Benefits of Trade Facilitation: A Quantitative Assessment

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Executive summary

Trade transaction costs (TTCs) related to border procedures vary depending on the efficiency and integrity of interacting businesses and administrations, the characteristics or kind of goods, and the size and type of businesses. Total costs may be seen as being composed of directly incurred costs, such as expenses relating to supplying information and documents to the related authority, and indirectly incurred costs, such as those arising from procedural delays. Empirical studies suggest that directly and indirectly incurred TTCs each amount to 1-15 per cent of traded goods' value.

Moreover, empirical evidence suggests that TTCs for agro-food products are higher than those for manufactured goods, as agro-food shipments are subject to special border procedures, such as sanitary and phyto-sanitary controls. Also, small and medium-sized enterprises face cost-disadvantages. In light of this diversity in TTCs, the potential for the realisation of benefits from trade facilitation varies across countries, sectors, and types of traders. In cases where best practices are already applied, further efficiency gains will be difficult to achieve. But if border clearance costs are substantially above those encountered under best practices, room for improvement through suitable measures of trade facilitation will tend to exist.

The model-based analysis of the economic impacts of trade facilitation carried out in this study differs from earlier research by taking several salient features of import and export procedures into account. In particular, the differing characteristics of direct and indirect TTCs are represented, and country-specific differences in trade facilitation potential are reflected according to empirical information on border waiting times and survey-based evidence on the quality of border processes. In addition, the higher TTCs for agro-food products and small and medium-sized enterprises are incorporated into the analysis. Several scenarios of hypothetical, multilateral trade facilitation efforts are evaluated, focusing on the comparison of scenarios rather than the overall welfare gains that might result from trade facilitation.

The results suggest that the potential benefits from trade facilitation are substantial. However, earlier analysis that did not reflect the conceptual differences between direct and indirect TTCs has overestimated the potential gains by ignoring adjustment needs, such as re-deployment of redundant employees in the logistics sector, associated with direct TTCs. Incorporating these adjustment needs into the analysis provides a more realistic assessment of the impact of trade facilitation and avoids creating inflated expectations concerning the potential benefits from reductions in TTCs. Moreover, the presence of these adjustment costs suggests that trade facilitation measures that focus on reducing indirect TTCs, notably border waiting times, might have a more marked impact on economic welfare than measures that aim at reducing documentation requirements and related direct TTCs.

Furthermore, if the existing diversity of TTCs across countries, sectors and traders is represented, a larger share of the global benefits of trade facilitation of up to two-thirds of the total gains is obtained by developing countries than under an assumption of flat reductions in TTCs. Developing countries are also the prime beneficiaries from trade facilitation if the facilitation-generated welfare gains are related to GDP, as they tend to have considerable potential for reductions in TTCs and relatively open economies, so that reductions in the costs of importing and exporting affect them to a larger extent than many OECD countries. Concerning the overall size of welfare gains, the global benefits from trade facilitation turn out to be proportional to the size of the assumed reduction in TTCs, but the magnitude of the reported welfare gains has to be seen as an upper boundary of the actual gains that might be achievable, as investment needs to realise the assumed reductions in TTCs have not been incorporated into the quantitative analysis, due to lack of corresponding information.

1. Introduction

Reductions of tariff barriers in subsequent Rounds of international trade negotiations and changes in supply chain management practices, such as greater reliance on just-in-time deliveries, have resulted in a relative increase in the importance of border procedure-related trade transaction costs (TTCs) for international commerce and triggered keen public interest in trade facilitation efforts. The WTO Doha Development Agenda envisaged trade facilitation as a subject for possible multilateral negotiations, even though at the WTO Ministerial Meeting in Cancún no agreement on concrete negotiation steps was reached.

While quantification of the economic impacts of trade facilitation represents a major analytical challenge due to the complexity of the underlying issues, a limited number of studies have tried to assess the implications of efforts to reduce TTCs. This literature on TTCs and trade facilitation benefits has been reviewed in OECD (2002). The first objective of the present paper is to update and extend the earlier literature survey by synthesizing relevant recent studies that report estimates of TTCs and the effects of trade facilitation measures. Particular attention is thereby devoted to differences across countries, sectors, and types of traders. Secondly, reflecting the numerical estimates of the costs of specific border procedures and measures and the impact of facilitation efforts on these found in the literature, model-based analysis on the world-wide economic effects of trade facilitation is undertaken.

The modelling analysis differs from earlier research by taking several salient features of import and export procedures into account. In particular, the differing characteristics of direct and indirect TTCs are represented, and country-specific differences in trade facilitation potential are reflected according to empirical information on border waiting times and survey-based evidence on the quality of border processes. In addition, the higher TTCs for agro-food products and small and medium-sized enterprises are incorporated into the analysis. Several scenarios of hypothetical, multilateral trade facilitation efforts are evaluated, focusing on the comparison of scenarios rather than the overall welfare gains that might result from trade facilitation.

The remainder of the paper is organised in four sections. Section 2 reviews available information on direct and indirect TTCs. Section 3 then reports findings on the impact of trade facilitation efforts on TTCs, while section 4 describes different approaches that have been used to quantify the benefits of trade facilitation. Finally, section 5 discusses new estimates from model-based analysis that reflect the existing diversity among countries, sectors, and traders.

2. Estimates of trade transaction costs

Trade transaction costs vary substantially. The OECD literature survey (OECD, 2002) found that such costs to businesses differ depending on the efficiency and integrity of interacting businesses and administrations, the characteristics or kind of goods, and the size and type of business. Total costs may be seen as being composed of directly incurred costs, such as expenses relating to supplying information and documents to the related authority, and indirectly incurred costs, such as those arising from procedural delays. The studies surveyed in OECD (2002) suggest that directly incurred TTCs involved in export and import procedures amount to 2-15 per cent of traded goods' value,[1] and this range also emerged from a subsequent literature survey carried out by the Swedish Trade Procedures Council (Hellqvist, 2002). Some recent studies (METI, 1998; Haralambides and Londoño-Kent, 2002; and JETRO, 2002), however, suggest that directly incurred TTCs could in some cases be lower (Table 1) and amount to merely about one per

[1] Some of the reviewed studies did not explicitly distinguish between direct and indirect trade transaction costs or cover some indirect cost elements along directly incurred costs.

cent of the traded goods' value, so that the full range of direct cost estimates stretches from one to fifteen per cent. All these estimates combine costs incurred on the import and the export side (Box 1).

Box 1: Trade transaction costs at the export *versus* the import side

Are the costs to businesses for clearing export procedures of a similar magnitude as those for complying with import procedures? Except for special cases, such as exports of dual-use goods, export procedures might be expected to be less costly and less time consuming than import procedures. Export procedures are often relatively simple, since customs inspections are rarely being undertaken and no special documents, such as rules of origin or health and safety certificates, need to be submitted. However, in a number of cases, pre-shipment inspection (PSI) leads to a shift of procedures from the importing to the exporting side. Indeed, more than a quarter of all WTO members — mainly developing countries in Asia, Africa, and Latin America — regularly use designated PSI-companies to inspect shipments at exporting locations for imports to PSI-using countries (WTO, 1999).

The available empirical studies suggest that TTCs are roughly the same on the import and the export side. According to a report by US-NCIT (1971), the absolute magnitude of documentation costs for exports is very similar to that for imports. A more recent World Bank survey of import and export procedures in CIS countries found for some countries that costs and delays on the import side exceeded those on the export side, while for other countries the inverse relationship prevailed (World Bank, 2002). Moreover, another survey found almost equal waiting times at borders of 3.5 days for imports to and 3 days for exports from Japan (MRI, 2001).

