TRADE FACILITATION IMPACTS: APPROACHES TO MODEL "JUST-IN-TIME" DELIVERY

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Paper for presentation at the

20th Annual Conference on Global Economic Analysis

June 7-9, 2017, West Lafayette, USA

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ECONOMY-WIDE IMPACTS OF TRADE FACILITATION: A METRO MODEL SIMULATION

Key policy implications

- Trade facilitation improvements matter; significant benefits for countries at all levels of development can come from reducing clearance times for both imports and exports. Clearance times are critical for trade in intermediate goods and time-sensitive goods, such as perishable agricultural products or high-tech manufacturing.

- For firms, efficient border procedures help to decrease losses of perishables, to reduce costs of managing stocks, and to improve the ability to respond rapidly to changes in consumer preferences and participate in time-sensitive global value chains (GVCs). For consumers, efficient border procedures can enable higher utility from goods delivered sooner rather than later, reflected in increasing willingness to pay for faster delivery.

- There are important economy-wide gains from trade facilitation across regions and sectors. Implementing the TFA could potentially increase welfare to between 0.05% and 0.63% of countries' final demand, depending on the level of development. The distribution of benefits largely favours developing and emerging economies.

- In a world of GVCs, there are new transmission channels for trade facilitation benefits between and within regions. Ambitious reformers can be the first to gain the most from faster access to competitively-priced inputs, as well as by becoming more export-competitive. But the full gains in terms of more efficient production and allocation of resources [economic efficiency and promotion of structural transformation] will only be reaped if the economy is free to adjust.

Executive summary

Global value chains (GVCs) have opened new opportunities to enhance and diversify production, but have also placed a premium on countries' ability to connect seamlessly, rapidly and efficiently with the global economy. The WTO Trade Facilitation Agreement (TFA) marked an important step in countries' efforts to increase the transparency and efficiency of customs and other administrative procedures involved in moving goods across borders. Addressing procedural obstacles at the border across a large number of countries, through a full and swift implementation of the TFA, would reduce worldwide trade costs and realise important global economic benefits.

Quantifying the economy-wide impacts of trade facilitation and disentangling the channels through which trade facilitation reform can benefit the global economy represent an analytical challenge given the complexity of the underlying issues. This report assesses how specific border procedures impact the operation of supply chains and the resulting policy implications, using the OECD Trade Facilitation Indicators (TFIs) database and the OECD METRO model. The OECD TFIs are incorporated within the METRO model using a novel methodological approach, which accounts for both supply and demand side gains triggered by trade facilitation improvements.

Overall, the aim of this assessment is to better represent empirical characteristics of the border process in the OECD METRO model analysis and to identify those features that crucially affect the results. Analysis based on the TFIs shows that trade facilitation measures can benefit all countries whether they are exporting or importing goods by allowing better access to inputs for production and greater participation in the GVCs that characterise international trade today. Economies with the biggest challenges in trade facilitation measures reap the greatest benefits from implementation. But the nature and extent of benefits will depend on how much of the TFA countries implement and the timeframes for implementation. Over time, trade facilitation reforms -- in reducing costs of trade and thereby promoting greater trade -- trigger a reallocation of production, ultimately leading to more efficient production and allocation of resources across regions and sectors.

On the supply side, efficient border procedures are linked to decreasing losses resulting from fewer delays of goods at the border. Delays in delivery increase the costs for firms of managing stocks and undermine their ability to respond rapidly to changes in consumer preferences. On the demand side, trade facilitation improvements are associated with an increase in the consumer's willingness to pay for faster delivery, as consumers derive more utility from goods delivered earlier rather than later. Faster delivery of intermediate goods through the supply chain also improves final delivery times and increases consumers' willingness to pay for the final product.

By significantly reducing trade transaction costs and clearance times, full implementation of the WTO TFA has the potential to increase world trade by 0.6% compared to the base, with lower middle income countries (LMICs) and upper middle income economies (UMICs) experiencing the strongest growth. Trade increases in all sectors, with manufacturing showing the highest growth rates. Several groups realise stronger increases in exports than imports, namely low income countries (LICs), LMICs and OECD countries. Intermediates account for the largest share of the trade increase: this shows the strength of the TFA in deepening GVC integration, as sectors in which selected regions can potentially realise the largest export increases are also those where the most significant import increases are observed.

Improvements in trade facilitation (as measured by the TFIs) also generate positive effects beyond trade to production. This is true across all regions, with LICs experiencing the strongest effects, followed by LMICs and high income countries outside the OECD area. A large share of the production growth is a direct result of increasing export activities, but the boost to imports from trade facilitation reforms also plays a significant role: while firms face increasing competition in the domestic market, they also benefit directly from lower input costs and faster delivery times. Decreases in intermediate inputs costs and overall production costs are most prominent in motor vehicles and parts (0.33% and 0.18%) and machinery, electronic and transport equipment (0.26% and 0.14%).

Implementing the TFA could potentially add between 0.04% and 0.41% to countries' GDP, depending on the level of development. Moreover, over time, significant trade facilitation reforms from a full implementation of the TFA would ultimately increase welfare across the selected country groups and for the key economic agents (including households and government). LICs benefit the most, with welfare increases accounting for 0.6% of total demand. Besides household consumption, for each country group, a large part of the welfare increase stems from increased utility triggered by faster delivery times.

1. Introduction

1. The predictability, reliability, and time sensitivity of trade flows are important factors behind firms' decision about a location. They condition the capacity of lead firms and intermediate producers in GVCs to satisfy demand on time. Reliable, predictable, and timely access to inputs and final products is, in turn, highly dependent on good infrastructure and efficient borders. Well-functioning trade facilitation measures enable trade by reducing the time, cost, and uncertainty involved in importing and exporting.

2. These considerations have led WTO members to negotiate the WTO Trade Facilitation Agreement (TFA), concluded in December 2013 at the Bali Ministerial Conference. The TFA will enter into force once two-thirds of members have completed their domestic ratification process. At time of writing, more than 87 per cent of the ratifications needed to bring the TFA into force have been received. The Agreement marked an important step in countries' efforts to increase the transparency and efficiency of customs and other administrative procedures involved in moving goods across borders. Addressing procedural obstacles at the border as a consistent effort across a large number of countries, through a full and swift implementation of the TFA, could reduce worldwide trade costs and realize important global economic benefits.

3. The most common tools used for estimating the potential impacts of trade facilitation reforms have been the gravity trade model and computable general equilibrium (CGE) models. OECD work based on a gravity econometric framework and using the OECD Trade Facilitation Indicators (TFIs) (Box 1), showed that implementing the WTO TFA could reduce trade transaction costs by between 10.4% and 17.4%, depending on the level of development (OECD, 2015a). To assess economy-wide impacts of trade facilitation reforms a suitable choice of method is CGE analysis[2], the solid microeconomic foundation of which explicitly depicts the production and demand interdependencies between agents within the economy and among sectors, markets and regions. This allows the model to capture some of the complex transmission mechanisms of effects, and distribution of the benefits, of such reforms. However, analysis has tended to concentrate on the efficiency gains or the supply side, while trade facilitation is likely to result in gains on both the demand and the supply side.

2. For example: Hertel et al. (2001); Francois et al. (2005); Walkenhorst and Yasui (2005); Décreux and Fontagné (2015); Walmsley and Minor (2016).

Box 1. OECD Trade Facilitation Indicators (TFIs)

The OECD TFIs were developed in 2012 to support governments in their efforts to improve their border procedures, reduce trade costs and reap greater benefits from international trade. They currently cover the full spectrum of administrative procedures at the border for more than 160 countries across income levels, geographical regions and development stages (Moisé et al., 2011; Moisé and Sorescu, 2013). They follow closely the structure of the WTO TFA, but the families of measures in the TFA have been re-organized, in order to take into account similarities between measures, underlying shared components, as well as areas where further distinctions were warranted. Another indicator, meant to capture elements of good governance and impartiality of border administrations, was also added (Box Table 1). Variables seek to reflect not only the regulatory framework in the concerned countries, but delve, to the extent possible, into the state of implementation of various trade facilitation measures. Overall, the indicators measure the actual extent to which countries have introduced and implemented trade facilitation measures in absolute terms, but also their performance relative to others, using a series of quantitative measures on key areas of the border process.

Box Table 1. Overall structure of the OECD Trade Facilitation Indicators

Indicator	Description
(a) Information Availability	Enquiry points; publication of trade information, including on Internet
(b) Involvement of the Trade Community	Consultations with traders
(c) Advance Rulings	Prior statements by the administration to requesting traders concerning the classification, origin, valuation method, etc., applied to specific goods at the time of importation; the rules and process applied to such statements
(d) Appeal Procedures	The possibility and modalities to appeal administrative decisions by border agencies
(e) Fees and Charges	Disciplines on the fees and charges imposed on imports and exports
(f) Formalities – Documents	Acceptance of copies, simplification of trade documents; harmonisation in accordance with international standards
(g) Formalities – Automation	Electronic exchange of data; use of risk management; automated border procedures
(h) Formalities – Procedures	Streamlining of border controls; single submission points for all required documentation (single windows); post-clearance audits; authorised economic operators
(i) Internal Co-operation	Control delegation to Customs authorities; co-operation between various border agencies of the country
(j) External Co-operation	Co-operation with neighbouring and third countries
(k) Governance and Impartiality	Customs structures and functions; accountability; ethics policy

Source: OECD (2015a).

4. The current study aims to provide a new methodological approach to assessing economy-wide impacts of trade facilitation reforms within the OECD METRO trade model, capturing gains both on the supply and the demand side. The proposed approach explicitly models the value of faster delivery linked to

the trade facilitation policy actions. It adds value to the current stock of research directed at the impacts of trade facilitation, and a full implementation of the TFA[3] in particular, by:

- incorporating the TFIs, which provide an up-to-date mapping to the main policy areas in the TFA, into the METRO model and estimating their effect employing different scenarios for trade facilitation policy developments;

- documenting new channels through which trade facilitation reform can benefit the global economy;

- discussing the distribution of potential benefits across country groupings at different levels of development;

- providing a more nuanced picture of effects, by exploring the reform outcomes across different sectors and on different use markets (i.e. intermediate, household, government and capital).

2. Capturing the economy-wide impacts of trade facilitation

5. As conventional trade barriers are lowered, transaction costs related to border procedures are increasingly important. Analysed through the lens of non-tariff measures, border procedures and formalities can have economy-wide impacts through different channels, including price effects and efficiency effects. Price effects increase the price of traded products over what they would otherwise be, with a generally dampening effect on the level of trade. They can be either direct, as in payments of customs fees, or indirect, as in costs resulting from inefficient and burdensome trading processes as well as border clearance delays. Efficiency effects can arise from distortions in the allocation of resources in the economy. Both price and efficiency effects generate welfare losses for consumers and producers in both importing and exporting countries (OECD, 2009).

