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Quantifying the Trade and Economic Effects of Non-Tariff Measures

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QUANTIFYING THE TRADE AND ECONOMIC EFFECTS OF NON-TARIFF MEASURES

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ABSTRACT

Significant progress has been made in quantifying the effects of non-tariff measures since OECD commissioned its last major review of this topic in 1997. This paper reviews the literature of NTMs and assesses the different methods available. Additionally, the paper develops a series of questions to help determine which method of analysis is best given the interests of the researchers or policy makers. Of the possible avenues of future research, the trade costs approach is offered. This approach has the potential of shedding new light on the interactions among various policies and practices by assessing which areas offer the greatest potential for gains, and improving the precision of available estimates.

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EXECUTIVE SUMMARY

Significant progress has been made in quantifying the effects of non-tariff measures since OECD commissioned its last major review of this topic in 1997. According to one estimate, the global welfare gains from liberalising only a subset of NTMs may be on the order of USD 90 billion.

Methods for assessing improvements in trade facilitation have much in common with methods for assessing NTMs. One estimate places the potential gains in global trade from improved trade facilitation at USD 377 billion annually. However, these estimates are preliminary. Further work could both help assess the magnitude of potential gains in more detail and assist policymakers in setting priorities for reform and negotiation.

The effects of NTMs can be assessed in several ways. The presence of NTMs may lead to higher domestic prices than would have been observed in their absence. NTMs may also lead to smaller imports. Looking for these effects is the primary task of quantification. Secondary analyses, such as simulation methods, can use these primary effects to develop further estimates of impacts on imports and exports, prices, production in particular sectors, GDP, and economic welfare.

Analysis of the effects of NTMs begins with inventories of their coverage in terms of products, sectors, and countries. Some inventories, such as the TRAINS database, rely on information provided by countries imposing the measures. Other inventories are based on information provided by exporters about difficulties they have selling in certain markets. The analyst does not have to resolve the difficult questions about the definition of NTMs, their legal status, or policy justification in order to research the impact of various measures on prices and trade flows.

For many purposes, examination of the price impacts of NTMs is ideal. These price impacts can be expressed in "tariff equivalent" or similar form. "Handicraft" methods for comparing the prices of goods affected and unaffected by NTMs have an established record of successful application. These methods are capable of capturing a good deal of information about policies and markets. However, their information requirements make them impractical to use for broad comparisons across products, industries and countries. Econometric analyses of prices, which have been introduced recently, offer the prospect of making such broad comparisons, at the loss of case-specific detail. Econometric analyses of trade flows have also been employed. Between the analyses of prices and trade flows, a number of tradeoffs exist. For example, trade data are more widely available in greater detail than price data, but price-based estimates may at present offer greater precision.

Specific methods have been developed for the analysis of such policies as tariff-rate quotas, standards (including SPS), trade facilitation, rules of origin and government procurement. The broad similarities among the methods applied to these various policies, as well as policy-specific features ought to be kept in mind.

Policymakers and negotiators may wish to ask themselves several questions about the purposes for which quantitative estimates will be used. Are they for illustrating the benefits of liberalization for a domestic audience? Identifying "winners and losers?" Deciding which policies to pay more attention to? In light of the answers, avenues for further work can be chosen. These could include improved price data, surveys, improvements in econometric methods, and research into specific measures. A "trade costs" approach, which analyzes costs and time incurred along the entire supply chain, offers promise for understanding the interactions among various policies and practices, assessing which areas offer the greatest potential for gains, and improving the precision of available estimates.

I. Introduction

1. In an Economics Department Working Paper, Alan Deardorff and Robert Stern noted that in a world of falling tariffs, the economic importance of non-tariff measures (NTMs) was becoming increasingly important.[1] (OCDE/GD(97)129) Therefore, they reviewed a variety of quantitative techniques for assessing the effects of NTMs and offered guiding principles for measuring the economic effects of NTMs. [2]

2. Since that time, interest in quantification of NTMs has continued unabated. In addition, the development of methods of quantification has made significant progress. The techniques available in 1997 have been widely disseminated and applied in a number of cases which have clarified the strengths and limitations.[3] The availability of new data and computational techniques as well as increased computing power has enabled new methodologies to be developed. Notable developments in the analysis of NTMs in services and merchandise trade have occurred.

3. Moreover, an increasing interest in trade facilitation issues, as manifested in the Doha Development Agenda of 2003, has stimulated an investigation of appropriate methodologies, developed for the analysis of NTMs to be applied to trade facilitation questions. In particular, the "5 percent" goal set forth in APEC's Shanghai Accord[4]of 2001 has stimulated a good deal of quantitative work in this area.

4. Preliminary estimates indicate that the potential for economic benefits from further liberalization of NTMs and trade facilitation is likely to be substantial. Andriamananjara, *et al*. (2004), considering only a limited range of NTMs, estimated that global gains from their removal were on the order of USD 90 billion. Walkenhorst and Yasui (2005) obtained estimated global welfare gains of USD 40 billion from a 1% lowering of trade transactions costs. Considering a variety of potential trade facilitation measures, Wilson, Mann and Otsuki (2005) consider improvements in ports, customs, regulation, and service sector infrastructure which would raise countries with below-average performance halfway to the global median. They estimate that such improvements would generate global increases in merchandise trade amounting to USD 377 billion, about a 9.7% increase in total trade.

5. This work surveys, summarizes and synthesizes the progress made in the quantification of NTMs and trade facilitation measures since 1997, with the goal of identifying priority areas for future research. The survey proceeds along two dimensions. First, it looks at the similarities and differences among the types of policies and practices to be analyzed and the extent to which the market characteristics of different

[1] A version of this was subsequently published as Deardorff and Stern (1998).

[2] The term "non-tariff measures" (NTMs), which has become standard usage in APEC, is used here in preference to non-tariff barriers (NTBs), which is used more frequently in the WTO context. The two terms are often used interchangeably. The present choice is motivated by a focus on the economic effect of the measures in question on international transactions, rather than a focus on the legal status or non-trade motivations that such measures may or may not have.

[3] The treatment of the topic by Laird (1997) also deserves mention as an indicator of the development of thinking on NTMs at this point.

[4] The APEC Economic Leaders' Declaration states, "Leaders instruct Ministers to identify, by Ministerial Meeting in 2002, concrete actions and measures to implement the APEC Trade Facilitation Principles by 2006 in close partnership with the private sector. The objective is to realize a significant reduction in the transaction costs by endeavouring to reduce them by 5% across the APEC region over the next 5 years. Leaders also instruct Ministers to explore the possibility of setting objective criteria on trade facilitation, taking fully into account the diversity among the members as well as progress achieved in respective economies so far." APEC (2001, Appendix 1)

policies may require different types of analysis. Second, it surveys the methodological toolbox which is currently available. It will become apparent that there is not a one-to-one correspondence between policies and analytical methods. Rather, lessons learned from assessing one type of NTM are often transferable to other types of NTMs, as long as analytically important differences between policies are respected.

6. This study primarily considers measures other than tariffs that affect the flow of international transactions in goods. Techniques for analyzing services have been reviewed elsewhere (e.g. Stern (2001); Dee (2005)); some of these techniques provide analogies to the quantification of measures pertaining to goods. Similarly, quantification of measures applying to foreign direct investment (FDI) is beyond the scope of this paper. Such measures are particularly important in the context of international services markets, since commercial presence is such a significant form of delivery for international services (Karsenty (2000)).

7. A number of schemes have been proposed for the classification of NTMs, in conjunction with inventories of such measures. The widely used UN Conference on Trade and Development (UNCTAD) typology (1996) relies on self-notifications of member countries. Categorization schemes such as Manifold and Donnelly (2005) are based on concerns about particular policies and practices which often arise originally in the business community but which find expression in government-prepared inventories of market access conditions in trading partners as well as the WTO's Trade Policy Review Mechanism (TPRM). The relative strengths and limitations of these inventories and their associated classification schemes will be addressed.

8. The economic effects of NTMs to be analyzed will include effects on prices, flows of export and import volumes, levels of production, and economic welfare. They may also include other measures of firm performance such as costs and mark-ups, particularly in the case of services.

9. Since the scope of this discussion is rather broad, particular attention will be paid to those NTMs and trade facilitation measures which raise special analytical issues, with less emphasis on those which can be analyzed by already available techniques. For example, subsidies and excise taxes have an impact on trade flows, but the techniques for analyzing them are comparatively well understood. Similarly, the analysis of antidumping and countervailing duties is in many cases similar to the analysis of conventional tariffs, though certain features of their administration may raise additional analytical issues. Tariff-rate quotas, which combine tariff and non-tariff elements, will receive some attention.

II. Sources of information on the presence of NTMs

10. In order to perform quantitative analysis of the effects of NTMs, an indication of which products and industries they affect, which countries apply them, and which policies are involved is useful. As we shall see in subsequent section, some analyses have sought to identify the effects of NTMs without prior information as to their incidence. If the domestic prices of certain goods, that might be imported, are unusually high, or if their import volumes are unusually low, compared to a standard emerging from analysis, it is tempting to attribute the differences to NTMs. Such analyses may generate interesting information. The analyses do not by themselves provide guidance as to what policies may be causing the observed behaviour in the marketplace, and they do not indicate what changes in policy might lead to lower prices or increased trade.

11. Thus, analysis of the economic effects of NTMs makes use of catalogues and databases which indicate their incidence. In order to make a catalogue, it is necessary to decide what to put in it. The catalogues, thus, require a definition of NTMs. A number of definitions have been offered. Bora (2005) provides a useful discussion of definitional issues.

12. The available functional or *a priori* definitions of NTMs generally deal with their economic effects. For example, Baldwin (1970) defines a "non-tariff distortion" as "any measure (public or private) that causes internationally traded goods and services, or resources devoted to the production of these goods and services, to be allocated in such a way as to reduce potential real world income." Similarly, Lloyd (1996, p. 44) analyzes the concept of a regional "single market," defining a single market as one in which the law of one price prevails, "allowing for transport and other transport costs which prevent perfect arbitrage," as a result of "the removal of all border and non-border restrictions on commodity trade, and the harmonization of commodity taxes and other measures which affect access to markets." In this concept, NTMs might be conceived as being included somewhere among the restrictions, taxes, and measures preventing the law of one price from being implemented.

13. While useful for organizing analytical thought, functional definitions like those presented above do not get one very far in practice. They imply that quantitative analysis, e.g. of income-reducing distortions or violations of the law of one price,[5] needs to be done even to identify NTMs, when in fact the identification of NTMs is wanted as an ingredient in such an analysis. This appears to be an unbreakable conundrum of circular reasoning. What is really needed is an operational definition of NTMs, that is, a definition which provides a taxonomy of NTMs and tells us what categories of items to include and exclude from the list. One can make such a list without coming to a final conclusion about whether the items on the list have price-raising, trade-reducing, welfare-reducing or other economic effects. The approach of drawing up an inventory of NTMs can be harmonized with the analytical perspective in the functional definitions by considering the items in the inventory or list as actually representing "candidate" or "potential" NTMs, which can be introduced into an economic analysis. Those measures which on examination turn out to have economic effects may then be considered to be "effective" or "binding" NTMs.

14. Tables 1 – 3 present three schemes of categorization of policies and measures. Deardorff and Stern (1998) develop a categorization scheme which is conceptual in nature and does not correspond to an inventory. Manifold and Donnelly (2005) and UNCTAD's Trade Analysis and Information System (TRAINS) use categorization schemes based on inventories on NTMs.[6] TRAINS relies on self-reporting by governments administering the measures. Manifold and Donnelly (2005) relies on self-reporting by trading partners which in many cases is based ultimately on concerns expressed by exporters. This difference in reporting distinguishes the two schemes.[7]

15. Certain commonalities exist among the categorization schemes of Deardorff and Stern (1998), Manifold and Donnelly (2005), and TRAINS. All of them contain categories for customs procedures, import quotas, prohibitions and licenses, and state trading entities. All of them mention restrictive measures in the export trade, behind-the-border taxes, and technical regulations.

[5] Another possible functional definition could be stated in terms of the effect of the NTMs have on reducing trade flows below an unconstrained or equilibrium level. As Bora (2005) pointed out, this might better be seen as a definition of NTBs, as "barriers to trade" per se.

[6] The TRAINS inventory is accessible on-line using the World Bank's World Integrated Trade Solutions (WITS) software. See Manole (2005) for details. The Manifold and Donnelly (2005) inventory is described more fully in Manifold and Donnelly (2005) and Donnelly and Manifold (2005).

[7] Another recent example of a categorization scheme generated by issues raised by trading partners is the Inventory of Non-Tariff Measures used in the WTO's Non-Agricultural Market Access (NAMA) negotiations (WTO, 2002). This scheme is described in OECD (2005) and applied in a modified form to generate tabulations based on seven broad categories ("government participation in trade," "customs and administrative procedures," "technical barriers to trade," "sanitary and phytosanitary measures," "trade remedies," "charges on imports," and "other"), with subcategories.

16. Certain differences exist as well. Deardorff and Stern (1998) take a view based on ultimate economic effect. They include nearly all policies and practices which might influence prices, trade flows or economic welfare. Deardorff and Stern (1998) also includes "subsidies and other aids," "government industrial policy and regional development measures," "Government financed research and development and other technology policies," "national systems of taxation and social insurance," "macroeconomic policies," and "competition policies." These categories are absent from TRAINS. Manifold and Donnelly (2005) partially cover these categories and include "anticompetitive practices/competition policy" and "taxes."

17. TRAINS includes all "trade control measures" including both tariff and non-tariff measures, only insofar as they apply to imports. (Both the Deardorff and Stern (1998) and Manifold and Donnelly (2005) categories have places to put policies which may affect exports). The items in TRAINS come either directly or indirectly from official government sources.[8] TRAINS includes policies which are designed to have a direct impact on imports. Unlike Deardorff and Stern (1998), TRAINS excludes policies which may have an indirect effect on imports but which are not directly applied at the border. TRAINS also excludes policies and practices which are not overtly declared by governments (e.g. corruption, or weak enforcement of competition policies) which may have an effect on imports.

18. TRAINS is the most widely available source of information on NTMs, and consequently, it is the most frequently used in research. More resources are devoted to the maintenance and update of TRAINS than to any other database on NTMs. Nonetheless, TRAINS could be improved substantially. There is a significant time lag for some information due to the unevenness of national reporting. Tables 4 and 5 reports the most recent available data coverage for the 149 countries represented in TRAINS. While almost all countries have some data for both tariffs and imports, over one-third of countries (58 out of 149) have no data on NTMs. The data that are available for NTMs are generally older than those for tariffs and imports. While 108 countries have tariff data from 2002-2004 and 106 have import data from 2002-2003, the data on NTMs are from 2001 or earlier. Over one-third of countries with available data on NTMs have records dating from 1992-1997.[9]

19. The compilation of measures described in Manifold and Donnelly (2005), Donnelly and Manifold (2005) is based on a textual analysis of the European Union's Market Access Database (2002), the US Trade Representative's National Trade Estimate (USTR, 2002), and the WTO's Trade Policy Reviews (TPR) (1996-2002, taking the most recent TPR for each country).[10] The major categories of measures used in this compilation are designed to reflect the categories used in the underlying documents analyzed, as opposed to making distinctions based on analytical or negotiating grounds. For example,

[8]That is, they may also arise from "other commercially available sources" or be collected by regional trade-related groupings of countries. For more details see http://wits.worldbank.org/witsweb/FAQ/Basics.aspx#Price, accessed 20 June 2005.

[9] For trade flows, the United Nations Commodity Trade Statistics (COMTRADE) database frequently has more recent data than TRAINS. For tariffs, data in the World Trade Organization Integrated Database (WTO-IDB) is often more recent than TRAINS. Access to the full TRAINS database is free to governments and requires a subscription for non-government users. By comparison, COMTRADE requires subscriptions for all users, while WTO-IDB is free of charge, in accordance with the WTO's dissemination policy. Users with access to the full TRAINS database often find it difficult to manipulate even using the free WITS software provided by the World Bank, which has only become available recently. More user-friendly extracts of TRAINS have been made available to TRAINS subscribers by Jon Haveman. Information on these and other useful trade data resources is available at http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/TradeData.html

[10] The original sources of these documents is the Market Access Database (EU, various years), the National Trade Estimate (USTR, 2002), and for the trade policy reviews (WTO, various years). The compilation is embedded as an Excel file within the .PDF document for Donnelly and Manifold (2005).

measures relating to investment in services may appear under either "services" or "investment" depending on how they were originally characterized. Measures relating to intellectual property rights (IPRs) are often not considered under NTMs but are included in the compilation because some of the underlying documents refer to violations or weak enforcement of IPRs.[11] Similarly, the descriptions of products and sectors in the compilation are those used in the underlying documents. This means that comparisons with TRAINS or with other trade and tariff data require the user to assign Harmonised System (HS) Code or Standard International Trade Classification (SITC) number to the verbal descriptions provided.