In addition, there are indirect TTCs, even though these are rarely expressed in monetary terms. As mentioned in OECD (2002), lengthy waiting times can result in loss of business opportunities and impose inventory-holding and depreciation costs on traders. Costs for inventory-holding include both the lost interest on capital tied up in goods at borders, as well as the need to keep larger buffer-stock inventories at the final destinations in order to accommodate possible variations in border clearance times. Depreciation captures costs related to spoilage of fresh produce, items with immediate information content, such as newspapers, and goods for which demand cannot be forecast well in advance, such as holiday toys or high-fashion apparel.

A recent World Bank publication reported evidence from the World Business Environment Survey on typical border waiting times for 80 countries (Batra, Kaufmann and Stone, 2003). The averages of typical time needed for release of imported cargo stretch from 1 to 24 days.[2] Assuming similar waiting times at the export side (Box 1), the range doubles to 2-48 days. These waiting times impose substantial costs on traders. Hummels (2001) investigated the willingness-to-pay of exporters for switching from slower ocean to faster air shipment and found that each day saved would be worth about 0.5 per cent of the value of the traded goods. The largest share of these costs is due to depreciation and lost business opportunities. Combining Hummels' cost estimate with the border waiting times from the World Bank survey gives a range for the indirect TTCs of about 1-24 per cent of traded goods' value. However, since only six of the 80 countries in the World Bank survey showed average import waiting times of 16 or more days, the "tail" in the sample's distribution is thin, and the range of the indirect TTCs might be thought of as being similar to the 1-15 per cent for directly incurred costs.

[2] The average border waiting times were obtained by excluding survey responses that reported waiting times of more than 90 days.

Table 1: Selected studies reporting estimates of trade transaction costs *

Study	Country/ Region	Import/ Export	Direct costs Scope	Direct costs Costs (%)*	Indirect costs Scope	Indirect costs Costs (%)*	Note
US-NCITD (1971)	USA	Average of imp. & exp. costs	Documentation; finance & insurance; carrier; and forward/broker	7.5%			Based on business survey.
SWEPRO (1985)	Sweden	Imp. & exp. costs combined	Customs compliance costs	8%.			Figures apparently based on information from customs and businesses.
Ernst & Whinney (1987a,b)	Intra-EC	Imp. & exp. costs combined	Customs compliance costs	1.5%	Delays for road haulers & lost business	1-3%	Reservations have been expressed on the survey on lost business & road haulers. Indirect costs calculated by authors.
EC (1989)	Intra-EC	Imp. & exp. costs combined	Documentation costs	3.5-15%			Methodology unclear.
UNCTAD (1994)	World		Costs for finance, customs; business information; transport & telecom	7-10%			Uses US-NCITD (1971), EC (1998) and other information sources. Coverage of direct and indirect costs.
METI (1998)	Japan	Imp. costs only	Costs for border procedures	0.5-2.4%			Based on a survey of Japanese manufacturing and trade companies.
Haralambides & Londoño-Kent (2002)	Between USA & Mexico	Imp. & exp. costs combined	Costs for handling, inspection, etc. for a) southbound, b) northbound	a) 0.8-2.1% b) 0.6-1.1%	Time delay	a) 1.6-4.0% b) 0.1-0.5%	Costs of time delay calculated based on Hummels (2001).
JETRO (2002)	Japan	Imp. costs only	Costs for import and port-related procedures a) EDI-use; b) non-ED-use	a) 0.5-0.8% b) 1.2%			Figures calculated by authors.

*) Percentage in terms of traded goods' value. Due to methodological differences, the estimates are not directly comparable. See the individual studies for details.
Source: authors.

2.1 Country-specific diversity

A large part of the variation in TTCs is due to country-specific differences. The cost differences seem closely related to the quality of border procedures, which in turn are heavily influenced by the trade facilitation efforts that governments have been pursuing. For example, among the 60 measures concerning "movement of goods" that have been proposed in the Menu of the APEC Trade Facilitation Action Plan, the implementation by countries ranges from zero to 50 measures (APEC, 2003a). It seems reasonable to expect that larger efforts at trade facilitation are associated with lower TTCs, while less attention to improving the quality of border services will tend to result in higher costs of importing and exporting operations.

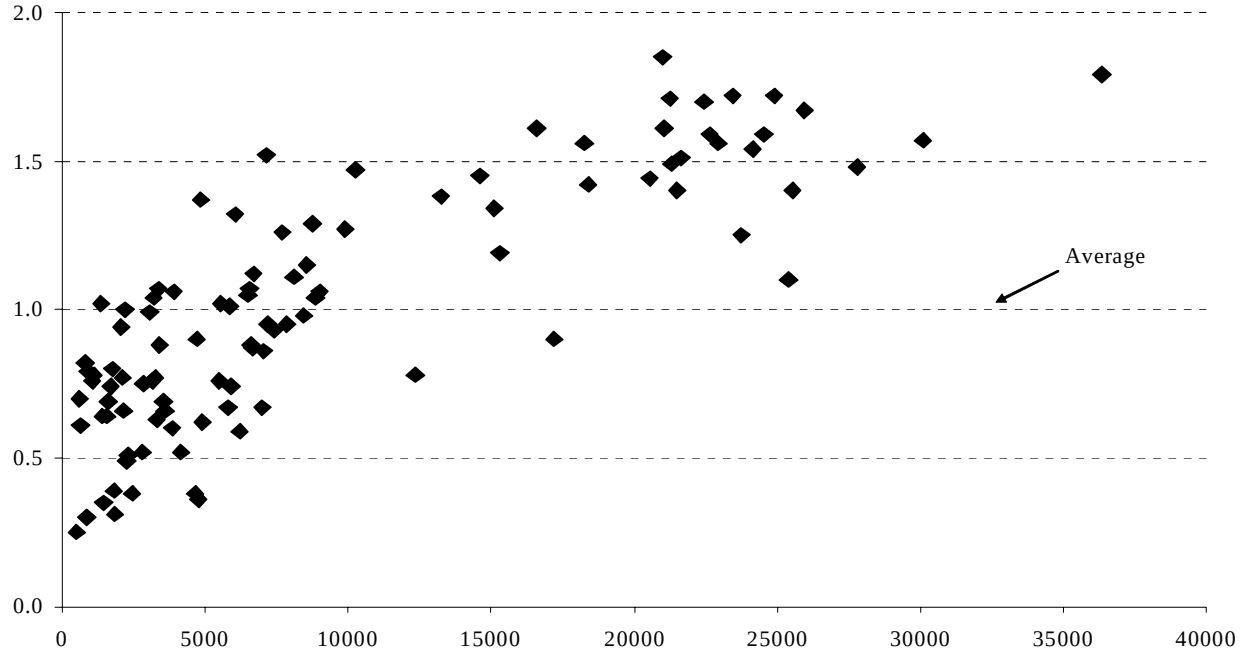
Unfortunately, truly comparable information on directly incurred TTCs is not available for a broad range of countries. In order nevertheless to try to estimate the economic and trade impacts of TTCs and trade facilitation across countries, analysts have recently used questionnaire-derived indicators of different aspects of border process quality as proxies for actual cost figures. For example, Wilson, Mann and Otsuki (2003) describe the extent and quality of trade facilitation efforts of countries in the APEC region by using survey information on port efficiency, customs environment, regulatory environment, and e-business practices. Each of these aspects is characterised through several indicators. For example, the quality of the customs environment is captured through indicators for the magnitude of import fees, transparency of import barriers, and perception of corruption. These indicators are normalised and then averaged to yield a proxy value for the quality of the customs environment across APEC countries.

