See Tröster et al. (2023) for the consideration of compliance cost in the case of the proposed EU-Tunisia free trade agreement.

2 Literature review

First, we examine the methodologies presently employed in standard trade CGE models to address NTBs and discuss associated limitations. Second, alternative approaches to analyze the comprehensive effects of NTBs in partial equilibrium models are introduced. Finally, we discuss CGE models that show the economic and welfare impacts resulting from changes in health outcomes caused for instance due to air pollution and related regulations.

In summary, standard trade CGE models commonly employ simplistic mechanisms to address NTBs, primarily focusing on protection effects, and struggle to comprehensively incorporate the diverse nature of NTBs. The trade-focused welfare analysis on the cost and benefits of NTBs challenges the perception of regulations solely as impediments to trade. Nonetheless, this approach is limited to single-country partial equilibrium models and standard welfare analysis.

Selected CGE applications assess economic implications of climate change and air pollution on human health, presenting potential strategies for integrating the costs and benefits of regulations into CGE models.

2.1 Non-tariff barriers in standard computable general equilibrium models for trade

Modelling changes to regulations related to trade policies in CGE models, which are fundamentally based on observable prices and quantities, poses a general challenge. This is because regulations induce economic choices not through price changes, but directly mandate the behavior of different actors (Burfisher 2016; Fugazza/Maur 2008).

Fugazza and Maur (2008) identify three economic effects of NTBs: cost-raising protection effects at the border, supply shifting effects due to regulations such as production process standards tackling externalities and demand shifting effects to address market failures, for instance due to labelling requirements.

Despite the growing importance of NTBs over the last decades and the diverse set of regulations with different objectives and impact channels, the mechanisms used in standard trade CGE models, such as the model by the Global Trade Analysis Project (GTAP), to address NTBs have been deemed “relatively simple to date” and predominantly focused on protection effects (Walmsley/Strutt 2021: 2).

The three major approaches, which were introduced already in the early 2000 (see for instance Andriamananjara/Ferrantino/Tsigas 2005), are export taxes, import tariffs (taxes) and trade efficiency, alternatively labeled iceberg trade costs (Burfisher 2016; Walmsley/Strutt 2021). Only recently have alternative methods emerged based on exporters' costs and consumers' willing to pay measures (ibid.).

The modelling of NTBs in standard CGE models relies on econometric estimations of ad valorem equivalents (AVEs), presuming these estimations mirror the same effects on prices and quantities as the existence of regulations (Burfisher 2016). AVEs can be derived from analyzing price wedges between import prices and world prices (Cadot et al. 2015; Dean et al. 2009). However, this approach is often constraint by the availability of the necessary information.

More commonly, the quantity effects of regulations are estimated with trade data through gravity models. These results are then converted to AVEs using estimated import demand elasticities (Ghodsi/Grübler/Stehrer 2016). Gravity model outcomes at aggregated or sectoral levels typically reveal positive AVE values, indicating trade-restrictive effects. Nevertheless, recent estimations at the product level have identified trade-enhancing effects of NTBs, particularly concerning the quality of traded goods (Beghin/Disdier/Marette 2015; Fell/Duver 2023; Ghodsi/Stehrer 2022).

The first two "tax mechanisms" can directly incorporate AVE estimations and integrate them into well-established modelling approaches to export taxes and import tariffs. The underlying concept is that regulations curtail trade volumes, thereby generating economic rents for domestic producers and exporters. The scarcity of imports opens up the opportunity for domestic producers through imperfect competition to benefit from higher domestic prices compared to world market prices.

In addition, exporters could benefit from higher prices in the specific export market. It is crucial to recognize that these rents should flow to domestic producers and exporters rather than as tax revenues to the government, necessitating inclusion in the modeling approach (Fugazza/Maur 2008).

However, most standard CGE models rely on a regional household instead of explicitly modelling the government, leading to a simple reinterpretation of welfare changes (Burfisher 2016; Walmsley/Strutt 2019). In this context, rents are also loosely equated with compliance costs for exports or incomes of certification agencies, lacking specific modelling of these incomes or costs.

The third mechanism is the iceberg trade costs approach, wherein AVEs are attributed to the efficiency losses due to the NTBs, described by Andriamananjara/Ferrantino/Tsigas (2005) as "sand in the wheels."

Following Samuelson's (1954) analogy, cross-border shipments "melt" away during transit, causing importers to receive less of a good at world market prices compared to what the exporter sent. The iceberg method simply represents a technical change in quantities as NTB adjustments can mitigate the quantity lost during trade.

This generates two opposing effects: Fewer imports are needed to satisfy the same demand, yet the lower "effective import price" stimulates demand for imports. The demand-driving effect multiplied with trade elasticities greater than one and therefore exceeds the demand-reducing effect (Burfisher 2016; Walmsley/Strutt 2021). From a modelling perspective, the trade efficiency effect is treated as a productivity shock equivalent to a technical change. Thus, addressing regulatory changes through iceberg costs yields efficiency gains for the importer at no cost. Specifically, iceberg costs do not create income flows.

The three NTB mechanisms exhibit distinct macroeconomic effects in standard trade CGE models, despite their common tendency to demonstrate favorable outcomes arising from trade liberalization. Productivity improvements in the iceberg method directly increase the quantity of products that can be produced or consumed at the same level of resources. In contrast, a decrease in rents (taxes) merely improves the allocation of resources, thereby increasing the efficiency with which resources are used (ibid.).

The assumption of iceberg costs leads to significantly larger impacts on real GDP compared to the tax mechanism. Additionally, welfare effects are generally higher with the iceberg method, which largely occur to the NTB adjusting importing countries due to the productivity gains. But also the exporting countries benefit from terms of trade improvements (Burfisher 2016; Walmsley/Strutt 2021).

It is generally recommended to employ a combination of various methods to capture more accurately the diverse nature of NTBs (Burfisher 2016). However, iceberg cost results dominate the overall outcomes also in a scenario with mixed approaches (see Raza et al. 2014 on TTIP impact assessments)

As a whole, the toolkit available for standard trade CGE models is relatively limited in effectively addressing the impacts of NTBs. The predominant methods commonly employed are limited to trade protection effects of NTBs, which concern only select regulations and standards.

Moreover, modelling of NTB effects through the "tax/rent" mechanism fails to capture the diverse effects of regulations beyond rent generation, and many standard CGE models application lack a detailed treatment of such rents. The trade efficiency approach, utilizing iceberg costs and technical changes to quantities, has faced criticism as the melting quantity concept restricts the applicability to the majority of NTBs and for the problematic modelling of trade flows through “effective” import prices and quantities (Fugazza/Maur 2008; Walmsley/Strutt 2019). Despite these limitations, the iceberg method is commonly applied for all types of NTBs.

Walmsley/Strutt (2021) proposed NTB methods for CGE models that take into account supply and demand shift effects of regulations and standards methods. An export cost approach incorporates the iceberg cost concept on the exporter side and a willingness-to-pay approach includes demand effects on the consumer side.

While these suggestions could advance methodologies for handling NTBs in standard CGE trade models, they still fall short in addressing various aspects related to the costs and benefits of NTBs.

2.2 Welfare costs and benefits of regulations

A group of scholars has delved into the costs and benefits of NTBs within trade-focused welfare analysis (Beghin et al. 2012; Von Tongeren/Beghin/Marette 2009). This research expands beyond the conventional understanding that regards regulations merely as impediments to trade, a notion traced back to Otsuki/Wilson/Sewadeh (2001).

The foundation of the cost-benefit perspective lies in the acknowledgement that regulations and standards are the essential tools for correcting market failures such as information asymmetries, negative externalities or monopoly power (WTO 2012). Furthermore, specific regulations can serve as catalysts, facilitating trade rather than constituting impediments, particularly within the context of agricultural goods trade (Maertens/Swinnen 2009; Santeramo/Lamonaca 2019; Xiong/Beghin 2014).

The cost-benefit approaches assert that the consumers’ preferences for standards safeguarding their health and safety affecting demand might outweigh compliance costs to standards. Thus, it is “not clear a priori that the trade impacts of the concerned regulations are informative on allocative efficiency, or that removal of associated NTBs that affect trade would achieve efficiency gains relative to the welfare level under existing regulations” (Beghin et al. 2012: 358).

It is noteworthy that while the authors use the terms costs and benefits, they do not refer to the same variables as in cost-benefit analysis. Instead, their focus is on assessing the impact of NTBs on both supply and demand, emphasizing the need for a nuanced analysis of NTBs.

To address this issue, Von Tongeren/Beghin/Marette (2009) propose a modular approach, in which the comprehensive welfare effects of regulations in supply and demand are analyzed for domestic consumers, domestic producers, domestic government, and foreign producers in a partial equilibrium model. They advocate using a partial equilibrium model for assessing NTBs as it enables a focused examination of markets and sectors impacted by the policy, facilitating a detailed analysis of specific welfare effects on consumers and producers.

Such an approach can be particularly adept at estimating changes in consumer surplus, producer surplus, and government revenue, while also offering insights into nuances of market structure—i.e., market power and market failure—that may be overlooked by a general equilibrium model.

The authors use the willingness to pay of consumers for safe and health products to model changes in the demand curve. Additionally, they consider compliance costs incurred by foreign and domestic producers to assess shifts in the supply curve.

Overall, they derive welfare changes and their distribution among the different actors. As an illustrative example, the framework is applied to the shrimp sector, demonstrating how stricter standards on antibiotic use in production can lead to net welfare benefits (Beghin et al. 2012).

While welfare cost-benefit approaches shed light on the impact of NTBs on trade, production, and consumption, their scope is confined to single-country partial equilibrium models and conventional welfare analysis. This limitation is further exacerbated by their reliance on methods that aim to reveal the preferences of consumers, particularly the willingness to pay (see also Tröster / von Arnim / Raza 2024) on details about willingness to pay).