20. As the most widely available source of information on NTMs, the TRAINS database is the most widely used in research. It has been often employed to generate "frequency counts" of the share of tariff lines or of imports covered by NTMs or by certain types of NTMs. A good example of this kind of work is Ando (2005). Kee, Nicita and Olarreaga (2005b) use the TRAINS data, supplemented with other sources, in an econometric approach to identify quantity impacts and infer price impacts. Andriamananjara *et al.* (2004) use a combination of data found in TRAINS and Manifold and Donnelly (2005) to identify price impacts. The Deardorff and Stern (1998) categorization so far does not correspond to a database or compilation of NTMs but can be used as a benchmark for comparison to other schemes.

Box 1. A Brief Description of the Various Methods of Analysing NTMs

The "handicraft" price gap method

This method estimates the degree to which NTMs raise domestic prices above international prices in the countries imposing them. It estimates a "price gap" between domestic prices and international prices by comparing prices of goods affected by an NTM with goods unaffected by an NTM. In some sense this is an ideal method. It can be used to incorporate detailed specific information about the workings of policies, and gives results in terms of a "tariff equivalent" (ad valorem percentage change) that can be compared with tariffs and used in simulation models. Price data are not always readily available for all products and countries of interest. It is often difficult to make two price measurements for the same good and be confident that one fully reflects the effects of an NTM while the other is unaffected. Adjustments need to be made for such factors as transport costs and wholesale and retail margins. It is costly or difficult to make comparisons for many countries or policies this way.

Price-based econometric methods

These methods attempt to incorporate the intuition behind the price-gap method and extend it to many countries and products simultaneously. They take advantage of systematic reasons prices are higher in some countries than others to identify the extent to which high prices for some countries and products may be attributable to NTMs. Because these methods are capable of handling larger quantities of data than the "handicraft" price-gap method, they offer the promise of being able to compare the effects of NTMs more broadly, in order to identify which categories of goods they are most applicable to, using a common method for all countries and products. Their results can also be expressed as ad valorem tariff equivalents and used in simulation models. Price data is not always readily available for all products and countries of interest. Because a common method is used for all products and countries, a good deal of product- and policy-specific detail must be set aside. Thus, results for specific cases may diverge widely from those which would have been obtained using a case-by-case analysis. Choices about the econometric specification may influence the results obtained.

[11] In fact, the economics of weak IPRs are in some sense the inverse of NTMs. The presence of an NTM is generally thought to raise prices and reduce trade, while the presence of weak or violated IPRs is more likely to lower prices.

Quantity-based econometric methods

These methods look for evidence that the presence of NTMs leads to lower trade flows, or that the presence of trade-facilitating policies or practices leads to higher trade flows. Statistical analysis of trade data is employed, including both gravity models (emphasizing country size and economic distance between countries as factors explaining trade), factor-content models (which emphasize differing availability of resources in different countries), and models blending features of gravity models and factor-content models. Trade data on quantities are much more abundant and more internationally standardized than price data, so that in principle all products in all countries can be analyzed. Recent advances in methods offer hope for future progress. The effect on trade flows may be of more direct interest to policymakers than the effect on prices. The general limitations of econometric work (using common methods may ignore product-specific information, choices about econometric specification may affect results) apply to both price-based and quantity-based methods and may be more severe for quantity-based methods. Results from quantity-based methods can only be expressed as tariff equivalents or price gaps by use of additional assumptions and information.

Simulation methods

Simulation models contain a representation of economic conditions consistent with basic economic principles. They have been used widely to simulate the effects of changes in tariffs on trade flows, prices, production in specific industries and sectors, GDP, and economic welfare. General equilibrium models represent the linkages between industries and countries. Partial equilibrium models are used to analyze specific narrowly-defined products or sectors in cases for which some of the linkages can be set aside. Simulating the effects of NTMs requires that a tariff equivalent or similar measure be estimated by one of the methods discussed above. By taking advantage of economic theory, simulation methods are able to produce estimates of a much wider variety of impacts of changing NTMs than other methods. The results obtained from such methods usually have a clear explanation in terms of causal factors. Some of the benefits of larger general equilibrium models require a significant up-front investment of time and effort. While the results obtained may be sensitive to certain assumptions, sensitivity analysis can usually be performed to find out how important these assumptions are.

III. The "handicraft" price gap method

A. The distinction between "handicraft" methods and "mass-produced" (econometric) methods

21. The basic idea behind the handicraft method of measuring the effects of NTMs is that NTMs are believed to raise the price paid by consumers above what it would be otherwise. This price increase or mark-up creates economic rents for some agents involved in the production or delivery of the good and can be detected by means of comparison of observable prices. The strategy involves comparing two prices at different stages of the distribution process before and after the NTM mark-up. From this difference one can infer the NTM rent. This difference must be corrected for other factors which may influence prices but which are not due to NTMs. The estimation of the NTM rent is an arithmetic exercise.

22. Numerous, good examples of the handicraft method exist (see Deardorff and Stern (1998)). To obtain the full benefits of this method requires precise information on prices, transport and distribution costs, tariffs, taxes, and/or subsidies at the product-specific level, and in some cases, information on quality differences between products. Thus, usable handicraft estimates tend to cover the policies of a single importing country for a few products of particular interest. The data requirements of the handicraft method to address NTMs across multiple countries and products can be unmanageable.

23. In an attempt to provide an assessment of NTMs for many products or sectors in many countries simultaneously, economists have increasingly turned to "mass-produced" estimates of the effect of NTMs using econometric techniques. These estimates help answer the following questions: why do product prices differ across countries? Why do trade flows differ across bilateral pairs of trading partners? Why do these variables change over time? Once adopted, both handicraft and mass-produced estimates may be introduced into simulation models to estimate other effects of NTMs, or conversely, their removal.

24. The advantage of mass-produced method over the handicraft method is that the mass-produced method covers many countries and products. On the downside, the econometric methods used to obtain the estimates for the mass-produced estimates are often much more sophisticated than simple arithmetic. In addition, the extra computational complexity does not usually provide extra precision on a product-by-product, country-by-country basis. The results obtained are likely to be sensitive to the details of the econometric techniques used, as well as to the availability of appropriate data, such as the policy data on NTMs described in Part II, and data on other variables, which may reasonably impact prices or quantities of traded goods.

25. Analysts often cite and consider the mass-produced method as useful as the handicraft method in estimating the global benefits of the removal of NTMs. However, the product-by-product, country-by-country estimates arising from "mass-produced" methods are not usually given the same degree of credence. The remaining part of this section will discuss details of implementing the "handicraft" method as it might be applied to a classic quantitative restriction, highlighting its strengths and limitations. Section IV will similarly discuss econometric methods.

B. Implementation of the classic "handicraft" method of estimating price gaps.

26. A primary challenge involved in the handicraft method is that prices of imported goods may increase everywhere along the supply chain, and some of these price increases would take place even in the absence of NTMs. The factors that increase the price include "shipping and handling" (costs of transport, and wholesale and retail distribution), rents or profits (market power), tariffs and other taxes, and subsidies.[12] These factors must be removed from the price difference (price gap) before the mark-up can be attributed to NTMs.

27. Factors that influence the price gap include the following:

- The marginal cost of production in the factory;
- The ex-factory (factory gate) price, which includes the profit, rent or mark-up of the factory;
- The f.o.b. (free on board) price at the point of export, which includes the cost of transport to the point of export as well as the costs of loading the ship, plane or truck;[13]
- The c.i.f. (cost, insurance, freight) price which includes the cost of international transport and insurance;
- The price after clearing customs, which includes any tariffs;[14]
- The wholesale price, which may include internal transport costs, the wholesale distribution margin, and taxes (sales, VAT, and/or excise); and

[12] The price along the supply chain would fall because of a subsidy.

[13] A variant of this concept is the f.a.s. (free alongside ship) price which includes the costs of getting the goods to the side of the vessel but not the costs of loading the vessel.

[14] Tariffs in most countries are applied to the c.i.f. price. For the United States, the customs value used to assess tariffs is essentially the f.o.b. price. This means that the difference between customs value and c.i.f. value can be used to infer the value of freight and insurance (the c.i.f. and f.o.b. margin). Australian customs data also permit direct calculation of the c.i.f. and f.o.b. margin.

- The retail price, which may include internal transport costs, the retail distribution margin, and taxes (sales, VAT, and/or excise).

28. One of the challenges of the price gap method is determining where the NTM occurs and who accrues the rents. The NTM mark-up may take place at any point (or points) along the supply chain. In simple applications, the NTM mark-up is often thought to occur "in the middle of the ocean" (between the f.o.b. and c.i.f. price). However, the rents may be divided among the importers, exporters, and distributors; thus, the rents may occur before or after the point of international transport.[15]

29. Another challenge of the price gap method is price data may be observable but may not correspond to the requirements of the analysis. Price measures associated with trade data are often unit values (value of trade flow divided by the quantity such as tons, bushels, number of items, etc.) rather than prices of particular transactions. At the end of the supply chain, only one price may be observable: the domestic price or a retail price which does not distinguish the domestic versus the import good. If there are differences in quality or attributes between the domestic and imported good these differences may influence the price gap. Similarly, while data on tariffs are often readily available, data on the transport and distribution costs often are not. Information on sales and excise taxes and subsidies may also be incomplete.

30. The price gap method faces another change because of differences in the quality of attributes of goods. A common assumption is the domestic and imported goods being compared are perfect substitutes. That is, the goods are identical in the attributes and should sell for the same price. However the prices may not always identify identical goods and price comparisons may use information from different sources. Prices generated explicitly for international comparison (e.g. the International Comparison Project, OECD, or EIU CityData) may not be entirely free from differences attributable to quality and not from NTMs.

31. Quotas pose a different type of challenge for the price gap method. Quotas are either 100 percent filled, which prevents additional imports, or not. In the former case, the price gap can be interpreted as the tariff equivalent of the quota or tariff rate quota (TRQ) while in the latter the price gap should be expected to equal zero. When the quota is not completely filled, licenses may be used to allocate the residual quota. The uncertainty about the availability of the last few licenses may mimic a filled quota even though the quota is only 80 or 90% filled. (Linkins and Arce (2002)) A price wedge may develop as the quota nears completion. Moreover, in the case of TRQs, imports over the quota come in at a much higher tariff. The value of this tariff needs to be taken into account (see the section on TRQs below).

32. The literature provides a number of examples of the basic price gap formula, which vary largely depending on the available prices used and the adjustments made. There are many useful formulae which are similar but not identical. Annex 1 gives a variety of alternate versions of the formula. The price-gap formulae also vary as to where the NTM is thought of as entering into the supply chain, e.g. they may be expressed as tariff equivalents, excise tax equivalents, export tax equivalents, export subsidy equivalents and so on. These variations are especially important for the purpose of introducing the measures of NTM rents into simulation models for the purpose of simulating their removal. This point will be discussed further in the section on simulation below.

[15] One case where the NTM rents are clear is when the rents are allocated and tradable, such as the case of a quota auction. The rents are directly observable from the quota market.

Box 2. Examples of the Price Gap Method

Several examples of the price gap method include the following: Chemingui and Dessus (2004) estimate price gaps for all categories of merchandise in the Syrian economy (see Table 6). In 1999, Syria had tariffs and quantitative restrictions covering much of commodity trade. The tariff equivalent of quantitative restrictions is the difference between the domestic Syrian price and the world price, with includes shipping costs and tariffs.[16] The results indicate that NTBs in Syria are larger and more variable than tariffs. The calculation also provides a convenient way of summarizing the total magnitude of the barriers across commodities. The calculations indicate that Syrian purchasers paid higher prices for imports because of NTBs which represented 6% of Syrian GDP, while tariffs represented 2% of GDP.

Huang *et al.* (2005) analyze China's trade in agricultural products. Because some goods are exported (e.g. fruits and vegetables, pork, and fish), others are imported (e.g. wheat, maize, and soybeans) and yet others are traded in both directions (e.g. rice, cotton, and poultry), their analysis seeks to capture both the effects of China's NTBs and of foreign NTBs facing China's exports. For each trade flow, the nominal protection rate (NPR) is defined as the percentage difference between China's domestic price and the price on board for the same commodity. The price on board is the c.i.f. price for China's imports and the f.o.b. price for China's exports. Conceptually, the difference between the c.i.f. prices and the f.o.b. prices includes the value of insurance and freight in transit. As for most countries, China's customs officials are not able to observe the c.i.f. price for China's exports. After subtracting visible policies which contribute to the NPR (tariffs and VAT for imports, and tax rebates and subsidies for exports), the remaining difference is attributed to China's NTBs for imports, and foreign NTBs, import subsidy equivalents, for exports (See Table 7).

The price gap for China's exports is presented as an "export subsidy equivalent," and is positive (negative) when the domestic price including tax rebates and subsidies is higher (lower) than the f.o.b. price. A negative value for the NPR on exports implies that the f.o.b. price of China's exports is lower than the domestic price, taking into account China's own tax rebates and subsidies. This presentation of the data allows the reader to infer that for the commodities analyzed, the tariff equivalent of China's NTBs is approximately the same order of magnitude as tariffs. Also, for most of China's exports, the f.o.b. price received in world markets is less than China's domestic price, implying that foreign NTBs (which may include foreigners' domestic agricultural subsidies as well as direct import restraints) push down the price. The interesting feature of this analysis is that usually the tariff equivalents are estimated using importers' data to capture the importing country's policy. The measures of "NTB abroad" thus represent an average of the effect of the policies imposed by all of China's trading partners, as they are experienced in China's market.

The "Import Restraints" studies of the US International Trade Commission (USITC) provide measures of the price gap equivalents corresponding to QRs and TRQs over time (USITC (1993)). The estimates presented in Table 8 are treated as export tax equivalents since they represent policies for which certain exporters secure rights to ship to the US market, which are valuable because of the price premium associated with them. The data used to implement the price gap method come from a variety of sources. In the case of textiles and apparel, purchase or auction prices for export licenses to ship to the United States were used to the extent available.

The estimates, which are presented along with information on tariff peaks for sectors without visible NTBs, illustrate some broad features of US import restraints. In most cases, the total price wedge for sectors with a TRQ or similar policy exceeds that in sectors experiencing tariffs only, and mostly comes from the TRQ.

[16] The Chemingui and Dessus (2004) method implies that the total effect of trade policies raised Syrian domestic prices over world c.i.f. prices in 1999 more than either the tariff or the tariff equivalent of the NTM; e.g. *Domestic price* = (1 + *tariff*)*(1 + *tariff equivalent of NTM*)*(*c.i.f. price of landed imports*).

In all three of the above analyses (Syria, China, and the United States), the estimated price wedges are both presented on their own and utilized in simulation models which can provide estimates of the impact of removal of NTMs and/or tariffs on exports, imports, economic welfare, and the level of output in particular sectors. As will be discussed further in Section V, the decision to represent the price gap as a tariff equivalent, export tax equivalent or export subsidy equivalent depends (or should depend) on the nature of the policies and how they are administered.

Bradford (2005) relies on retail prices originally collected as part of an OECD survey. Using data on internal-country margins collected from input-output tables and c.i.f. and f.o.b. margins based on the trade data of Australia and the United States, Bradford infers each country's producer prices by removing wholesale and retail margins. He then infers the f.o.b. export price by adding the export margin, and then obtains the c.i.f. price for each country's least-cost import source by identifying the minimum f.o.b. price and adding the c.i.f. and f.o.b. margins. The difference between the inferred price of the least-cost import source and the inferred producer price yields an estimate of total protection from tariffs and NTMs. The tariff equivalent of the NTM thus equals total protection minus the tariff. If the estimate is less than the tariff, the NTM is inferred to have no price effect.

The advantages of Bradford's method are that it allows a large number of price comparisons to be made for multiple countries and uses some systematically observed data on the internal margins. The disadvantage is that the border prices (f.o.b. and c.i.f. prices) arising from the method are inferences. The border prices may not correspond closely to prices of exports and imports as observed directly by customs authorities.

Some examples of price comparisons obtained using Bradford's method are presented in Table 9. The estimates represent aggregates at the sectoral level from a larger number of estimates on individual products. Also, the estimates illustrate the principle that using a single method to generate a large number of tariff equivalents may produce estimates with broadly reasonable patterns while providing estimates in specific cases that are less plausible. According to Bradford's calculations in Table 9, NTMs do not affect sugar in the United States. According to the USITC's calculations in Table 8, NTMs affect sugar substantially, a tariff equivalent of 107%. Also, some of the estimates of high NTMs, while they arise from estimates of high prices, are not obviously associated with any policy. For example, the estimates of high NTMs for petroleum and coal products in many countries lead to the suspicion that all of the relevant internal taxes have not been captured in the margins data.

Nonetheless, Bradford's exercise is useful in that it illustrates that "mass production" of tariff equivalents of NTMs need not be done solely with econometric methods. Mass produced results may in principle be done by arithmetic methods that stay close to the original logic of the price-gap method. Bradford's method provides a bridge between handicraft and price-gap methods.