This indicator-based methodology of deriving estimates for the quality of the customs environment can easily be generalised beyond APEC countries and applied to countries world-wide. Such a generalisation is pursued and used in this study for a broad set of border procedures (see the Annex for details on the construction of the "border process quality indicator"). The resulting estimates of border-process quality are to some extent subjective, reflecting the nature of the underlying information sources, and can only be indicative of the direct TTCs actually incurred by importing and exporting firms. But as will be discussed in section 3, the potential to improve border procedures through trade facilitation measures depends largely on the existing quality of border services, so that an estimate of the qualitative diversity of border procedures is necessary to appropriately assess the benefits from trade facilitation.

Differences in border process quality across the 102 countries for which indicator data are derived tend to be related to income levels (Figure 1). Countries with a higher per capita income generally score better with respect to border process quality than countries whose inhabitants are less well off. However, there are a number of examples of relatively poor countries scoring rather well, while several relatively rich countries show only mediocre performance with respect to the aggregate indicator of border process quality. In other words, a higher per capita income and the related availability of public financial resources explain differences in border process quality across countries to some extent, but the data suggest that low-income countries do not necessarily have to wait until they become rich before being able to adopt good border practices.

While the border process quality-indicator might be seen as being inversely related to directly incurred TTCs, border clearance times might serve as a proxy for indirect transactions costs. Figure 2 shows the relationship between waiting times, as reported in Batra *et al*. (2003), and per-capita incomes. Higher per-capita incomes are generally associated with shorter border waiting times, but considerable variation in waiting times, and by implication indirect TTCs, exists particularly for countries with a per-capita income of less than USD 9 000.

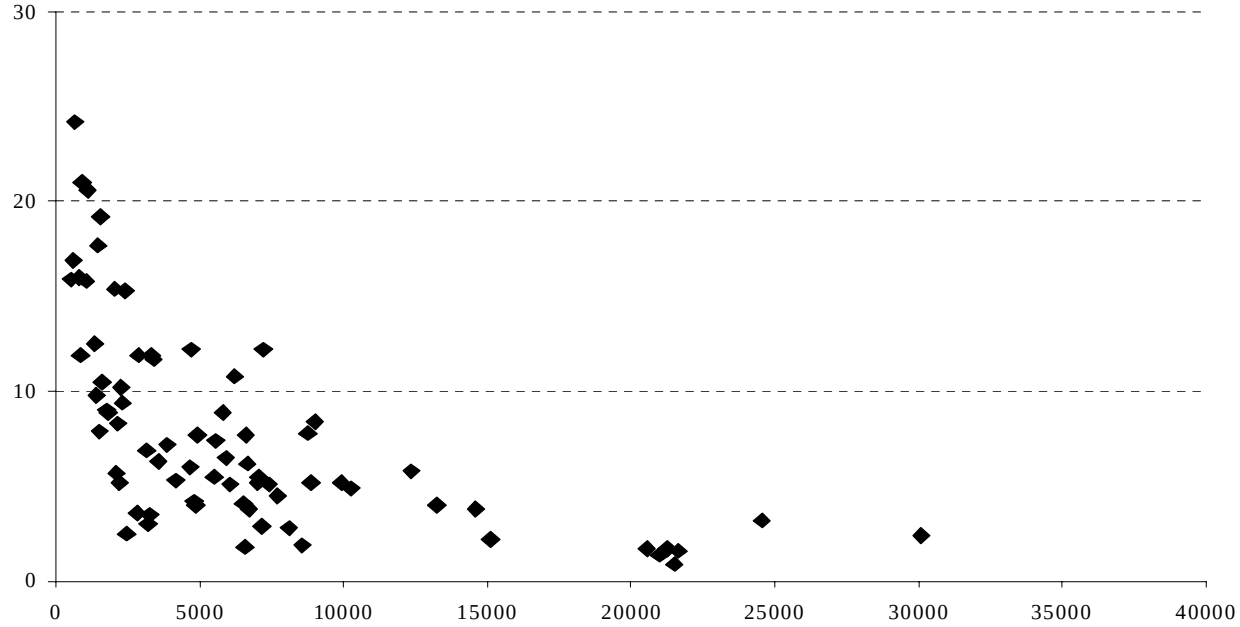
Figure 1: Country-value of the border process quality-indicator in relation to per-capita GDP
(USD, purchasing power parity)



Note: A higher indicator value suggests a better border process quality. See the Annex for details.
Source: Authors.

Figure 2: Country-average of number of days of import clearance time in relation to per-capita GDP

(USD, purchasing power parity)



Source: Authors.

2.2 Sector-specific diversity

In addition to divergent integrity, transparency and efficiency of border procedures across countries, TTCs also depend on the type of goods that are imported and exported. In particular, for goods that are perishable by nature, such as agro-food products, delays and incongruities at the border can prove very costly. Moreover, agriculture and food products, fish, and forest and wood products are generally subject to additional border procedures and have to undergo documentary and physical inspection to ensure compliance with sanitary and phytosanitary requirements. This need for physical inspections, in particular, can lead to a considerable increase in border process fees and clearance times per consignment. Other goods undergo physical examination only according to prevailing risk management practices, which could mean that only a small fraction of containers is checked. Hence, the border clearance costs of these other goods tend on average to be significantly lower than those of agro-food and like products.

A recent study by the Japan External Trade Organization (JETRO) measured directly incurred costs and time for a "typical" container ship entering Japan (Table 2). The directly incurred costs and waiting time vary depending on whether the border procedures are paper-based or handled *via* electronic data interchange. But even though only about 20 per cent of the containers on a "typical" ship are subject to mandatory sanitary and phytosanitary controls, 37-44 per cent of the directly incurred costs and 18-22 per cent of the time from entry to release of an "average" container are due to "special" procedures applicable to agriculture and food products.[3] And if, hence, the direct costs and waiting time for agro-food products are taken to account on average for roughly a third of the total costs of a shipment, TTCs for agro-food products turn out to be 50 per cent higher than those for manufactured products.[4]

Table 2: Directly incurred costs and time required from port entry to release in Japan

	Costs (JPY and percentage)		Time (hours and percentage)	
	Paper-based	EDI-based	Paper-based	EDI-based
Common procedures for all goods	16,706 (63%)	10,197 (56%)	19.1 (82%)	12.8 (78%)
Special procedures for agro-food products*	9,864 (37%)	7,884 (44%)	4.2 (18%)	3.7 (22%)
Total	26,570 (100%)	18,081 (100%)	23.2 (100%)	16.5 (100%)

*) Including animal/plant quarantine and food sanitary procedures.
Source: Authors based on JETRO (2002).

2.3 Trader-specific diversity

Trade transaction costs can vary also according to characteristics of the trader, such as the size of the trading firms. Smaller firms which engage less frequently than bigger competitors in cross-border transactions have several disadvantages: (i) they will tend to have fewer specialised personnel, so that they might have to devote relatively more resources towards acquiring knowledge on trade formalities and administering cross-border procedures; (ii) they might have weaker capital reserves, so that unforeseen delays at the border, tying-up a part of their working capital, can affect their liquidity and force them to seek expensive interim financing; and (iii) small firms might not have a sufficiently rich track record with customs authorities, so that they might be classified in a higher risk category and, hence, more frequently subjected to costly documentary and physical cargo checks (OECD, 2002; Hellqvist, 2003).

[3] Similarly, according to a survey by Japan's Customs Tariff Bureau on the time required for release of imports (CTB, 2001), imported sea cargo subject to controlling agencies other than customs stays at borders for about 38 per cent longer than other goods (about 94 hours *versus* about 68 hours).