Beyond the general critique of methods, including concerns about hypothetical bias and self-reporting issues, willingness-to-pay estimations are limited to specific goods or services, with a primary focus on food items. These estimations are closely linked to particular regulations and standards. This severely restricts the broader applicability of this approach to a more comprehensive domain, impeding a holistic understanding of broader economic and societal dynamics.

2.3 Economic effects of health outcomes in computable general equilibrium models

In a third literature strand, the economic valuation of changes to human health and regulatory costs and benefits serve as inputs to CGE models. These applications mainly deal with health impacts for a broader part of the populations for instance from air or water quality.[3]

Studies and guidelines on CBAs and regulatory impact assessments emphasize the importance of assessing the comprehensive social and economy-wide benefits and costs of such regulations beyond the sector-specific perspective (Ragona/Mazzocchi 2008; EPA 2010).

In particular, general equilibrium models are supposed to capture economy-wide effects of regulations on key macroeconomic variables such as GDP and value added as well as distributional consequences of regulation by identifying winners and losers in terms of production and income distribution.

Furthermore, feedback effects of regulations and related market adjustments become more nuanced when regulations cover several sectors or target sectors with multiple linkages to other sectors in an economy. Marten/Garbaccio/Wolverton (2019) notes that engineering or partial equilibrium cost estimates as part of CBAs likely underestimate the social cost of single-sector environmental regulations, and using these estimates to approximate social costs could result in a downward bias, a consideration that holds true for assessing the comprehensive benefits of regulations.

An early example linking changes in health endpoint to macroeconomic and welfare variables in CGE is found in Bosello/Roson/Tol (2006). They explore the economic implications of climate change on human health, specifically examining alterations in the prevalence of specific illnesses like malaria. The study interprets changes in morbidity and mortality rates as changes in labor productivity and demand for healthcare. The effects are simulated in a standard GTAP-E CGE model and result in economic and welfare losses.

Several articles delve into the economy-wide impacts of air pollution. Matus et al. (2012, 2008) and Nam et al. (2010), apply the MIT EPPA-HE model to assess the economic impact of health effects from air pollution in the United States, China and Europe, respectively. This CGE model

3 Golan et al. (2010) provide an assessment of the economy-wide effects of the costs and benefits of the Hazard Analysis and Critical Control Point (HACCP) regulatory program for meat and poultry in the United States in a multiplier SAM model (SAM: serviceable addressable market). The authors find that with economy-wide benefits significantly exceed the CBA benefits.

values lost labor and leisure by assessing changes in time endowments due to increased illness cases and deaths. It incorporates higher demand in the health services sector, necessitating additional labor, to calculate the overall economic impact in terms of both economic and welfare considerations.

For the European economy, Nam et al. (2010) report an annual 2.8 percent to 4.7 percent loss of historical consumption levels due to air pollution between 1970 and 2005. Similar applications with simpler scenario designs and models were conducted for air pollution effects in China (Nam et al. 2019; Wang et al. 2016; Wu et al. 2017).

CGE applications were also conducted to assess the economic effects of regulations aimed at reducing air pollution and improving associated health outcomes. Notably, these applications explicitly incorporate inputs from CBA.

For the EU case, Vrontisi et al. (2016) consider direct benefits of reduced healthcare costs of treating air pollution associated sickness and the increased availability of labor time ensuing from less workdays lost, which increases the labor input in the production function. Costs are included as abatement costs to production and abatement expenditures of private households, which at the same time create demand for goods produced by the sectors providing environmental technologies. Overall, they find these benefits from avoided sickness due to EU clean air policy offset the resource costs associated to this policy and result in positive macroeconomic impacts for the economy of the EU.

Similarly, the Environmental Protection Agency (EPA) uses an inhouse CGE model (EMPAX-CGE) model to supplement the CBA on the Clean Air Act Amendments EPA 2011: Chapter 8). On the benefit side, changes in the medical expenditures associated with pollution-related illness and in workers' time endowment due to pollution-related mortality and morbidity are incorporated into the model, representing changes in the labor force due to stricter air pollution regulations.

The major channels of benefit effects are changes in the labor force and changes in consumption patterns, which both contribute to welfare enhancements. On the cost side, the expenditures for companies and households assessed in the related CBA are included as direct cost components in the production function or as price changes for households. Overall, the macroeconomic benefit effects are found to more than offset the expenditure effects.

In general, the ratio of economic benefits to costs reported in CGE applications is significantly smaller than in the underlying CBA. The large cost-benefit ratios stated in the CBA are mainly driven by the estimates of "value of a statistical life" (VSL), reflecting the trade-off between mortality risk and wealth in monetary terms. These estimates are not considered in macroeconomic CGE modeling exercises. Moreover, other CBA benefit methodologies such as WTP are commonly not included.

Instead, lost household income is commonly used to estimate the impact of air pollution-related deaths similar to the more conservative cost of illness (COI) approach (see also WP for more details on CBA methodologies). In more recent papers the possibilities to integrate VSL estimates into CGE model applications are discussed, in particular around the EPA CGE models SAGE (Carbone et al. 2022; Marten/Garbaccio/Wolverton 2019; Marten/Newbold 2017; Marten/Schreiber/Wolverton 2021). However, these approaches require a specific intergenerational model to capture the impact of behavioral changes due risk reductions on macroeconomic variables.

Overall, the outlined examples of CGE applications, translating changes in health outcomes into economic and welfare impacts, employ standard modelling structures with neoclassical assumptions of profit-maximizing firms and utility-maximizing households, along with welfare calculations.

The connection between health outcomes to labor productivity and health expenditures provide interesting approaches to integrate costs and benefits of regulations into CGE models. However, these applications are constrained to single economies without addressing trade issues and are primarily focused on air pollution and health outcomes, leveraging data that is widely accessible.

3 The ÖFSE global trade model

This chapter presents an overview of the applied ÖFSE global trade model.[4] The model is a structuralist computable general equilibrium (CGE) model.[5] The major difference between this model and standard CGE models is the macroeconomic causality applied.[6] In the ÖFSE model, output and income are determined by aggregate demand rather than through a neoclassical clearing labor market. In other words, the underlying macroeconomic model is that of an income-expenditure framework rather than a full-employment model (Raza et al. 2016).

In essence, a multi-sectoral income-expenditure framework determines equilibrium in the goods market, and employment levels follow therefrom, given labor productivity changes. Wages, in turn, are functions of labor market tightness, and prices are mark-ups on intermediate, import and labor costs. In this sense, macroeconomic causality conforms to a demand-supply structure in which (i) demand determines output, output drives employment and (ii) wages and prices are the outcome of bargaining in a non-clearing labor market.

In the following paragraphs, we discuss model structure and principal causal linkages. Table 1 lists the key model equations. To begin, we introduce notational issues; these can then be compared to equations in Table 1. First, model description requires indexation.

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4 The chapter draws on Raza et al. (2016) and Tröster et al. (2023).

5 Economy-wide policy models arose decades ago for the purpose of development planning (Chenery/Uzawa 1958). The early modeling literature built on Keynesian foundations in Leontief economies. Later trade impact assessment models took a neoclassical turn, with a focus on full employment closures and price-clearing markets. For critical discussions, see Rattsø (1982) and Taylor/Lysy (1979). For a renewed critique of neoclassical CGEs, see Von Arnim/Taylor (2007) and Raza et al. (2014). We are using the standard label "CGE," though this can be considered a misnomer, given the macroeconomic nature of the underlying accounts, and the Keynesian closures applied. Further, the model builds on structuralist traditions, even though in the present application sectors and countries are treated uniformly. We refrain from a survey regarding origin and genesis of these models and the applicable labels; see Robinson (2006) and Taylor (2016) for discussion and references.

6 Economy-wide policy models arose decades ago for the purpose of development planning (Chenery/Uzawa 1958). The early modeling literature built on Keynesian foundations in Leontief economies. Later trade impact assessment models took a neoclassical turn, with a focus on full employment closures and price-clearing markets. For critical discussions, see Rattsø (1982) and Taylor/Lysy (1979). For a renewed critique of neoclassical CGEs, see Von Arnim/Taylor (2007) and Raza et al. (2014). We are using the standard label "CGE," though this can be considered a misnomer, given the macroeconomic nature of the underlying accounts, and the Keynesian closures applied. Further, the model builds on structuralist traditions, even though in the present application sectors and countries are treated uniformly. We refrain from a survey regarding origin and genesis of these models and the applicable labels; see Robinson (2006) and Taylor (2016) for discussion and references.