6. The nature and magnitude of the effects may differ depending on the type of products traded. For highly perishable products, delays of goods at the border can generate product losses or increased costs for storage and refrigeration and thus impose depreciation and inventory-holding costs (including high opportunity costs). Multi-stage production may be especially sensitive to lags and variability in timely delivery. Most large manufacturers are heavily dependent on frequent and timely delivery of raw materials and intermediate goods for their production processes. When consumers' preferences are taken into account, speed and flexibility also play a key role where there is uncertainty in the quantity demanded, product quality, or desired product characteristics (this is particularly the case for products subject to changing consumer preferences, such as fashion clothing items or particular toys). Moreover, if the product has a limited shelf life, then prolonged stays at the border could push the product out of the market (OECD, 2009; Walmsley and Minor, 2016).

2.1. Trade facilitation as efficiency gains from decreasing shipping losses

7. Hummels (2001) emphasized that time savings associated with the elimination of customs-related delays can have an effect on international trade by reducing both "spoilage" and inventory holding costs. Inventory costs include not only the capital costs of the goods while they are in transit, but also the need to hold larger inventories to accommodate variation in arrival time. The latter has become increasingly

3. The full implementation of the TFA considers countries worldwide would implement all the options contained in the Agreement - including those formulated on a "best endeavours" basis – as measured by the TFIs.

important due to the use of "just in time" production techniques (Hertel et al., 2001). Hummels et al. (2007) show that speedy delivery is less important for bulk commodities and simple manufactures, while it is critical when goods are subject to rapid depreciation and when demand for them is uncertain.

8. Losses and costs associated with border inefficiencies, spoilage or inventory holding can be modelled following the widely used *iceberg* cost approach. The idea behind this approach is that the costs of transporting a good are being paid for by a portion of the transported good, rather than any other resources (Samuelson, 1954). Like an iceberg, the value of the product "melts" away, as it is "towed" to more distant destinations. In this sense, several recent CGE studies attempted to translate trade facilitation improvements into technological progress in trading activities[4]. Indeed, inefficient trade procedures increase the cost of trade and drive a wedge between the price received by the producer of the good and the price paid by the consumer - this represents a pure deadweight loss. Following this "sand in the wheels" approach (Fugazza and Maur, 2008) for depicting efficiency losses, other studies tried to account for both direct and indirect transaction costs associated to trade facilitation deficiencies.[5] Other recent research aims at capturing more accurately the magnitude and sources of indirect transaction costs. [6]

9. In a nutshell, the efficiency-gains (*iceberg*) approach considers that the implementation of trade facilitation reforms lowers the cost of trade, raising the quantity of imports consumed relative to the quantity exported through an import-augmenting technological change. This approach is appropriate to the extent that time delays lead to real costs for importing firms, such as when agro-food products spoil due to long delays in customs or when the delay of an imported intermediate induces delays in the entire production process. In many cases, however, such time delays are an inconvenience, rather than a real cost. In those cases, employing the iceberg approach alone is likely to overstate the impact of a full implementation of the TFA on real costs and hence real GDP (Walmsley and Minor, 2016).

2.2. Gains derived from the speed of delivery

10. The speed and timeliness attached to efficient border procedures also need to be seen in terms of their impact in the context of dynamic production networks and fast-evolving consumer tastes. In the case of agro-food products, spoilage may not only affect the product quantity arriving in the market (as in the iceberg approach), but also influence consumers' willingness to pay for that product: assuming that both

4. Hertel et al. (2001) were the first to introduce an efficiency-shock variable to simulate the impact of lower non-tariff trade costs such as customs clearance costs. The import-augmenting technological change was inspired by the iceberg model of Samuelson (1954), originally designed to model transportation costs. Notably, Samuelson's approach reduced the quantity arriving in the importing market, compared to that which left the dock in the exporting country. The loss of the quantity was deemed a stylized payment for shipping. Similarly, the "technical efficiency" variable introduced by Hertel et al. (2001) into the import demand equation changes the quantity received by the importer and captures the overall impacts of lowering trade transaction costs.

5. For instance, Fox et al. (2003), Francois et al. (2005),Walkenhorst and Yasui (2005). Direct transaction costs are modelled as a normal import tax, reflecting a transfer of rent between importers and domestic agents, while indirect transaction costs are modelled as efficiency losses. Walkenhorst and Yasui (2005) split in addition the taxes between those borne by importers and those borne by exporters.

6. For instance: Zaki (2014), Decreux and Fontagné (2015), Fontagné and Fouré (2016). In modelling trade facilitation, Zaki (2014) tried to account for effects of bureaucracy, internet coverage, corruption, and geographical barriers on the time to trade. Decreux and Fontagné (2015) represent trade costs as the *ad valorem* equivalent of the time at the frontier (customs procedures and time at the port). Fontagné and Fouré (2016) use trade costs impacts based on the OECD TFIs and derive country-pair specific reductions in trade costs required to reach TFA commitments.

the quantity and quality of these products will lessen along the way, their importers will factor this into the price they are willing to pay for the goods, so as to account for any losses selling them on to customers.

11. Timeliness is also important in the presence of demand uncertainty, a characteristic of "lean retailing" in modern textile or apparel supply chains (Evans and Harrigan, 2005). Long lags between ordering and delivery require firms to commit to product specifications and quantities to be supplied before uncertain demand is resolved (Hummels and Schaur, 2013). Consumer tastes are volatile, and retailers face the prospect of having to liquidate vast inventories of unpopular clothing at the end of a selling season or of running short of suddenly popular styles. "Lean retailing" – the combination of low inventories and frequent restocking – offers a partial solution to these problems. With low inventories, stores will not be stuck with large amounts of unsold goods even if demand collapses. The essence of lean retailing is to respond rapidly to demand fluctuations instead of holding large inventories. From the standpoint of producers, lean retailing demands great flexibility. If they want to sell to lean retailers, producers must be able to adjust output rapidly and ship products quickly. The benefit for flexible producers is that they can charge a premium over their less flexible competitors, who can compete only on selling cost and not on timeliness (Evans and Harrigan, 2005). But importers and exporters cannot be flexible without smooth border procedures.

12. While demand shifts are less frequently applied when implementing non-tariff measures (NTMs) in CGE models, the importance of the "willingness to pay" concept and its impacts on welfare in the context of NTMs have been recognized in a number of cost-benefit studies, and in particular the analysis of food regulations (Van Tongeren, Beghin and Marette, 2009; Van Tongeren et al., 2010; Beghin et al., 2012; Beghin et al., 2013)[7].

13. In order to capture the importance of timeliness for the user or consumer, Walmsley and Minor (2016) developed a *willingness to pay* approach for trade facilitation. Consistent with previous literature on importers' willingness to pay to reduce shipping times (Hummels et al., 2007; Hummels and Schaur, 2013), the newly developed alternative approach postulates that consumers prefer goods delivered more quickly to those that are delayed and are thus willing to pay more for them. This is valid not only for final products, but also for intermediate goods, the faster delivery of which through the supply chain also improves final delivery times and increases consumers' willingness to pay for the final product. On the firm side, the ability to delay importing decisions until better market knowledge is obtained, and then to receive those imports quickly once the decision has been made, has distinct advantages that retailers and importers exploit (Walmsley and Minor, 2016). So, the *willingness to pay* approach explicitly models the reduction in customs delays from the demand side as an increase in the consumer's willingness to pay for faster delivery.

14. Quantification of the economy-wide impacts of trade facilitation and disentangling the channels through which trade facilitation reform can benefit the global economy represent thus a major analytical challenge given the complexity of the underlying issues. The choice of the transmission mechanism can have important consequences for impact estimates of GDP, trade, and welfare (Walmsley and Minor, 2016).

7. These papers argue that the efficiency gains or losses from NTMs may be less important for welfare than consumer preferences regarding health and safety standards or other concerns these NTMs were intended to address, particularly when the measure is non-discriminatory. For instance, the imposition of a standard on a traded good that removes doubt over the quality or safety of the good may provide an additional benefit to the importer or exporter of the good for which they are willing to pay.

3. Incorporating the TFIs into the OECD METRO model

15. In order to quantify the potential economy-wide impacts of a full TFA implementation, the OECD TFIs are incorporated within METRO, the OECD's static multi-regional computable general equilibrium (CGE) model (Box 2). The model is particularly well suited to this analysis because of the detailed inter-linkage effects that it captures as a result of its ability to differentiate between the use of domestic and foreign intermediate inputs. METRO is thus able to capture how changes in trade facilitation policies affect interconnected modes of production.

Box 2. What is the OECD METRO model?

In 2015, the OECD launched a new global computable general equilibrium (CGE) trade model, known as METRO (ModElling TRade at the OECD). CGE models are computer simulation models that use data to explore the economic impact of changes in policy, technology and other factors. They show how different sectors inside one economy are linked and how multiple economies are connected to each other, and how resources such as labour, capital and natural resources are best allocated across all economic activities. The METRO model builds on the GLOBE model developed by Scott McDonald and Karen Thierfelder (2013).

The METRO database currently covers 61 economies across 57 economic sectors. It is based on the GTAP (Global Trade Analysis Project) database, and uniquely incorporates recent OECD statistical developments. METRO allows users to analyse global value chains (GVCs) by drawing on the OECD-WTO Trade in Value Added (TiVA) database, providing a platform to more fully integrate structural policy issues in the analysis of trade policy. METRO also features an extensive library of trade-related policies, including current border tariff rates and export restrictions, as well as domestic taxes and support. Using METRO, it is now possible to track trade flows by their use (i.e. intermediate, household, government and investment) in addition to bilateral links between source and destination markets. This will greatly enhance the ability to model movements of goods and services, especially along global value chains.

Source: OECD (2015b).

16. In order to reflect the varying characteristics of the countries covered, which may result in differing outcomes as to the relative impact of improvements in trade facilitation, as captured by the TFIs, several groups of countries (as opposed to individual countries) are formed according to income and geographic criteria. The 42 goods sectors are aggregated into 8 groups. Table 2 provides a summary of the country and sector level focus (details in Annex 1).