[4] The extra cost ratio for agro-food products equals the total costs over the TTCs for manufactured products, i.e. 100%/(100%-33.3%) = 1.5.

Yet, based on analysis of about 650 survey responses from Dutch firms, Verwaal and Donkers (2001) concluded that it is not firm size *per se*, but the size of international trade activities of firms that determines the level of TTCs. Hence, small firms with a focus on international markets are often able to reap the available benefits from economies of scale in border procedures. Moreover, small firms have often the opportunity to outsource customs-related activities to trading partners, logistical service providers or specialised international trade intermediaries in order to avoid size-related disadvantages they might otherwise face.

Nevertheless, in a study of customs procedures in the EU, Ernst & Whinney (1987a) found that firms with fewer than 250 employees incur TTCs that are 30-45 per cent higher per consignment than those falling on bigger firms. One of the main reasons for the higher costs is that due to too infrequent transactions, small and medium sized enterprises (SMEs) are generally not able to participate in "simplified procedures", which according to Ernst & Whinney reduce TTCs by 50 per cent. Similarly, the ability to participate in the Swedish "Stairways®" system is reported to have reduced TTCs of large-scale traders by 55 per cent (Hellqvist, 2002).

3. Anecdotal evidence on benefits of trade facilitation

Trade transaction costs can not be entirely eliminated. Checks by customs and other controlling agencies are necessary to ensure that domestic regulations are implemented. But increasing the efficiency of border procedures can help to lower TTCs and, hence, shrink the wedge between domestic and international prices to the benefit of consumers and producers. Estimates of the potential medium-term income gains from trade facilitation have centred around 2-3 per cent of the total value of traded goods (UNCTAD, 1994; APEC, 1999), even though much larger benefits might be reap in particular countries or regions (APEC, 2002). In some cases, a simple re-organisation of tasks and procedures might already make it possible to reap substantial benefits, while in others successful trade facilitation might require investments in physical infrastructure and human resources (Box 2).

Obviously, the potential for the realisation of benefits from trade facilitation varies across countries, sectors, and characteristics of traders. In cases where best practices are already applied, further efficiency gains will be difficult to achieve. But if TTCs are substantially above those encountered under best practices, room for improvement through suitable measures of trade facilitation will tend to exist.

Even though it is difficult to generalise from available information, the largest potential for improvements from trade facilitation seems to exist in developing countries. For example, a business survey conducted in the APEC region found that traders expected the largest benefits from hypothetical trade facilitation measures that would reduce transaction costs by 50 per cent to materialise in the lower-income countries within the region (Table 3). The median responses to the questionnaire suggest that the trade facilitation efforts would yield reductions in total TTCs of 10.7 per cent in industrialising APEC economies, compared with 7.8 per cent in newly industrialised economies and 5.2 per cent in industrialised economies. These results reflect to some extent the findings from section 2, namely that less developed countries tend to have less efficient customs services and, hence, more room for improvement.

Table 3: Estimates of reduction in trade transaction costs through customs-related trade facilitation
(weighted average of responses, in per cent)

APEC country group	Minimum estimate	Maximum estimate	Median estimate
Industrialised APEC economies	2.9	7.4	5.2
Newly industrialised APEC economies	5.3	10.7	7.8
Industrialising APEC economies	6.6	14.8	10.7

Source: APEC (2002).

Box 2: Costs to implement trade facilitation measures

Reducing TTCs through trade facilitation will in many cases involve upfront investments and higher operational expenses for governments and businesses. As customs services play a vital role for the functioning of border procedures, their modernisation and reform often constitutes an important element in promoting trade facilitation. The magnitude of the implementation costs varies according to the size of the customs service, existing customs infrastructure and available human resources. Moreover the general economic environment plays an important role. One frequent element of trade facilitation in developing countries is, for example, the introduction of automated customs systems, which crucially depends on the availability of functioning basic infrastructure, such as communication facilities and stable electricity supply.

Given the substantial costs involved, many developing countries appreciate assistance from bilateral and multilateral agencies to help them improve their customs services. In 1999, the World Bank extended 15 adjustment loans with components addressing customs reform (Wilson, 2001). For example, an amount of USD 78 million was devoted to customs improvements in six south-eastern European countries and USD 35 million towards export development in Tunisia. Moreover, a five year project for customs modernisation in Bolivia has been financed from several sources with about USD 38 million since 1999, of which about USD 25 million is being spend for institutional improvements and USD 9 million for computerised systems (Gutierrez, 2001).

One major type of investment concerns customs automation systems. According to UNCTAD (2002), the costs of introducing automated customs system could sometimes be as high as USD 20 million provided that countries develop their own system, and less than USD 2 million for the widely-used Automatic System for Customs Data (ASYCUDA) system. In Chile, the total investment cost of implementing an automated customs system amounted to USD 5 million in the early 1990s (WTO, 2000), while in Jamaica, the introduction of the ASYCUDA system in connection with overall requirements analysis, the development of software suites, data communication equipment and computers cost about USD 5.5 million (Grant, 2001).

Once an improved customs system is running, there are operating expenses that in some countries are passed on to traders in the form of higher user fees, while in other countries these higher costs are financed from government budgets. Moreover, systems have to be updated from time to time in order to reflect the latest technological developments. The costs for such updates can be of a similar magnitude as the initial investments to introduce a new system. For example, Chinese Taipei updated its air cargo clearance system in 2000 at a cost of USD 5 million, and is scheduled to improve its existing ocean-going cargo system in 2004 for about USD 6.5 million (WTO, 2002). In the Philippines, updating the existing automated system from a DOS to a Windows-based platform cost about 40 per cent of the original system installation (Bhatnagar, 2001).

The impact of trade facilitation measures on TTCs is likely to differ across products and transaction size. These differential effects were highlighted in a recent study by the Australian Department of Foreign Affairs and Trade (DFAT, 2001). The study investigated the potential for cost savings for businesses of changing from a paper-based to a paperless customs administration system. The savings estimates of the interviewed traders ranged from 1.5 per cent for bulk sea shipments of coal to 15 per cent for air shipments of fresh asparagus (Table 4). The differences seem partly due to the fixed costs of completing paperwork requirements manually, which are estimated to amount to USD 75-125 per transaction irrespective of transaction-size.

Table 4: Estimate of savings from switch to paperless customs system

Product and transport mode	Typical volume	Cif-value of cargo (USD)	Estimate of savings (USD)	(per cent)
Coal – bulk by sea	10 000 tons	520 000	7 800	1.5
Rice – bulk by sea	1 500 tons	810 000	17 820	2.2
Machine parts – by sea	20 foot container	175 000	5 425	3.1
Sugar – bagged by sea	1 500 tons	273 000	12 012	4.4
Fresh asparagus – by air	45 kg	1 370	206	15.0

Source: DFAT (2001).

Another means of trade facilitation is the establishment of a single window border automation system. Such a system makes it possible to minimise documentation cost by streamlining paperless processing needs of various regulatory agencies. In Singapore, the so-called TradeNet system was first conceived in the mid-1980s and is reported to have helped reduce the documentation cost borne by government and businesses by more than half (APEC, 2003b).