Table 1: Equations for the ÖFSE global trade model

$P_{kj}^{x} = \sum_{i=1}^{n} a_{kij}P_{kj}^{x} + P_{kj}^{y}\frac{Y_{kj}}{X_{kj}} + t_{kj}^{x}P_{kj}^{x} + \sum_{q=1}^{c} (1 + t_{kqj}^{m} + \mu_{kqj})e_{kq}P_{qj}^{x}\frac{M_{kqj}}{X_{kj}}$	Output price	(1)
$P_{kj}^{y} = (1 + \tau_{kj})\frac{w_{kj}}{\xi_{kj}}$	Value-added price	(2)
$r_{kj} = \frac{\tau_{kj}}{1+\tau_{kj}}\frac{P_{kj}^{y}Y_{kj}}{P_{kj}^{x}K_{kj}}$	Profit rate	(3)
$w_{kjs} = f_{kjs}^{w}\left(L_{kjs}, \xi_{kjs}, P_{k}^{c}, -\frac{Mj_{kj}}{X_{kj}}\right)$	Nominal wage	(4)
$\tau_{kj} = f_{kj}^{\tau}\left(\frac{w_{kj}}{\xi_{kj}}\right)$	Mark-up rate	(5)
$\xi_{kj} = f_{kj}^{\xi}(Y_{kj})$	Labor productivity	(6)
$X_{ki} = \sum_{j=1}^{n} a_{kij}X_{kj} + C_{ki} + G_{ki} + I_{ki} + E_{ki}$	Output	(7)
$Y_{kj} = X_{kj} - \sum_{i=1}^{n} a_{kij}X_{kj} - t_{kj}^{x}X_{kj} - \sum_{q=1}^{c} (1 + t_{qj}^{m})M_{kqj}$	Value added	(8)
$GDP_{k} = C_{k} + G_{k} + I_{k} + E_{k} - M_{k} = \sum_{j=1}^{n} (Y_{kj} + T_{kj})$	GDP	(9)
$C_{ki} = b_{ki} + \frac{c_{ki}}{P_{ki}^{x}}\left((1 - s_{k} - t_{k}^{y})P_{k}^{Y}Y_{k} - \sum_{j=1}^{n} b_{kj}P_{kj}^{x}\right)$	Consumption	(10)
$s_{k} = \frac{s_{lk}w_{lk}L_{lk}+s_{hk}w_{hk}L_{hk}+s_{rk}R_{k}P_{k}^{I}K_{k}}{P_{k}^{Y}Y_{k}}$	Savings rate	(11)
$M_{kqj} = f_{kqj}^{M}\left(-\frac{(1+t_{kqj}^{m}+\mu_{kqj})e_{kq}P_{qj}^{x}}{P_{kj}^{x}}, Y_{kj}\right)$	Imports	(12)
$L_{kjs} = ł_{kjs}\frac{Y_{kj}}{\xi_{kj}}$	Employment	(13)
$B_{k}^{g} = P_{k}^{G}G_{k} - \mathrm{T}$	Public balance	(14)
$B_{k}^{p} = P_{k}^{I}I_{k} - s_{k}P_{k}^{Y}Y_{k}$	Private balance	(15)
$B_{k}^{f} = P_{k}^{E}E_{k} - P_{k}^{M}M_{k}$	Foreign balance	(16)

Source: Own elaboration

We define c as the number of countries or regions, indexed *k,q,* and n as the number of sectors, indexed *i,j*. For example, M_{kqj} are real imports of sector *j* product from country q into country *k*.

Second, constant elasticity functions are defined as $x=f^x(y,-z)$, so that *x* is a positive (negative) function of *y (z)* with constant elasticities.

Third, Table 1 abstracts from a host of quantity and price indexes, which nevertheless and obviously matter for the solution of the model. We do not work with CES aggregates, as is standard in neoclassical CGE applications. Instead, we specify country-level and global real aggregates as value aggregates deflated by the corresponding price index. The corresponding price index, in turn, is calculated as Fisher price indexes.[7]

Next, we can work our way through Table 1. P_{kj}^x is the supply price of output *X* in country *k* in sector *j*. This price is a linear function of expenditures on intermediate inputs, factors of production, trade cost margins and imports. P^y is the corresponding sectoral price of a unit of value added, which is defined as a mark-up on nominal unit labor cost. The latter is the ratio of nominal wage w to average labor productivity ξ. *r* is the profit rate.

The nominal wage in country *k* and sector *j* of skill level *s* is w_{kjs} and is a constant elasticity function of an index of employment L, labor productivity, the consumer price index P^c as well as the sectoral import share. The mark-up rate τ is a constant elasticity function of nominal unit labor costs.

Sectoral real output *X* is determined in a standard Leontief system. Real imports of sectoral product *i* in country *k* are aggregated across partner countries *q*. Real value-added *Y* is proportional to *X*. Real consumption *C* is determined in a standard linear expenditure system with "floor" consumption levels *b* and depends on the relative price of the sectoral output.

The aggregate savings rate in country k is s_k; it varies with the differential savings rates across income types (low-skill wages, high-skill wages and profit income, respectively). Real imports are constant elasticity functions of the appropriate relative price, which includes the adjustment for tariff and NTB margins. Aggregate labor demand *L* is determined by the interaction of aggregate demand and labor productivity; the sectoral skill composition is fixed.

Public, private and foreign balances are defined in nominal terms and as injections minus leakages. The public balance B^g is the difference between government expenditures and revenues; the private balance B^p is

7 A Fisher index is defined as the square root of the product of the price index with base-year quantity weights (Laspeyres) and the price index with current-year quantity weights (Paasche).

the difference between investment and (private) savings; and the foreign balance B^f is the difference between exports and imports.

On the basis of this overview, we can now discuss key causal linkages of the model. First, and most importantly, output and income are determined by aggregate demand. Standard CGE models assume full employment, and thus situate determination of the level of output in the labor market. Here, in sharp contrast, investment into productive capacity generates income, which in turn generates increased savings (which can be from profits as well as wages).

Income generation from the initial expenditure expansion occurs through a multiplier process. Outlays are financed by an accommodative financial system —which is not modeled— and the savings generated will adjust to the new macroeconomic equilibrium. In other words, the balance between real investment and total savings is brought about by income changes.

The production technology is assumed to feature fixed proportions with underutilized resources. Installed capital equipment features excess capacities, as firms retain capacity margins to respond to variations in demand and to deter entry of competitors.

The labor market features involuntary unemployment, as workers are idle not due to a presumed optimal trade-off of work and leisure at the offered real wages, but due to a lack of employment opportunities. The implicit assumption is that the economy is not supply constrained, but demand constrained: If demand increases, the installed capital stock would be utilized at a higher rate, and labor demand would increase.

Labor productivity increases with demand. First, higher demand allows for improvements of the production process and learning-by-doing, or what is commonly labeled Kaldor-Verdoorn Law. Second, labor productivity rises with demand since firms retain workers (and especially managers) to avoid high turnover and associated costs. This effect is of course labeled Okun's Law.[8]

Aggregate labor demand is determined by the interplay of aggregate demand and aggregate productivity growth. Put simply, job creation depends on the strength of demand relative to the strength of productivity

8 The Kaldor-Verdoorn Law and Okun's Law are not the same thing. Crucially, Kaldor-Verdoorn effects are generally seen to arise over a longer time horizon, whereas Okun's Law specifically addresses the linkages between output, employment and productivity at business cycle frequency. We assume here, drawing on this broad yet distinct literature, a positive link from level of value added to the level of labor productivity. See Kaldor (1966), Okun (1962) and Verdoorn (1949) for original discussions, and Blecker/Setterfield (2019) and Foley/Michl/Tavani (2019) for textbook treatments. The Keynesian employment closure with elastic labor supply is presented in (op. cit.: Chapter 4); see also Storm/Naastepad (2012).

increases, which change the labor requirements implicit in the production technology. The implicit assumption is that labor supply is elastic.

Product markets are imperfectly competitive, and output prices are mark-ups on nominal unit labor costs. Products, in turn, are imperfect substitutes. Thus, firm's pricing power derives from the fact that their products are differentiated.

Put differently, firms have a degree of price-setting power, rather than being simply price takers: The existence of excess capacity implies that firms do respond to rising demand with rising production. They do so, however, at prices that reflect their evolving cost structure.

The distribution of factor income is modeled as the outcome of a social bargaining process. In neoclassical theory, the production technology and profit maximization together imply that the firm employs factors such that their "rental rates" are equal to their marginal productivities. Such mechanisms do not apply here since the economy is not at the efficient frontier.

In sharp contrast, we model the factor distribution of income as the outcome of social conflict: Workers bargain for nominal wages, and firms in imperfectly competitive markets set prices. The relevant parameterizations—informed by empirical evidence—then describe how real (product) wages respond to changes in employment rates and demand conditions.

The labor share of income, in turn, is of course the ratio of the real wage to labor productivity. The labor share of income thus changes in accordance with the nominal wage bargain, firm's price setting, and endogenous changes in labor productivity. Importantly, wage functions can be calibrated to reflect differential bargaining strength for different skill types.

Imports and exports are functions of relative prices and demand. Hence, aggregate demand depends in standard fashion on global demand through the export channel. Increases in firm's costs—for example through increases in nominal unit labor costs—are passed on to supply prices, which (ceteris paribus) implies a reduction in external demand as competitiveness is reduced.

Crucially, the trade structure is modelled bilaterally, so that the existing trade linkages across countries (and sectors) are explicitly modelled. Trade costs, driven as well by non-tariff barriers (NTB), enter these bilateral import costs: A reduction in NTB decreases supply prices, which in turn improve competitiveness in the relevant countries vis-à-vis all other countries and regions.

Further, the treatment of NTBs in the OFSE model differs from GTAP and other neoclassical models. As already mentioned in the introduction, the most common approach to include NTBs in CGE studies is as an iceberg cost, and rents from either export or import taxes. NTBs as iceberg costs promise “free gains from trade,” in that they have no income flow counterpart. This is highly unrealistic and not pursued here.

NTBs enter the OFSE model as ad valorem tariff equivalent in the import function and hence the cost decomposition. Our model does not feature a representative agent who is both government and household simultaneously, which implies that tariffs and NTBs need to be clearly distinguished. Tariff revenue is public income and a macroeconomic leakage. In analogy, we assume that NTB rents accrue to households (i.e., firms or, more precisely, their owners) in the form of a macroeconomic leakage (i.e., private savings).

This approach has the clear advantage that the reduction of ad valorem equivalents as either tariff or NTB rates leads to analogous changes in trade balances as well as macroeconomically well-understood quantities (public revenue, or private savings).

We additionally view NTB changes as having direct implications for labor productivity, and therefore simulate NTB removal most commonly as a combination of changes to labor productivity and ad valorem equivalents.

Last but not least, the present study investigates the costs and benefits of regulations in the trade relationships between three countries, each aggregated into three sectors. The three regions are the EU, the United States and the rest of the world (ROW), and we specifically focus on the effects of NTB removal in the EU and United States.

As such, this study does not focus on North-South issues and does not foreground issues of structural heterogeneity. We emphasize that this appears plausible, given the particular focus, but also that the model is well-suited to introduce structuralist facets.

In line with this approach, parameters are calibrated uniformly across countries and sectors. This places the burden of adjustment on model closures and scenario design, rather than additionally differential elasticities. Again, we choose this line of inquiry to simplify and foreground the inclusion of benefits of regulations in trade impact assessments, while we recognize that future research could introduce differential calibration.