Table 1. Summary of country and sector aggregations

Country groupings		Sector groupings
Income criteria	**Geographic criteria**	**METRO aggregates**
Low income countries (LICs)	South America	Agro-food
Lower middle income countries (LMICs)	Central America and Caribbean	Mining and extraction
Upper middle income (UMICs)	North America	Textile and wearing apparel
High income countries outside the OECD area (HICs)	East Asia and the Pacific	Light manufacturing
OECD countries (OECD)	Southeast Asia	Paper and paper products
Rest of the World (RoW)	South Asia	Heavy manufacturing
	Europe	Motor vehicles and parts
	Rest of Europe and Central Asia	Machinery, electronic and transport equipment
	Middle East and North Africa	Services
	Sub-Saharan Africa	
	Rest of the World (RoW)	

3.1. Trade facilitation modelling approach

17. The modelling strategy for incorporating trade facilitation into METRO differs in several respects from the earlier studies in the field[8]. Trade facilitation reforms are depicted through a mix of the two approaches described in the first section[9]: partly as decreasing losses (the 'iceberg costs') on the producer side (following the approach of Hertel et al., 2001) and partly as increasing 'willingness to pay' (WTP) on the consumer side (following the approach of Walmsley and Minor, 2016). With the implementation of trade facilitation reforms, it is indeed likely that both effects – iceberg and willingness to pay – occur. First, trade facilitation improvements are likely to reduce losses accruing from shipping and clearance delays and thus enhance efficiency. Second, in the context of GVCs and rapidly changing consumer preferences, firms and consumers are also willing to pay more for a product for which they obtain a higher utility from a faster delivery.

18. The trade facilitation policy changes are captured through *ad valorem equivalents* (AVEs). The AVEs express the value associated with a reduction in clearance delays triggered by improvements in border procedures and are obtained in two stages[10]:

i. Estimating the improvements in clearance times triggered by improvements in the trade facilitation environment, as measured by the TFIs. This first step links the time to trade[11] with the

8. Such as: Francois et al. (2005), Walkenhorst and Yasui (2005), Zaki (2014).

9. The detailed description of the modelling techniques is provided within the METRO technical paper TAD/TC/WP(2016)20.

10. Further details on the methodology can be found in the METRO technical paper TAD/TC/WP(2016)20.

Trade Facilitation Indicators (TFIs)[12]: trade facilitation improvements in the policy areas covered by the TFIs are shown to lead to reductions in both the import and export clearance times, measured in hours, for each individual country. The total change in the delivery time for a good is then defined as the reduction in a country's own estimated import time coupled with the reductions in its trading partners' trade-weighted estimated export times.

ii. Linking the clearance time improvements with the value associated to one hour "saved" in transit. The value associated to time is available at the product level from the database constructed by Hummels et al. (2007) and expressed in ad valorem or "tariff equivalent" terms[13]. The authors estimate the value of one day saved in transit at the Harmonised System 4 digit (HS4) product level ("the per-day value of time savings" by product), drawing on trade and shipping data that reveal how much the timely delivery of each good is valued by consumers. A mapping is conducted between the HS4 product classification and the sectors used in METRO in order to obtain AVEs for the time to trade for each METRO sector.

19. The trade facilitation policy impacts are introduced in the METRO model as ad valorem equivalents by importer grouping – exporter grouping – aggregated sector – use (i.e. intermediate, household, government, or capital: a summary table is provided in Annex 2)[14]. There are currently no data available on the relative importance of supply and demand effects (iceberg and willingness to pay) for the various product categories considered. The analysis therefore assumes equal importance and applies a mixed approach where the AVE estimate is introduced 50% as iceberg cost and 50% as willingness to pay. To explore the boundaries of this methodological assumption, the scenarios are also run with a full iceberg versus a full willingness to pay approach.

3.2. Sensitivity analysis and caveats

20. The model's trade parameters and macroeconomic assumptions will inevitably influence the outcome of the policy simulations. To address this issue, a sensitivity analysis is conducted in order to evaluate the effects of various assumptions on the results (Annex 2).

21. It is also important to bear in mind that the METRO model is comparative-static in nature, and, hence, not designed to capture dynamic adjustment processes. An additional caveat that needs to be taken into account is the fact that the model does not consider at this stage implementation costs of trade facilitation reforms. The magnitude of benefits has to be seen as an upper boundary of the gains that might actually be achievable, as the investments needed to achieve the trade facilitation improvements are not incorporated in the quantitative analysis, owing to the lack of consistent cross-country information. Moisé (2013) was able to provide data on the costs and challenges of implementing trade facilitation measures for nine developing countries. That study confirmed earlier findings (OECD, 2009) that the costs of putting in

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11. World Bank Doing Business – Trading Across Borders dataset. Details on the time to trade components are provided in Annex 1. Authors are thankful to Dorina Giorgieva and Valentina Saltane in the Doing Business Unit of the World Bank for providing the data.

12. The approach is inspired by Hillberry and Zhang (2015) and Walmsley and Minor (2016).

13. Authors are thankful to Peter Minor from ImpactEcon for sharing the version used in Walmsley and Minor (2016).

14. The shock simulating trade facilitation policy impacts represents the reduced number of hour delays in import and export customs and the average hourly ad valorem equivalent of the willingness to pay for reduced shipping delays. Details on how the shocks are introduced in METRO are provided in the technical paper TAD/TC/WP(2016)20.

place and maintaining trade facilitation measures are not particularly large and are far smaller than the benefits gained from implementing these measures. Capital expenditure to introduce the measures ranged between EUR 3.5 and EUR 19 million, while annual operating costs did not exceed EUR 2.5 million. Information technologies and single window mechanisms seemed to be the most expensive elements but the most important area was training, because of its role in changing the business practices of border agencies. Additionally, some measures may be expensive to introduce but not costly to operate, while others require political commitment rather than funds. Moreover, technical and financial assistance to implement these measures is being made available to developing countries to assist with trade facilitation reforms.

4. Impacts of trade facilitation reform and channels of transmission

22. Trade facilitation reforms will reduce border delays and improve overall product delivery times, thus changing incentives of economic agents and ultimately impacting worldwide production and consumption patterns. Such impacts will encompass changes in prices of inputs and outputs, overall production, and trade of goods and services. These can have further knock-on effects on employment and wages.

23. The effects of trade facilitation improvements will greatly depend on the adjustment possibilities in the labour market and on how labour is employed across sectors. Labour markets are currently characterised by rigid wages and unemployment, warranting the use of an unemployment assumption in the short term. This assumption would better depict economies with significant labour market rigidities and a larger pool of unemployed workers. In the longer run, it is assumed that labour markets may be more likely to adjust to imbalances by adjusting wage rates while sustaining employment levels through a highly flexible and mobile labour force, and hence a fixed labour-supply assumption is used.

24. The impacts of trade facilitation reforms are analysed under the short and long term horizons: section 4.1 looks at the effects in the short term, assuming wage rigidities and unemployment[15], while section 4.2 analyses the effects in a longer term perspective[16], assuming full employment and flexible wage rates.

4.1. Trade facilitation reforms as an efficiency trigger

25. Over a short time horizon, the possibilities for economies to adjust to changing market conditions are more likely to be limited; investment and government expenditure, for instance, are already committed. In addition, labour markets are more likely to be characterised by the presence of rigidities and unemployment. This is reflected in the first setting of the analysis which explores the efficiency-induced effects triggered by improving administrative procedures at the border in a situation of wage rigidities and unemployment.

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15. Other production factors, i.e., capital land and natural resources are fully employed and mobile. In the capital market, investment volume is fixed and the savings rate flexible. The selected setup thus resembles more a short-to-medium term setup. It also assumes that government expenditure is committed (fixed) and the internal balance flexible to balance government income (all tax rates are fixed) and expenditure; and that the exchange rate balances the current account.

16. In the long term setup, government expenditure is flexible to adjust to changes in government income (all tax rates are fixed) and investment is savings driven; the exchange rate balances the current account. Other production factors, i.e., capital land and natural resources are fully employed and mobile.

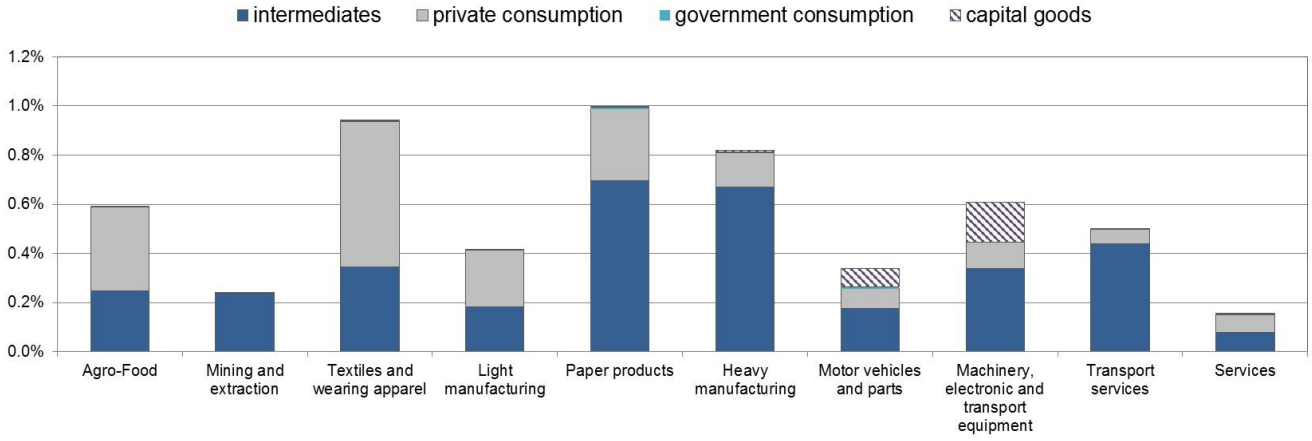
Enhancing GVC linkages by reducing inefficiencies and delays in the delivery of intermediates

26. Benefitting from GVCs is not just a question of whether firms are better able to manage the costs of exporting, but also of whether they have access to competitively-priced inputs, know-how and technologies (Lopez Gonzalez, 2016). Messages from the literature are consistently that firms which use a higher share of imported intermediates can enhance their productivity, allowing them to access new export markets. Such gains can arise through two channels: first, via the use of more varieties of (and potentially more competitively priced) intermediates, and second, via technology transfers 'embodied' in foreign intermediates. Imported intermediates from developed countries are found to provide a greater boost to productivity and exporting propensity (Bas and Strauss-Kahn, 2014).

27. METRO analysis shows that by significantly reducing trade transaction costs and clearance times, worldwide implementation of the TFA has the potential to increase world trade by 0.6% compared to the base[17]. Trade increases in all sectors, with manufacturing sectors showing the highest growth rates (Figure 1). These findings generally confirm earlier analysis of impacts of improvements in trade facilitation as captured by the TFIs on goods trade, performed within a gravity framework (Moisé et al., 2011; Moisé and Sorescu, 2013). While the impacts remain higher for the manufacturing sectors considered than for agro-food, the current analysis shows trade facilitation improvements can also lead to higher trade in the agro-food sector. By contrast, the results for this sector proved less stable in the gravity analysis framework, thus highlighting the importance of capturing the economy-wide interactions.