C. Analogy to supply-chain analysis

33. Once a price gap (or tariff equivalent) is calculated for a particular product in a particular market, it provides a single measure of the effects of NTMs. When there is a single, transparent NTM, the tariff equivalent reflects the effect of that policy. The tariff equivalent can be used to simulate the removal of that policy. In the case of multiple NTMs, the interpretation is not so clear. Should each policy be thought of as contributing a certain percentage of the tariff equivalent? Or, should the tariff equivalent be understood as representing the effects of all policies jointly? If a series of NTMs prohibit trade and the removal of some of the NTMs does not permit market access, then, the "true" tariff equivalent of a single policy change may in fact be zero even when the measured tariff equivalent of all NTMs jointly may be quite large.[17]

34. The understandable desire of policymakers to identify the effects of each present policy or proposed reform is thus frustrated by the coincidence of multiple policies associated with a single, non-

[17] See Tilton (1998) for a case involving attempted importation of cement in which port practices, government procurement policies, private boycotts, discouragement of foreign direct investment, and weak enforcement of competition policy in effect created a de facto ban on importation. A price gap estimated for cement in the country in question would not be directly attributable to any single policy or practice but to the operation of the entire system.

decomposable tariff equivalent for their joint effects. One approach to dealing with this problem is econometric analysis dealing with multiple barriers in multiple countries simultaneously. Another approach, which has been less explored, is to use the multiple stages in the shipping-and-delivery process as a way of decomposing the price increase.

35. In a thought-provoking exercise, Anderson and van Wincoop (2004) suggest that the "typical" cost increase from the factory to the retailer is on the order of 170%, which may be decomposed as follows: 21% transportation costs, 44% border related trade barriers and 55% retail and wholesale margins (2.7 = 1.21*1.44*1.55). The 44% may include tariffs, NTMs, and "natural" barriers (such as different languages, information costs, and the cost of using different currencies).

36. In some cases the mark-up from factory to consumer may be even higher. Feenstra (1998), citing Tempest (1996), reports data which imply the mark-up on Barbie dolls produced in China and sold in the United States is approximately 900%. Costs of labour and materials in China are approximately USD 1, the price leaving Hong Kong (which includes services and profit) is approximately USD 2, and the average sales price in the United States is USD 10 which includes primarily transportation, wholesale and retail services performed in the United States. The 900% may somewhat overstate the mark-up over production costs, since some moulds and paints are obtained from the United States. Nonetheless, a large share of the costs of international trade comes from "shipping and handling," and substantial scope exists for increasing international trade by reducing these costs.

37. In recent years, the agenda of international trade discussions has increasingly taken up the topic of trade facilitation. For example, in the APEC Shanghai Accord of 2001, APEC leaders instructed ministers to "identify…concrete actions and measures to implement the APEC Trade Facilitation Principles by 2006 in close partnership with the private sector. The objective is to realize a significant reduction in the transaction costs by endeavouring to reduce them by 5% across the APEC region over the next 5 years. APEC (2001, Appendix 1)." The Doha Development Agenda of 2003 contains an explicit trade facilitation component, with "a view to further expediting the movement, release and clearance of goods, including goods in transit" (WTO (2004), Annex D).

38. The idea of "expediting the movement, release, and clearance of goods," when considered in conjunction with the idea of a staged increase in delivered prices discussed in the previous section, suggests that each stage of movement, release, and clearance can be analyzed separately. The costs associated with each stage may include both pecuniary costs as well as the implicit costs of delay associated with increased time. Trade facilitation thus implies both reducing the pecuniary costs and increasing the speed at each stage. The benefits of increasing speed can be substantial. Hummels (2001) estimated that each day saved in shipping time is worth 2.8% ad valorem for manufactured goods. The increase in speed due to increased use of air cargo and faster ocean vessels over 1950-1998 was equivalent to a reduction in tariffs on manufactured goods from 32% to 9%.

39. When considered in terms of the technology and institutions of international logistics, each of the stages of cost increase discussed so far can be further decomposed into sub-stages, with potentially identifiable and measurable factors of cost and speed. These speed and cost factors, in turn, may be responsive to specific policies. In the case of ocean-going trade, for example, the processes involved in landing and clearing cargo and delivering it outside of the port for inland transport only make up a portion of the f.o.b. and c.i.f. margin, since they do not include procedures at the point of export or transoceanic insurance and freight charges.

Box 3. The Twelve Stages of Seaport Logistics for Imports

1. The process of physically guiding the vessel into the berth, which involves navigation, pilotage, tug assist and line handling charges;
2. Application of berthage or "parking" charges to vessels secured to the berth;
3. Inspection, e.g. for security and drug enforcement;
4. Unloading by crane, the efficiency of which is measured in crane moves per hour, and which incurs charges if the port's rather the ship's crane is used;
5. Charges for "wharfage," the use of the apron and other areas in which cargo is moved around;
6. Inspecting the seal;
7. Dispatching the cargo to and from an assigned spot in the yard;
8. Storage, either in the port or in an alternate storage facility such as a bonded warehouse;
9. Customs clearance per se;
10. Fumigation, if necessary;
11. Possible charges for trucks enter the port from inland; and
12. Gate processing at the point of physical exit from the port.

Each stage involves identifiable costs and/or time.

Source: Londoño-Kent and Kent (2003)

40. The time and charges at each stage may be associated with specific policies and activities of government or private agents.[18] Similar considerations apply to airports, to "behind-the-border" activities outside of ports and airports associated with export and import, and to in-country transport, wholesaling and retailing.

41. Thus, the technology and institutions of logistic activities give rise to a natural decomposition of the tariff equivalent, which may be used in a complementary fashion with other information on policies for quantification purposes.

IV. Econometric approaches to estimating the effects of NTMs

A. General considerations

42. Deardorff and Stern (1998, p. 24) write:

> First, by attributing to NTBs all departures of trade from what the included variables can explain, there is a tremendous burden on the model used to explain trade. Indeed, the worse is the model of trade flows, the greater will be the estimates of NTBs, suggesting a considerable upward bias in their estimation. Second, it can be argued that theoretical trade models are capable of determining patterns of trade only when a series of highly unrealistic assumptions are made. In their absence, such models can only determine patterns of trade in an average sense and are not adequate to the task of predicting trade exactly for particular industries and countries. Thus a departure of actual trade from what is predicted by a regression model may reflect only this indeterminacy and not the presence of NTBs. Third, these approaches can really only make comparisons among industries or countries. They cannot tell us how far trading patterns depart from free trade. For if NTBs restrict trade everywhere, that characteristic may be imbedded in the parameters of the regressions and will not be reflected in the residuals or coefficients of

[18] Ports and airports themselves vary widely in terms of their ownership and operation. Besides fully government-owned-and-operated and fully private-owned-and-operate facilities, there are intermediate arrangements in which private firms own or rent facilities within a government-owned port or airport and operate them.

> the dummy variables used to represent unusual circumstances. For these reasons, one should be very cautious in using the results based on estimates of trade models. At best, such estimates may be most helpful for identifying relative levels of non-tariff protection across sectors and countries.

43. While the above comments refer specifically to estimates attempting to explain trade flows, they serve to illustrate the main disadvantage of regression models in general versus direct comparisons like the price gap method, namely, the "noise" (error) around regression estimates. If the error is sufficiently large, then no plausible inferences can be made about the NTBs. An additional disadvantage, as stated above, is that models are statistical generalizations rather than predictors of free trade outcomes. Thus, the model reflects already existing patterns of protection.

44. Recent econometric models to estimate NTM effects come in a number of varieties. A broad distinction can be made between price-based and quantity-based econometric models. Price-based models look for evidence that NTMs cause the domestic price of certain goods to be higher than it otherwise would be, while quantity-based models look for evidence that NTMs caused trade in certain goods to be smaller than it otherwise would be. Because prices and quantities are both part of the same market process, they are interrelated, and in principle the results of the two types of models can be compared.

45. Price-based regression methods (e.g. Dean, Feinberg and Ferrantino (2005)) exploit the so-called Balassa-Samuelson effect (Balassa (1964); Samuelson (1964); see Obstfeld and Rogoff (1996), pp. 210-216, for a discussion). The Balassa-Samuelson effect is an attempt to explain the empirical observation that the real exchange rate (absolute price level) is systematically higher in rich countries than in poor countries, by noting that rich countries have systematically higher levels of productivity in tradables relative to non-tradables.[19] If it is possible to account for these systematic price differences between countries, then in principle some of the remaining price differences which are not otherwise accounted for may be due to NTMs. Thus, as a starting point for price-based regression methods, it is necessary to explain more carefully the systematic reasons for international price differences.

46. The comparative non-tradability of services internationally means that there are systematic differences in the prices of services. These differences not only affect the overall price index, they may be passed on to goods prices since these prices are likely to contain a significant services component. Table 10 illustrates the extent to which the value of some traded goods in representative countries embodies the value of purchased services. The share of purchased services in total costs is significant in many cases and tends to be higher in high income than in low-income countries.

47. Some differences in international service prices can be proxied by per capita GDP, which is why a regression of absolute price levels on per capita GDP performs fairly well.[20] When data on individual services prices are available, a group of them can be used together with per capita GDP. For example, Dean, Feinberg and Ferrantino (2005) use the hourly wage for maid service and the rental of a one-bedroom furnished apartment along with per capita GDP.

[19] This, in turn, is due to the fact that it has been historically easier to achieve productivity gains in the tradable sectors (agriculture, manufacturing, and the extractive industries) than in services, as reflected in the fact that the price index of services relative to the GDP deflator has risen over time.

[20] For a basic example of this correlation, see Dollar (1992). For a fuller exploration of the relationship between per capita income and the absolute price level, and its implications, see the working paper series of the Center for International Comparisons at the University of Pennsylvania, which may be found at (http://pwt.econ.upenn.edu/papers/paperev.html).

48. Regressions on trade flows, by contrast, often employ some form of the gravity equation (model).[21] This equation, is consistent with a wide variety of theoretical underpinnings (see Deardorff (1998); Evenett and Keller (2002)). It also allows a substantial amount of the variation in bilateral trade flows to be captured by relatively few variables. Some of the earlier literature used tests based on the Heckscher-Ohlin theory of international trade, in which trade flows are related to relative resource abundance, to identify anomalously large or small trade flows (Leamer (1984); Saxonhouse and Stern (1989)).

49. Therefore, some modelling options are available. The consideration as to whether to do price or quantity analysis, as transposed from the direct-measurement context to the regression context, can be made in large part by considering factors such as the availability of data, and the prospects that the available data can be handled in such a way as to reduce the inevitable error involved in estimation and enhance the degree of available accuracy.

50. These considerations include the following:

i) The degree of aggregation of the dependent variable and how well it matches data in the presence of NTMs.

51. Data on the prices of well-defined products are preferable to data on industry aggregates. International price comparison data are often either relatively aggregated or expensive to obtain in disaggregated form. Even then the data are unlikely to be comprehensive. Some international price comparison data gathered for research purposes has yielded relatively aggregate (national or sectoral) price comparisons, e.g. the International Comparisons Project (see Bradford (2005); Pilat (1996); Summers and Heston (1991)). The disaggregated data have not been made widely available. Private databases of retail prices, gathered primarily for executive compensation purposes, have been compiled by firms such as AIR Inc. and the Economist Intelligence Unit (EIU CityData). For access to a single year's data, private databases can cost upwards of USD 10 000.

52. The EIU CityData database has been used to examine questions relating to NTMs and price dispersion by Warren, Hufbauer, and Wada (2002) and Dean, Feinberg, and Ferrantino (2004).[22] Descriptions of tradable products in EIU CityData range from the relatively specific ("Gin, Gilbey's or equivalent, "Cigarettes, Marlboro, pack of 20," and "Kodak colour film, 36 exposures") down to the relatively general ("Cheese, imported, 500g," "Ground coffee," and "Boys' jacket, smart,"). This leaves open the possibility that the price data collected may still contain significant sampling variation in product quality with unknown statistical attributes. The data-collecting organization may use additional protocols in an attempt to minimize such variation. For example, the samplers may have been told to price Kodak colour film at 400 speed as opposed to 200 or 800 speed. In some cases these protocols may be readily accessible to the researcher (e.g. EIU CityData prices are identified as coming from a "chain store,"

[21] Examples in the literature on product standards include Moenius (2003) and Otsuki, Wilson and Sewadeh (2000). Examples in the literature on trade facilitation and logistics include Wilson, Mann and Otsuki (2005) and USITC (2005).

[22] It has also been used to examine the related question of the slowness of exchange rate movements in reducing deviations from purchasing power parity (PPP) by Rogers (2000, 2002) and Parsley and Wei (2001). Both lines of research are attempting to answer the question of why deviations from the Law of One Price are so large and persistent even among advanced market economies, one by focusing on NTMs and other frictions and the other by focusing on inefficiency in the market for foreign exchange. In a widely cited paper, Obstfeld and Rogoff (2000) raise the possibility that trade costs, including NTMs, are linked not only to slow convergence of exchange rates to PPP, but to other "puzzles in international macroeconomics" such as the unusually large degree of "home preference" for both domestically produced consumer goods and for investors to purchase assets in the domestic economy.

"supermarket," or "mid-priced store," with prices in different kinds of retail establishments available for most products) while in other cases these protocols may not be readily available to the researcher.[23]

53. The relative abundance and degree of disaggregation of data on trade flows makes them attractive for analytical purposes. For most countries, export and import data are available at the six-digit HS-level of aggregation.[24] While price data often are only available for consumer goods, and then only for the countries in the price survey, trade data provide at least some information about raw materials, intermediate and capital goods, and some data for virtually all countries in the world, whether reported by the countries themselves or by the partners. It looks at first glance as if import and export data offer a greater prospect for being able to analyze markets for the universe of products and countries than do price data.

54. Trade data are value data (price times quantity) rather than pure quantity data, and care needs to be exercised in the microeconomic assumptions used to interpret the results. Some analyses implicitly or explicitly treat all international variation in values of trade flows as if it represents international variation in quantities traded. This choice is tantamount to assuming that prices are everywhere the same, which is not the case.

55. A problem of data reconciliation arises with trade data, since numbers reported by exporters and importers are often very different. A variety of factors have been offered to explain this. For example, exports are valued in most countries on an f.o.b. basis while imports are valued in most countries on a c.i.f. basis. Timing differences may cause shipments to be classified in different years, as well as to be valued differently due to exchange rate fluctuations. This timing difference may be especially true for a shipment leaving the exporter in December and arriving at the importer in January. The standardized classifications envisaged by the Harmonized System may not be uniformly applied by all customs authorities. Some merchandise may be over- or under-invoiced for purposes such as tax evasion or not recorded at all due to corruption, etc. Simple forms of data reconciliation often involve taking the larger of the two values or accepting the importers' value as correct on the grounds that tariff collection provides an incentive for more accurate data collection. Both of these assumptions may often be incorrect. Gehlhar (2005a) describes the procedures used to reconcile importer and exporter data for the GTAP database. The procedure is based on a product-by-country comparison of whether a given country's data is likely to be replicated by its trading partners within a given tolerance. Even for bilateral trade between large, developed-country trading partners, discrepancies between imports and exports may be substantial. Further challenges are posed for trade flows involving countries with a substantial amount of re-export trade, such as Hong Kong, Singapore, and the Netherlands (Gehlhar (2005b)).

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[23] This point is meant to apply broadly to all international price comparison data, rather than singling out EIU CityData.

[24] The Harmonized System, administered by the World Customs Organization, assures that countries maintain consistent product classifications worldwide, so that import and export data are internationally comparable. International standardization takes place at the two-digit or "chapter" level (e.g. HS 83, "miscellaneous articles of base metal"), four-digit or "heading" level (e.g. HS 8301, padlocks, locks, keys, and parts thereof), and 6-digit or "subheading" level (e.g. HS 830120, "locks of a kind used on motor vehicles"). National authorities may create additional breakouts below the six-digit HS level which are not standardized across countries (e.g. U.S. data have an eight-digit tariff line breakout and an additional 10-digit statistical breakout). The UN COMTRADE data present international imports and exports at a six-digit HS level. Classifications below the six-digit HS level usually are obtained from national sources (e.g. the Dataweb of the U.S. International Trade Commission at http://dataweb.usitc.gov). GTIS, a private firm, offers products such as "World Trade Atlas" which make the fine national breakouts for many countries available on a timely basis for paying customers, but even this does not free the researcher from the need to make personal judgments about comparability of products at levels below the 6-digit level.

ii) The goodness of fit of "basic" specifications.

56. The Balassa-Samuelson and the gravity models are attractive because they produce a relatively good fit to the data with relatively few explanatory variables. Thus, the ability of either method to detect effects of NTMs in the data begins with residual of the model.

57. The goodness of fit for a regression model is often measured with the R^2. This measure captures the share of variation in the dependent data explained by the independent variables. With a relatively small number of variables, both models routinely obtain "good" values of R^2 in the range of 0.4 to 0.7, with gravity model perhaps more likely to be at the higher end of that range.