4 A balanced approach towards costs and benefits of non-tariff barriers

As discussed in Chapter 2, the literature around standard trade CGE models has no mechanisms to account for the comprehensive costs and benefits of NTBs that are associated with regulations and standards. However, applications of such regulatory costs and benefits in standard CGE models exist and are linked to assessments of these impacts in CBA.

While the CBA method faces criticism for its theoretical foundations and empirical limitations, it challenges conventional assumptions in CGE modeling of trade impact assessments and the perception of regulations solely as trade barriers (see Tröster / von Arnim / Raza 2024).

4.1 Capturing costs and benefits in simulations

To ensure clarity, it is essential to precisely define "costs" and "benefits" within the given context. In our case, costs refer to compliance costs incurred by firms in their production processes, while benefits encompass expenditures on health services and variations in the effects of illness cases and mortality rates.

Both costs and benefits are dynamic and can increase and decrease depending on the specific scenario. In the case of regulatory changes leading to higher benefits, less is spent on health services and there are fewer illness and death cases.

The translation of these costs and benefits to effects on macroeconomic variables is possible as discussed in Chapter 2. In the case of compliance costs, cost estimations can be integrated into CGE models as a change in labor productivity, given that the labor requirements for activities such as quality management adjust with regulatory changes.

In addition, changes in inputs, such as specific parts or certification services can be modeled, as applied to the case of the EU-Tunisia DCFTA in Tröster et al. (2023).

In trade modelling, these cost effects can affect both importing and exporting countries, for instance, when exports need to make specific adjustment to their products to be able to export to a certain country.

On the benefit side, the changes in expenditures for medical services can be expressed as shifts in consumption patterns (see also CGE applications presented in Chapter 2). This concerns the private and public households. A further element on the benefit side are changes in morbidity due to regulatory changes, which lead to changes in work days absent due to illness. Standard CGE models, take this in as adjustments to time available for work and leisure. An alternative are changes in labor productivity.

The most challenging factor on the benefit side is the modelling of mortality. The monetarized benefits in CBA are driven by the VSL estimates, which capture the risk-reducing effects of changes to health and safety regulations. As this measure builds on a trade-off between wealth and health risk, it does not imply an impact on macroeconomic variables.

The alternative is to measure the forgone income due to premature deaths. However, a detailed calculation requires income data and assumptions on the cohorts affected, as the death risks are typically the highest for oldest and youngest members of a society. We use a simple method for now, that uses changes in lost working days.

We also link costs and benefits with the effects on international trade flows. Contrary to the approaches in standard trade CGE models that relate regulatory differences only to trade cost, we see NTB border costs as ad-valorem equivalents and changes in labor productivity are crucial for international trade flows.

Border costs, for instance due to administrative procedures, directly affect relative prices, analogous to a tariff. Labor productivity directly affects nominal unit labor costs, which feed into mark-up prices, which in turn drive sectoral output prices. Hence, lower border costs and higher labor productivity both, ceteris paribus, increase external competitiveness.

Last but not least, we propose in this paper the consideration of generalized trust as a key facet of regulation.[9] An extensive literature on trust extends across several disciplines, including sociology, political science and economics. Endreß (2002) presents a useful survey of sociological perspectives on trust.

The author takes Émile Durkheim and Max Weber, foundational voices in the field, as his starting point, and emphasizes that sociology as a discipline emerges as processes of change in society and economy accelerate.

These processes move in the direction of increasing complexity, which in turn necessitates layers of mediating institutions, whom individuals are

9 The following paragraphs draw on von Arnim / Tröster / Raza 2024.

asked to extend trust. In fact, Endreß identifies trust as a core theme in sociology, even if not always labeled as such, referring here also to the prevalence of mistrust as the Hobbesian "state of nature."

In the economic literature on trust, nearly every piece of research cites Arrow's 1972 paper on "Gifts and exchanges." The most frequently quoted passage states that "[v]irtually every commercial transaction has within itself an element of trust, certainly any transaction conducted over a period of time" (357).

Arrow here weighs the tendency of humans to want to contribute to a collective greater good, against their narrow self-interest. The seeds of the debate, in other words, go back to Adam Smith.

Algan/Cahuc (2014: 4) summarize, in modern terms, as follows:

> For trust to have an economic impact and to improve efficiency, one has first to consider the reasons why the economy would depart from the first-best allocation in absence of trust. In his analysis of the limits of organization, Arrow (1972) considers trust as co-substantial to economic exchange in presence of transactions costs that impede information and contracts. Fundamentally, the economic efficiency of trust flows from the fact that it favors cooperative behavior and thus facilitates mutually advantageous exchanges in presence of incomplete contracts and imperfect information. In Arrow's terms, trust would act as a lubricant to economic exchange in a second-best allocation.

The basic insight expressed here is confirmed in game theory and the behavioral experiments this generated, as well as the econometric literature (Algan/Cahuc 2014; Bowles/Polanía-Reyes 2012; Gintis et al. 2005; Knack/Keefer 1997; Zak/Knack 2001): Generalized trust can be seen as a causal factor in economic activity and economic growth.

We draw on these findings to advocate for the inclusion of generalized trust as a factor in regulation. Importantly, we hypothesize that domestically legitimated regulation fosters trust, and that trust in turn supports economic activity, and hence implement an adverse shock to trust from cross-border deregulation as a decline in investment in the respective sector.

We emphasize already at this point that sensitivity analyses suggest that our results are not heavily dependent on the inclusion of trust. Moreover, key simulation scenarios which do not include the trust factor do support our general conclusion that the benefits of regulation easily exceed their costs.

4.2 Modes of cross-border regulatory adjustment

DCFTAs target current national regulations in order reduce differences between the trading partners. Such regulatory adjustments can technically be achieved through different approaches: regulatory alignment, mutual recognition and harmonization.

The various models of cross-border regulatory adjustment differ in terms of the cost and benefit effects, the trading partners affected and the impact on trade costs and trade flows.

We define regulatory alignment as asymmetric regulatory adjustment in which one country aligns its regulatory system to that of a different country. Thus, trade costs at the border for exporters from the partner country to the aligning country change, assuming that products enter this market with less or more barriers.

In addition, the exporters in the partner country face differential burdens to adjust products to the export market in the partner country. In the aligning country, the production costs change and the private households see changes in medical expenditures, as well as in health outcomes.

In case of mutual recognition, each DCFTA partner country accepts and acknowledges the standards and regulations of the other as they achieve similar or equivalent levels of health outcomes, even if there are differences in specific requirements. Generally, this leads to lower border and production costs in both countries and leaves the benefit elements (health expenditures and health outcomes) unchanged.

However, mutual recognition can be linked to generalized trust, as the recognized regulations of the partner countries might not be accepted in the own country and create uncertainties for consumer and investors. As shown in the literature survey von Arnim / Tröster / Raza 2024, generalized trust positively affects economic activity and growth.

A mutual recognition case can also be simulated as an asymmetric change in case the requirements to fulfill a certain health and safety are related to very different production costs.

Regulatory harmonization refers to the case that the partner countries negotiate a new and common regulatory framework. Different scenarios are possible in this context, as the new regulations can be higher or lower in one or all DCFTA partner countries. Dependent on the scenario, this alters costs and benefits in all harmonizing countries. Similar to mutual recognition, harmonization can also affect generalized trust and impact macroeconomic variables therewith.

5. Scenarios and simulations

In this chapter, we detail a set of scenarios, and subsequently present and discuss simulation results. While the previous chapter discussed costs and benefits of regulations more generally, we now consider specifically foodborne illnesses and their health effects.

The applied scenarios are based on health outcomes data from foodborne illness in the EU and potential changes due to regulatory adjustments. The literature on the matter is crystal clear: Regulations aimed at reduction of disease incidence generate benefits that significantly outweigh costs.

Benefits arise, in essence, from lessened morbidity and mortality and associated gains in labor productivity, whereas costs arise from firm expenditures on labor time and material inputs for compliance. In the present context of trade, further costs might arise when producers have to abide by rules of partner countries.

For this study, the underlying social accounting matrix data by GTAP (n.d.) (version 10, base year 2014) are aggregated to three countries/regions (EU, United States, rest of the world) and three sectors (Sector 1: agrifood; Sector 3: health services; Sector 2: all other activities).

We emphasize that modeling at this level of aggregation requires abstraction and generalization. Regulatory systems and procedures are tailor-made to specific products, i.e., the "production of organic chicken eggs high in omega-3 fatty acids," and the related testing, inspection and documentation requirements.

No models can take such specificity into account. Case studies or a detailed cost-benefit analysis of this particular product might be able to do that—but it is our very intent to include the logic of costs and benefits of such regulations in an economy-wide trade model. While we strive for sound justification of our scenarios, the reader should keep in mind that these scenarios are "what-if" exercises that by their very nature require broad abstraction.

Further, we emphasize again that deregulation or liberalization under a DCFTA implies a decrease in the costs, trade and otherwise, of regulations, and the loss of associated benefits. As mentioned above, the use of the terms costs and benefits requires a clear definition.

We define three scenarios each under regulatory alignment, mutual recognition and harmonization. To do so, we draw on a number of different exogenous changes to parameters and variables as outlined in the preceding chapter. We then combine these "shocks" to create plausible and interesting scenarios that speak to the issues of concern in the debate on NTBs.

5.1 Definition of shocks

Hence, we begin with an overview of these assumed shocks, and indicate their respective magnitudes. We follow the categorization developed previously: The costs of regulation include border costs in the form of the ad-valorem equivalent of NTBs as well as increased labor costs, which imply lower labor productivity.