28. Trade in the sector groups covered increases between 0.2% and 1%. Intermediates account for the largest share of this increase for the majority of selected sectors, namely: mining and extraction; paper and paper products; heavy manufacturing; motor vehicles and parts; as well as the sector of machinery, electronic and transport equipment (Figure 1). These sectors are characterised by strong GVCs linkages and therefore firms are likely to see further cost savings from 'just-in-time' access to a higher variety of competitively-priced intermediate inputs. Intermediates also account for the largest increase in developing and emerging economies' exports, underscoring that the unbundling of tasks and business functions typical of value chains increases their opportunities to engage in global markets without having to develop complete products.

Figure 1. Trade effects by commodity (% changes by end use categories, short term)

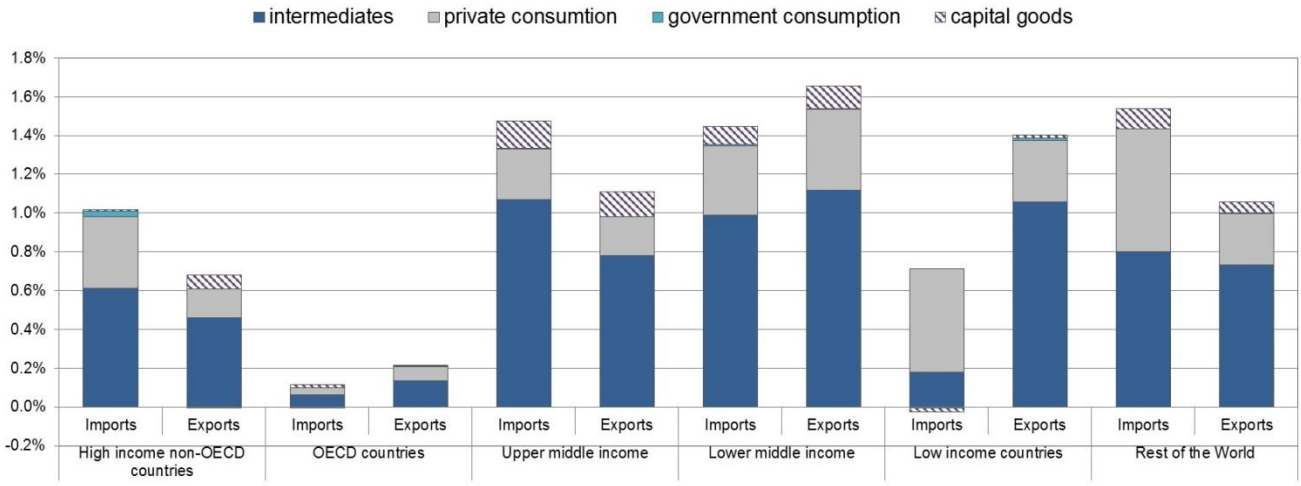


Source: METRO simulation results.

17. The base refers to the 2011 data used in the METRO model to reflect the structure of the world economy.

29. Trade increases also for all country groups covered (Figure 2). The magnitude of the increase is stronger for exports than for imports in the case of LICs, LMICs and OECD groups. For LICs, the rise in exports is twice as high as the increase in imports. While the largest share of the increase in imports is accounted for by goods and services for final consumption, the effect of increasing imports of intermediates appears particularly important in enhancing LICs' competitiveness.

Figure 2. Impacts on imports and exports by income group (% changes to base, short term)



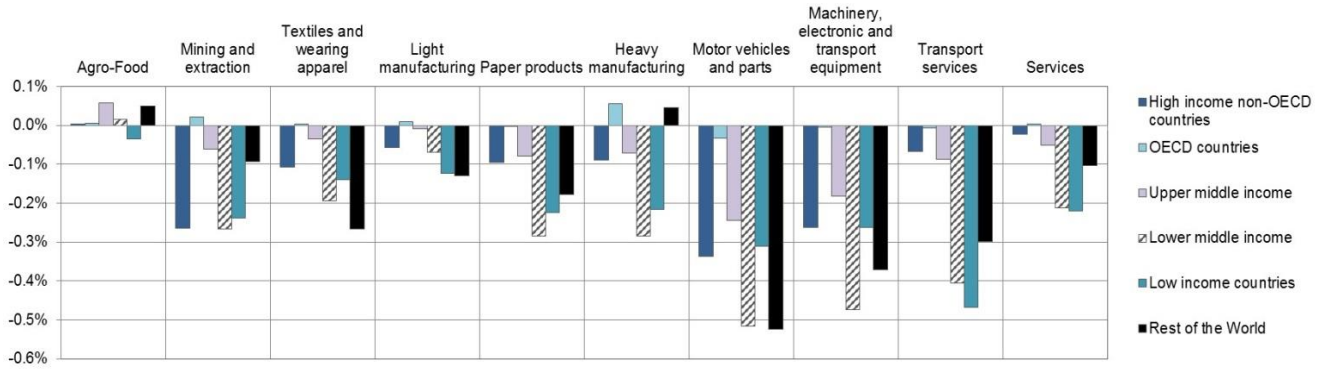
Source: METRO simulation results.

Overall impacts on input costs

30. Trade facilitation reforms generate positive effects beyond trade to production. The decrease in the costs of imported intermediates further contributes to lowering overall input costs across the large majority of sectors, with the exception of agro-food products (Figure 3). The latter is explained by the specific production structure of the agro-food sector: as for the other sectors, the cost of imported intermediates decreases; unlike other sectors, however, the agricultural sector is characterised by a relatively small share of use of intermediates relative to primary production factors. Increasing demand for agricultural production increases demand for arable land and this in turn increases agricultural output prices. The food sector in turn uses mainly agricultural goods as intermediate inputs for which prices for domestic supply increase and this specific impact dominates the overall effect.

31. The intermediate inputs cost decrease is most pronounced in the machinery, transport and electronic equipment; heavy manufacturing; and transport service sectors. This confirms that importing is a necessary condition for firms to remain competitive in the domestic economy as well – sectors not only benefit from the direct effect of lower costs for imported intermediates, but also from lower costs for domestically produced intermediates.

Figure 3. Intermediate inputs costs, by sector and income group (% change to the base, short term)



Source: METRO simulation results.

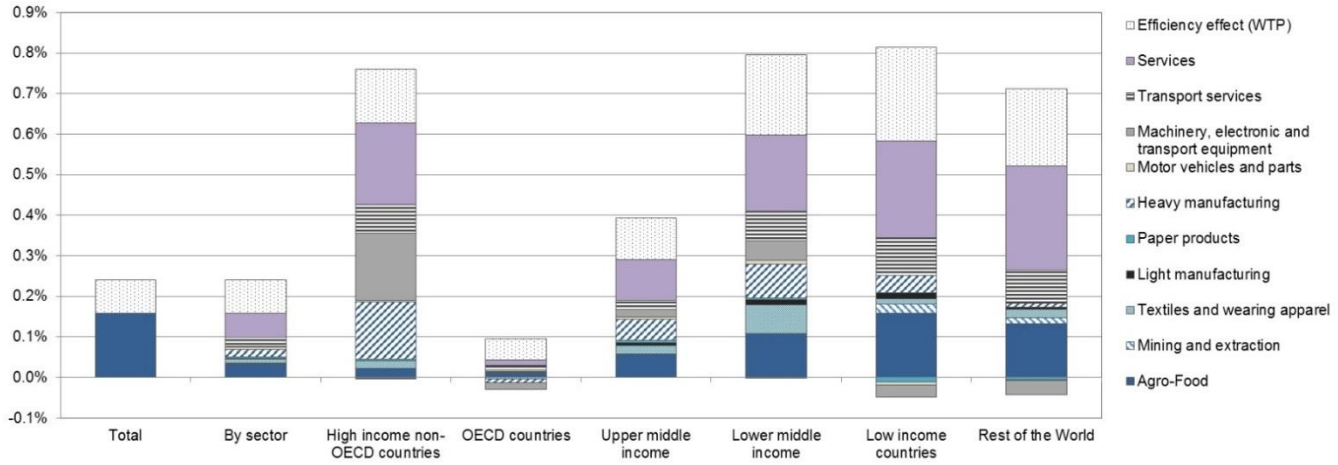
Production effects

32. Declining input costs lower output prices and this leads to a positive impact on both domestic and export demand, which in turn stimulates production. Overall output levels increase across all income groups, up to 0.5%. The strongest increases are for LICs and LMICs, followed by high income countries outside the OECD area and RoW (Figure 4). The smaller trade and production effects observed for OECD countries compared to the other selected regions are linked to their already high level of trade facilitation performance and faster clearance times.

33. The goods sectors for which output expands the most are agro-food and heavy manufacturing, with strong effects across the groups of developing and emerging economies (including LICs, LMICs, UMICs, and RoW)[18]. A key share of the worldwide output increase is linked to the expansion of the services sectors, highlighting the importance of services in both connecting the nodes of different production segments and as an increasingly important input to the production processes. The "real" increases in output levels are "complemented" by the efficiency increase triggered by trade facilitation improvements, as depicted in Figure 4. This efficiency increase reflects both the reduced quality losses and time delays at the border which boost firms' and consumers' willingness to pay (WTP).

18. The rise in production is triggered by an increase in demand. Although the increasing production costs in agriculture dampen the positive demand effect in this sector, the overall impact on agro-food output is positive.