58. When a dummy variable for the presence of an NTM is introduced into a regression model, the estimated coefficient for that model is essentially equivalent to an estimate of the value of the residual for the particular observation(s) that the NTM applies. In order to address the Deardorff-Stern critique, one would like for the underlying regression specification to capture a good amount of the variation in the dependent variable *other than* that which might be attributed to the NTM, so that the residual can be reasonably interpreted to contain mostly the effect of the NTM with relatively little confounding noise.

59. The standard R^2 is not necessarily a useful measure for the purpose at hand, for a couple of reasons. In the first place, the R^2 measures the size of errors relative to the dispersion in the dependent variable; whereas for policy purposes, we are interested in measuring the effect of the NTM relative to the total value of the dependent variable (e.g. the price of the good or the value of imports). The price of a certain good in different countries is likely to exhibit a certain amount of variation, with the highest prices in many cases being five or ten times higher than the lowest prices. The size of bilateral trade flows between pairs of exporters and importers have a much greater amount of variation – the typical trade flow between the United States and Japan may be hundreds or thousands of times as large as the trade flow for the same goods between two smaller countries which appear in the sample for analysis. It then follows that explaining the same percentage of variation in prices (using a regression to explain international price differences) as in quantities (using the gravity model) is in some sense more useful in the case of prices than in quantities, if the purpose is to identify the particular amount of unexplained variation associated with a particular importer and associate that unexplained variation with an NTM effect. [25]

60. In the second place, R^2, or any other summary measures of goodness of fit, are in fact summary measures; that is, they attempt to capture the overall fit of the regression. However, it is generally the case that the fit is better in some places rather than others. In order to obtain high-quality estimates of NTM effects, it is desirable that the fit be good particularly in those regions of the data for which NTM effects are observed. If the functional form is well chosen, then at least there will be no systematic pattern to the places of good and poor fit, but some places will still fit worse fit than others. As in any regression application, review plots of the residuals may be useful. For policy applications, considerations of localized measures of goodness-of-fit in the region of the data for which NTMs are observed may usefully supplement more general measures of goodness-of-fit when choosing a functional form.

61. The prospects for obtaining useful information out of either method thus depends both on the "baseline" degree of accuracy obtainable from each method and the prospects of improving that accuracy by refinements of the method. Many of these refinements have been developed in contexts other than the analysis of NTMs, making available a rich menu of methodological choices. In evaluating such econometric refinements, avoidance of the pitfall of "over fitting" the model is important. Some methods

[25] See Annex 2 for a formal definition of R^2 and a statistical elaboration of the argument in this section, including a criterion which may be employed as a rule of thumb to identify regression frameworks which are more likely to yield well-determined estimates of NTM effects.

which are designed to obtain the value of a specific parameter such as a price or income elasticity may soak up more of the variation in the data than may be desirable for the purposes of estimating the effects of NTMs. [26]

iii) The inherent value of using price data in obtaining tariff equivalents.

62. Statistical analysis based on price data allows the "price gap" or "price wedge" associated with an NTM to be inferred directly and expressed as a tariff equivalent. When the analysis begins with quantities (i.e. with trade flows), the result is an estimate of the effects of NTM on the trade flow. This can be translated into an estimate of the effects on prices so long as there is available an estimate of the responsiveness of trade to prices, i.e. of the "price elasticity of demand" for imports.[27] The disadvantage of this procedure, compared to working directly with prices, is that a tariff equivalent estimated using price data comes from a single statistical exercise, whose uncertainty can be measured. However, using quantity data, there are two sources of statistical uncertainty from the analysis of trade flows itself and from the separate analysis in which the elasticities were obtained. These sources of error are approximately compounded in the estimate of the resulting price effect or its tariff equivalent. In many applications, the situation is worse because the value of the elasticity is simply posited or drawn from a database. In this case, the second source of uncertainty is still present, but any information which may be used to assess the magnitude of the uncertainty may have been obscured or lost.

63. An additional, more technical, issue arises with the use of estimated elasticities to infer the market effects of NTMs. Some analysis of NTMs, e.g. welfare effects, may be based on a simulation model or other model which assumes a certain theoretical structure. The values of elasticities used in the model may have been derived from an econometric exercise which either implicitly or explicitly assumes a different theoretical structure. In fact, this situation is by far the most common one even in simulation analyses of tariffs, in which a complex structure is used for the simulation (e.g. computable general equilibrium or CGE analysis) while the elasticities are derived from a simple structure. However, Kee, Nicita, and Olarreaga (2004a, b, and c) represent an attempt to address this issue in the context of assessing NTMs and tariffs. They also examine of the question of compounding the separate errors in the estimation of elasticities and the estimation of the effects of NTMs on trade flows.

iv) The position of prices and quantities in the chain of causation.

64. An argument for using trade flow data to detect the market effects of NTMs can be adduced from the way in which NTMs affect the mechanisms of the marketplace. In the first instance, NTMs reduce imports and in many cases are explicitly designed to do so. This reduction in imports leads to an overall reduction in domestic supply and in turn an increase in prices. However, many other factors may influence the level of domestic prices besides the level of imports. These factors may have a first-order impact on domestic prices but only a second-order effect on the level of imports. If so, the "signal" of NTMs provided by import volumes would be in some sense "cleaner" than that provided by domestic prices.[28] In

[26] Very high values of R^2 exceeding 0.9, may be obtained in applications in which "fixed effects" are employed. Fixed effects are essentially dummy variables designed to capture the average values for each country, country-pair, time period, and product. The concern arises that the use of fixed effects may obscure the information about NTMs which the analysis is attempting to derive. Some technical discussion of this point is provided below.

[27] That is, *Percentage change in price of imports* = (1/*e*)**percentage change in volume of imports,* which *e= the price elasticity of demand for imports*= (% *change in volume of imports*)/(% *change in price of imports*).

[28] Readers, who think in general-equilibrium terms, remaining aware that everything affects everything else in the economy, may be sceptical of this line of argument. For example, domestic incomes as measured by GDP are an important variable that one might expect to affect domestic prices but are also included in statistical attempts to explain import demand.

any case, the imports are in an institutional sense the direct target of NTMs as a policy while domestic prices, like domestic employment, are secondary targets.

65. The problem created by multiple forces affecting domestic markets is related to the problem with to price-based approaches; that is obtaining the price of imports without wholesale and retail margins.

B. Price-based methods

i) Current examples

66. A variety of attempts have been made to assess the effects of NTMs or other trade restrictions using data on prices. Most of these attempts have used retail price data, for the simple reason that retail prices are easier to observe than prices at other stages of the supply chain. The use of retail price data can be criticized on several grounds. One critique is that many traded goods are primary and intermediate goods, which do not have retail prices. In some cases, analysts have sought to represent the effects of NTMs for broad categories of goods by examining prices and NTMs for a few consumer goods. If those categories contain significant amounts of intermediate goods (e.g. chemicals, steel or electronic components), this may be problematic, since both pricing behaviour and presence or absence of NTMs may be different for the intermediate goods than for the consumer goods.[29]

67. Another critique of the use of retail price data is that they contain wholesale and retail margins, which are thought to complicate the identification of the NTM mark-up. The consensus in the field is that the in-country price (landed duty-paid price) includes all of the NTM rent and that the wholesale and retail margins are free of such rents. On this view, the wholesale and retail margins are nuisances which need to be purged from the prices.

68. For the purpose of analyzing NTMs the tradition of handicraft price comparisons treats wholesale prices as "better" than retail prices, and landed duty-paid or "in-country" prices as better than either. The tradition implies that this preference should be carried over into econometrics. It is not obvious that the tradition is correct either for handicraft or econometric methods. For the case of auctioned quotas, where the rents are easiest to observe, there has long been evidence that rent sharing can take place between exporters and importers (Bannister (1994); Krishna and Tan (1994)), and many of the formulae for NTM rents account for this explicitly. There is no obvious theoretical reason that importers at the border, wholesalers, and retailers should not share the NTM rents among themselves, especially since large retailers like Wal-Mart are backward-integrated into the earlier stages of distribution in any event. Moreover, "behind-the-border" barriers to entry or access to wholesale and retail distribution are often considered to be NTMs in themselves, applied formally to services markets but affecting multiple markets for goods.

[29] For example, in the work of the USITC's NTM Project (Andriamananjara, *et al.* (2004)), the prices which represent the aggregate of "metal products" is represented by two retail items (Teflon frying pans and razor blades), while the prices of "electronic goods" come from two other retail items (colour televisions and personal computers).

Box 4. Examples of Price Based Methods

Warren, Hufbauer, and Wada (2002) assess the potential benefits of reducing the dispersion among international prices of consumer goods and services. They evaluate the benefits by reducing the worldwide price dispersion to approximately the degree of the "broad world price band," which is the price dispersion observed among the 17 cities of the United States in the sample. The "broad world price band" is calculated by finding the mean and standard deviation of US prices and setting the limits of the band to two standard deviations plus and minus of the mean. This reduction still leaves a substantial degree of dispersion for many products. [30] They then perform the experiment of moving higher international prices down to the top of the band and lower international prices up to the bottom of the band. The countries experiencing reductions in prices are assumed to achieve gains from importing, while the countries experiencing price increases are assumed to achieve gains from exporting. These gains are assessed with a partial equilibrium model. Using 1999 data, the gains are approximately 2.1% of global GDP (USD 600 billion) when calculated at market exchange rates or 6.3% of GDP (USD 2.4 trillion) when calculated at purchasing power parity (PPP) exchange rates (Table 11). These gains are divided in dollar terms approximately equally between developed and developing countries but are larger for developing countries as a percentage of GDP. The gains for high-income countries are primarily due to falling prices. The gains for middle and low-income countries are attributed primarily to rising prices when market exchange rates are used but to falling prices when PPP exchange rates are used. The policies and methods by which this dispersion might be reduced (whether by reducing NTMs, improving transport and communication, facilitating information about international markets, improving domestic distribution, etc.) are left undefined.

Hassink and Schettkat (2001) study prices for 220 furniture products sold by IKEA furniture for 10 countries within the European Union. This case is of completely homogeneous products within a region for which all formal trade barriers are supposed to have been dismantled. They find that substantial price variation, with many prices deviating more than 25 percent from the EU-wide mean, and their formal statistical tests reject the Law of One Price. They conclude that only some of this price variation is due to "pricing-to-market" (i.e. international price discrimination as part of IKEA's strategy as a multinational firm) and the non-tradable cost components such as wages and excise taxes. However, a great deal of the price variation remains unexplained.

Another example of an analysis looking at price comparisons for a specific set of products is Goldberg and Verboven (2001). They analyze prices of about 150 varieties of motor vehicles in five European countries during the period of 1970-2000, a period during which the countries in question were subject to several different exchange rate regimes. They use hedonic techniques to take into account the differences in attributes of different vehicles. Their measure of the degree of integration of the various markets is the speed of price convergence using either the absolute version of the Law of One Price (prices absolutely converge) or the relative version (rates of price inflation or deflation converge).[31] These are expressed as "half-lives," the length of time it takes for half of a "shock" to the difference between countries' prices to disappear due to convergence. They find rates of convergence similar to those found elsewhere in the literature – using the relative Law of One Price, half of the price shock disappears in 1.3 to 1.6 years, while half of a shock to absolute prices disappears in five to eight years.

[30] For example, the "broad world price band" for 1 kg of mushrooms ranges from USD 3.27 to USD 10.18 and for a 56 cm colour TV set from USD 390.84 to USD 1 027.40. These reductions approximate the actual price dispersion among the observed U.S. cities. Alternate calculations using price dispersion among the 25 EU cities in the sample produce comparable results, with somewhat greater dispersion within the EU for most products.

[31] Studies based on the relative version of the Law of One Price are easier to conduct and more abundant in the literature, because they can be done using price indices published by national statistical authorities. However, such price indices, because they are normalized (e.g. set equal to 1 or 100 in a given base year), obscure the actual level of prices, and it is reasonable to think that NTMs induce absolute rather than relative price differences. Thus, the emphasis in this review is on the smaller number of studies which employ absolute price comparisons.

The US International Trade Commission's (USITC) NTM project (Andriamananjara *et al.* 2004) uses EIU CityData's retail price data as a starting point, examining over 100 products in 115 cities and 67 countries for the year 2001. Following the Balassa-Samuelson hypothesis, much of the international deviation in goods prices can be explained by deviation in the prices of non-tradable services. In the econometric approach, three variables are used to capture this systematic variation – the wage for domestic cleaning help, rental of a one-bedroom furnished apartment, per capita GDP, and dummy variables for regions. Data on NTMs from both TRAINS and the Manifold and Donnelly (2005) database are used to identify countries and products for which NTM effects might be expected, and estimates are generated for these effects. The method is designed to aggregate the various effects for countries and products into effects for 14 sectors encompassing the universe of traded goods and 18 regions of the world (Table 12). This estimating strategy is used in order to use the tariff equivalents obtained in a simulation model in order to estimate the effects of their removal.

C. Quantity-based econometric methods

69. In principle one can detect the effects of NTMs using either price data or quantity data. Data on merchandise trade flows are an example of quantity data. NTMs which are effective in the marketplace both raise the prices of domestic goods and reduce the volume of imports. Since the relative advantages and limitations of price-based and quantity-based methods have already been discussed, this section is devoted to the main features of quantity-based methods, particularly gravity modelling, and to the use of quantity-based methods to attempt an overall assessment of the impacts of NTMs. Quantity-based methods have also been frequently used in analyses focusing on particular categories of policies, including standards, rules of origin, and trade facilitation.

i) Gravity modelling

70. Since the early 1960s, economists have observed that international trade flows tend to be larger between pairs of large economies and smaller between pairs of economies which are more physically distant from each other (Tinbergen (1962); Pöyhönen (1963)). As has already been mentioned, gravity modelling allows the analyst to give a reasonably good statistical account of the levels of trade flows with just three variables (exporter's GDP, importer's GDP, and a measure of distance) or even only two (many applications use the product of exporter's GDP and importer's GDP as a single variable).[32] Physical distance is accounted for either by "great circle" or air distance, waterborne shipping distance, or time zones.

71. Impediments to trade can be viewed as additional factors which increase economic distance. Additional variables can be included in the model almost without limit:, "cultural" distance factors such as linguistic distance (Boisso and Ferrantino (1997)), cultural "good feeling" (Noland (2005)), ethnic networks (Rauch and Trinidade (2002)), and bilateral trust of business persons (Guiso, Sapienza, and Zingales (2005)). One can add measures of "policy distance" such as tariffs, NTMs, the presence or absence of free trade agreements (FTAs), membership in international organizations, etc. Measures of economic freedom, institutional quality, transparency or corruption have also been used in gravity models.[33]

[32]A good guide to the basic principles of gravity modelling is Frankel (1997), chapters 3-6. In principle, gravity modelling can be applied to any international transaction in which flows between two partners can be identified, not only merchandise trade. The interested reader will find applications of the gravity model to foreign direct investment, portfolio investment, passenger air traffic, telecommunications, Internet usage, and immigration, among others.

[33] The large number of candidate variables which have been used in gravity models has led some researchers to suspect the possibility of obtaining spurious effects of some variables on trade in models which use "kitchen-sink" specifications to "overfit" the gravity model. Ghosh and Yamarik (2004), using extreme-bounds analysis, show that

72. The potential of gravity models in identifying the effects of policies comes about in cases in which some countries are implementing a particular policy while others are not. Such variation exploits the cross-sectional richness of the available trade data. For example, a sample of observations of the bilateral trade of 30 countries for a single year includes 870 (30*29) observations on bilateral trade, while a sample of 100 countries yields 9 900 (100*99) observations. Such samples are frequently used in practice. Panel data, which includes observations of the trade flows in multiple years, can be used to expand the sample size even further as well as to pin down the estimates of persistent effects with more accuracy. By contrast, the traditional method of estimating import demand functions, in which imports are a function of national income and relative prices, uses time series data on a single trade flow (e.g. Goldstein and Khan (1985)). In principle this method can be only used to assess NTMs or other policies when one has a situation in which there is a reasonable period of time before and after the policy has been implemented (See also the discussion under vector autoregressive methods below). Gravity models estimated on panel data can also be used to do "before-and-after" analyses when the estimation is performed on a series of annual cross sections.[34]

73. The heavy use of gravity models, particularly for policy purposes, has caused renewed attention to be directed to improving their specification. The demands placed on such models increasingly involve not only providing an overall picture of the major determinants of trade, but also identifying the effects of particular policies (such as NTMs or FTAs) which affect only a small number of observations in the sample. The result is a greater demand for increasingly precise estimates of residuals. In recent developments, Anderson and van Wincoop (2003) show that the estimation of gravity models can be significantly improved. Also, gravity models can provide "before and after" policy experiments, when one takes into account the fact that prices and quantities of traded goods are simultaneously determined.[35] Their method, while attracting a good deal of attention in the profession, has thus far received limited application because it requires the use of customized software to produce non-linear least squares (NLLS) estimation. Even though the authors have made their software readily available, the technical barrier has been daunting for many researchers. More recently, Baier and Bergstrand (2005) have shown that many of the advantages of Anderson and van Wincoop's approach to estimation of the gravity model can be obtained by using standard statistical software which runs ordinary least squares (OLS) by use of an appropriate approximation.

ii) The World Bank approach to an overall assessment of NTMs

74. Kee, Nicita and Olarreaga set out to assess the effects of NTMs and tariffs using the framework of the Trade Restrictiveness Index (TRI) of Anderson and Neary (1992 and 1994). The TRI is a device for summarizing the tariff schedule of a country with a single number. Also the TRI reflects the equivalent uniform tariff which would have the same effects on economic welfare as the actual tariff schedule containing both high and low rates. Combined with estimates of the tariff equivalent of NTMs, the TRI can be used to summarize the joint effect of tariffs and NTMs on the economy. In order to aggregate the various tariffs to obtain the TRI, measures of the sensitivity of import demand to price (price elasticities) for the various tariff lines are required. Typically, the TRI (expressed as a single tariff rate) yields a higher summary value for the level of protection than either the simple or import-weighted average of tariffs, since it captures the distortions caused by tariff peaks.