On the other hand, the benefits of regulation include lower expenditures to address consequences of negative externalities, decreased labor costs (implying higher labor productivity), and increased generalized trust. We discuss these items in turn, while again emphasize that our scenarios (mostly) consider reductions in costs due to deregulation, and losses of associated benefits. Table 2 summarizes this discussion.[10]

Table 2: Overview of shocks and magnitudes

	Shock	Notes
Costs		
1	NTBs	–2.5% to –5% growth of AVE parameter
2	Productivity (agrifood, Sector 1)	0.025% to 0.1% of productivity function intercept
Benefits		
3	Expenditure shift, private	0.01% of GDP towards health services (Sector 3)
4	Expenditure shift, public	0.01% of GDP towards health services (Sector 3)
5	Productivity (all sectors)	–0.02% of productivity function intercept
6	Trust (investment in agrifood)	–0.025% of GDP
7	Imperfect competition	half of profits gained absorbed by mark-up increase
8	Import shock	10% increase in agrifood import function intercept

Source: Own elaborations

10 In Table 2 and subsequent discussion, items 1 through 5 are derived on the basis of available data and the extant discussion in the CBA literature. We emphasize that the precise magnitude of these shocks is exceedingly difficult to establish. See also Box 1 and related discussion. Items 6 through 8 in Table 2 additionally illustrate important facets related to trust, imperfect competition and the possibility of an import surge, though the size of these shocks remains somewhat speculative. Given the significant uncertainty surrounding the size of these shocks, an appendix presents the results of selected sensitivity analysis.

NTBs (item 1 in Table 2) are the only element traditionally included in CGE-style trade impact assessments and estimated as ad-valorem equivalents in gravity models. Estimates from econometric gravity models and surveys differ greatly across sectors and studies, but a ballpark average amounts to roughly 25 percent.

Since our approach details behind-the-border developments through assumed changes to labor productivity, our NTB cost category is much narrower. We model NTBs in the importing country as a form of rent that accrues to the private sector. In other words, the presence of trade-related border costs allows firms to charge higher prices than otherwise. The ad valorem equivalents are a form of protectionism that falls away as regulations are removed or harmonized.

To reflect the narrower scope of our NTBs as solely border-related costs accruing as rents in the importing country, we assume across scenarios a 2.5 percent reduction of NTBs, and 5 percent in a subset of asymmetric scenarios. The parameter capturing NTBs appears in the import demand function, analog to a tariff rate.

As discussed above, productivity costs (item 2 in Table 2) can arise both in the exporting and the importing country and can differ in magnitude. Our key assumption concerning labor productivity gains in the deregulating sector are roughly of the same order of magnitude as the productivity losses across sectors from increased incidence of disease (see discussion further below).

Specifically, the positive productivity shock is implemented as an increase of the base-year intercept of the productivity function in the agri-food sector by 0.1 percent in the countries that make a regulatory adjustment. This represents an increase in labor productivity corresponding to sectoral value added by that amount. In a scenario where a small set of exporting firms are affected, the base-year intercept of the productivity function is increased by a quarter of that amount (0.0025 percent).

The core benefits of regulation of food production are the avoidance of foodborne illnesses. Lower incidence of foodborne illness reduces morbidity and mortality, which in turn requires lower expenditures on health services (item 3 and 4 in Table 2) but furthermore decreases the number of lost workdays, i.e., an increase in labor productivity (item 5 in Table 2).

Based on WTO data of foodborne diseases for the EU (see box), the estimated medical costs of the assumed increase in disease incidence amount to $2.9 billion or 0.03 percent of base-year GDP in the EU ($15 trillion) or 0.05 percent of base-year value added ($11.1 trillion).

Estimated Implications of Changes in Food Safety Regulations on Public Health

Assuming that changes in food safety regulations lead to negative health effects, with a projected increase of 10 percent in cases of illness and death per year over a 10-year period, we derive data on the potential health outcomes.

The baseline data, sourced from the World Health Organization (WHO 2024), indicates that there are currently 10,600,000 cases of foodborne diseases in the EU, resulting in 2,000 deaths annually. The number of cases is assumed to increase by 10 percent.

Further assumptions, based on Buzby et al. (1996) and Golan et al. (2010), break down the impact of these diseases:

- 80 percent of new cases exhibit no or mild symptoms, leading to the loss of one working day for half of these cases.
- The remaining 20 percent experience more serious symptoms:
  - All visit a physician twice.
  - Three quarters (15 percent of total cases) miss work for four days.
  - One quarter (5 percent of all cases) require hospitalization, missing work for 10 days.
  - Among the hospitalized, 200 individuals succumb to the illness; all others recover, necessitating two additional physician visits and another day of missed work.

Economic implications are calculated based on estimated average daily earnings, the cost per physician office visit, and the cost per hospitalization in the EU.

For fatal cases, it is assumed that individuals miss half a year's worth of working days, considering most fatalities occur among those potentially not in the working age. The cumulative values for each year are tallied over a 10-year period, without applying any discounting at this stage.

We implement the increased demand for health services as an expenditure shift. Specifically, the intercept of the consumption demand function for health services is increased by an amount representing 0.01 percent of GDP and decreased proportionally across the other two sectors by the same amount.

Further, public expenditures also shift, by an amount representing 0.01 percent of GDP to health services.[11] In combination, private and public demand for health services increases by 0.02 percent of GDP while demand for other goods and services decreases by the same amount.

The estimated productivity losses amount for the EU to $2.4 billion or 0.016 percent of base-year GDP or 0.022 percent of base-year value added. We implement this adverse productivity shock as a decrease of the intercept of the productivity functions across all three sectors by 0.02 percent, representing roughly a decline of value added across these sectors of the same magnitude.

Our scenarios include two further items. First, we include generalized trust as a benefit of domestic and appropriately legitimated regulation (item 6 in Table 2). There are good theoretical reasons as well as empirical evidence to support the notion that generalized trust positively affects economic activity and growth.[12] See our companion working paper on trust (von Arnim / Tröster / Raza 2024) for a detailed discussion of this issue.

In line with this argument, we assume that liberalization or deregulation in a DCFTA erodes trust, and hence reduces economic activity and growth. This assumption is implemented in scenarios as a decrease in investment in the deregulating sector in the amount of 0.025 percent of GDP.

Last but not least, we consider the extent of competition (item 7 in Table 2). Gains from trade, across schools of thought and theoretical approaches, materialize through an intensification and internationalization of competition. Competition forces firms to innovate and specialize, and, importantly, pass on labor productivity increases to consumers via price decreases.

11 The public deficit is endogenous in the model and follows changes in public expenditures and revenues. In this scenario, public expenditures shift, so that the public deficit is primarily affected by changes in aggregate real GDP—which affects revenue collection.

12 The hypothesis underlying this scenario design is that (i) domestically legitimated regulation fosters generalized trust, and that (ii) generalized trust fosters economic activity. See von Arnim / Tröster / Raza 2024 for more comprehensive discussion on the rationale for this approach. To our knowledge, it is new and has not been implemented in this fashion previously. We recognize that alternative hypotheses are plausible. In a north-south context in particular, one might consider the possibility that regulations ought to be externally legitimized. Indeed, ongoing debates over investor-state dispute settlement (ISDS) mechanisms, property right protections, and liberalized capital accounts pertain to the perceived need to lock in "foreign" regulations. In contrast, an extensive literature considers the need to maintain policy space for governments in the South. For the present study, we consider the juxtaposition of EU and U.S. regulatory systems to justify the simple hypothesis as introduced above.

If the degree of competition is limited, and productivity increases are not passed on into price declines, gains from trade cannot materialize. An investigation of this issue has taken on significantly more importance as concentration ratios have risen and a lack of competition is discussed as a potential cause of high inequality and stagnation.

We implement an “imperfect competition” scenario as an increase in the mark-up. Specifically, firms in the deregulating sector experience labor cost savings and therewith labor productivity increases, but do not pass these on into price decreases.

Our scenario is built on the assumption that half of the additional profit flow from the positive productivity shock are absorbed into a higher mark-up. This is implemented as a ceteris paribus exercise, i.e., we translate half of the increase in the intercept of the productivity function into an increase of the intercept of the mark-up function.

5.2 Description of scenarios

We are now in a position to describe our set of specific scenarios. We define three scenarios each under regulatory alignment, mutual recognition and harmonization. Tables 3 through 5 offer details.

Table 3: Regulatory alignment scenarios

		Scenario 1		**Scenario 2**		**Scenario 3**	
		EU	United States	EU	United States	EU	United States
Costs							
1	NTBs	–2.5%		–2.5%		–2.5%	
2	Productivity (1)	0.1%	0.025%	0.1%	0.025%	0.1%	0.025%
Benefits							
3	C-shift, private	0.01%		0.01%		0.01%	
4	C-shift, public	0.01%		0.01%		0.01%	
5	Productivity (1–3)	–0.02%		–0.02%		–0.02%	
6	Trust			–0.025%		–0.025%	
7	Imperfect competition					0.5	
8	Import shock						

Source: Own elaboration

Table 4: Mutual recognition scenarios

		Scenario 1		Scenario 2		Scenario 3	
		EU	United States	EU	United States	EU	United States
Costs							
1	NTBs	–2.5%	–2.5%	–5.0%	–2.5%	–5.0%	–2.5%
2	Productivity (1)	0.025%	0.025%	0.025%	0.025%	0.025%	0.025%
Benefits							
3	C-shift, private						
4	C-shift, public						
5	Productivity (1–3)						
6	Trust	–0.025%	–0.025%	–0.05%	–0.025%	–0.05%	–0.025%
7	Imperfect competition						
8	Import shock					10%	

Source: Own elaboration

Table 5: Harmonization scenarios

		Scenario 1		Scenario 2		Scenario 3	
		EU	United States	EU	United States	EU	United States
Costs							
1	NTBs	–2.5%	–2.5%	–2.5%	–2.5%	–5%	–2.5%
2	Productivity (1)	–0.025%	–0.025%	+0.025%	–0.025%	+0.025%	–0.025%
Benefits							
3	C-shift, private						
4	C-shift, public						
5	Productivity (1–3)	+0.02%	+0.02%	–0.02%	+0.02%	–0.02%	+0.02%
6	Trust	+0.025%	+0.025%	–0.025%	+0.025%	–0.025%	+0.025%
7	Imperfect competition						
8	Import shock					10%	

Source: Own elaboration

Regulatory alignment is, by definition, asymmetric, as one country aligns its regulatory system to that of a different country. The three scenarios summarized in Table 3 reflect this structure. The first scenario assumes that regulation in EU agrifood production converges to regulation in U.S. agrifood production, but furthermore that the U.S. system is cheaper and laxer, in the sense that it imposes fewer costs on firms and leads to an increased incidence of disease.