Figure 4. Production effects by income region and sector (% change to base, short term)

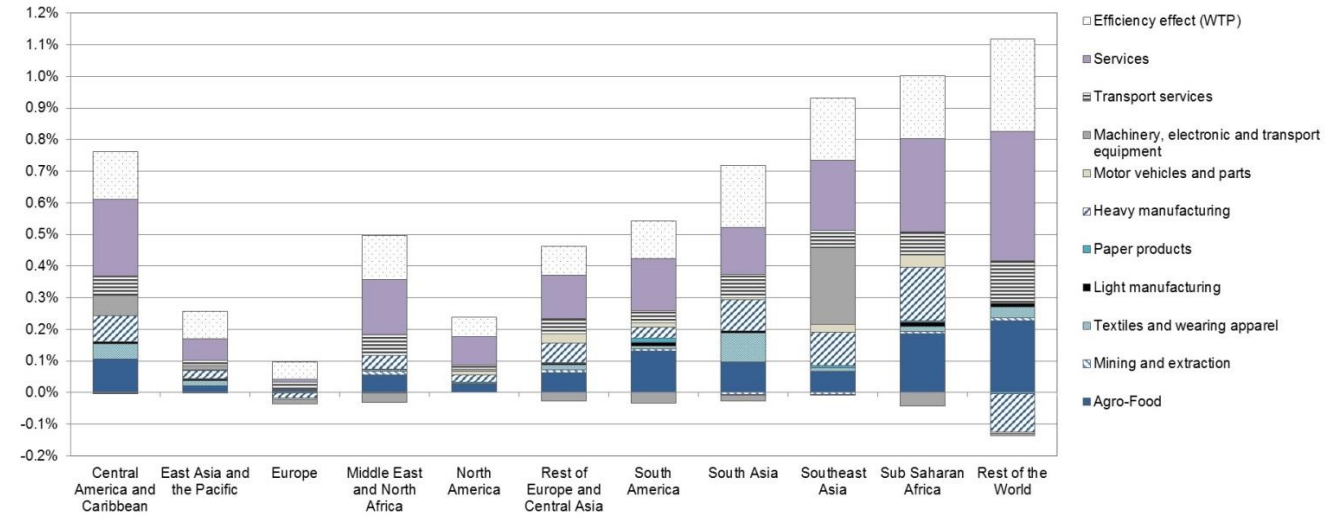


Note: The sectoral change represents the contribution to the overall production change of a country group. The efficiency effect (WTP) depicts the higher levels of utility resulting from faster delivery times. This applies for all production and welfare analysis charts.

Source: METRO simulation results.

34. In the case of Asian regions (South East and South), the sectors which would expand the most are heavy manufacturing, textile and wearing apparel, machinery, electronic and transport equipment, as well as services. In South America and Sub-Saharan Africa, notable output effects would be seen for the agro-food sector as well as heavy manufacturing and services. In other regions, such as North America or Europe, the production effect is dominated by services. Once again, across all regions, the expansion of manufacturing is strongly linked to strengthening the base for services expansion (Figure 5). These impacts reflect improved output in areas of comparative advantage for the selected regions.

Figure 5. Production effects by geographical region and sector (% change to base, short term)



Source: METRO simulation results.

4.2. Long-term impacts on resources allocation and wages

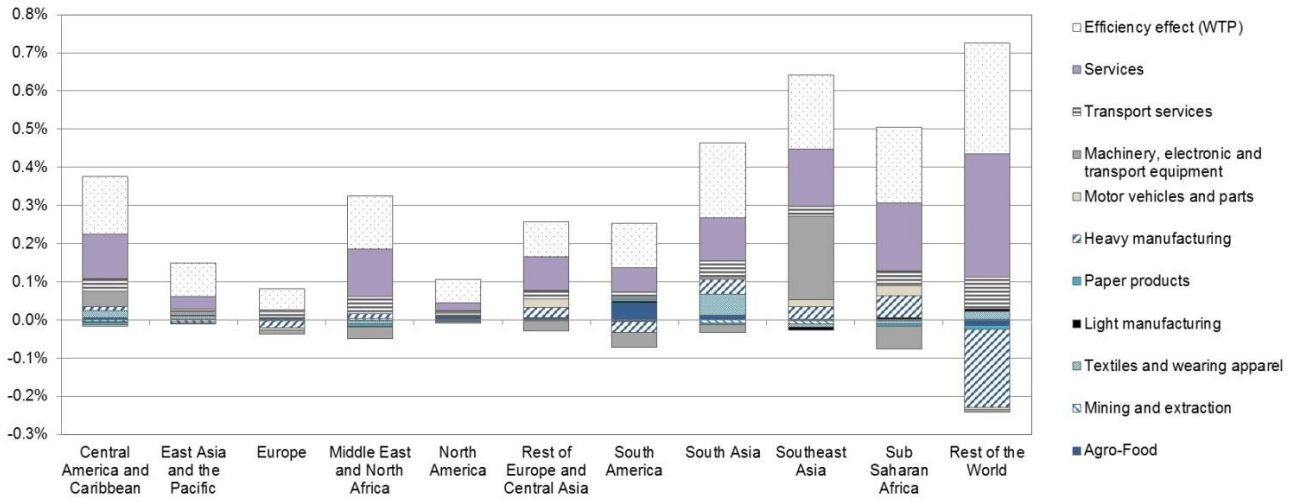
35. In the longer run, the assumption is that the adjustment of labour markets to production needs through more flexible wage rates sustains employment levels, so an assumption of full employment is used. This setting highlights the broader economic benefits stemming from the efficiency spill-overs of trade facilitation reforms over a longer-term horizon, along with the associated impacts on the allocation of resources across sectors and on wages.

A more efficient production and resource allocation

36. Over the longer term, improved worldwide trade facilitation performance would lead to increased production by encouraging specialisation and the reallocation of resources towards those activities that reflect a country's comparative advantage. Due to increased efficiency and lower costs, including from greater use of imported intermediates, the degree of competition faced by domestic producers will also be intensified, generating a more efficient allocation and use of resources. Triggered by increased competition, in a scenario where factors are free to adjust, production shifts would take place both between and within regions. If cumbersome procedures at the border had the effect of reducing competition for inefficient local production, then on the one hand, cheaper imports would put pressure on local firms to increase their efficiency and reduce production costs; on the other hand, competing domestic firms would also experience efficiency gains from accessing lower cost inputs. At the domestic level, certain sectors would be able to grow by sourcing labour from other sectors. At the global level, intensifying competition in the world market may further impact the price reductions triggered by trade facilitation.

37. The longer run setting shows that the economic efficiency and competition gains spurred by trade facilitation would have positive effects on aggregate production across all regions, reaching up to 0.4% in Southeast Asia (Figure 6). As in the short term setting, the overall benefits from trade facilitation reforms would consist of both "real" production effects and increased utility derived from faster delivery times as well as reduced quality losses (that is, gains from increased consumer and user willingness to pay). The strongest production effects in Southeast Asia are in the machinery, transport and electronic equipment sectors. South Asia has the potential to increase production in heavy manufacturing and textiles. There is also a key role for services (including transport services) for developing the production base in the Asia region. In Sub-Saharan Africa, notable increases would be experienced by heavy manufacturing, motor vehicles and parts, and services. Production in regions such as MENA would be dominated by the services expansion. This effect is also linked to the availability of cheaper imports of consumer goods, which leads to a shift of the domestic production structure towards services.

Figure 6. Production effects by geographical region and sector (% change to base, long term)

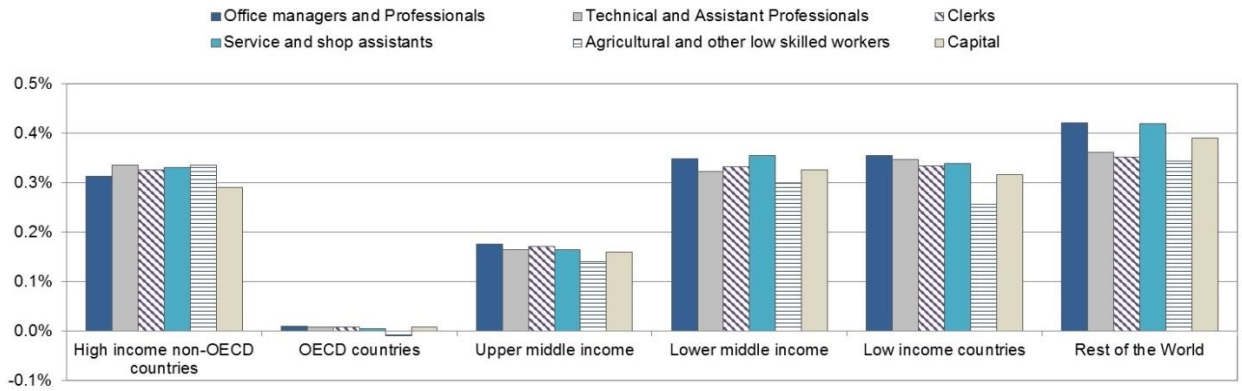


Source: METRO simulation results.

Incomes increase in the long run

38. In the long run, trade facilitation reforms would also translate into increasing incomes (Figure 7). All labour categories in developing and emerging economies, including skilled and unskilled, would experience higher returns. Across developing country groups, labour income increases are in the range of 0.3%. The magnitude of effects is most notable for LICs, LMICs, high income countries outside the OECD area, and RoW. High-skill labour incomes increase in OECD countries; overall, the more modest income effects for this group are directly linked to the output impacts which are smaller compared to the other economies given their already high level of trade facilitation performance and faster clearance times.

Figure 7. Labour income evolution in the long run



Source: METRO simulation results.

39. The rise in income also leads to increasing consumption in all regions; such effects go up to 0.3% in LICs. This impact is compounded by the decreasing losses at the border and faster delivery, both of which increase efficiency - as a consequence, final demand increases.

Welfare driven by higher utility associated to faster delivery times

40. The increased efficiency of border procedures triggered by a full TFA implementation could potentially add between 0.04% and 0.41% to countries' GDP, depending on the level of development. Meanwhile, the utility increase from faster delivery will not be captured in the GDP measure, as this cannot be expressed through prices or quantities. In this sense, welfare analysis can provide a broader lens for assessing broader economic impacts from trade facilitation reforms over the longer term, as this will capture the utility benefits going beyond the output and GDP impacts[19]. According to this analysis, welfare would increase by between 0.05% and 0.63% of total demand (Table 2 presents the slight variations between approaches).