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the finding that particular FTAs are trade-creating is highly sensitive to the choice of other variables included or excluded from the gravity model. Similarly, Anderson, Ferrantino and Schaefer (2004), using Monte Carlo analysis, show that the finding of Rose (2002) that currency unions are highly trade-creating can be reproduced in gravity regressions on synthetic datasets in which the "true" underlying specification omits any such effect.

[34] A good example this analysis is in Aitken (1973) shows trade-creating effects of the European Union.

[35] In more technical language, one can speak of accounting for the endogeneity of prices in general equilibrium.

75. In the first paper (Kee, Nicita and Olarreaga, 2005a), the authors estimate import demand elasticities for a very large number of commodities and countries using time series data over the period 1988-2002. The estimation involves 117 countries and begins with the approximately 4 600 commodities classified at the six-digit HS level. Eliminating extreme values and commodities with very small trade flows, they estimate approximately 315 000 elasticities, an average of about 2 700 per country, in a manner which is theoretically consistent with the TRI. They find significant dispersion of elasticities across countries and products, with some systematic patterns in the estimates – larger countries tend strongly to have higher price elasticities of import demand, while poorer countries tend (less strongly, but still significantly in the statistical sense) also to have higher price elasticities.

76. In the second paper (Kee, Nicita and Olarreaga 2005b), they derive country-by-country quantity impacts of NTMs by analyzing trade data econometrically. Rather than employing either a gravity model or a "classic" import demand function in terms of prices and income, they use an analysis of imports based on the comparative advantage approach of Leamer (1988 and 1990), which is based on the Heckscher-Ohlin model of international trade. In this approach, imports are a function of national factor endowments. Gravity-type variables included in the model are a dummy variable for islands and "remoteness," which is the average (import-weighted) distance of each country from its world trading partners. Additional policy variables include the level of tariffs and domestic agricultural support for each country and commodity. The presence of NTMs is introduced by a dummy variable which is derived from the TRAINS database, updated with information from the WTO Trade Policy Reviews and a database on EU standards as described in Shepherd (2004).

77. From the estimates, the authors calculate ad valorem tariff equivalents and compare the relative magnitude of NTMs and tariffs. Finally Kee, Nicita and Olarreaga (2005c) derives various versions of the TRI, taking both tariffs and NTMs into account: the Overall Trade Restrictiveness Index (OTRI), which gives the uniform single tariff that produces the observed level of imports, and the Market Access Overall Trade Restrictiveness Index (MA-OTRI), which summarizes the protection each country's exports face from its trading partners. They then compare the TRI, OTRI and the MA-TRI. In doing so, they examine the consequences of combining the error in the estimation of the elasticities with the error in the estimation of the impact of NTMs on trade flows. Some of these estimates are summarized in Table 13.

D. Vector-autoregressive methods

78. When an NTM has been applied to a particular good at a particular time and time-series data span the time before and after the implementation, an opportunity exists to evaluate the effect of the NTM directly by a comparison of *ex ante* vs. *ex post* prices and quantities. In some cases, as for example quantitative restrictions, a fairly good idea of the effect of the policy can be obtained by casual examination of the data. However, more powerful time series techniques can be employed as well.

79. The effects of a US wheat import quota similar to that imposed on certain imports of Canadian wheat during 1994-95 is analyzed in Babula, *et al.* (2005) using a vector-autoregressive (VAR) model. The model includes the price and quantity of wheat demanded and supplied in the US market, as well as the wholesale prices of goods which use wheat as an input – wheat flours, mixes and dough, bread, wheat-based breakfast cereals, and cookies and crackers. The model is estimated for quarterly data for a period running from 1986 to 2003, with appropriate adjustments to accommodate the time series methodology used.[36] In the model, all variables are functions of the lagged values of all other variables. Estimation of the model leads to a set of "directed acyclic graphs" which show the chains of statistical causation by

[36] For example, the price of bread is found to be non-stationary (roughly, it has a time trend) and enters the model in first differences of logarithms, while the other prices and quantities enter in logarithms.

which a shock is transmitted through the system. The estimates are then used to simulate a shock to the market comparable to the quantitative restriction.

E. The issue of multiple policy measures

80. Knowledge of the types of NTMs that are most likely to produce increases in trade or economic welfare upon their removal would be useful for policymakers. Such information would, for example, help negotiators set priorities. However, this question is one of the most difficult ones to answer in quantitative work. One example of the difficulty can be illustrated by reconsidering the standard "handicraft" price method. Suppose that good estimates of the price gap exist in a market with multiple NTMs (e.g. a quantitative restriction, inefficient customs procedures, product-specific inspection standards, etc.) A natural question to ask is what percentage of the price increase is due to each of the separate NTMs, but the question has no obvious answer. The single price gap reflects the cumulative effects of all policies. Each NTM may raise the price by a percentage or the price gap is created (or eliminated) by the implementation (or removal) of *all* the NTMs.

81. Econometric methods offer some promise for resolving this situation, at least in broad terms. If trade flows for many countries with NTMs are being studied simultaneously, then regression methods can be used to identify the effects of different NTMs. A number of results of this type are available in the literature. However, they need to be interpreted with caution, since the presence of restrictive or inefficient policies tends to be correlated. Countries and products which are subject to one type of restrictive or inefficient policy are more likely to be subject to others. For example, Wilson, Mann, and Otsuki (2005) consider four measures of policy quality relevant to trade facilitation: port efficiency, the customs environment, the regulatory environment, and service sector infrastructure. They report that the correlation among each of these measures across pairs of countries ranges from 0.60 to 0.78, which is fairly high. In general, when variables in a regression analysis are highly correlated (multicollinearity), it is difficult to distinguish the effects of each individually. The authors are aware of this issue and discuss some methods of addressing it. They note that both longer time series and time-varying indicators of policy quality would make identification of separate effects easier, but both are difficult to obtain.

82. In a related application, USITC (2005) studies the effects of logistics quality in non-US ports and airports by econometrically estimating the effect of questionnaire-based logistics indicators on US exports to various countries. The list of measures, covering six factors of logistics quality (regulation, airports, seaports, complementary resources, security burden, and customs) is similar to that developed by Wilson, Mann, and Otsuki (2005). The factors also show a high degree of correlation across country pairs, in most cases between 0.45 and 0.60. The USITC analysis examines the robustness of each of the effects to the inclusion of other effects, considering them each individually, all together in a group, and in subgroups selected by a statistical procedure known as "stepwise regression." The results show that the fewer the number of policy indicators included, the greater is the effect on trade which is attributed to each included indicator. The robustness of the policy implications derived is based on which indicators of policy perform well regardless of which other indicators are included.

83. Analyses which decompose the supply chain into its component parts may offer a new avenue for studying the relative importance of different policies which may affect trade.

V. Simulation Methods[37]

84. Simulation methods in economics offer the possibility of examining the effects of a policy change which is roughly, but not precisely, equivalent to the controlled experiments used in the natural sciences. The historical data used in econometric analysis does not represent a controlled experiment but describes whatever actually happened historically. The historical data are subject to multiple influences not all of which are known to or measurable by the investigator. Simulation methods begin with a fully calibrated picture of a given market or set of markets which are structured to ensure the operation of standard economic theory: For example, supply increases with increases in price; demand falls with increases in price; the quantity supplied equals the quantity demanded; accounting identities are observed; etc. The models may include policy measures such as tariffs or the tariff equivalent of NTMs, which can be altered in a series of experiments. When the model describes one or a few markets (e.g. the market for wheat, or the interlinked markets for hot-rolled steel and cold-rolled steel) they are known as *partial equilibrium* models. When the model describes all markets simultaneously in a national economy (representing, e.g. the linkage between the steel and auto markets) or in the world economy (further including, e.g. the linkage between one country's steel market and another country's auto market) they are known as *general equilibrium* models. Thus, a simulation which alters the level of a tariff or NTM will simultaneously influence prices and quantities in all markets in the model, in a manner consistent with economic theory. Estimates of the effect on various economic factors (exports and imports; prices, wages, and returns to capital and land; production and employment in particular industries or sectors; GDP; and economic welfare) can be generated.

85. Simulation models thus offer great advantages in terms of providing estimates of the effects of policy change, and explaining why those changes have come about. A criticism often made of simulation models, particularly large general equilibrium models with thousands of equations, is that the internal workings the models are too complex to be understood, thus, the analyst can produce any desired result. However, well-documented models, such as the GTAP general equilibrium model, are capable of providing a detailed accounting of the various effects operating in any particular policy experiment. The quantitative results of simulation models depend on price and income elasticities, which come from econometric models, the judgment of analysts or a combination of the two. However, this also is not a fatal objection, since best practice suggests documentation of the elasticities used and sensitivity analysis to check the robustness of results to different values of the elasticities.

A. The relationship between tariff equivalents and simulation methods

86. It should be clear that the results obtained from any simulation of a change in policy are highly dependent on the quantitative measures used to describe the policy changes themselves. For example, the proliferation of general equilibrium results which began to appear in the early 1990s prior to the implementation of the Uruguay Round and NAFTA often made use of relatively simple representations of national tariff schedules. Improvements in analysis have come with the increasing availability of tariff data accounting for such details as preferential arrangements, specific tariffs, and compound tariffs (combinations of specific tariffs and ad valorem tariffs expressed in percentage terms). The desire to obtain ad valorem tariff equivalents for the effects of NTMs is in significant part motivated by the success of simulation models of tariff liberalization in trade agreements, thus, the extensive emphasis above on price gaps. Moreover, the tariff equivalent provides a convenient metric for comparing the relative effects of tariffs and NTMs even if the further step of simulation methods is not undertaken.

[37] The simulation methods referenced in this section refer to general equilibrium and partial equilibrium methods. "Out-of-sample" estimates generated using an econometric analysis as a starting point and inserting new data into the estimated model are also referred to as "simulation," e.g. as in the discussion above of the experiment performed using the VAR model of Babula *et al.* (2005).

87. However, the use of such a tariff equivalent is not always appropriate in a simulation model. Tariffs create a wedge between the price received by exporters and the price received by importers, with the revenue corresponding to this wedge collected by the importing government. While most NTMs cause price gaps, only a few, such as quotas for quantitative restrictions auctioned by an importing government, generate a tariff-type revenue for the importing country. Thus, estimated price gaps may be introduced into the model in different ways. The differences are important because estimates of national welfare depend on who captures the rents from a given policy, which in turn depends on how the policy is administered.

88. For example, Andriamananjara, *et al.* (2005), estimate price gaps for apparel. The price gaps were treated as export tax equivalents rather than tariff equivalents. In this case, the primary policy operating was the WTO Agreement on Textiles and Quota, which required exporter-administered quotas; thus, the higher prices of in-quota apparel are largely captured by the exporter or the exporting government in the case of a quota auction. Price gaps for footwear were treated as tariff equivalents, and price gaps for processed foods were treated using a type of price wedge which creates purely wasteful friction between the exporter and importer without either side capturing revenue ("sand-in-the-wheels"). A similar "sand-in-the-wheels" method is used to capture the implications of improving customs clearance in the "New Age" FTA between Japan and Singapore (Hertel, Itakura and Walmsley (2005)), since the costs of inefficient customs procedures are not explicitly measured in the GTAP model used for the simulation.

89. One relatively unexplored issue involves the interpretation of price effects obtained from econometric analyses, when these are subsequently introduced as price gaps in CGE models. When a price gap is obtained by the "handicraft" method, it can be reasonably treated either as a tariff equivalent or other appropriate concept depending on how the policy is administered. Price effects obtained from econometric analyses, however, may be interpreted either as deviations from the exporter's supply price, which is consistent with the tariff equivalent interpretation, or as deviations from the equilibrium price, which would be observed in the absence of a tariff. In any given market with a price gap operating, the difference between the importer's demand price and the exporter's supply price is generally less than the difference between the importer's demand price and the free-market equilibrium price (For a graphical presentation see Deardorff and Stern (1997), fig. 1). If estimated price effects of NTMs are interpreted as deviations from free-market equilibria, then their corresponding tariff equivalents would be significantly larger. Thus, the consequences of altering or removing the policies consequently would also be larger.

B. Choice of method – general equilibrium vs. partial equilibrium[38]

90. If the analyst desires to examine the effect of changing policies in many markets (many countries and/or many products) at the same time, general equilibrium models offer the advantage of being able to model the forward and backward linkages between various markets. However, the start-up costs of learning to operate CGE models can be high, with model-specific training required to achieve basic facility in the use of the model. In addition, the data requirements for such models can be fairly large, even when a baseline dataset is provided by a source such as the GTAP consortium.

91. Partial-equilibrium models are more appropriate for the analysis of single markets, such as in an antidumping case for a particular variety of steel. If the analyst desires to study a particular narrowly defined product, for example, women's non-knitted blouses made of particular fibres, partial-equilibrium modelling is particularly indicated since the economy-wide databases assembled for CGE models are fairly aggregated and unable to represent more detailed sectors than, e.g. "apparel". Both the start-up costs and the data requirements for partial equilibrium models are relatively modest. They are often implemented on

[38] See also the discussion in Francois and Reinert (1997).

standard spreadsheet software such as Excel or QuattroPro.[39] General equilibrium models require extensive code run on non-linear "solver" software such as GAMS or (for the GTAP model) GEMPACK, which require some initial investment.

VI. Methods for Particular Policies

A. Tariff-rate quotas

92. Tariff-rate quotas (TRQs) are two-tiered tariffs for which a lower duty is charged on imports receiving quota allocations ("in-quota" imports) and a higher duty is charged on imports in excess of the quota ("over-quota" imports). The extensive use of TRQs in agriculture as a replacement for quantitative restrictions originates with the Uruguay Round's Agreement on Agriculture in 1994. At the end of 1999, over 80 percent of TRQs notified to the WTO were in five categories of products; fruit and vegetables, meat, cereals, dairy products, and oil seeds (Skully (2001)).

93. Estimates of the restrictive effect of TRQs have many similarities to estimates of the restrictive effect of pure quantitative restrictions. The price gap method, for example, can be used to estimate the difference between the domestic and world prices of an agricultural commodity in a country imposing TRQs.[40] Since the above-quota tariff represents a direct ad valorem cost imposed when the quota is full, the value of the above-quota tariff is sometimes used as a proxy for the price gap. In principle, the tariffication process in the Uruguay Round set the level of the above-quota tariff equal to the estimated aggregate effect of the previously existing protection. Even if these estimates were to be accepted as accurately representing conditions in the early 1990s, market conditions have changed substantially in the intervening period.[41] In cases for which the estimated price gap exceeds the above-quota tariff, the analyst should consider a number of possibilities, including the details of quota administration and whether there are less visible policies impacting the price.

94. Theoretically, the full effect of the tariff in raising prices and restricting imports takes place only when the import quotas are binding, i.e. are completely utilized. Some analysts have proposed that in the case of nearly full import quotas, administrative costs and other inconveniences involved in obtaining quota licenses imply a level of ad valorem protection higher than the in-quota tariff but lower than the above-quota tariff.

95. The simplest way to simulate removal of a tariff rate quota is to assume that the market as if it were subject to a single large tariff equal to either the above-quota tariff or the estimated price gap (whichever is larger) and to simulate the effects of either lowering the tariff to the in-quota rate or to zero. A more challenging problem involves simulations in which TRQs remain in place for some categories of products. Changing some policies while leaving TRQs intact can lead to situations in which the market changes from a state in which the quota is filled (binding) to one in which the quota is not filled (not binding). Therefore, the tariff rate changes suddenly and discontinuously. Such "non-linearities" create problems for traditional methods of solving the system of equations underlying models. Techniques do

[39] The COMPAS model and related partial-equilibrium models used both historically and currently by the U.S. International Trade Commission can be obtained by contacting the Office of Economics, 500 E St. SW, Washington DC 20436, United States of America. A variety of partial and general equilibrium models can be downloaded from the website of Joseph Francois at Erasmus University at http://www.intereconomics.com/francois/data.html .