Hence, deregulation in the EU agrifood sector reduces border costs and leads to productivity gains. In the United States, smaller productivity gains materialize, reflecting the fact that only firms exporting to the EU are affected by the regulatory change in that market.

On the side of lost benefits, items 3 through 5 are implemented in the EU. These are private and public expenditure shifts necessary due to increased disease incidence, as well as productivity losses across sectors as the number of lost workdays rises.

The next scenario adds to this set of shocks item 6, namely a shock to generalized trust. Since the EU deregulates and does so by binding itself to the standards and procedures of a foreign country, trust erodes, and this leads to a decline in economic activity (see also footnote 11). The third scenario additionally introduces the issue of imperfect competition (item 7).

Mutual recognition scenarios are summarized in Table 4. The first scenario of this type highlights the role of generalized trust. The underlying assumption is that regulatory systems are functionally equivalent, in the sense that the incidence of disease does not differ across countries even though standards and procedures do.

Hence, cross-border deregulation in the form of mutual recognition leads to a reduction of costs in both countries (items 1 and 2), but no loss of benefits related to higher incidence of disease (items 3 through 5). However, since both economies now recognize agrifood output produced under the other countries' standards, an erosion of trust decreases investment in this sector.

The extended scenarios add elements of asymmetry. Scenario 2 incorporates higher border-related costs and therefore NTB reductions in the EU, and a more substantial erosion of trust. The implicit assumption is that consumers in the EU are more aware, and more strongly wedded to "local" regulation than in the United States. Scenario 3 further adds an adverse import shock in the EU.

Harmonization scenarios (Table 5) reflect the most ambitious—and unlikely—mode of cross-border regulatory liberalization, namely that the partner countries negotiate a new and common regulatory framework. The first scenario further assumes that this new and common set of standards and procedures is more expensive and tighter, in the sense that it reduces incidence of disease. This implies that key shocks enter with reversed sign: Costs increase (item 2), but benefits increase (items 5 and 6), too.

The second scenario is built on the idea of a "harmonization compromise." The negotiating partners meet in the middle, which implies that one country tightens whereas the other loosens regulatory standards.

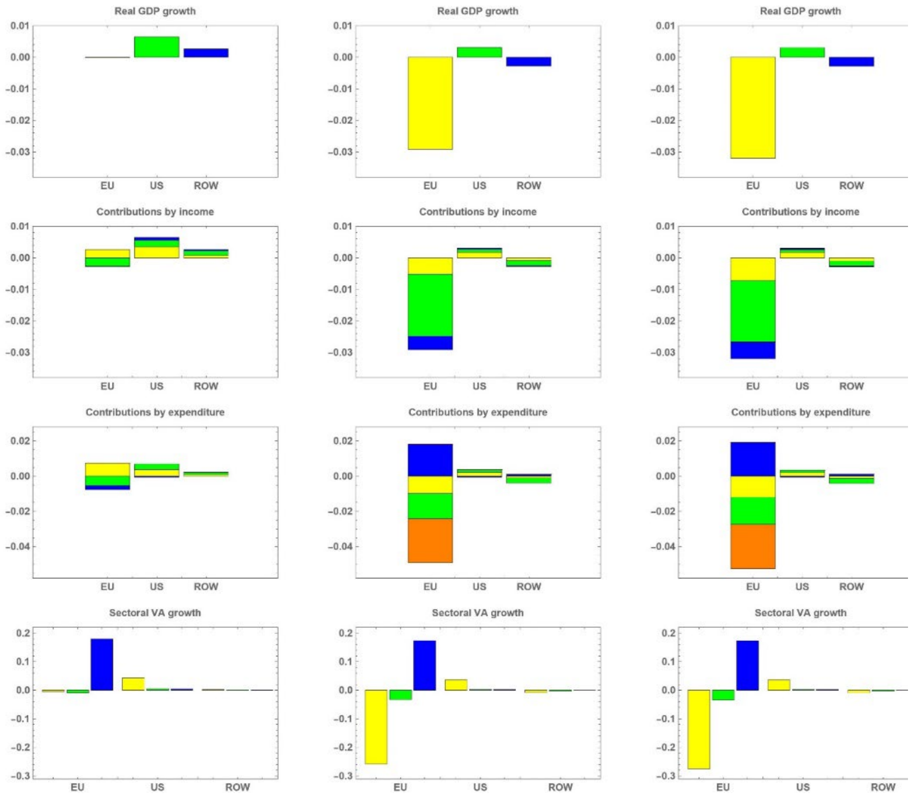
Along these lines, the second scenario assumes that the EU loosens, so that costs decrease but benefits are lost (items 2, 5 and 6), whereas the United States tightens (as in the first scenario). To this, the third scenario adds elements of asymmetry, namely that EU border costs fall more strongly (item 1), and an import surge results (item 7).

5.3 Simulation results

Figures 1 through 3 present simulation results for the three country (EU, United States and ROW) – three sectors (agrifoods, health service and other sectors).[13] Each figure summarizes three scenarios each under regulatory alignment (Figure 1), mutual recognition (Figure 2) and harmonization (Figure 3). For each mode of deregulation, a column of charts reflects the respective scenario, in turn defined in Table 3 through 5. We begin with Figure 1 on regulatory alignment.

13 We use GTAP 10 Database (GTAP n.d.) with the base year 2014. The agrifood sector includes the GTAP sectors 1 to 14 and 19 to 26 The health sector includes the GTAP sector 64.

Figure 1: Regulatory alignment



Notes: Row 1: Growth rates of real GDP; Row 2: Growth decomposition by income (yellow: wages, green: profits, blue: taxes); Row 3: Growth decomposition by expenditure (yellow: consumption, green: exports, blue: imports, red: government, orange: investment); Row 4: Growth rates of sectoral value added. All charts report growth rates in percentage points. First (second, third) column is scenario 1 (2, 3).
Source: Simulation results from the ÖFSE global trade model

The top row of charts reports growth rates of real GDP. Before we delve into specific numbers, it is clear from inspection that the key result for regulatory alignment scenarios is that the EU experience losses in real GDP, compared to gains in the United States. This pattern holds across the three scenarios and is rooted in the assumption that the EU aligns itself to the cheaper and laxer standards of the United States, and hence introduces negative externalities.

For scenario 1, the growth rate of real GDP in the EU is negative, but very close to zero. The growth rate of real GDP in the United States is

0.006 percent —which is positive, but also very small. For scenario 2 (scenario 3), the EU growth rate is –0.029 percent (–0.032 percent), amounting to roughly 3/100 of one percentage point of GDP.

The second row of charts decomposes the headline number of real GDP growth into growth contributions by income component. The growth contribution of any component is the product of this component's base-year share in total GDP and its growth rate. As the caption outlines, the colors indicate these components (yellow wages, green profits, blue taxes).

To illustrate, we focus on the first column (scenario 1), where total wage income in fact contributes positively (due to an expansion of income and employment in sector 3). This increase is smaller, however, than the decrease in profit income. (The sum of these two items equals the aggregate real GDP growth in the row above.)

In scenario 2 and 3, the effect of a decline in agrifood investment overwhelms the expansion of employment and income in health services, leading to negative growth contributions across components.

The third row of charts, in turn, decomposes the headline number into growth contributions by expenditure component. Colors indicate these components (yellow: consumption, green: exports, blue: imports, red: government, orange: investment).

Consider scenario 1: Consumption contributes positively in the EU, again through increases in health services. Key here is that health services feature a smaller import propensity, so that the sectoral multiplier exceeds that of the other sectors—in other words, the expenditures shifts towards sector 3 have positive consumption effects.

Further, comparing results for the EU and the United States in scenario 1 highlights the importance of labor productivity changes for external competitiveness. As previously mentioned, lower (higher) labor productivity increases (decreases) nominal unit labor costs, which in turn feed into sectoral output prices. These enter import demand functions and therewith determine the trade balance.

As is clear from inspection of the growth contributions by expenditure, the productivity decline in the EU erodes competitiveness and leads to a rise in imports, which contributes negatively to the growth rate of real GDP.

In scenarios 2 and 3, the negative impact of the agrifood investment decline takes center stage. Further, the decline in incomes that arises due to this adverse demand shock also reduces imports. This reduction in imports contributes positively to aggregate real GDP growth.

The last row of charts reports sectoral growth rates of real value added. These charts highlight which sectors are driving the headline results, but furthermore the stark differences across the two countries. In scenario 1, the EU experience relatively strong sectoral real value-added growth in health services (blue, sector 3), whereas the United States experiences sectoral growth in value added in agrifood (yellow, sector 1). This pattern of relative growth and decline repeats across scenarios 2 and 3.