Several countries have experienced significant reductions in import clearance times following the implementation of trade facilitation measures. For example, in Japan significant reductions in the lead time from entry to release have been realised over the past decade. For air-cargo, the average processing time fell from 53 hours in 1991 to 26 hours in 2001, while for sea cargo the lead time was over the same period reduced from 168 hours to 74 hours (CTB, 2001). Similar progress has been reported for customs clearance time, which constitutes an important element in overall border procedures. In New Zealand, the institution of a multimedia electronic paperless clearance system has, over a four-year period, reduced customs processing times from ten days to an average of 12 minutes (WTO, 2003). Similarly, in Costa Rica, the switch towards single window warehouse clearing, electronic customs declaration, and risk management with automated method of selection made it possible to reduce customs clearance times from an average of six days in 1994 to 12 minutes (115 minutes in case of physical inspection) in 2000 (WTO, 2001). In Peru, different types of trade facilitation measures were pursued, with emphasis on staff training, the introduction of a code of conduct, and penalties for lack of integrity of customs officers. Through these initiatives, customs release times were shortened from 15-30 days to 2-48 hours (Lane, 2001).

4. Overview of available quantitative studies on the benefits of trade facilitation

There have been several studies that have tried to quantify the potential impact of trade facilitation on trade flows and income levels. Some researchers have based their analysis on the UNCTAD estimate that trade facilitation could result in savings equivalent to 2-3 per cent of the value of traded goods (UNCTAD, 1994). Relating these savings to the value of international trade, the reduction in TTCs are estimated to amount to about USD 1 billion per year for the former Soviet Union (Molnar and Ojala, 2003) and about USD 60 billion annually for the APEC region (DFAT, 2001). As the savings are seen as reductions in previously existing inefficiencies that did not benefit the public or private sector, they are taken to represent income gains for traders and consumers. Furthermore, it might be expected that the reduced wedge between domestic and international prices will stimulate additional trade, further specialisation according to comparative advantage, and dynamic adjustments, so that the economic welfare gains will tend to be higher than those derived using existing trade flows as the basis for the calculations (Hellqvist, 2002).

Model-based analysis makes it possible to investigate the impacts of trade facilitation in more detail. Gravity model analysis, for example, has related trade flows among APEC economies to indicators of port efficiency, customs environment, regulatory environment, and e-business (Wilson, Mann and Otsuki, 2003). Assuming that trade facilitation would lead countries with below average indicator values to improve their performance half-way to the average of all APEC members, intra-APEC trade would

increase by USD 254 billion, i.e. 21 per cent, per year. Using estimates of the effect of trade on per capita GDP (Dollar and Kraay, 2001), the facilitation-related expansion of trade suggests an increase in APEC average per capita GDP of 4.3 per cent. This scenario analysis of improvements in trade-facilitation capacity that result in increases of performance halfway to the average has recently been extended beyond the APEC region. A study published in the World Bank's Global Economic Prospects Report suggests that such improvement in port efficiency, customs environment, regulatory environment, and service-sector infrastructure would increase trade among the 75 countries covered in the analysis by USD 377 billion, i.e. an increase of 9.7 per cent of trade (Wilson, Bagai and Fink, 2003).

Another line of analysis has used computable general equilibrium (CGE) models to quantify the benefits from trade facilitation on a regional or world-wide basis. In these models, trade facilitation is generally represented as technical progress in trading activities, following the approach pursued by Hertel, Walmsley, and Itakura (2001). For example, when using a dynamic version of the GTAP model, APEC (1999) found that a reduction in TTCs of 1 per cent in industrialised countries and 2 per cent in developing countries would result in welfare gains of USD 46 billion for the APEC region. On a world-wide basis, Francois, van Meil and van Tongeren (2003), using a modified version of the GTAP model that allows for imperfect competition in the manufacturing sector and assuming a uniform 1.5 per cent reduction in TTCs, estimate the benefits of trade facilitation to amount to USD 72 billion. A roughly comparable figure was obtained in OECD (2003), when evaluating a uniform 1 per cent reduction in TTCs with the standard GTAP model under the assumption of perfect competition. Table 5 provides an overview of relevant CGE studies. Most of these investigations use flat reductions in TTCs across countries (or large groups of countries) and do not differentiate the trade facilitation effects by sector or type of trader. Moreover, the assumption of trade facilitation as being technical progress ignores any adjustment costs relating to employees that are no longer needed to process border documentation and, hence, tends to overestimate the benefits of trade facilitation. The following analysis uses a different set of assumptions concerning the potential for trade facilitation across countries, sectors and traders and the adjustment costs involved and thereby aims to contribute to the refinement of quantitative assessments of trade facilitation.

Table 5: CGE-based studies of the benefits of trade facilitation

Study	Base year	Model characteristics		Scenario specification			Annual income gains *	
		Competition	Dynamics	Regional coverage	Sector coverage	Reduction in trade value	(in USD billion)	(% of GDP) **
Dee (1998)	1992	Imperfect	Dynamic	APEC	All goods and transport services	Uniform a) 5% b) 10%	a) 216 b) 442	a) 1.1 b) 2.3
APEC (1999)	1996	Perfect	Dynamic	APEC	All goods	By country group a) 1% & 2% b) 2% & 3%	a) 45.8 b) 64	a) 0.25 b) 0.4
Hertel, Walmsley & Itakura (2001)	1995-2020	Perfect	Dynamic	Japan & Singapore	All goods	By goods sector 0.21-3.5%	6.6 (Japan) & 0.17 (Singapore)	0.16 (Japan) & 0.29 (Singapore)
UNCTAD (2001)	1997	Perfect	Static	Developed countries	a) Trade services b) Air & sea transport c) All services	Uniform 1%	a) 47.9 b) 6.1 c) 117.9	a) 0.22 b) 0.04 c) 0.54
APEC (2002)	1997	Perfect	Static	Intra-APEC trade	All goods	a) 5% *** (uniform) b) 2.9-7.7% *** (by country group)	a) 154.0, b) 100.9-203.5	a) 0.98 b) 0.64-1.30
Fox, Francois & Londoño-Kent (2003)	1997	Perfect	Static	Bilateral USA & Mexico trade	Goods shipped by truck	1% (northbound) & 5% (southbound)	1.4 (US) & 1.8 (Mex)	0.02 (US) & 0.47 (Mex)
Francois, van Meijl & van Tongeren (2003)	1997	Imperfect	Dynamic	World	All goods	Uniform a) 1.5% b) 3%	a) 72.3 b) 150.9	a) 0.25 b) 0.52
OECD (2003)	1997	Perfect	Static	World	All goods and services	Uniform 1%	76.4	0.26

*) Due to methodological differences, the estimates are not directly comparable. See the individual studies for details.
**) Calculated from GDP data if not available in the particular study.
***) Reduction in trade transaction costs.
Source: Authors.

5. Model-based assessment of the benefits of trade facilitation

As discussed in section 3, trade facilitation can reduce TTCs considerably, but the extent of the improvements depends, of course, on the measures and instruments that are put into place. Negotiations on trade facilitation in the WTO-context have been envisaged, but it seems virtually impossible to predict the outcome of such negotiations. In turn, it is not possible to forecast the impacts that a trade facilitation agreement might have on world trade and income. Instead, the aim of the following assessment will be to better represent empirical characteristics of the border process in model-based analysis and to identify those features that crucially affect the results and that, therefore, deserve to be further explored in future research. In other words, the focus will be more on the distribution of gains among groups of countries and on the comparison of results with those of existing studies than on the determination of the possible income gains from trade facilitation in absolute USD-terms.

5.1 The modelling approach

The analysis is carried out by using the well-established GTAP database and model. The latter is a static, multi-region, computable general equilibrium model that operates under assumptions of perfect competition and constant returns to scale. The model reflects bilateral trade flows, international transport margins, and country and sector-specific rates of import protection. GTAP thereby makes it possible to determine changes in production, consumption, trade, and economic welfare from particular trade-related external shocks, such as changes in TTCs. A full description of the model can be found in Hertel (1997).