[40] The Import Restraints studies of the USITC (various dates) provide examples of this methodology.

[41] This presumption was widely questioned once the final results of the Uruguay Round became available, e.g. Ingco (1996).

exist for models which take full account of the two-stage nature of TRQs, but they are more computationally complex than traditional techniques.[42]

B. Technical standards, including sanitary and phytosanitary (SPS) standards[43]

96. The methods used to analyze the effects of standards cover almost the full range of methodologies discussed in this review, including surveys of firms (USITC (1998); OECD (1999); Henson *et al.* (2000)), econometric analyses (Swann, Temple and Shurmer (1996); Moenius (1999); Otsuki, Wilson and Sewadeh (2000)), partial equilibrium studies (Thilmany and Barrett (1997); Paarlberg and Lee (1998); Calvin and Krissoff (1998)), and general equilibrium studies (Gasiorek, Smith and Venables (1992); Harrison, Rutherford and Tarr (1996)). The analysis of standards presents particular challenges, since many standards have multiple economic effects which are not captured as a simple increase in the cost of imported goods. These include, but are not limited to, the following:

- While some technical standards discriminate against imports, others are non-discriminatory and must be met by domestic producers as well. Thus, estimates that the price of imported goods is higher than its "world" level, or than the domestic price, may not convey useful information on the costs imposed by the standard. Even if importing firms bear higher costs of compliance than domestic firms, the total cost of compliance will not be captured by a tariff equivalent measure.

- Technical standards are generally administered as a physical or engineering requirement that a product must meet, not as a cost increase per se. Thus, because of differences in product specifications, production technologies or technical capacity, the cost of complying with a standard may vary widely across suppliers. Additionally, a standard which is non-discriminatory in the legal sense may be reflected in different cost factors for different countries and firms seeking to export into the market where the standard is imposed.

- Standards may influence product demand. The imposition of a standard may cause consumers to perceive the imported product as having higher quality or less risk associated with its consumption than in the absence of the standard. This change in perception adds a complication not ordinarily present in the analysis of NTMs, which are usually treated as driving a wedge between supply and demand without altering the underlying determinants of supply and demand. If a standard is costly to comply with but increases demand for the good, the effects of the standards on the price and quantity of the good sold are a priori ambiguous.

[42] Bach and Pearson (1996) pioneered a method using linearized inequalities. For a more recent implementation of a method using mixed complementarity, see van der Mensbrugghe, Beghin, and Mitchell (2003).

[43] This section is heavily indebted to Maskus and Wilson, (eds.) (2001), which extensively covered the area of quantitification of service barriers, especially to the methodological overview chapter (Maskus, Otsuki, and Wilson, (2001)). The studies highlighted in this section represent only a few of the more recent and notable. The reader is referred to that excellent volume for details of the other studies cited in this section.

Box 5. Examples from the Literature on Standards

The following examples will serve to highlight the diversity of methods used in the quantitative analysis of standards:

Otsuki, Wilson and Sewadeh (2000) study the impact of uniform aflatoxin standards proposed by the European Commission on imports of cereals, dried fruits, and nuts from Africa. The statistical analysis exploits the fact that the level of allowable aflatoxins (particularly aflaxoxin B1, for which the standard is most stringent) varied across European countries and to some extent across foodstuffs for the period in question. They estimate a gravity model for exports of food products from African countries to European countries from 1989-1998. In particular, they estimate the effects of the historical aflatoxin standard while controlling for other effects such as exporter and importer GDP, colonial status, distance, and the year. The estimates of the effects of the historical standards are then used to simulate the effects of the proposed uniform European Commission standard, as well as the less stringent standard of Codex Alimentarius. The difference between the proposed EU standard and the CODEX standard was estimated to amount to a 64% (USD 670 million) reduction in African exports of the goods in question to Europe, as contrasted with an estimated health benefit of the standard of 1.4 annual deaths per billion persons.

Anderson and Jackson (2004) use a general-equilibrium methodology to estimate the global effects of the adoption of agricultural techniques based on GM (genetically modified) biotechnology. In the base case, as in reality, GM crops are adopted only for a certain share of crops in certain regions of the world. This adoption is associated with a productivity increase. By simulating the adoption of GM crops in other regions, this productivity increase is disseminated. The relative unwillingness of consumers in some regions of the world to purchase food produced by GM methods is captured by lowering the substitutability in consumption between GM and non-GM varieties. The estimated effect of GM adoption is to decrease global prices and increase agricultural production and exports in GM-producing countries at the expense of other countries. Adding to the simulation the EU moratorium on the importation of GM-containing products causes the world price of the GM variety to drop so low as to more than offset the productivity gains originally experienced by farmers in GM-adopting countries. The moratorium creates net benefits for EU farmers due to the decreased competition.

A pair of papers by Moenius (1999 and 2003) is an example of an analysis in which the presence of standards may increase the demand for goods. His hypothesis is that technical standards convey information about whether or not a product will be acceptable to domestic markets. In Moenius (1999), the author finds evidence that shared product standards between the exporter and importer encourage trade among a sample of developed countries for relatively narrowly defined products (4-digit SITC). Country-specific standards imposed by importers are found to hinder trade in technologically simple products, while country-specific standards imposed by exporters enhance trade in technologically complex products. The estimation is done using a variety of "fixed-effects" specifications which sweep out unobserved common explanatory factors for country pairs, years, and industries.[44] Moenius (2003) examines the hypothesis that the role of standards in facilitating or hindering trade is different for Japan than for other countries.

C. Trade facilitation

97. Discussion of trade facilitation policies often proceeds on the tacit assumption that trade facilitation policies represent positive actions government can take with respect to trade and related procedures to increase trade. NTMs, by contrast, are usually portrayed as actions governments take which frustrate trade; if the actions stopped, trade might increase. For analytical purposes, the distinction is not very important. Methods which may be used to detect an association of NTMs with lower trade can be

[44] The use of "fixed effects" is often motivated by the desire to control for influences which may be common to subsets of observations in the dataset, in the absence of any observations of specific influencing variables. There is a continuum of approaches which combine gravity modelling and fixed effects. For example, the use of country-pair fixed effects eliminates the need for a distance variable, while the use of exporter and importer-specific fixed effects eliminates the need for measures of exporters' and importers' GDP. Whether or not this is an appropriate procedure depends on the particular application. See Cheng and Wall (2004) and Baier and Bergstrand (2005).

readily adapted to detect the association of trade-facilitating policies and procedures with higher trade, by analogy. Thus, practically all of the methods applicable to the analysis of NTMs can be applied to the analysis of trade facilitation, and vice versa.

Box 6. Examples from the Literature on Trade Facilitation

Walkenhorst and Yasui (2005) is an example of the use of general equilibrium simulation methods to estimate the benefits of a generalized improvement in trade facilitation. The authors show that the quality of trade-related logistics processes tends to be better in higher-income countries. [45] For purposes of simulation, trade-related logistics costs are introduced into the GTAP model using the method of Fox, Francois, and Londoño-Kent (2003). In this method, indirect transactions costs are modelled partially as a technical improvement in trading activities,[46] while direct transactions costs are modelled as a "tax" reflecting traders' expenditures on logistic services. The original level of trade transactions costs (TTC) is set to vary across countries and to be higher for agro-food products than for manufactured products. Two scenarios are considered: TTC worldwide fall by one percent of the value of traded goods and the reduction of TTC vary across countries and sectors. The scenarios produce estimates of global income gains centred on USD 40 billion. The largest share of these gains is attributed to indirect cost reduction and is received by developing (non-OECD) countries.

Wilson, Mann and Otsuki (2005) represent an example of the use of the econometric technique of gravity modelling to examine trade facilitation questions. As discussed above, measures of trade policy or institutional quality which vary across countries can be readily introduced as additional "distance" variables into the standard gravity equation. The authors consider four such indicators, based on measures in the *World Competitiveness Yearbook* (IMD (2000)), *Global Competitiveness Report* (WEF (2001), and Kaufmann, Kraay, and Zoido-Lobaton (2002). These are, respectively, port efficiency (port facilities and inland waterways, and air transport), customs environment (hidden import barriers, and irregular extra payments or bribes), regulatory environment (transparency of government policy, and control of corruption) and service sector infrastructure (speed and cost of Internet access, and Internet contribution to lower inventory costs). The analysis takes into account three of the four measures for both exporters' and importers' trade, while using the customs environment to explain importers' trade only. These indicators are introduced into a rich gravity model focused on bilateral manufactured trade among 75 economies for 2000 and 2001. All of the trade facilitation indicators are found to be statistically significant and of the expected sign. The authors then use the estimated regression coefficients to simulate the effects of raising the indicators for the weakest countries halfway to the global median. The result is an increase in trade among the economies in question of approximately USD 377 billion (9.7%). Some information on the distribution of these increases across indicators and regions is presented in Table 14.

[45] The authors construct a "border-process quality indicator" which is an aggregate of measures of customs efficiency in the *World Competitiveness Yearbook* (IMD (2002)), "hidden import barriers" in the *Global Competitiveness Report* (WEF (2002)), the corruption perceptions index in the *Global Corruption Report* (TI (2002)) and a count of participation in or implementation of "trade facilitation instruments" (UN CEFACT, 2001), and show that this indicator is positively correlated with per capita GDP. They also show that an average of the number of days of import clearance time (JETRO (2002)) is negatively correlated with per capita income.

[46] This is known as the "iceberg" approach. Using the metaphor that goods transported disappear through "melting" the further they are transported (Samuelson (1954)), a technological improvement in trading activities reduces the rate of "melting."

The role of third-party logistics (3PL) services was the subject of a recent study by the US International Trade Commission (USITC (2005)). 3PL firms offer a variety of supply-chain consulting and transportation management services to importers and exporters. The global market for such services was valued at USD 130 billion in 2002. In order to assess the quality of such services, a questionnaire was administered to US-based 3PL firms on their experiences shipping to over 50 countries. The questionnaire included a large number of items related to specific procedures in ports and airports, as well as more general items describing the policy environment in each importing country. Responses to the questions were aggregated into six indicators (regulation, airport quality, seaport quality, availability of complementary resources, security burden, and customs). The indicators were then employed in a gravity model explaining the geographic distribution of US exports both in aggregate and by mode (air, water, land). Improvements of airport logistics, seaport logistics, and customs quality were associated most strongly with increases in US exports. The market significance of the results was assessed using the same procedure as in Wilson, Mann, and Otsuki (2005): simulating an improvement in the countries with the weakest indicator scores halfway to the global median. For US airborne exports, improvements in the importer's customs quality (or airport quality) were associated with increases in US exports of over 10% for 17 (11) countries, and with increases in US exports of over 20% for 11 (7) countries.

D. Rules of origin

98. There has been a recent surge of interest in and work on the potential effects of rules of origin (RoOs) on trade. Most of this work has focused on the preferential rules of origin associated with FTAs. Researchers have looked for three types of effects:

- Evidence that imports from FTA partners are lower (higher) than they might be otherwise when relatively restrictive (non-restrictive) rules are used to determine originating status. A restrictive rule is one that requires a greater degree of product transformation or within-FTA content to qualify for originating status.

- Evidence that exports of intermediate goods from one FTA partner to another (e.g. textile products used to manufacture apparel) are higher when restrictive RoOs encourage the use of within-FTA inputs (Cadot, Estevadeordal and Suwa-Eisenmann (2004)).

- Evidence that restrictive RoOs of origin cause trade diversion reducing exports of non-FTA intermediate goods to FTA members.

Box 7. Examples from the Literature on Rules of Origin

The analysis of rules of origin has been greatly advanced by the development of an extensive database at the Inter-American Development Bank on preferential rules of origin in a variety of agreements, as described in Estevadeordal and Suominen (2004). The relative restrictiveness of RoOs for each product in each agreement is classified on a scale from 1 (least restrictive) to 7 (most restrictive). For example, RoOs, which grant originating status to any product transformation at the 8-10 digit HS tariff level, are classified as a 1, while rules which require both a change in chapter (two-digit HS level) combined with a technical requirement are classified as a 7. The authors introduce the index into a gravity model of product-specific bilateral trade in order to assess the general effects of more or less restrictive RoOs.[47] They also use a "facilitation" index which describes the presumed degree of restrictiveness of certain across-the-board provisions in various agreements. The use of the gravity model treats the presence of a restrictive RoO as a factor increasing economic distance and of a relatively liberal RoO as a factor reducing economic distance. In a similar approach, Augier, Gasiorek, and Lai-Tong (2004a and 2004b) study the effects of the PANEURO system by adding to the standard gravity model a dummy variable capturing whether or not a given pair of countries is subject to diagonal cumulation.[48]

In the case of specific products, RoOs can also be studied by simulation modelling. A framework for such modelling is described by Francois (2004). Depending on the pre-existing levels of trade flows and tariffs, some counterintuitive effects of changes in RoOs are possible according to economic theory. For example, a restrictive RoO requiring use of intermediate inputs sourced from within an FTA might be intended to increase exports from the FTA member producing the intermediate good to the one producing the final good, which in turn is exported to the country producing the intermediate good. But if the policy raises the total cost of producing the final good by a large amount, the opposite effect might be observed. Fetzer and Rivera (2005) demonstrate a practical implementation of the Francois framework in partial equilibrium, using it to analyze a proposed change in the NAFTA RoO for gold used in making gold jewellery. Georges (2005) presents a preliminary example of the use of general equilibrium modelling to analyze NAFTA RoOs.

E. Government procurement

99. Compared with the categories of policies described above, there has been relatively little empirical work done on the effects of government procurement policies. Deardorff and Stern (1998) describe some of the theoretical and practical considerations involved. In many cases government procurement regulations are difficult to understand. Data on the value of purchases subject to procurement regulations, the prices of goods procured and the prices of imported substitutes may be difficult to obtain. Sometimes the preferential policy is expressed explicitly as a percentage of the price or cost (e.g. "source domestically unless the price of the imported good is less than 80 percent of the domestic price"). Since non-government demanders are not subject to the procurement rule and overall import demand on an economy-wide basis is a mix of government and non-government demand, the value of the stated preference usually overstates the tariff equivalent on an economy-wide basis. Moroz and Brown (1987) represent an early attempt to quantify the effects of procurement rules in Canada. Their relatively simple method assumes that the average propensity to import of government purchases would be the same as that of non-government purchasers in the absence of the procurement rule. Given a particular value for the price elasticity of import demand, they produce a tariff equivalent of the procurement policy. The

[47] This procedure assumes that the trade effects of interval change in the Estevadeordal index is uniform, e.g. moving from a score of two to three restricts trade by the same amount as a move from five to six, by half the amount as a move from five to seven, and so on. Use of the index in work on NAFTA by Carrère and de Melo (2004) relaxes this assumption and shows that it may not always be valid.

[48] The PANEURO system pertains to trade of the European Union with various trading partners, mainly in Eastern Europe and North Africa, with which it has trade agreements. Under diagonal cumulation, some EU trading partners may count imported content from other EU trading partners with which the EU also has agreements in order to satisfy domestic-content provisions.

discussion of Evenett and Hoekman (2004) of the effects of government procurement rules on market access, though focusing on theoretical and institutional aspects rather than empirical applications, provides useful clues to those interested in designing empirical studies.

VII. Areas for Further Investigation

100. This section describes five broad areas in which there are promising avenues for further policy-relevant empirical investigation into the effects of NTMs and trade facilitation. These areas overlap to a considerable degree, and progress in any one area is likely to facilitate progress in others. Additionally, specific examples of possible research topics are provided to help guide future work in the Trade Directorate.

Box 8. Some Questions for Policymakers and Negotiators

There are a number of ways in which policymakers and negotiators can potentially benefit from better quantitative estimates of the effects of NTMs and trade facilitation. Different methods may be chosen depending on the goals to be achieved. Here are some questions policymakers and negotiators might like to ask themselves:

Is it important to have good illustrations of the benefits of liberalization or reform for a domestic audience?

The benefits of different policies can be expressed in a number of different ways – for example, increased exports, lower prices, or increases in GDP or economic welfare. Almost all of the available methods can give some measure of benefits. One consideration in choosing methods is deciding which metric is most useful or persuasive. Once the impact of changing policies has been assessed by a price- or quantity-based method, simulation methods can be used to obtain other measures such as changes in GDP or economic welfare.

Is it important to identify "winners and losers" from policy change?

If policies are being considered which would affect many sectors at once, it may be desirable to have an idea which sectors are likely to expand or contract. For this purpose, methods which are capable of processing data from many sectors simultaneously may be preferable to methods such as "handicraft" price gaps or partial-equilibrium simulations which focus on one or two products at a time. Simulations in general equilibrium can help identify interactions between sectors.