Table 2. GDP and welfare effects by country income grouping

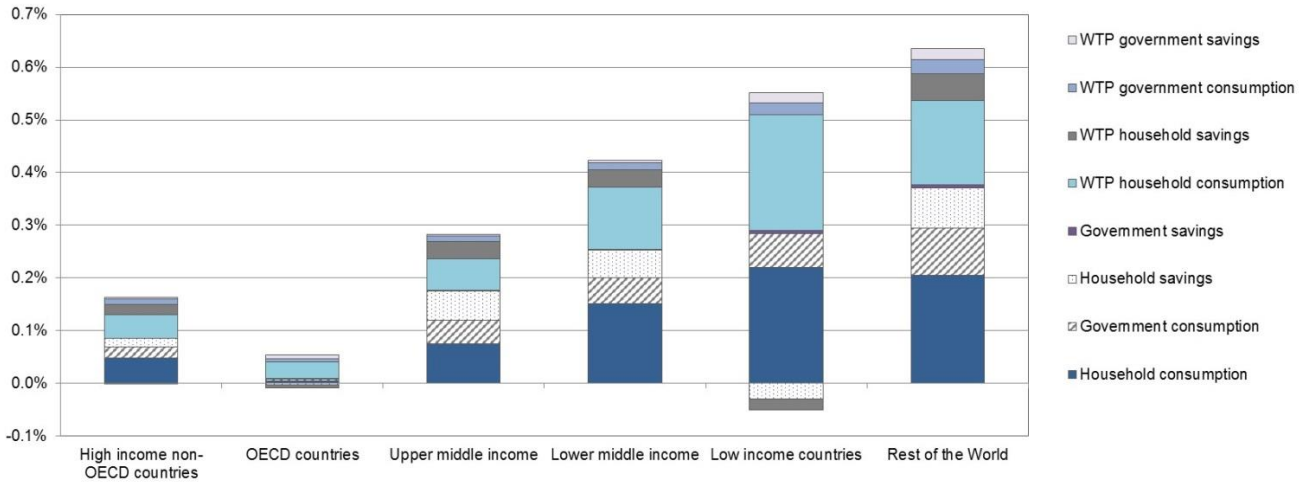
	High income non-OECD countries	OECD countries	Upper middle income	Lower middle income	Low income countries	Rest of the World
	Real GDP (expenditure)					
Iceberg – WTP[1]	0.18%	0.04%	0.13%	0.27%	0.41%	0.33%
Iceberg only[2]	0.35%	0.07%	0.22%	0.47%	0.77%	0.60%
WTP only[3]	0.01%	0.00%	0.04%	0.07%	0.03%	0.05%
	Welfare					
Iceberg – WTP[1]	0.16%	0.05%	0.28%	0.42%	0.50%	0.63%
Iceberg only[2]	0.15%	0.04%	0.26%	0.40%	0.51%	0.60%
WTP only[3]	0.17%	0.05%	0.31%	0.44%	0.49%	0.66%

Note: [1] accounting for both decreasing losses on the supply side and increased utility from faster delivery times on the demand side; [2] accounting only for decreasing losses; [3] accounting only for increased utility from faster delivery times.
Source: METRO simulation results.

41. Welfare increases across all the selected income groups and all key economic agents (including households, government and investment) (Figure 8). LICs and RoW benefit the most, with welfare increases accounting for 0.5% and 0.6% of total demand. Besides household consumption, a large part of the welfare increase for each country group stems from the higher utility triggered by faster delivery times. Increasing household consumption in LICs is counterbalanced by a negative effect on household savings, suggesting a need for further inward FDI to compensate for the fall in the pool of domestic capital.

19. The 'regional Equivalent Variation' (EV) is used, which allows accounting for such utility increases. This measures the amount of money that the household and government would need in order to reach the same level of utility without the policy change. The measure is depicted here relative to total regional final demand (absorption) in the base situation.

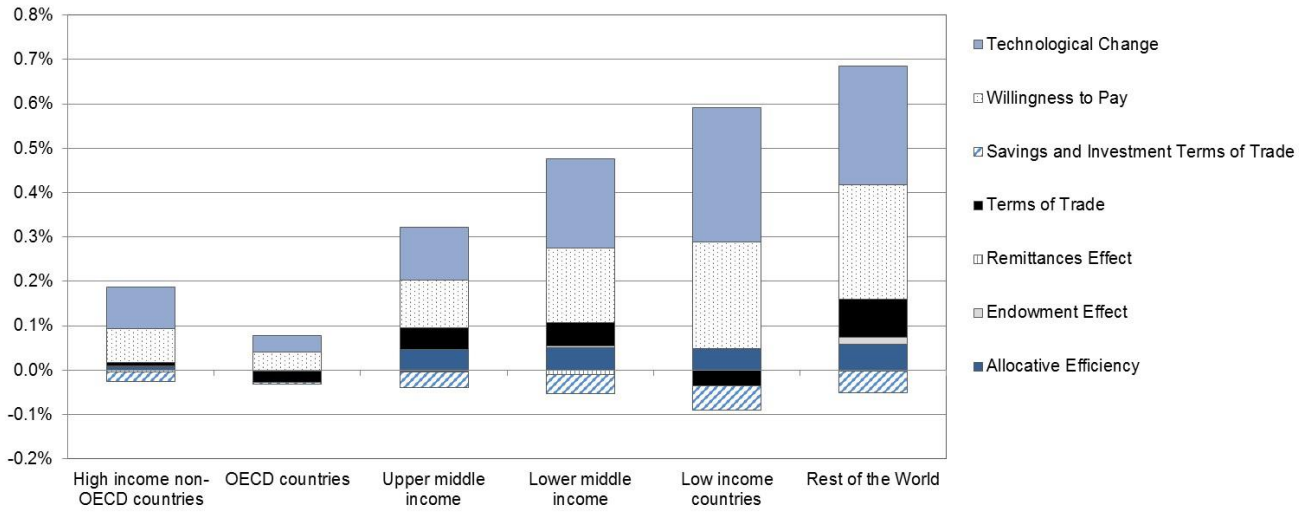
Figure 8. Welfare decomposition by income groups (long term)



Source: METRO simulation results.

42. A further decomposition of welfare impacts shows that across all groups covered, these increases in welfare over the longer term are driven by the overall utility gains and technological changes, followed by allocative efficiency effects which reflect the more efficient allocation of resources in domestic economies (Figure 9).

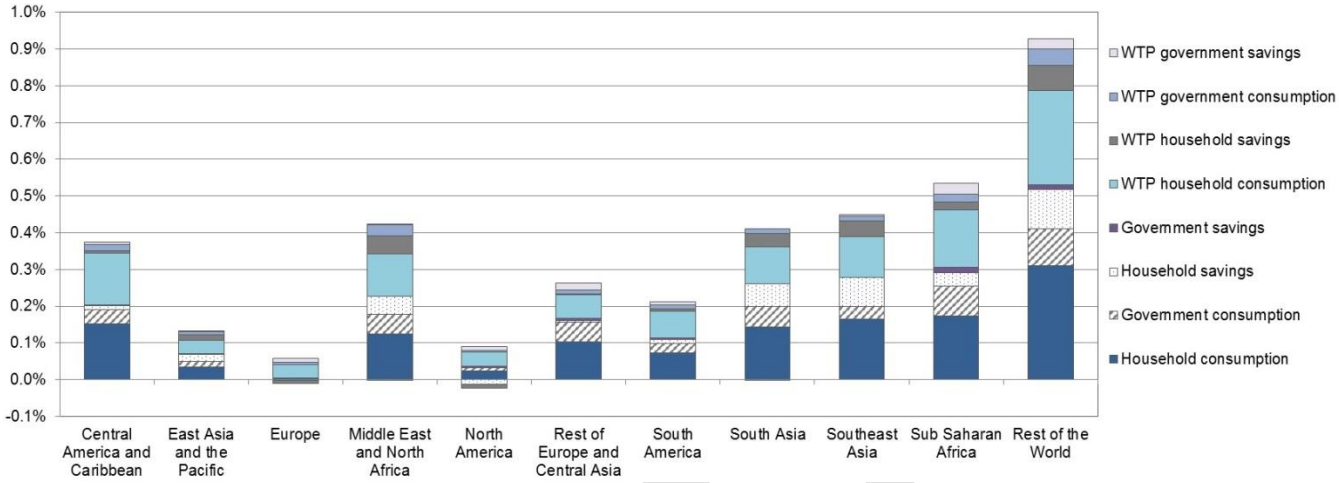
Figure 9. Further decomposition of welfare effects, by income groups



Source: METRO simulation results.

43. Over the longer term, trade facilitation reforms also lead to welfare increases in all selected geographical regions (Figure 10). Sub-Saharan Africa, Southeast Asia, South Asia, MENA, Central America and Caribbean experience welfare gains between 0.4% and 0.5% of their original regional demand. Welfare effects are at 0.2% for South America and the Rest of Europe and Central Asia, and 0.1% in Europe, North America, and East Asia and the Pacific. Households experience the largest welfare gains, followed by governments.

Figure 10. Welfare decomposition by geographical regions



Source: METRO simulation results.

Conclusions and policy implications

44. This paper aims to identify the broader economic impact of trade facilitation over the short and long term and the features that crucially affect the economy-wide transmission of those impacts by better representing the empirical characteristics of the border process in the OECD METRO model analysis, using the information from the OECD TFIs database. To this end, the study makes several contributions. The first is to adopt a modelling strategy for incorporating trade facilitation aspects into METRO which differs in several respects from earlier studies in the field. The second is to use the extensive information on border procedures provided by the OECD TFIs in order to identify the transmission mechanisms of trade facilitation improvements within a GVCs setting. A third contribution is to provide a quantification of the distribution effects across different country groups, including developing and emerging economies.

45. By significantly reducing trade transaction costs and clearance times, implementation of the WTO TFA has the potential to increase world trade by 0.6% compared to the base, with LMICs and UMICs experiencing the highest growth rates.

46. Improvements in TFIs also generate positive effects beyond trade to production. Trade facilitation reforms lead to a more efficient production and allocation of resources. Trade facilitation increases the degree of competition faced by domestic producers through reducing transactions costs associated with import and export and faster delivery times. In the long run, this allows a country to improve its efficiency of production in various ways. First, it increases the efficiency with which existing resources are used. Second, it encourages specialisation and the reallocation of resources towards those activities that reflect the country's comparative advantage. Finally, it promotes exploitation of economies of scale through exports to the world market.

47. There are positive production effects over the short term across all income groups, with LICs experiencing the strongest impacts, followed by LMICs and high income countries outside the OECD area. A large share of the production growth is a direct result of increasing export activities, but the boost to imports from trade facilitation reforms also plays a significant role: while firms face increasing competition in the domestic market, they also benefit directly from lower input costs and faster delivery times. While benefits can be seen across many sectors, decreases in intermediate inputs costs and overall

production costs are most prominent in motor vehicles and parts (0.33% and 0.18%) and machinery, electronic and transport equipment (0.26% and 0.14%).

48. Private consumption increases in all regions considered. The impact is compounded by the decreased losses at the border and faster delivery, both of which increase expenditure. As a consequence, final demand increases. When markets are functioning efficiently, this will result in a reduction in the domestic price of goods by making either cheaper foreign goods available or reducing the rents that may have previously been captured by domestic producers.

49. A longer run setting highlights the broader economic benefits stemming from the efficiency spill-overs of trade facilitation reforms, along with the associated impacts on the allocation of resources across sectors and on wages. Significant trade facilitation reforms from a worldwide implementation of the TFA would ultimately increase welfare over the long term across the selected country groups and for the key economic agents (including households, government and investment). LICs benefit the most, with welfare increases accounting for 0.6% of total demand. Besides household consumption, for each country group, a large part of the welfare increase stems from increased utility triggered by faster delivery times.