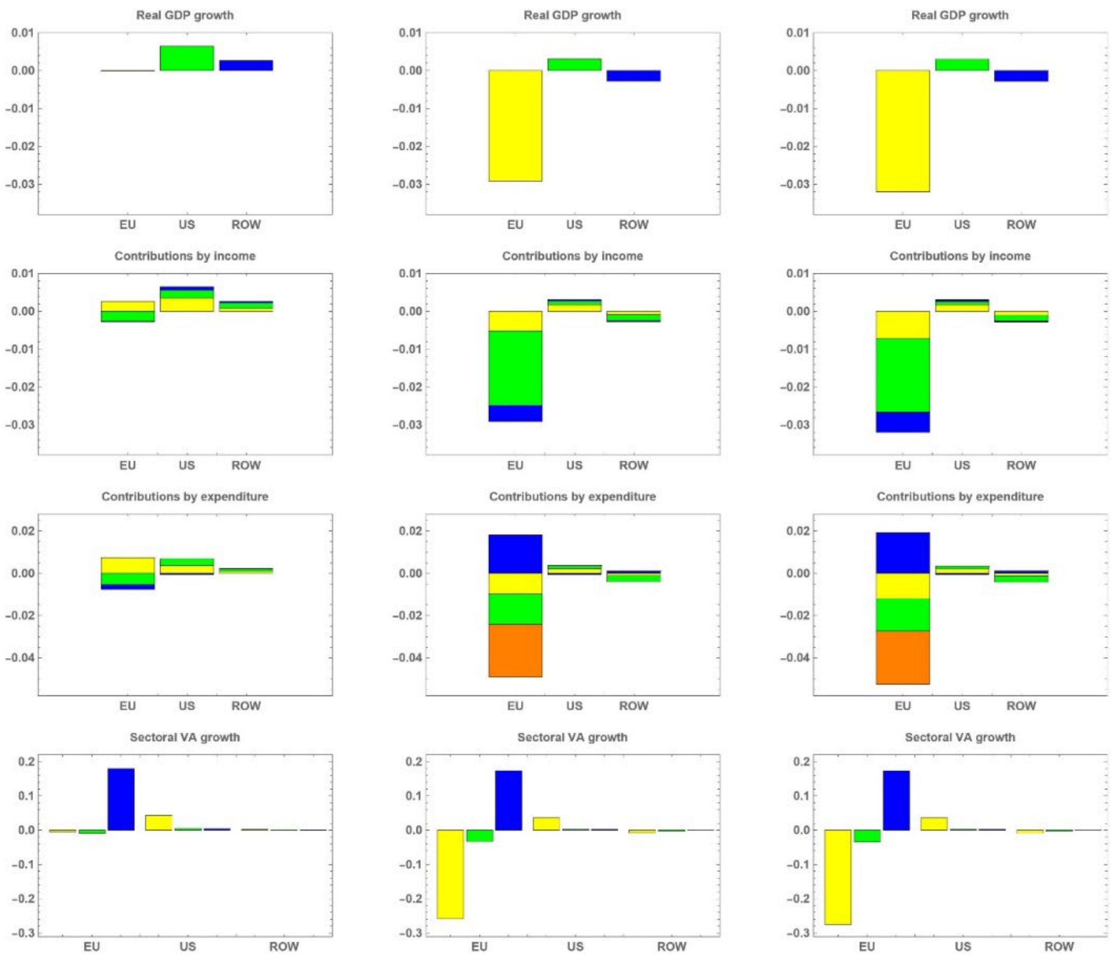
It is crucial to emphasize here that the headline losses of EU real GDP would be larger, were they not buffered by expansion of demand in health services. Put differently, the EU economy realizes a monetary benefit from addressing consequences of increased negative externalities. This is akin to expenditures rising for disaster cleanup and highlights the very imperfect nature of GDP as the standard yardstick for the assessment of societal well-being.

Figure 2 summarizes mutual recognition scenarios. The top left chart reports real GDP decline in the EU of –0.029 percent against –0.042 percent in the United States. (The difference is driven by the country-specific multipliers and structural characteristics.) For scenarios 2 and 3, the real GDP decline in the EU becomes more pronounced than in the United States, due to the asymmetric scenario design.

Growth contributions across income and expenditure components are negative across the board, with the only exception the decline in imports in both the EU and the United States. In particular the assumption of asymmetric trust erosion and the resulting investment gap in the EU are important in the overall results for scenarios 2 and 3.

The key issue in these mutual recognition scenarios is the implicit assumption that the erosion of generalized trust imposes a barrier to economic activity that outweighs cost savings even in the absence of “standard” negative externalities (i.e., morbidity and mortality, item 3 through 5). See also footnote 11 above, and an appendix for results regarding sensitivity analysis.

Figure 2: Mutual recognition

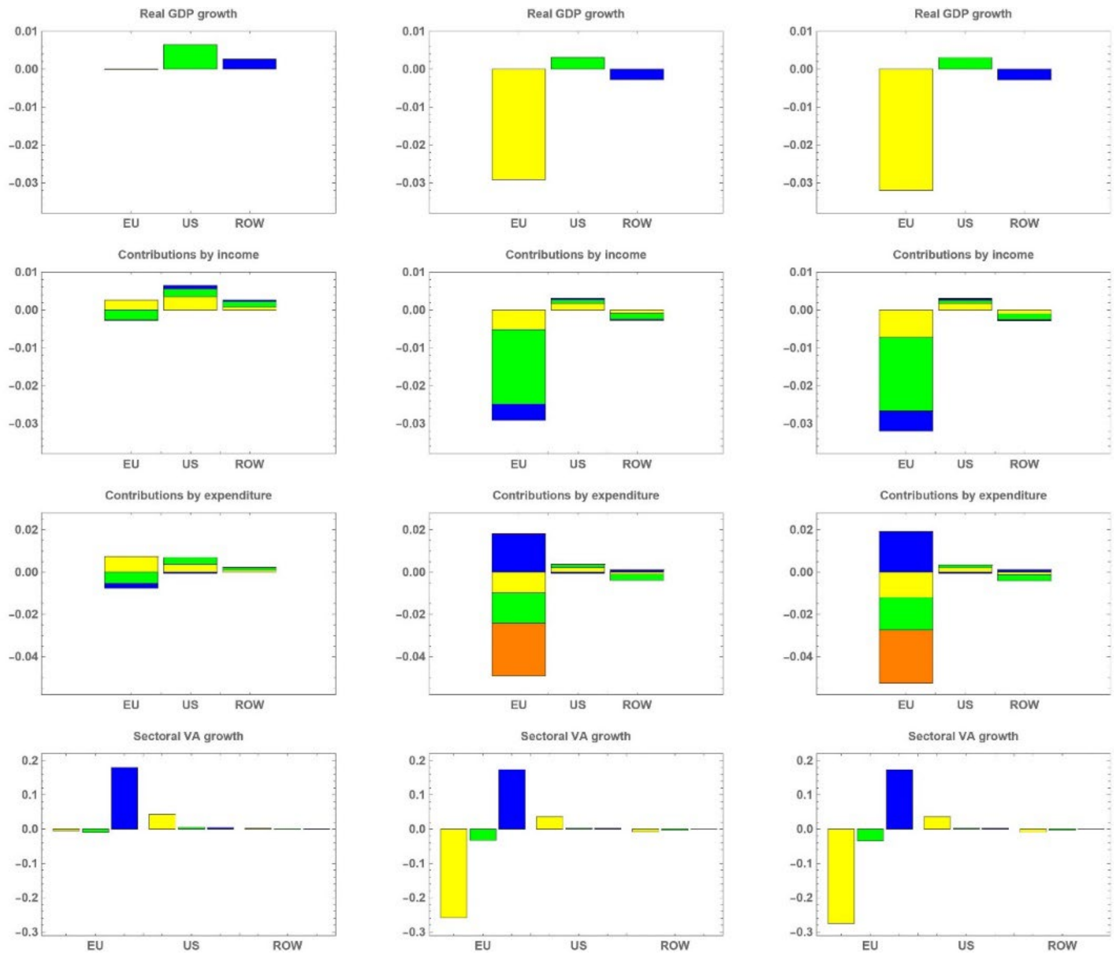


Note: Row 1: Growth rates of real GDP; Row 2: Growth decomposition by income (yellow: wages, green: profits, blue: taxes); Row 3: Growth decomposition by expenditure (yellow: consumption, green: exports, blue: imports, red: government, orange: investment); Row 4: Growth rates of sectoral value added. All charts report growth rates in percentage points. First (second, third) column is scenario 1 (2, 3).
Source: Simulation results from the ÖFSE global trade model

Figure 3 presents results for harmonization scenarios. The first scenario emphasizes precisely the issue just mentioned. In this scenario, both countries commit to a more expensive but also tighter, i.e., disease incidence reducing, regulatory system. In line with the implicit assumption above, the creation of generalized trust dominates the increase in firm costs of compliance with the new standards. Hence, sectoral output in the agrifood sector increases in both countries, and real GDP in the aggregate follows.

The middle column of Figure 3, in turn, again defines an asymmetric scenario structure, which imposes negative (positive) effects on the EU (United States). In the third column, the adverse import shock amplifies the results.

Figure 3: Harmonization



Note: Row 1: Growth rates of real GDP; Row 2: Growth decomposition by income (yellow wages, green profits, blue taxes); Row 3: Growth decomposition by expenditure (yellow: consumption, green: exports, blue: imports, red: government, orange: investment); Row 4: Growth rates of sectoral value added. All charts report growth rates in percentage points. First (second, third) column is scenario 1 (2, 3).
Source: Simulation results from the ÖFSE global trade model

5.4 Sensitivity analysis

As emphasized throughout, scenario design on not only costs but also benefits of regulations presents trade impact assessment researchers with substantial difficulties. Case, product, and regulation specific CBA results tend to build on the value of a statistical life (VSL), which is not transferable to standard CGE modeling approaches.

Where data on cost and benefit implications of regulations are available, they need to be adjusted and creatively yet plausibly implemented.

In our scenario design, direct border costs (NTBs, item 1 in Table 2), and labor productivity losses (item 5) as well as changes to the demand composition (items 3 and 4) are based on such calculations. Other items, including the productivity gain from a cost reduction (item 2) are subject to greater uncertainty.

Further, generalized trust and its impact on economic activity proposes an entirely new mechanism to investigate in the context of costs and benefits of regulations in trade impact assessments. We believe that the hypothesis, grounded in the theory and empirics discussed in detail in von Arnim / Tröster / Raza (2024), has merit and is worthwhile to pursue.