Is it important to have tools to help set priorities, that is, to help identify the policy changes with the biggest potential gains?

Are the potential gains from liberalizing NTMs bigger or smaller than those associated with tariff reduction? How do the gains from import licensing compare with those from customs reform or changes in standards policies? Identifying large price impacts associated with policy distortions may not be useful in setting priorities if there are multiple policies contributing to the distortions. Econometric analyses can potentially identify which policies have larger effects, but the results are sensitive to the list of effects being considered simultaneously. Analyses which track costs and time elapsed over the course of the supply chain offer potential for comparing the effects of one type of policy with another.

A. Improving the available data

101. There are a number of areas in which collection and dissemination of additional data would enable new progress in areas where it is currently being hindered. These include, but are not limited to, the following:

i) Improved data on international price comparisons.

102. International price comparisons tend very often to be made with retail price data for consumer goods. Retail data are relatively easy to collect. However, they contain more mark-ups and cost components than any other price data, thus compounding the difficulty of extracting NTM rents from other components of the price. In many cases, c.i.f. prices are available from merchandise trade data. Collection of price data closer to the middle of the supply chain (e.g. ex-factory prices, f.o.b. prices, wholesale prices) would be an improvement.

103. Collecting prices on consumer goods alone means that primary and intermediate goods are ignored; yet, these goods are also internationally traded and may also be subject to NTMs. The database described in Manifold and Donnelly (2005) cites allegations or notifications of NTMs on such diverse products as agricultural feed, chemicals and petrochemicals, iron and steel, and electronic goods. Studies which begin with retail price data and seek to simulate the removal of NTMs on all merchandise trade (e.g. Andriamananjara *et al.* (2005), Bradford (2005)) inevitably end up using a small number of consumer products to proxy NTMs on sectors which contain largely intermediate goods.

104. In addition to price data, other types of data on supply chain performance can be very useful.

ii) International performance measures for ports, airports, and transportation

105. In order to isolate the effects of NTMs on pricing, removal of the margins is necessary for international transport and for export and import services, many of which are performed at ports and airports. However, it is comparatively difficult to price international cargo transport and handling services. Better data are useful for direct analysis of trade facilitation and to adjust measures of NTM rents.

106. Non-cost measures of performance, such as speed of clearance and technological measures (e.g. crane moves per hour) can be useful as direct measures of the quality of logistics as well as to provide correlates with cost and efficiency. Well-designed survey instruments can obtain a variety of measures of port and airport performance.

B. Extending the econometric toolbox

107. Researchers seeking to document the effects of NTMs have sought econometric evidence both by examining international price differences of merchandise (the "price-based approach") and by examining data on exports and imports (the "quantity-based approach"). Each approach offers the possibility of producing estimates of the effects of NTMs for multiple products and countries simultaneously. However, the utility of these approaches to date has been limited by concerns about the precision of the estimates derived thereby, which touches concerns about the underlying econometric specification.

108. The approach has probably been relatively underutilized, considering the availability of product and country detail, especially relative to price data. The price-based approach is preferred for a number of reasons, but price data of comparable richness to the quantity-based data is unlikely to be widely available anytime soon. Recent improvements in the technique of gravity modelling hold out some hope for estimates of NTM effects with greater claims to precision than in the past.

109. As demonstrated in some of the World Bank research, the use the prices (unit values) and quantities in the trade data simultaneously is also possible, in a number of ways that have yet to be exploited. Even at the tariff line (8-10 digit HS) level, unit values are not as precise a measure of prices as actual price data gathered for a well-defined product because many products may use the same HS classification, and many differentiated manufactured goods are missing their unit values. On the other hand, unit values do represent proxies for price gathered on either an f.o.b. or c.i.f. basis or at some

intermediate point in the supply chain such as US customs value, which means they are not influenced by wholesale and retail mark-ups.

C. Bridging the gap between "handicraft" and "mass-production" methods

110. The ongoing expansion of computing power makes it possible to repeat procedures for large numbers of different products and countries. Some of the research described above has demonstrated that it is possible to work with data on many different countries and disaggregated products simultaneously. There will always be a large role for microeconomic work of the "handicraft" type that delves in depth into the details of production, demand, distribution, and policies affecting a particular product. However, some of the advantages of the "handicraft" method, particularly of price gaps, depend on presumed data limitations. It is necessary for example to know particular transport costs, particular tariffs, particular wholesale and retail margins and so on. Some of the necessary data elements for the handicraft method (e.g. tariffs) already exist in a fairly convenient and disaggregated form. Other elements (e.g. wholesale and retail margins) do not. Researchers should simultaneously press forward with improving data while using available data (including imputed data) in creative ways to produce more estimates of price gaps for many commodities and countries to examine their properties.

111. Another potentially fruitful avenue is to use insights gained from the handicraft method to improve econometric methods. This could potentially be done either by using the relationships implied by the handicraft approach to inform more fully econometric specifications, and/or by performing handicraft-type transformations to prices before entering them into regression analysis.

D. Using the supply chain as a unifying analytical framework

112. Analysis of the supply chain may provide a useful, unifying analytical framework. Supply-chain analysis, which tracks the progressive price increases (and physical transformation) of goods, can establish a metric by which seemingly disparate factors (such as international transportation costs, costs in ports and airports, tariffs, market power, NTM rents, and the process of wholesaling and retailing) can be compared to each other. At present we do not have more than a vague idea, on a global basis, of the relative magnitudes of each of the cost-increasing phases of the supply chain. However, the diversity of sources of information on each part of the supply chain permits some reasonable inferences to be drawn, which have not been drawn yet.

113. One of the most exciting potentialities of supply-chain analysis is that it offers the prospect of providing concrete insights into policy priorities. As noted above, characterization of the effects of NTMs or weak logistics regimes by a single price gap faces limitations, since the price gap itself is difficult to decompose. Precisely because full supply-chain analysis generates multiple price gaps, they can both be compared with each other and mapped onto specific policies. There are visible policy measures associated with international transport, with ports and airports, with wholesaling and retailing, with customs, inspection policies and so forth. An assumption can be made that those parts of the supply chain which are most expensive, relative to the marginal cost of moving through that part of the supply chain, offer the greatest prospects for enhancing international trade through policy reform.

114. Further comparisons can potentially be made between gains achievable through improved technical efficiency and gains obtainable by reducing rents and mark-ups associated with NTMs. The distinction between whether specific policies are purely rent-creating, and whether they (also) add to costs by inhibiting technological improvements, can be further used as a guide to policy. Following further on the work of Hummels (2001), the effect of time delays in the supply process can be assigned a tariff equivalent and generalized comparisons between time costs and direct financial costs can be made throughout the process.

E. Research into specific measures

115. While supply-chain analysis may be able to help set priorities in terms of specific measures to receive focus, considerable scope for work on particular measures directly still exits. In particular, finding ways in which institutional or "handicraft" considerations for particular products or sectors of interest can be brought to bear to improve quantification would be useful.

116. In cases where relatively little work has been done so far, such as government procurement, there is great scope for work in simply documenting stylized facts – identifying the total value and type of goods involved, explaining the workings of "buy domestic" policies, finding cases of goods to which such policies apply for which an imported substitute can be identified and priced, etc.

117. Similarly, work on technical standards and SPS policies can proceed on a case-by-case basis, identifying both cost-increasing and demand-enhancing[49] effects of policies and identifying the proper location of the effect on such policies on the supply chain. For example, it would be useful to understand from an institutional point of view how much of the effect of standards is observed within the production unit, how much at the border, how much at the retail level, and so on.

118. In the case of rules of origin, there are both data challenges and institutional considerations need to be addressed. Relatively little work has been done at the micro level of the costs undergone by firms to comply with rules of origin. These costs include the direct costs of more expensive imported inputs, the costs to exporters of generating inventory control data to satisfy importing officials that goods have originating status, and the costs to importing countries of verifying originating status. Along similar lines, attempts of simulation modellers to understand RoOs have often relied on imputed data, with assumptions such as the share of imported inputs in domestic and imported varieties are equal. This reliance on imputed data is the result of a general lack of comparable cost data on an international or intersectoral level which corresponds well to the actual concepts used to specify and enforce RoOs. Any efforts to address this gap, even on a case-by-case basis, could potentially prove very productive.

F. Some specific projects which OECD may consider pursuing

i) Surveys to track costs and time along the supply chain

119. Except for isolated examples such as the Barbie doll, relatively little is known about the extent to which the cost of goods increases as they pass from the exporting production facility to the seaport or airport, through international transport and the importer's seaport or airport, through customs clearance and inspection, and through domestic wholesale and retail channels. Even less is known about how these costs vary from product to product, or in different parts of the world. Well-designed surveys of multinational firms and/or logistics providers, which isolate each step in the supply process and ask about the costs associated with particular policies, could do much to address this gap.

ii) Gathering and dissemination of price data, particularly for intermediate goods

120. As noted, price-based investigations of the effects of NTMs have many advantages over estimates based on quantities and trade flows. Their most severe limitation is the relatively limited amount

[49] The demand-enhancing effects of SPS policies can be difficult to assess because SPS policies, if applied correctly, are to protect the life and health of humans (plants and animals). Fully incorporating the potential enhancements into the demand can be difficult, especially when the benefits are not directly observable by the consumer. For example the absence of illness possesses interesting problems for the researcher such as determining the willingness to pay to avoid illness.

of data for international price comparisons. OECD has been in the past a leader in this area. Better databases should include more price comparisons for intermediate goods, as well as price comparisons for consumer goods at standardized points in the distribution chain prior to the retail level. Such work can potentially be carried out in cooperation with the International Comparison Programme currently underway at the World Bank. These efforts could involve both new data collection and wider dissemination of already collected data.

iii) Improvements in the data on trade transactions costs used in simulation modelling

121. A great deal of simulation modelling in the general equilibrium framework relies on the GTAP database. Contributions to the database are made by organizations worldwide belonging to the GTAP consortium, including institutions in OECD member countries and multilateral organizations, and OECD's Environment Directorate. At present, the representation of trade transactions costs in the GTAP database involves a number of simplifications, and could be made much more realistic in terms of differences between transactions costs associated with particular goods and the way in which different industries involved in the logistics of importing and exporting pay for and receive revenues from moving imports and exports.

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Table 1. UNCTAD Coding System of Trade Control Measures

1000 TARIFF MEASURES

- 1100 STATUTORY CUSTOMS DUTIES
- 1200 MFN DUTIES
- 1300 GATT CEILING DUTIES
- 1400 TARIFF QUOTA DUTIES
  - 1410 Low duties
  - 1420 High duties
- 1500 SEASONAL DUTIES
  - 1510 Low duties
  - 1520 High duties
- 1600 TEMPORARY REDUCED DUTIES
- 1700 TEMPORARY INCREASED DUTIES
  - 1710 Retaliatory duties
  - 1720 Urgency and safeguard duties
- 1900 PREFERENTIAL DUTIES UNDER TRADE AGREEMENTS
  - 1910 Interregional agreements
  - 1920 Regional and sub regional agreements
  - 1930 Bilateral agreements

2000 PARA-TARIFF MEASURES

- 2100 CUSTOMS SURCHARGES
- 2200 ADDITIONAL TAXES AND CHARGES
  - 2210 Tax on foreign exchange transactions
  - 2220 Stamp tax
  - 2230 Import licence fee
  - 2240 Consular invoice fee
  - 2250 Statistical tax
  - 2260 Tax on transport facilities
  - 2270 Taxes and charges for sensitive product categories
  - 2290 Additional charges n.e.s.
- 2300 INTERNAL TAXES AND CHARGES LEVIED ON IMPORTS
  - 2310 General sales taxes
  - 2320 Excise taxes
  - 2370 Taxes and charges for sensitive product categories
  - 2390 Internal taxes and charges levied on imports n.e.s.
- 2400 DECREED CUSTOMS VALUATION
- 2900 PARA-TARIFF MEASURES N.E.S.

3000 PRICE CONTROL MEASURES

- 3100 ADMINISTRATIVE PRICING
  - 3110 Minimum import prices
  - 3190 Administrative pricing n.e.s.
- 3200 VOLUNTARY EXPORT PRICE RESTRAINT
- 3300 VARIABLE CHARGES
  - 3310 Variable levies
  - 3320 Variable components

3330 Compensatory elements
3340 Flexible import fees
3390 Variable charges n.e.s
3400 ANTIDUMPING MEASURES
3410 Antidumping investigations
3420 Antidumping duties
3430 Price undertakings
3500 COUNTERVAILING MEASURES
3510 Countervailing investigations
3520 Countervailing duties
3530 Price undertakings
3900 PRICE CONTROL MEASURES N.E.S.

4000 FINANCE MEASURES

4100 ADVANCE PAYMENT REQUIREMENTS
4110 Advance import deposit
4120 Cash margin requirement
4130 Advance payment of customs duties
4170 Refundable deposits for sensitive product categories
4190 Advance payment requirements n.e.s.
4200 MULTIPLE EXCHANGE RATES
4300 RESTRICTIVE OFFICIAL FOREIGN EXCHANGE ALLOCATION
4310 Prohibition of foreign exchange allocation
4320 Bank authorization
4390 Restrictive official foreign exchange allocation n.e.s.
4500 REGULATIONS CONCERNING TERMS OF PAYMENT FOR MPORTS
4600 TRANSFER DELAYS, QUEUING
4900 FINANCE MEASURES N.E.S.

5000 AUTOMATIC LICENSING MEASURES

5100 AUTOMATIC LICENCE
5200 IMPORT MONITORING
5210 Retrospective surveillance
5220 Prior surveillance
5270 Prior surveillance for sensitive product categories
5700 SURRENDER REQUIREMENT
5900 AUTOMATIC LICENSING MEASURES N.E.S..

6000 QUANTITY CONTROL MEASURES

6100 NON-AUTOMATIC LICENSING
6110 Licence with no specific ex-ante criteria
6120 Licence for selected purchasers
6130 Licence for specified use
6131 Linked with export trade
6132 For purposes other than exports
6140 Licence linked with local production
6141 Purchase of local goods
6142 Local content requirement

- 6143 Barter or counter trade
- 6150 Licence linked with non-official foreign exchange
- 6151 External foreign exchange
- 6152 Importers' own foreign exchange

6160 Licence combined with or replaced by special import authorization
6170 Prior authorization for sensitive product categories
6180 Licence for political reasons
6190 Non-automatic licensing n.e.s.

6200 QUOTAS

6210 Global quotas
- 6211 Unallocated
- 6212 Allocated to exporting countries

6220 Bilateral quotas
6230 Seasonal quotas
6240 Quotas linked with export performance
6250 Quotas linked with purchase of local goods
6270 Quotas for sensitive product categories
6280 Quotas for political reasons
6290 Quotas n.e.s.

6300 PROHIBITIONS

6310 Total prohibition
6320 Suspension of issuance of licences
6330 Seasonal prohibition
6340 Temporary prohibition
6350 Import diversification
6370 Prohibition for sensitive product categories
6380 Prohibition for political reasons (embargo)
6390 Prohibitions n.e.s.

6600 EXPORT RESTRAINT ARRANGEMENTS

6610 Voluntary export restraint arrangements
6620 Orderly marketing arrangements
6630 Multifibre arrangement (MFA)
- 6631 Quota agreement
- 6632 Consultation agreement
- 6633 Administrative co-operation agreement

6640 Export restraint arrangements on textiles outside MFA
- 6641 Quota agreement
- 6642 Consultation agreement
- 6643 Administrative co-operation agreement

6690 Export restraint arrangements n.e.s.

6700 ENTERPRISE-SPECIFIC RESTRICTIONS

6710 Selective approval of importers
6720 Enterprise-specific quota
6790 Enterprise-specific restrictions n.e.s.

6900 QUANTITY CONTROL MEASURES N.E.S.

7000 MONOPOLISTIC MEASURES

7100 SINGLE CHANNEL FOR IMPORTS
7110 State trading administration
7120 Sole importing agency

7170 Single channel for sensitive product categories
7200 COMPULSORY NATIONAL SERVICES
7210 Compulsory national insurance
7220 Compulsory national transport
7900 MONOPOLISTIC MEASURES N.E.S.

8000 TECHNICAL MEASURES

8100 TECHNICAL REGULATIONS
8110 Product characteristics requirements
8120 Marking requirements
8130 Labelling requirements
8140 Packaging requirements
8150 Testing, inspection and quarantine requirements
8160 Information requirements
8170 Requirement relative to transit
8180 Requirement to pass through specified customs
8190 Technical regulations n.e.s.
8200 PRE-SHIPMENT INSPECTION
8300 SPECIAL CUSTOMS FORMALITIES
8400 RETURN OBLIGATION
8900 TECHNICAL MEASURES N.E.S.

Source: TRAINS, http://r0.unctad.org/trains/, accessed on June 20, 2005.