50. Overall, analysis based on the TFIs shows that trade facilitation measures can benefit all countries whether they are exporting or importing goods by allowing better access to inputs for production and greater participation in the GVCs that characterise international trade today. Economies with the biggest challenges in trade facilitation measures reap the greatest benefits from implementation. But the nature and extent of benefits will depend on how much of the agreement countries implement and the timeframes for implementation.

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ANNEX 1. COUNTRY AND SECTOR AGGREGATION

Annex Table 1.1. Country groupings by income

Group ID	Group name	Mapping to METRO regions
OECD	**OECD countries**	Australia, Austria, Belgium, Canada, Switzerland, Chile, Czech Republic, Germany, Denmark, Estonia, Finland, France, Greece, Hungary, Ireland, Israel[a], Italy, Japan, Korea, Latvia, Luxembourg, Mexico, Netherlands, Norway, New Zealand, Poland, Portugal, Slovak Republic, Slovenia, Sweden, Turkey, United Kingdom, United States
HICNOECD	**High income non-OECD economies**	United Arab Emirates; Bahrain; Brunei Darussalam; Cyprus[bc]; Croatia; Hong Kong, China; Kuwait; Lithuania; Malta; Oman; Qatar; Saudi Arabia; Singapore; Chinese Taipei; Trinidad and Tobago; Uruguay;
LMICs	**Lower middle income countries**	Armenia, Bangladesh, Bolivia, Cote d'Ivoire, Cambodia, Cameroon, Egypt, Ghana, Guatemala, Honduras, Indonesia, India, Kenya, Kyrgyz Republic, Lao PDR, Sri Lanka, Mongolia , Morocco, Nigeria, Nicaragua, Pakistan, Philippines, Senegal, El Salvador, Ukraine, Viet Nam, Zambia
UMICs	**Upper middle income countries**	Argentina, Albania, Azerbaijan, Bulgaria, Belarus, Brazil, Botswana, China, Colombia, Costa Rica, Dominican Republic, Ecuador, Georgia, Jamaica, Jordan, Kazakhstan, Mauritius, Malaysia, Namibia, Panama, Peru, Paraguay, Romania, Russian Federation , Thailand, Tunisia, South Africa, Venezuela
LICs	**Low income**	Benin, Burkina Faso, Ethiopia, Madagascar, Mozambique, Malawi, Nepal, Rwanda, Togo, Tanzania, Uganda, Zimbabwe
RoW	**Rest of the World**	
	Rest of Southeast Asia	Myanmar
	Rest of Oceania	Fiji, Papua New Guinea
	Rest of South Asia	Bhutan
	Rest of South America	Suriname
	Rest of Central America	Belize
	Caribbean	Antigua & Barbuda, Bahamas, Barbados
	Rest of Eastern Europe	Moldova
	Rest of Europe	Bosnia and Herzegovina, Macedonia, Montenegro, Serbia
	Rest of Former Soviet Union	Tajikistan, Uzbekistan
	Rest of Western Asia	Lebanon
	Rest of North Africa	Algeria
	Rest of Western Africa	Gambia, Liberia, Mali, Sierra Leone
	Central Africa	Central African Republic, Republic of Congo, Gabon
	South Central Africa	Angola
	Rest of Eastern Africa	Burundi, Djibouti
	Rest of South African Customs Union	Lesotho

a) The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

b) Note by Turkey: The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of United Nations, Turkey shall preserve its position concerning the "Cyprus" issue.

c) Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

Note: The income groups are based on the World Bank classification, as available in March 2016.

Annex Table 1.2. Country groupings by geographic region

Group ID	Group name	Mapping to METRO regions
SA	**South America**	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Peru, Paraguay, Uruguay, Venezuela, Rest of South America
CAC	**Central America and Caribbean**	Costa Rica, Dominican Republic, Guatemala, Honduras, Jamaica, Nicaragua, Panama, El Salvador, Trinidad and Tobago, Rest of Central America, Caribbean
NA	**North America**	Canada, Mexico, United States
EAP	**East Asia and the Pacific**	Australia; China; Hong Kong, China; Japan; Korea; Mongolia; New Zealand; Chinese Taipei
SEA	**Southeast Asia**	Brunei Darussalam, Indonesia, Cambodia, Lao PDR, Malaysia, Philippines, Singapore, Thailand, Viet Nam, Rest of Southeast Asia
SAS	**South Asia**	Bangladesh, India, Sri Lanka, Nepal, Pakistan, Rest of South Asia
EUR	**Europe**	Albania, Austria, Belgium, Bulgaria, Belarus, Switzerland, Cyprus[ab], Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, United Kingdom, Greece, Croatia, Hungary, Ireland, Italy, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovak Republic, Slovenia, Sweden, Ukraine
ECA	**Rest of Europe and Central Asia**	Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyz Republic, Russian Federation, Turkey, Rest of Europe, Rest of Eastern Europe, Rest of Former Soviet Union
MENA	**Middle East and North Africa**	Bahrain, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, Egypt, Israel[c], Morocco, United Arab Emirates, Tunisia, Rest of North Africa
SSA	**Sub-Saharan Africa**	Benin, Burkina Faso, Botswana, Cote d'Ivoire, Cameroon, Ethiopia, Ghana, Kenya, Madagascar, Mozambique, Mauritius, Malawi, Namibia, Nigeria, Rwanda, Senegal, Togo, Tanzania, Uganda, South Africa, Zambia, Zimbabwe, South Central Africa, Central Africa, Rest of Eastern Africa, Rest of South African Customs Union, Rest of Western Africa
RoW	**Rest of the World**	Rest of Oceania, Rest of Western Asia

a) Note by Turkey: The information in this document with reference to “Cyprus” relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of United Nations, Turkey shall preserve its position concerning the “Cyprus” issue.

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c) The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Annex Table 1.3. Sectoral groupings

Sector grouping	Code	Description
Agro-food	pdr	Paddy rice
	wht	Wheat
	gro	Cereal grains nec
	v_f	Vegetables, fruit, nuts
	osd	Oil seeds
	c_b	Sugar cane, sugar beet
	pfb	Plant-based fibres
	ocr	Crops nec
	ctl	Cattle, sheep, goats, horses
	rmk	Raw milk
	wol	Wool, silk-worm cocoons
	fsh	Fishing
	frs	Forestry
	pcr	Processed rice
	oap	Animal products nec
	cmt	Meat: cattle, sheep, goats, horse
	omt	Meat products nec
	vol	Vegetable oils and fats
	mil	Dairy products
	sgr	Sugar
	ofd	Food products nec
	b_t	Beverages and tobacco products
Mining and extraction	coa	Coal
	oil	Oil
	gas	Gas
	omn	Minerals nec
Textiles and wearing apparel	tex	Textiles
	wap	Wearing apparel
Light manufacturing	lea	Leather
	lum	Lumber
Paper and paper products	ppp	Paper and paper products
Motor vehicles and parts	mvh	Motor vehicles and parts
Machinery, transport and electronic equipment	otn	Other transport equipment
	ome	Other machinery and equipment
	ele	Electronic equipment
Heavy manufacturing	p_c	Petroleum, coal products
	nmn	Mineral products nec
	crp	Chemical rubber products
	i_s	Iron and steel
	nfm	Non-ferrous metals
	fmp	Fabricated metal products
	omf	Manufactures nec
Services	ely	Electricity
	gdt	Gas distribution
	wtr	Water
	cns	Construction
	trd	Trade
	otp	Other transport
	wtp	Water transport
	atp	Air transport

Sector grouping	Code	Description
	cmn	Communications
	ofi	Other financial intermediation
	isr	Insurance
	obs	Other business services
	ros	Recreation and other services
	osg	PubAdmin, Defence, Health, Education
	dwe	Dwellings

Source: METRO.

ANNEX 2. TRADE FACILITATION AVES SNAPSHOT

Annex Table 2.1. Trade facilitation policy shocks (percent ad valorem equivalent)

a. By income importer group and sector

	LICs	LMICs	UMICs	HICs non-OECD	OECD	ROW
Agro-food	0.47	0.53	0.41	0.41	0.31	0.79
Mining and extraction	0.26	0.28	0.21	0.22	0.15	0.60
Textiles and wearing apparel	1.19	1.09	0.88	0.78	0.53	1.74
Light manufacturing	0.67	0.71	0.54	0.51	0.35	1.04
Paper and paper products	2.46	1.83	1.68	1.59	1.00	3.57
Motor vehicles and parts	2.07	1.83	1.35	1.24	0.86	2.79
Machinery, transport and electronic equipment	1.71	1.62	1.21	1.12	0.75	2.28
Heavy manufacturing	1.84	1.79	1.25	1.21	0.78	2.70

b. By income importer group and use

	LICs	LMICs	UMICs	HICs non-OECD	OECD	ROW
Intermediates	1.67	1.62	1.16	1.02	0.70	2.05
Capital goods	1.18	0.98	0.74	0.70	0.45	2.05
Government consumption	0.85	0.98	0.76	0.80	0.57	1.71
Private consumption	1.64	1.51	1.10	0.80	0.64	2.05

c. By income exporter group and sector

	LICs	LMICs	UMICs	HICs non-OECD	OECD	ROW
Agro-food	0.44	0.57	0.51	0.31	0.38	0.70
Mining and extraction	0.23	0.32	0.28	0.15	0.27	0.47
Textiles and wearing apparel	0.97	1.19	1.00	0.85	0.60	1.60
Light manufacturing	0.63	0.75	0.62	0.47	0.33	1.01
Paper and paper products	2.06	2.42	2.01	1.62	1.21	3.33
Motor vehicles and parts	1.60	1.89	1.63	1.33	1.02	2.67
Machinery, transport and electronic equipment	1.46	1.66	1.42	1.12	0.81	2.21
Heavy manufacturing	1.27	1.85	1.62	1.41	1.03	2.39

ANNEX 3. SENSITIVITY ANALYSIS

Sensitivity to macro-economic assumptions

The model simulations employ several assumptions on macro-economic behaviour. In how far these assumptions affect model outcomes is explored in this section. Assumptions in 4 areas are explored, where the long term setup is defined as base setup.

- Factor market: a) Full employment (base setup) and b) unemployment, represented by the short term setup. With unemployment, labour supply can increase but wages remain fixed until full employment is reached. At that point, wages can adjust.