There is no representation of customs-activities or costs of border procedures in the model. Earlier GTAP-research on the impact of changes in border procedures has mostly assumed that trade facilitation takes the form of technical progress in trading activities, which can be incorporated in the model. According to this approach, trade facilitation makes it possible for traders to lose less of the value of the traded goods in transit, so that goods can be sold to consumers at the location of destination at lower prices (and/or generate higher returns for producers). This "iceberg-type" representation of TTCs seems very appropriate for indirect cost components, i.e. border clearance times. If goods are in transit for a long time, a large part of their value "melts" away. Shortening the border clearance time through trade facilitation efforts would result in more of the product reaching its final destination.

However, the iceberg analogy appears to be less accurate for directly incurred TTCs, like the wage costs for providing necessary documentation. Trading firms have to buy the "form-filling" services from company-internal or external service providers. If trade facilitation leads to reduced form-filling needs, trading firms will encounter lower TTCs. But at the same time, the form-filling sector will experience a decline in the demand for its services and corresponding adjustment costs. The latter are not appropriately captured through an iceberg-type representation of TTCs.

These shortcomings have been realised, and Fox, Francois and Londoño-Kent (2003), for example, split the effects of TTCs into an iceberg and a tax component, when investigating the impact of trade facilitation at the US-Mexican border. The tax component is thought to represent the direct costs that firms incur due to border procedures. Traders are assumed to buy "logistics services" from public sector providers corresponding to an amount equal to the directly incurred TTCs.[5]

The analysis in this study follows the approach of Fox *et al*. by representing direct and indirect TTCs differently in the model. The indirect costs are modelled according to the iceberg-approach, while the direct costs are reflected in "logistics duties". The latter are split into charges applying at the export side

[5] In practice, border procedures do in general not generate revenues for the government budget and logistics services are provided by private sector firms.

and representing the direct TTCs in the exporting country and levies that correspond to the direct TTCs in the importing country. These additional duties are incorporated into the analysis by using the "Altertax" option, which makes it possible to change parameters in the model database. The procedure is designed to integrate additional information on policy variables into existing GTAP data aggregations (Malcolm, 1998).[6] Trade facilitation in the form of reduced direct TTCs is then modelled as a cut in export and import charges, which reduces TTCs, but also triggers adjustments in the government sector, due to the loss of revenues from logistics duties. These adjustments are associated with economic costs. For example, employees that used to work in documentation-processing but are no longer needed in this function might need to be retrained and moved to other jobs.

For presentational and computational purposes, a data aggregation with nine regions and three sectors is used. The regions are OECD Asia-Pacific, OECD Europe, OECD North America, Former Soviet Union, Latin America and Caribbean, Middle East and North Africa, Non-OECD Asia-Pacific, Sub-saharan Africa, and a Rest of the World aggregate.[7] The sectors are agro-food, manufacturing, and services. In this study, trade facilitation is investigated in the context of agro-food and manufacturing trade, reflecting the focus of current WTO work.

5.2 Scenario analysis

A number of salient observations in the earlier sections of this study are reflected in the modelling analysis:

- There are indirect and direct TTCs that show a similar range of magnitude (1-15 per cent of the value of traded goods).
- Indirect transactions costs have an "iceberg"-character, while direct transactions costs can be seen as traders' expenditure on logistics services.
- Trade transactions costs vary considerably across countries, as suggested by empirical information on border waiting times and indicators of border process quality.
- Trade facilitation measures will tend to result in larger reductions of TTCs in countries where the latter are currently higher than in those that are closer to best practices already.
- Trade transactions costs are higher for agro-food products than for manufactured products.
- Small and medium-sized companies are confronted with higher TTCs than large companies.

Several scenarios are evaluated. In all cases, a re-calibrated version of the GTAP database that reflects direct TTCs in the form of additional logistics duties is used. As no consistent empirical information on these costs is available across countries, direct TTCs are taken to be inversely proportional to the value of the border process quality indicator, discussed above. In particular, the country with the highest border process quality is associated with the low end of the range of direct TTCs, i.e. 1 per cent of traded goods' value. Conversely, the country that showed the poorest performance with respect to the indicator of border process quality is assigned the highest observed TTCs, i.e. 15 per cent of the value of traded goods. Countries with intermediary performance are proportionally associated with intermediary

[6] Technically, the additional duties are incorporated in the database by applying appropriately sized "shocks" to tax variables at the export (parameter "txs") and the import (parameter "tms") side.

[7] The latter is composed of countries, such as Cambodia, Malta and Papua New Guinea, that are not represented through country-specific social accounting matrices in the GTAP database.

cost estimates. Trade facilitation concerning direct TTCs is then represented as a reduction in logistics duties.

Trade facilitation with respect to indirect TTCs is modelled according to the iceberg approach. Indirect TTCs across countries are thereby assumed to be proportional to the border waiting times recently established in the World Bank survey discussed above.[8] Trade facilitation is assumed to lead to a shortening of these waiting times and, hence, a reduction in the associated costs.

Several assessments of hypothetical, multilateral trade facilitation efforts are undertaken, focusing on the comparison of scenarios rather than the overall welfare gains that might result from trade facilitation. A first set of experiments with the model addresses the question to what extent the empirical features listed above influence the modelling results. For this purpose, it is assumed that trade facilitation leads to a reduction in TTCs of 1 per cent of the value of world-wide trade, of which half is taken to occur through savings in directly incurred TTCs and half through reductions in indirect TTCs. This assumption of a 1 per cent reduction in global trade value is similar to those made in earlier quantitative research on the impact of trade facilitation.

In a baseline scenario (the "uniformity scenario"), TTCs for all countries, sectors and types of traders are assumed to fall by 1 percentage point of the value of traded goods. In other words, for a country with rather efficient procedures and total TTCs (before the implementation of the assumed trade facilitation measures) of, for example, 3 per cent, the post-facilitation TTCs would amount to 2 per cent. For a country with less efficient border services and, for example, pre-facilitation TTCs of 13 per cent, the assumed trade facilitation efforts would bring border costs down to 12 per cent of the traded goods' value.

In the scenarios that reflect country and/or sector and trader diversity, the implementation of the hypothetical trade facilitation measures is assumed as resulting in a "closing of the gap" to best practices by a percentage common to all countries, sectors and types of traders. In cases where good practices are already applied, the assumed trade facilitation would result in reductions of TTCs by less than 1 per cent, while the cuts in border costs would exceed 1 per cent in cases where the currently existing TTCs are above average. For example, with a best practice of costs of 1 per cent of the value of traded goods and a "convergence" factor of 20 per cent, a country with pre-facilitation TTCs of 3 per cent would see a reduction in border costs by 0.4 percentage points to 2.6 per cent (20 per cent of the gap between 1 per cent and 3 per cent of the value of traded goods). A country with pre-facilitation costs of 13 per cent would experience a drop in TTCs by 2.4 percentage points to 10.6 per cent (20 per cent of the gap between 1 per cent and 13 per cent of the value of traded goods). In other words, the implementation of the hypothetical trade facilitation measures would in this example result in reductions of TTCs that are six times higher in the low-efficiency than in the high-efficiency country.

The diversity in TTCs across sectors is reflected through the assumption that border costs for agro-food products are 50 per cent higher than those for manufacturing products. Similarly, it is assumed that SMEs face 50 per cent higher TTCs than big enterprises. As the GTAP model does not distinguish between enterprises according to their size, the higher costs of SMEs are integrated into the country-averages of TTCs, implying that countries with a higher share of SMEs in international trade face correspondingly higher TTCs. Information from APEC suggests that the share of SMEs in trading operations of non-OECD countries, such as China and Chinese Taipei, is 50-56 per cent, while the corresponding share in OECD countries, such as Australia, Japan, and the United States, is 10-29 per cent

[8] The World Bank survey did not report border waiting times for any of the OECD countries in the Asia-Pacific region. To nevertheless cover these countries in the analysis, it was assumed that the border waiting times for Australia, Japan, Korea and New Zealand equal the average of the border waiting times in the OECD Europe and the OECD North America regions.