This chapter presents sensitivity analysis in order to gauge the importance of the size of two key shocks for the gamut of our simulation results. Our objective is to improve our understanding of the scenario designs, provide a measure of robustness, and solidify interpretations of results.

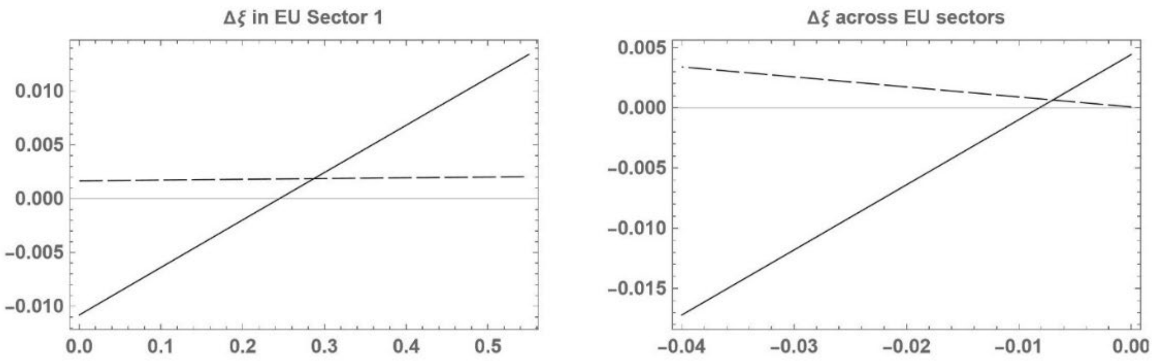
In these exercises, we focus first on the trade-off between assumed labor productivity costs and benefits of regulations. To fix ideas, consider Table 1. We pick productivity gain (item 2), and loss (item 5), and simulate multiple scenarios to assess how important assumptions about the relative size of these shocks are for overall results. This exercise can be seen as a subset of regulatory alignment, scenario 1.

Second, we focus on the importance of the size of the investment shock, resulting from the assumed erosion of trust (item 6). To isolate this shock, we compare it to the border cost reduction (item 1), and additionally the productivity gain (item 2). Simulations here hold NTB reduction and productivity gain constant but vary the magnitude of the investment decline.

Figure 4 reports results for sensitivity analysis regarding productivity shocks. The left panel simulates a decline in labor productivity across all three EU sectors of –0.02 percent (item 5, Table 1) in combination with different increases in EU sector 1 labor productivity. Note that the assumed shock in this sector is an increase in labor productivity of 0.01 percent (item 2, Table 1).

For real GDP growth in the EU to become positive and given the decline across sectors of –0.02 percent, sector 1 labor productivity would have to be (roughly) 0.24 percent, or more than twice as large as assumed in Table 1. Further, U.S. real GDP growth is dominated by the relative competitiveness gain from the labor productivity decrease across sectors in the EU.

Figure 4: Sensitivity analysis: Productivity shocks



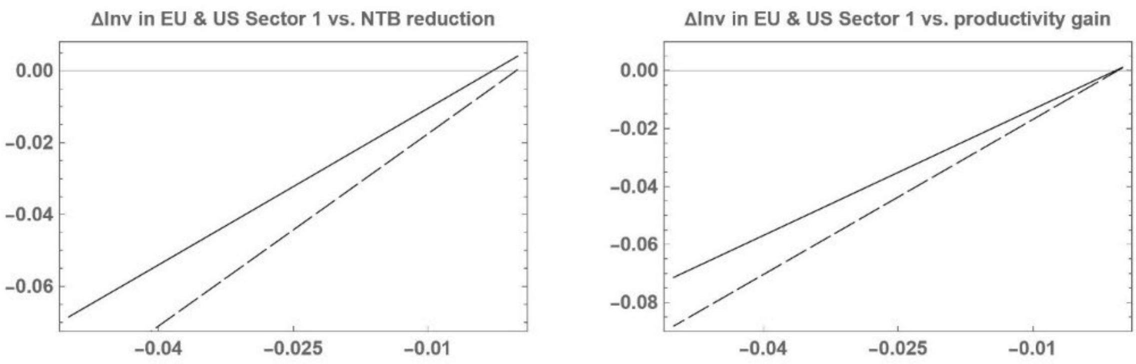
Note: This figure reports results for sensitivity analysis regarding productivity shocks. On the vertical axis, both panels report the growth rate of real GDP in percentages (solid: EU; dashed: United States). The left panel simulates a decline in labor productivity across all three EU sectors of –0.02% (item 5, Table 1) in combination with an increase in EU sector 1 labor productivity as shown on the horizontal axis. Note that the assumed shock in this sector is an increase in labor productivity of 0.01% (item 2, Table 1). For real GDP growth in the EU to become positive and given the decline across sectors of –0.02%, sector 1 labor productivity would have to be (roughly) 0.24%, or more than twice as large as assumed in Table 1. Further, the dashed line indicates that U.S. real GDP growth is dominated by the relative competitiveness gain from the labor productivity decrease across sectors in the EU. The right panel takes the increase in labor productivity in sector 1 as given (0.01%) and combines this with different decreases across sectors (which are now shown on the horizontal axis). For the EU real GDP growth rate to become positive, the labor productivity loss across sectors from an increased incidence of disease would have to be less than half as pronounced (i.e., about –0.008%) as assumed in Table 1 and throughout our scenarios.
Source: Simulation results from the ÖFSE global trade model

The right panel takes the increase in labor productivity in sector 1 as given (0.01 percent) and combines this with different adverse labor productivity shocks across sectors. For the growth rate of EU real GDP to become positive, the labor productivity loss across sectors from an increased incidence of disease would have to be less than half as pronounced (i.e., about –0.008 percent, or 4/10 of the assumed –0.02 percent) as in Table 1 and throughout our scenarios.

The figure also clarifies that U.S. gains depend on the loss of EU external competitiveness: The smaller the assumed decline in EU labor productivity across sectors, the smaller are the gains in U.S. real GDP.

Figure 5 reports results for sensitivity analysis regarding an erosion of trust, implemented as a decline in investment in the agrifood sector 1. On the vertical axis, both panels report the growth rate of real GDP in percentages.

Figure 5: Sensitivity analysis: Trust "shocks"



Note: This figure reports results for sensitivity analysis regarding an erosion of trust, implemented as a decline in investment in the agrifood sector 1. Both panels report on the vertical axis the growth rate of real GDP in percentages (solid: EU; dashed: United States). The left panel simulates the reduction in border costs (NTB –2.5%, item 1 in Table 2) in both the EU and the United States in combination with a decline in agrifood sector investment as indicated on the horizontal axis. The right panel simulates in both the EU and the United States the productivity gain in sector 1 (0.1%, item 2 in Table 2) in combination with a decline in agrifood sector investment as indicated on the horizontal axis.
Source: Simulation results from the ÖFSE global trade model

The left panel simulates in both the EU and the United States the reduction in border costs (NTB –2.5 percent, item 1 in Table 2) in combination with a decline in agrifood sector investment as indicated on the horizontal axis. The right panel simulates in both the EU and the United States the productivity gain in sector 1 (0.1 percent, item 2 in Table 2) in combination with a decline in agrifood sector investment as indicated on the horizontal axis.

As clear from inspection of these figures, very small changes in agrifood investment are sufficient to dominate the gains made in either the EU and the United States from border cost reductions or productivity gains.

For an example, consider the threshold for the EU to experience a net gain in the border cost reduction analysis (left panel). The EU growth rate of real GDP turns positive at roughly one tenth of the adverse investment shock assumed in Table 1 (i.e., 0.0025 percent rather than 0.025 percent of GDP). The thresholds are tighter in the right panel, and for the United States in both panels.

These exercises in sensitivity analysis suggest that the overall pattern of simulation results is not overly dependent on the assumed magnitudes of shocks. In summary, simulation results illustrate (i) the complexity of introducing benefits from regulation in trade impact assessments and (ii) the ease with which at least one country could lose from cross-border deregulation in a DCFTA.

6. Conclusions

This paper presents first steps towards integration of the benefits of regulation in a trade impact assessment model. These are routinely de-emphasized relative to the (trade) costs of regulation. Since border- and behind-the-border costs of regulation are central to DCFTA negotiations, this effort is critical and necessary.

We build upon the extant literature on CBAs of case and product specific regulations. This literature finds mostly large benefits of regulations, but the commonly applied concept of the "value of a statistical life" is difficult to transfer to trade impact models. Further, a general lack of data availability and coverage across products and sectors makes transference into economy-wide models near impossible.

Our literature review shows that standard trade CGE models oversimplify NTBs, focusing on protection effects. Some CGE studies explore the economic impacts of climate change and air pollution on human health, offering insights into incorporating regulation costs and benefits into CGE models.

We propose an approach to integrate the costs and benefits of NTBs in the ÖFSE global trade model with easily measurable items. These pertain on the cost side to (1) narrowly conceived border costs, (2) labor (time or productivity) costs associated with compliance of standards, and on the benefit side (3 and 4) expenditure shifts required to address the consequences of negative externalities, (5) labor (time or productivity) lost due to the loss of positive externalities from regulation, as well as—new and complementary—(6) an erosion of generalized trust.

We demonstrate how to connect these items to specific variables (or associated parameters) in the ÖFSE Global Trade Model. We roughly estimate plausible magnitudes of shocks for the case of changes in food safety standards. Finally, we simulate the model on the basis of carefully crafted scenarios that reflect possible outcomes of cross-border regulatory liberalization negotiations in a DCFTA.

Clearly, results depend on the magnitude of implemented shocks and the specific structure of various scenarios. However, across all scenarios, simulation results highlight that it is highly plausible that at least one country faces adverse consequences from a DCFTA.

The novel inclusion of trust in domestically legitimated regulation as a positive and causal factor in economic activity requires further work and critical scrutiny. We emphasize that our overall conclusion—that benefits of regulations tend to clearly exceed their costs, and that cross-border deregulation in DCFTAs carries significant economic risk—does not depend on the inclusion of trust.

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