- Government behaviour: a) Governments are assumed to have predefined income and tax rates are fixed. With a fixed internal balance government expenditure adjust to changing income levels (base setup). b) Alternatively government expenditure is fixed and the income tax adjusts to balance the government account.

- Investment and savings: a) savings are a fixed share of final demand, allowing investment volumes to adjust to changing final demand (base setup). b) Savings are investment driven, and the investment value is fixed.

- Exchange rate: a) the current account balance is constant and the exchange rate floating (base setup). b) Alternatively the exchange rate is fixed and the current account balance adjusts.

Annex Table 2.1 shows the results of the sensitivity analysis. The labour market assumption, i.e. full employment or unemployment, has strong effects on the level of results, as shown by short and long term results. It does not, however, change the relationship between regions and result variables. If a sector wants to increase production it needs to source production factors from other sectors, this factor is naturally then not available for other production activities and with factor demand the price also increases. With unemployment, there is no such restriction and each sector can pool additional workers as needed, without competing with other sectors. Production effects are therefore clearly higher with unemployment.

Other macro-economic assumptions have only little effect on economy-wide variables. Thus, the assumptions on investment, government and the exchange rate influence the composition of GDP, but not the total amount of GDP.

Annex Table 3.1. Sensitivity of results to macroeconomic assumptions, geographical regions

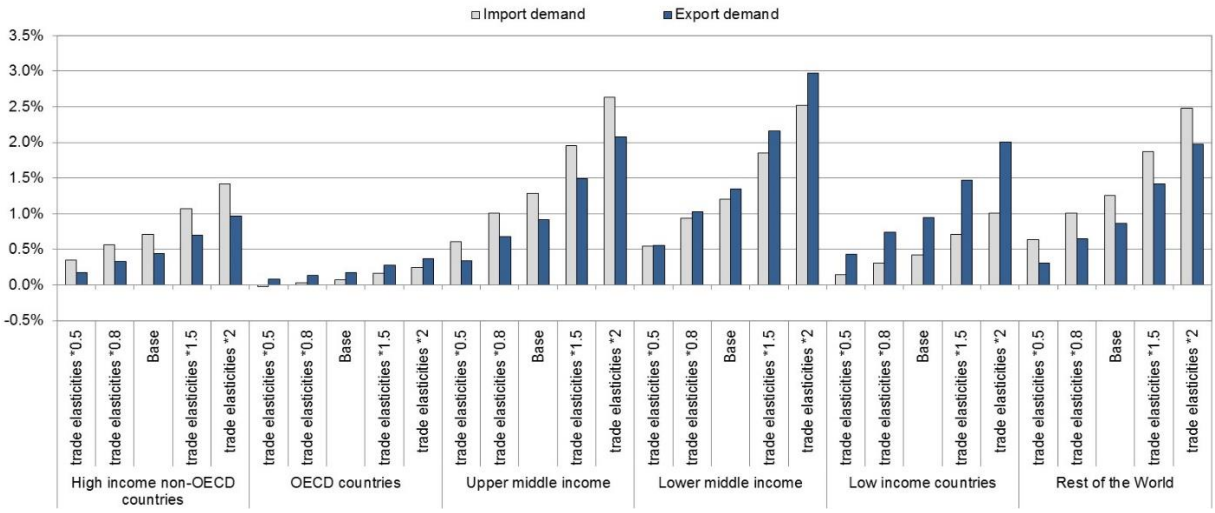
	short term	long term - base	fix investment	fix government expenditure	fix exchange rate	short term	long term - base	fix investment	fix government expenditure	fix exchange rate
	Central America and Caribbean					South America				
EVin % of final demand	0.72%	0.37%	0.38%	0.38%	0.38%	0.54%	0.21%	0.21%	0.21%	0.21%
Real GDP (expenditure)	0.65%	0.24%	0.24%	0.24%	0.24%	0.46%	0.12%	0.12%	0.12%	0.12%
Import demand	0.97%	0.66%	0.66%	0.67%	0.56%	1.68%	1.40%	1.40%	1.41%	1.27%
Export demand	1.27%	0.81%	0.82%	0.83%	0.95%	1.33%	1.11%	1.11%	1.12%	1.22%
Domestic production	0.51%	0.10%	0.10%	0.11%	0.11%	0.35%	0.02%	0.02%	0.03%	0.03%
	East Asia and the Pacific					South Asia				
EVin % of final demand	0.27%	0.13%	0.13%	0.13%	0.13%	0.65%	0.41%	0.41%	0.41%	0.38%
Real GDP (expenditure)	0.23%	0.08%	0.08%	0.08%	0.08%	0.55%	0.26%	0.27%	0.26%	0.23%
Import demand	0.78%	0.67%	0.67%	0.67%	0.64%	1.48%	1.30%	1.30%	1.30%	0.90%
Export demand	0.72%	0.59%	0.59%	0.60%	0.68%	2.05%	1.70%	1.71%	1.70%	2.39%
Domestic production	0.16%	0.03%	0.03%	0.03%	0.04%	0.40%	0.12%	0.13%	0.12%	0.12%
	Europe					Southeast Asia				
EVin % of final demand	0.07%	0.05%	0.05%	0.05%	0.04%	0.79%	0.45%	0.45%	0.45%	0.43%
Real GDP (expenditure)	0.06%	0.03%	0.03%	0.03%	0.02%	0.65%	0.29%	0.29%	0.29%	0.27%
Import demand	0.03%	0.00%	0.00%	0.00%	0.11%	1.34%	1.08%	1.07%	1.08%	0.62%
Export demand	0.10%	0.07%	0.07%	0.07%	-0.12%	1.16%	0.89%	0.88%	0.89%	1.84%
Domestic production	0.01%	-0.01%	-0.01%	-0.01%	-0.03%	0.57%	0.25%	0.25%	0.25%	0.34%
	Middle East and North Africa					Sub Saharan Africa				
EVin % of final demand	0.67%	0.42%	0.42%	0.42%	0.40%	1.06%	0.53%	0.53%	0.53%	0.53%
Real GDP (expenditure)	0.38%	0.20%	0.20%	0.20%	0.21%	0.83%	0.30%	0.30%	0.30%	0.30%
Import demand	1.03%	0.77%	0.77%	0.77%	1.00%	1.55%	1.19%	1.20%	1.21%	1.02%
Export demand	0.60%	0.50%	0.50%	0.50%	0.32%	1.35%	1.04%	1.04%	1.05%	1.16%
Domestic production	0.24%	0.06%	0.06%	0.06%	0.07%	0.63%	0.11%	0.11%	0.11%	0.11%
	North America					Rest of the World				
EVin % of final demand	0.21%	0.07%	0.07%	0.07%	0.07%	1.42%	0.93%	0.93%	0.93%	0.93%
Real GDP (expenditure)	0.20%	0.05%	0.05%	0.05%	0.05%	0.92%	0.46%	0.46%	0.46%	0.46%
Import demand	0.47%	0.36%	0.37%	0.36%	0.50%	1.46%	1.13%	1.13%	1.14%	1.01%
Export demand	0.74%	0.56%	0.57%	0.56%	0.41%	0.95%	0.71%	0.71%	0.72%	0.76%
Domestic production	0.16%	0.01%	0.02%	0.02%	0.01%	0.56%	0.09%	0.09%	0.09%	0.09%
	Rest of Europe and Central Asia									
EVin % of final demand	0.51%	0.26%	0.26%	0.26%	0.26%					
Real GDP (expenditure)	0.35%	0.13%	0.13%	0.13%	0.12%					
Import demand	1.21%	1.01%	1.01%	1.01%	0.58%					
Export demand	0.70%	0.59%	0.60%	0.60%	0.90%					
Domestic production	0.29%	0.07%	0.07%	0.08%	0.08%					

Sensitivity of results to trade elasticities

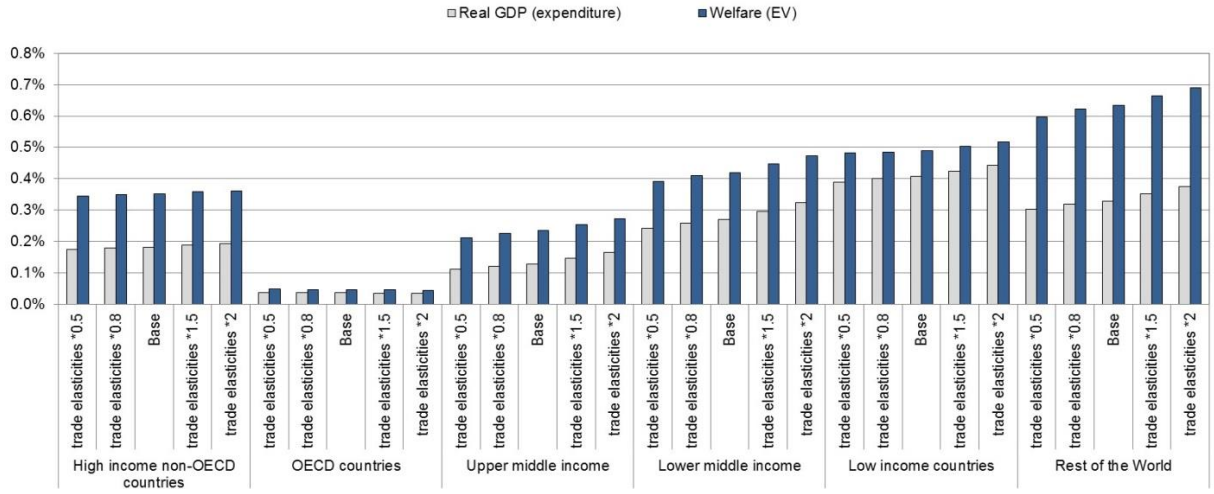
METRO employs various trade elasticities that govern the response of the respective quantities to price changes. These are import and export elasticities on two different levels each. Depending on the elasticity level, a 1% change of export prices has a lower or higher quantity effect. To test the sensitivity of model results to trade elasticities they are varied and the results compared to the standard setup. Annex Figure 10.1 shows effects on trade and GDP/welfare results with 50% and 20% lower elasticities and 50% and 100% higher elasticities on both the import and export side. The results are stable with respect to trade elasticities. Unsurprisingly, higher trade elasticities lead to stronger quantity effects and exports and imports increase more. In some regions, this leads to more positive effects in GDP and welfare. However, besides the significant higher trade effects, the increases in GDP and welfare remain moderate. Lower elasticities on the other hand are decreasing the responsiveness to price changes, quantity effects are lower resulting in slightly lower changes.

Annex Figure 3.1. Trade effects and GDP/welfare by geographic groups: sensitivity analysis

Panel a. Trade effects



Panel B. GDP and welfare results



Source: METRO simulation results.