(APEC, 1994). Based on this information, a differential of 25 percentage points in the share of SMEs is assumed to prevail between all OECD and non-OECD countries. In combination with the finding that SMEs face 50 per cent higher TTCs, non-OECD countries are, *ceteris paribus*, assumed to have TTCs that are 12.5 per cent higher than those in OECD countries.

In addition to the "uniformity" scenario, three diversity scenarios are considered. A first model set-up reflects country diversity but no sector or trader diversity ("country diversity scenario"), a second scenario incorporates also sector diversity ("country & sector diversity scenario"), and a third one deals with the full diversity across countries, sectors and traders ("country, sector & trader diversity scenario"). In all three diversity scenarios, the convergence in TTCs following trade facilitation, i.e. the degree to which a "closing of the gap" to best practice is achieved, is adjusted such that the global reduction in trade transactions costs amounts to 1 per cent of the value of traded goods. This makes it possible to directly compare the uniformity and the three diversity scenarios.

A further scenario ("OECD only scenario") is closely related to the full diversity setting, but assumes that trade facilitation efforts are only undertaken in OECD countries. For OECD countries, the modelled reductions in TTCs are identical to those in the "country, sector & trader diversity scenario", while no reduction is assumed to occur in non-OECD countries. The total reduction is, hence, less than 1 percentage point of world trade value. Table 6 summarises the assumptions of the modelling scenarios.

Table 6: Main scenario assumptions

	Uniformity scenario	Country diversity scenario	Country & sector diversity scenario	Country, sector & trader diversity scenario	OECD-only scenario
Overall reduction of TTCs by 1% of the value of world trade	Yes	Yes	Yes	Yes	No
Reduction in TTCs differs across countries	No	Yes	Yes	Yes	Yes
Higher TTCs for agriculture and food products	No	No	Yes	Yes	Yes
Higher TTCs for small and medium-sized enterprises	No	No	No	Yes	Yes

Source: Authors.

Finally, a set of experiments with the full diversity setting is pursued that relax the assumption that trade facilitation leads to reductions in TTCs that correspond to 1 percentage point of the value of traded goods. A range of reductions amounting to 0.5-3 per cent of traded goods' value is explored in order to evaluate the linkage between the assumed change in TTCs and overall welfare gains.

5.3 Scenario results

The results from the modelling analysis indicate that the world income gains from a 1 per cent reduction in TTCs would be considerable and amount to about 40 billion USD with no losers (Table 7). However, this estimate is substantially below those from earlier studies. The result is partly due to the narrower focus of this study than, for example, OECD (2003), which also considered reductions in TTCs for services. But a second important factor that leads to the lower benefit estimate are adjustment costs in the logistics sector that are represented in the analysis through governmental revenue losses for the provision of logistics services. Indeed, less than 20 per cent of the overall gains are due to trade facilitation-related reductions in direct TTCs, which are modelled as cuts in logistics duties, while more

than 80 per cent of the benefits derive from reductions in indirect TTCs, for which trade facilitation is represented as a pure efficiency gain in trading activities. If the characterisation of directly and indirectly incurred TTCs is appropriate, this finding suggests that trade facilitation measures that focus on reducing border waiting times might have a more marked impact on economic welfare than measures that aim at reducing documentation requirements and related direct TTCs.

Table 7: Scenario results on income effects of trade facilitation
(million USD and per cent of total)

	Uniformity	Country diversity	Country & sector diversity	Country, sector & trader diversity	OECD-only
World-wide income gains	**38454**	**41844**	**42247**	**43259**	**14053**
- due to direct cost reduction	6041	7689	8119	8250	2650
- due to indirect cost reduction	32413	34155	34128	35009	11402
OECD	**69%**	**37%**	**37%**	**35%**	**103%**
OECD Asia-Pacific	8%	7%	7%	7%	22%
OECD Europe	43%	17%	17%	17%	45%
OECD North America	18%	13%	12%	11%	36%
Non-OECD	**31%**	**63%**	**63%**	**65%**	**-3%**
Former Soviet Union	2%	7%	7%	7%	-1%
Middle East & North Africa	5%	11%	11%	11%	0%
Latin America & Caribbean	5%	13%	13%	13%	-1%
Non-OECD Asia-Pacific	16%	24%	24%	24%	-1%
Sub-saharan Africa	2%	7%	7%	7%	0%
Rest of World	1%	1%	1%	1%	0%

Source: Authors.

Another result concerns the distribution of income gains among regions that differs fundamentally between the uniformity and the three diversity scenarios. While under the assumption that trade facilitation leads to a uniform reduction of TTCs by 1 percentage point of the value of traded goods about 69 per cent of the total gains accrue to OECD countries, the incorporation of country, sector and trader diversity leads to a marked shift of the benefits from trade facilitation towards non-OECD countries. This is because developing countries have, in general, less efficient border procedures and, hence, a bigger potential for improvements through trade facilitation, a larger part of their trade is in agro-food products, and a larger share of their traders are small and medium-sized enterprises. If the full diversity is considered, non-OECD countries obtain almost two-thirds of the global benefits from trade facilitation. This finding highlights the importance of incorporating the empirically observed diversity, and in particular diversity in the potential for improvements in border procedures across countries, into quantitative assessments of trade facilitation.

The large gains that developing countries could obtain from trade facilitation are further illustrated by linking the welfare gains in USD to regional GDP (Table 8). In the "uniformity scenario", the gains from trade facilitation in developing countries already exceed those in OECD countries in relative terms, as imports and exports account for a relatively large share of the economy in many developing countries, so that reductions in TTCs have a strong impact. If in addition the large potential for improvements through trade facilitation in non-OECD countries is considered, as in the diversity scenarios, the relatively larger impact on the economies of these countries becomes even more pronounced. Sub-saharan Africa is the

most striking example, with welfare gains in the full diversity scenario of more than 0.9 per cent of GDP, i.e. more than twelve times the OECD average in relative terms.

Table 8: Scenario results on income effects of a one per cent reduction in trade transactions costs
(Per cent of gross domestic product)

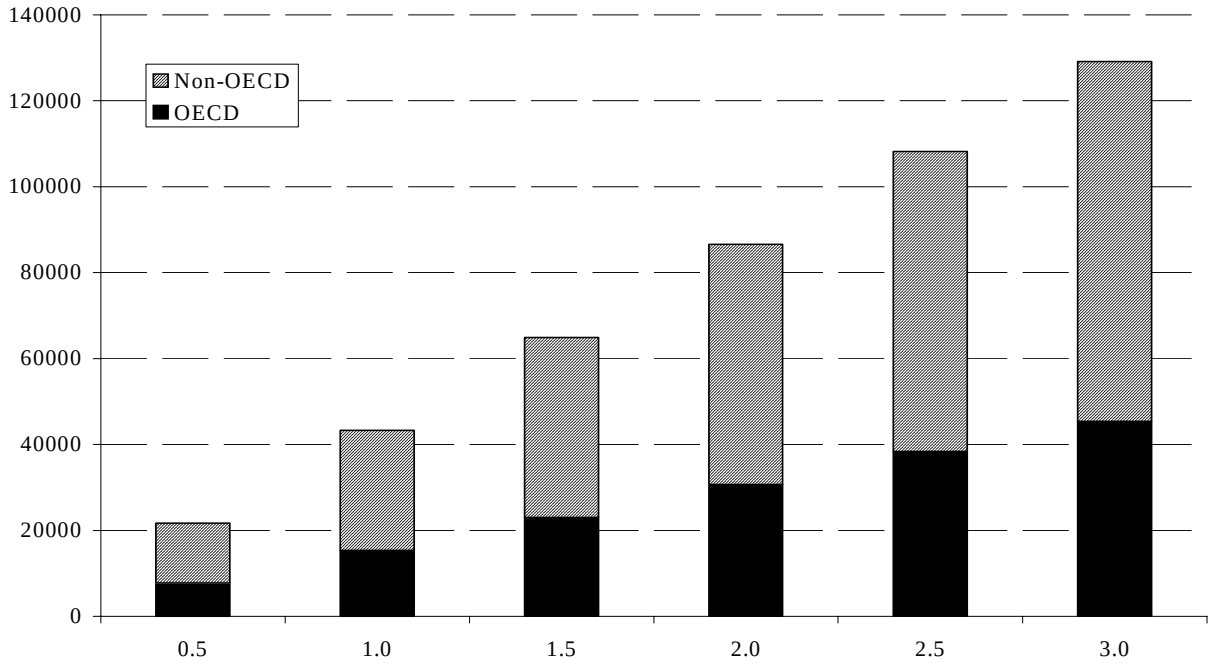
	Uniformity	Country diversity	Country & sector diversity	Country, sector & trader diversity	OECD-only
World-wide income gains	**0.13%**	**0.14%**	**0.15%**	**0.15%**	**0.05%**
- due to direct cost reduction	0.02%	0.03%	0.03%	0.03%	0.01%
- due to indirect cost reduction	0.11%	0.12%	0.12%	0.12%	0.04%
OECD	**0.12%**	**0.07%**	**0.07%**	**0.07%**	**0.06%**
OECD Asia-Pacific	0.06%	0.06%	0.06%	0.06%	0.06%
OECD Europe	0.19%	0.08%	0.08%	0.08%	0.07%
OECD North America	0.08%	0.06%	0.06%	0.06%	0.06%
Non-OECD	**0.20%**	**0.44%**	**0.44%**	**0.47%**	**-0.01%**
Former Soviet Union	0.14%	0.48%	0.49%	0.51%	-0.02%
Middle East & North Africa	0.27%	0.64%	0.64%	0.67%	0.00%
Latin America & Caribbean	0.12%	0.33%	0.34%	0.36%	-0.01%
Non-OECD Asia-Pacific	0.25%	0.40%	0.40%	0.42%	0.00%
Sub-saharan Africa	0.18%	0.85%	0.88%	0.92%	-0.02%
Rest of World	0.13%	0.21%	0.21%	0.22%	0.00%

Source: Authors.

Tables 7 and 8 also report results from the "OECD-only" scenario that assumes full diversity in TTCs, but limits trade facilitation efforts to OECD countries. It turns out that non-OECD countries actually lose under these circumstances, as TTCs in the OECD area fall in absolute and relative terms and divert trade away from non-OECD countries. This effect outways any better market access that lower TTCs in OECD markets might offer to non-OECD countries. Hence, the benefits of trade facilitation accrue primarily to those countries that actively engage in it.

Concerning the size of the global benefits from trade facilitation in relation to the assumed reduction in TTCs, experiments with the full diversity setting suggest that the welfare gains are roughly proportional to the size of the assumed cut in TTCs (Figure 3). Trade facilitation efforts that lead to a reduction in TTCs that is twice as large as assumed in the above scenario analysis, for example, will result in welfare gains that are of about twice the size. However, the magnitude of these benefits has to be seen as an upper boundary of the actual gains that might be achievable, as investment needs to realise the assumed reduction in TTCs have not been incorporated into the quantitative analysis, due to lack of corresponding information.

Figure 3: Welfare gains under alternative assumptions on the extent of trade facilitation



Source: Authors.

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Annex: Deriving an indicator of border process quality

The approach for designing an indicator of border process quality is related to the method used by Wilson, Mann and Otsuki (2003). As no consistent data on direct TTCs is available across countries, Wilson *et al.* use survey-based information to derive indicators of TTCs. In constructing these indicators, different sources of survey information are used in order to reduce dependence on any one business survey. Yet unlike Wilson *et al*., the border process quality indicator derived in this study does not exclusively rely on business perceptions of border transactions, but also incorporates information on government commitments towards trade facilitation.

There are four components of the indicator of border process quality. Three of these are constructed from survey information on different aspects of the border process environment, namely customs efficiency, hidden import barriers, and administrative integrity, obtained from three different information sources. The fourth component is based on the implementation of the nine trade facilitation instruments listed in the 2001-edition of the UN/CEFACT compendium of trade facilitation recommendations:

- *Customs efficiency*: Survey information on "Customs authorities do [do not] facilitate the efficient transit of goods?" Published in IMD, 2002. *World Competitiveness Yearbook*. Lausanne.

- *Hidden import barriers*: Survey information on "In your country, hidden import barriers, i.e. barriers other than published tariffs and quotas, are an important problem [not an important problem]?" Published in WEF, 2002. *Global Competitiveness Report*. Geneva.

- *Administrative integrity*: Corruption perceptions index. Published in Transparency International, 2002. *Global Corruption Report*. Berlin.

- *Trade facilitation commitments:* Count of participation in or implementation of "trade facilitation instruments". Listing taken from UN/CEFACT, 2001. *Compendium of Trade Facilitation Recommendations*. Geneva.

In the surveys, business representatives were asked to rate the quality of the particular aspect of the border process environment, with a higher rating indicating greater satisfaction. As the scaling of the survey responses differs, such that survey responses on customs efficiency, for example, range from 1 to 10, while those on hidden import barriers range from 1 to 7, the raw data is normalised by dividing the data value for each individual country by the average of the respective data series. A similar normalisation procedure is used for the indicator component representing trade facilitation commitments. Afterwards, the country-related information in the four components is averaged to yield the indicator for border process quality.

Due to the different comprehensiveness of the information sources, sometimes country-specific data are not available for all indicator-components. To avoid undue influence of any particular indicator-component, only those countries for which at least two indicator components are available were considered in the analysis. For the resulting sample of 102 countries, the country-specific indicator of border process quality is derived as the simple average of the available components-data. Annex table 1 shows the correlation between the different indicator-components.

Annex table 1: Correlation between indicator-components* on border process quality

	Customs efficiency	Hidden import barriers	Administrative integrity	Trade facilitation commitments
Customs efficiency	1.00	0.84	0.86	0.38
Hidden import barriers		1.00	0.86	0.55
Administrative integrity			1.00	0.54
Trade facilitation commitments				1.00

*) normalised values at individual country level.
Source: Authors.

The GTAP model that is used to undertake the quantitative analysis of the impact of trade facilitation distinguishes between 66 countries/regions (for details on the regional aggregation see www.gtap.agecon.purdue.edu). For the countries that are covered as part of wider regions rather than individual entities, the regional values of the components of the customs quality indicator are obtained as the simple averages of the component values for the countries within that GTAP-region. For example, the component values of Algeria, Egypt, Libya, and Tunisia are averaged to yield the component values for the GTAP-region "Rest of North Africa".

The value of the border process quality indicator for the 66 GTAP countries/regions ranges from 0.25 to 1.85, implying that the country with the worst indicator value received a score in the rankings that was 75 per cent below average, while the country with the highest value scored 85 per cent higher than the mean. These indicators form the basis for the derivation of world-wide estimates of direct TTCs in the quantitative trade facilitation analysis (see the corresponding section in the main body of the text).