Table 2. Deardorff and Stern's Major Categories of Non-Tariff Measures and Related Policies

I. Quantitative restrictions and similar specific limitations
   1. Import quotas
   2. Export limitations
   3. Licensing
   4. Voluntary export restraints
   5. Exchange and other financial controls
   6. Prohibitions
   7. Domestic content and mixing requirements
   8. Discriminatory bilateral agreements
   9. Counter trade

II. Non-tariff charges and related policies affecting imports.
   1. Variable levies
   2. Advance deposit requirement
   3. Antidumping duties
   4. Countervailing duties
   5. Border tax adjustments

III. Government participation in trade, restrictive practices, and more general government policies
   1. Subsidies and other aids
   2. Government procurement policies
   3. State trading, government monopolies, and exclusive franchises
   4. Government industrial policy and regional development measures
   5. Government financed research and development and other technology policies
   6. National systems of taxation and social insurance
   7. Macroeconomic policies
   8. Competition policies
   9. Foreign investment policies
   10. Foreign corruption policies
   11. Immigration policies

IV. Customs procedures and administrative practices
   1. Customs valuation procedures
   2. Customs classification procedures
   3. Customs clearance procedures

V. Technical barriers to trade
   1. Health and sanitary regulations and quality standards
   2. Safety and industrial standards and regulations
   3. Packaging and labelling regulations, including trademarks
   4. Advertising and media regulations

Source: Deardorff and Stern (1998), appendix I. See source for a description of each of the measures and policies above.

Table 3. Major Categories of Measures

I. Anticompetitive practices / Competition policy
II. Corruption
III. Customs procedures
IV. Exports
V. Government procurement
VI. Import licensing
VII. Import prohibitions
VIII. Import quotas
IX. Intellectual property rights
X. Investment-related measures
XI. Sanitary and phytosanitary requirements
XII. Services
XIII. Standards, testing, certification and labeling
XIV. State trading
XV. Taxes

Source: Manifold and Donnelly (2005)

Table 4. Data Coverage of TRAINS Data as of 1 November 2004

	Tariffs	NTMs	Imports
	Number of countries		
Some data available	149	91	147
No data available	0	58	2
	Source of import data		
Reported by importer			103
Inverted data reported by trading partner			42

Source: TRAINS, http://r0.unctad.org/trains/, accessed on June 20, 2005, and author's calculations

Table 5. Most recent year of available data

	Tariffs	NTMs	Imports
2004	7	0	0
2003	55	0	37
2002	53	0	69
2001	24	32	35
2000	4	2	7
1999	4	15	2
1998	1	7	1
1997	0	12	0
1996	1	8	1
1995	1	5	2
1994	0	5	0
1993	1	3	0
1992	1	1	0
None Available	0	58	2

Source: TRAINS, http://r0.unctad.org/trains/ , accessed on June 20, 2005, and author's calculations

Table 6. Syria: Estimated Non-Tariff Barriers and Tariffs in 1999

Groups of Products	Tariff Equivalent of NTBs	Tariffs
	percentage	
Fish products (SITC 03)	18.8	22.7
Fruits and nuts (SITC 057)	36.8	58.8
Other food, live animals, oils, fats and waxes (rest of SITC 0, SITC 4)	31.8	8.7
Tobacco and beverages (SITC 1)	329.6	116.0
Textile fibres (SITC 26)	8.3	2.5
Other crude materials and inedible, except fuels (SITC 2)	4.9	5.7
Mineral fuels, lubricants and related materials (SITC 3)	17.7	7.8
Fertilizers (SITC 56)	6.3	27.0
Plastics (SITC 58)	164.2	56.0
Other chemicals and related products (rest of SITC 5)	35.1	6.6
Steel (SITC 67)	9.2	9.4
Textiles (SITC 65)	137.5	112.5
Leather and manufacture of leather (SITC 61)	7.7	111.5
Other manufactured goods (rest of SITC 6)	67.0	12.5
Transport equipment (SITC 79)	55.5	25.3
Other machinery (rest of SITC 7)	124.2	36.3
Miscellaneous manufactured articles (SITC 8)	6.7	11.1
Commodities and transactions not elsewhere classified (SITC 9)	0.8	3.3
Weighted average	22.1	8.2
Standard deviation /average	1.4	1.1
Trade barriers as percentage of GDP	6.0	2.4

Source: Chemingui and Dessus (2004), Table 5.

Table 7. Nominal Protection Rates and Sources of Policy Distortion in China's Agriculture, 2001

	Import Tariff Equivalent				Export Subsidy Equivalent			
	Tariff Rate	VAT	NTB in China	NPR	Tax Rebate	Subsidy	NTB	NPR
Rice	1	13	3	17	1	0	-9	-8
Wheat	1	13	1	15				
Maize	1	13	8	22	32		0	32
Other grains	1	13	1	15				
Soybeans	3	13	1	17				
Cotton	3	13	2	18	5	10	0	20
Oilseeds	13	13	21	47				
Sugar crops	25	15	10	50				
Vegetables					1	0	-11	-10
Fruits					1	0	-11	-10
Pork					5	0	-25	-20
Beef	45	15	0	60	5	0	-13	-8
Mutton					5	0	-10	-5
Poultry	20	15	0	35	13	0	-30	-17
Eggs					1	0	-5	-4
Milk	50	17	0	67				
Fish					5	0	-20	-15

Source: Huang, *et al.* (2005), Table 1

Table 8. Quantifiable Significant US Import Restraints, by Sector, Percent Ad Valorem, 2002

Sector	US Import Tariff	Rest-of-world Export Tax Equivalent	Total Price Wedge
	Textile and Apparel Sectors		
Textile mill goods	6.6	2.3	8.9
Textile products	5.4	8.2	13.6
Apparel	11.3	9.5	20.8
	Agricultural Sectors		
Sugar	1.0	107.1	109.3
Tobacco and tobacco products	7.1	13.2	20.2
Dairy	10.0	27.8	37.7
Canned tuna	3.6	2.6	6.3
Peanuts	1.8	10.0	11.9
Beef	0.7	1.1	1.8
	Other Manufacturing Sectors		
Footwear and leather products	10.8	0.0	10.8
Glass and glass products	4.7	0.0	4.7
Watches, clocks, watch cases, and parts	5.4	0.0	5.4
Ball and roller bearings	5.8	0.0	5.8
Ceramic wall and floor tile	8.4	0.0	8.4
Table and kitchenware	7.6	0.0	7.6
Costume jewellery	6.1	0.0	6.1
Pens, mechanical pencils, and parts	4.9	0.0	4.9
Cutlery and handtools	4.4	0.0	4.4

Source: USITC (2004), Table ES-1.

Table 9. Some Estimates of NTBs Using Bradford's Method

Sector	Australia	Belgium	Canada	Germany	Italy	Japan	Netherlands	UK	US
Vegetables, fruit, nuts	1.055	1.031	1.046	1.257	1.036	2.048	1.000	1.317	1.203
Crops, n.e.c.; garden products	1.000	2.231	3.227	1.956	1.326	2.478	1.197	2.259	1.524
Bovine cattle, sheep, goat meat, horse meat	1.000	1.563	1.021	2.140	1.259	5.332	1.773	2.026	1.001
Poultry and pork meat, etc.	1.010	1.165	1.003	1.346	1.085	2.600	1.157	1.256	1.004
Dairy products	1.274	1.164	1.237	1.022	1.065	1.759	1.056	1.081	1.145
Sugar	1.000	1.157	1.052	1.000	1.000	1.216	1.199	1.000	1.000
Beverages and tobacco products	1.488	1.012	1.166	1.004	1.009	1.519	1.047	1.234	1.063
Textiles	1.304	1.000	1.459	1.447	1.030	1.367	1.984	1.663	1.271
Wearing apparel	1.002	1.417	1.009	1.111	1.421	1.281	1.327	1.149	1.000
Petroleum and coal products	2.170	3.011	1.002	2.689	4.579	4.042	3.686	4.515	1.000
Metal products	1.000	1.487	1.000	1.253	1.042	1.581	1.503	1.291	1.192
Motor vehicles and parts	1.000	1.113	1.000	1.014	1.016	1.002	1.394	1.403	1.157
Weighted geometric means	**1.102**	**1.224**	**1.078**	**1.131**	**1.083**	**1.528**	**1.222**	**1.284**	**1.087**

Source: Bradford (2005), p. 431.

NB: A value of 1 represents a non-distorted (free trade price). The implied ad valorem tariff equivalents are equal to (value – 1) * 100 percent. Weighted geometric means include 14 sectors not shown, but exclude petroleum and coal products.

Table 10. Share of Services in Total Cost Structure, 2001

	Brazil	China	Germany	India	Japan	United States
Wheat	0.091	0.122	0.214	0.233	0.140	0.233
Petroleum	0.360	0.055	0.414	0.057	0.282	0.381
Wearing apparel	0.105	0.078	0.300	0.198	0.220	0.164
Chemical, rubber, and plastics	0.159	0.125	0.246	0.188	0.256	0.234
Ferrous metals	0.235	0.150	0.191	0.282	0.240	0.264
Motor vehicles and parts	0.163	0.083	0.215	0.261	0.145	0.222
Electronic equipment	0.170	0.072	0.266	0.191	0.230	0.212

Source: GTAP version 6 database

Table 11. Potential Benefits of Price Convergence
(percent of GDP, weighted by GDP within groups)

	Benefits of Falling Prices	Benefits of Rising Prices	Benefits of Falling Prices	Benefits of Rising Prices
	at market exchange rates		at PPP exchange rates	
High-income countries	**0.49**	**0.12**	**0.31**	**0.13**
Germany	0.78	0.21	0.45	0.52
Japan	1.82	0.00	0.91	0.11
United States	0.06	0.01	0.06	0.01
Middle-income Countries	**0.16**	**3.68**	**1.79**	**0.19**
Brazil	0.02	9.32	1.79	0.32
Korea	0.27	0.05	1.94	0.00
Mexico	0.11	1.24	1.55	0.96
Low-income countries	**1.79**	**17.62**	**24.54**	**1.36**
China	2.88	0.73	35.50	0.00
India	0.22	63.45	4.89	7.83
Indonesia	0.24	2.81	2.39	0.00
World	**0.52**	**1.57**	**5.81**	**0.45**

Source: Adapted from Warren, Hufbauer and Wada (2002), Table 1-1. See original study for countries not shown.

Table 12. Regression-based Estimates of the Effects of NTMs on Prices, in Ad Valorem Percentages[50]

	GTAP Sectors[51]											
Regions	Bovine Meat Products	Meat Products n.e.c.	Vegetables Oils & Fats	Food Products n.e.c.	Beverages/ Tobacco Products	Wearing Apparel	Leather Products	Paper & Publishing	Chemicals, Rubber, & Plastic	Metal Products	Electrical Equipment	Machines/ Equipment n.e.c.
S.Africa/Zimbabwe			90									
Rest of SS Africa				56								
Aus/NZ										45		
EU						66					15	
FSU/E. Europe						37						
MERCOSUR							112					
Mexico/Central Am.			30		25	101	80		36			
South Asia			49					67				
East Asia		29						119				
China	191											
Canada						25						
Japan						190	39	199				
Mid. East/Turkey	19										22	38
US						16						

Source: Adapted from Andriamananjara, *et al.* (2004). The definition of "NTMs" includes import quotas and quantitative restrictions, prohibitions, licensing including non-automatic licensing, VERs, prior authorizations e.g. for environmental reasons, import surcharges, and some customs measures.

[50] Estimates corrected using the Kennedy (1981) correction. Standard errors are corrected with the van Garderen-Shah (2002) approximate, unbiased variance estimator. Only estimates which are positive and significant at the 10 percent level or above are shown. Estimates are rounded to the nearest integer.

[51] For the boxes in grey, the NTM dummy for this region is collinear with the regional fixed effect. This estimate is calculated as the difference between this region's fixed effect coefficient and the average regional fixed effect for this sector (exclusive of the collinear cases). Some regions and sectors were eliminated if they did not have observations.

Table 13. Aggregate Simple (not import-weighted) Averages of Tariffs and Estimated Tariff Equivalents of Core NTBs, in Ad Valorem Equivalents (AVE), and Trade Restrictiveness Indices, in Percentage Terms

Country	Simple Average AVE of Core NTMs	Simple Average Tariffs	Trade Restrictiveness Indices (Tariffs and NTBs)	
			OTRI	TRI
Argentina	9.13	13.70	20.4	31.4
Australia	8.20	4.45	11.6	27.0
Brazil	16.29	13.72	26.2	41.1
Canada	4.48	3.92	6.1	18.6
China	5.66	15.51	19.9	31.4
European Union	*.*	*.*	12.6	33.1
Hong Kong	2.89	0.00	1.4	9.7
India	14.39	32.29	39.9	50.8
Indonesia	4.72	6.80	9.8	23.4
Japan	9.95	5.87	14.3	47.4
Mexico	15.94	16.04	28.7	44.0
Norway	5.26	8.21	7.5	35.8
Poland	3.77	11.53	15.2	28.4
Russia	13.28	10.49	22.6	35.5
Saudi Arabia	5.37	12.89	10.8	22.1
South Africa	2.73	8.73	8.9	18.2
Switzerland	4.09	5.76	9.0	32.0
Thailand	4.37	18.85	15.3	25.9
Turkey	5.63	9.41	11.8	27.3
United States	7.47	3.23	8.2	21.5

Source: Adapted from Kee, Nicita, and Olarreaga (2004b; 2004c).

NB: OTRI is the overall trade restrictiveness index, the equivalent uniform tariff which keeps imports at their observed levels. TRI is the trade restrictiveness index (Anderson and Neary (1994)), the equivalent uniform tariff which keeps real income or welfare constant. *.* measures defined in Kee, Nicita and Olarreaga (2004b) for individual countries rather than for the European Union as a whole. For other measurement concepts and countries, see the original papers.

Table 14. Estimated Effects of Improving National Trade Facilitation Indicators Halfway to the Global Median, Expressed in Percentage Increases in Merchandise Trade

By Region	Percentage Increase in Exports	Percentage Increase in Imports
East Asia	24.0	16.7
East Europe and Central Asia	30.0	19.8
Latin American and Caribbean	20.0	16.1
Middle East and North Africa	3.3	6.6
OECD	3.8	6.9
South Asia	40.3	24.4
Sub-Saharan Africa	10.9	15.2
Total, All Regions	**9.7**	**9.7**
By Measure	Percentage Increase in Global Merchandise Trade	
Port Efficiency		
Of Importers	0.6	
Of Exporters	2.2	
Total	*2.8*	
Customs Environment	0.8	
Regulatory Environment		
Of Importers	0.6	
Of Exporters	1.5	
Total	*2.1*	
Service Sector Infrastructure		
Of Importers	0.9	
Of Exporters	3.0	
Total	*4.0*	
Total, All Policy Measures	**9.7**	

Source: Adapted from Wilson, Mann, and Otsuki (2005)

Annex 1. Price-gap formulae

In each of these formulae, ρ is defined as the ad valorem tariff equivalent of the NTM, unless otherwise specified.

1. A basic formula (adapted from Moroz and Brown (1987), as cited in Linkins and Arce (2002)):

   $p = (P_d / P_w) - (1 + t + d)$

   where

   P_d = the domestic price, net of wholesale and retail margins
   P_w = the world price, net of wholesale and retail margins
   t = the ad valorem tariff equivalent
   d = the ad valorem international transport margin (c.i.f./f.o.b. margin).

The formula is simple because some adjustments have already been applied to get the correct prices for comparison.

2. A formula to use when quota auction prices are available:

   $\rho = (A / P_c)$
   P_c = the c.i.f. price of imports and
   A = the per-unit auction price of the quota.

If the quotas are assigned to exporters, as in the case of the Agreement on Textiles and Clothing, ρ represents an export tax equivalent rather than a tariff equivalent.

3. A set of formulae which break apart the supply chain into more pieces (adapted from Deardorff and Stern (1998, Appendix 3):

   P_e = ex-factory price = $MC + r_p$

   where

   MC = factory marginal cost of production
   r_p = producers' rent at factory, which may or may not include some NTM rents

   P_f = f.o.b. price = $P_e + c_s + r_x$

   where

   c_s = costs of getting the good to the point of exit and loading the ship
   r_x = exporters' NTM rents

   P_c = c.i.f. price = $P_f + c_t$

   where

$c_t = d/P_c$ = international insurance and freight margin, expressed as a specific cost
P_i = in-country price (or "landed duty-paid value") = $P_c + t_0 + r_m$

where

$t_0 = t^*P_c$ = the tariff, expressed as a specific value[52]
r_m= importers' NTM rents

P_w = wholesale price = $P_i + c_w$

where

c_w = the wholesale distribution margin

P_r = retail price = $P_r + c_r$

where

c_r = the retail distribution margin

In the above formulae all of the c's can be modified to include additional terms representing taxes and subsidies at any part of the supply chain at which they may be applied.

The total effect of NTMs can be defined as

$r = r_x + r_m + \theta r_p$,

where

θ is the share of the factory mark-up which is attributed to NTMs.

The tariff equivalent of the NTM is thus

$\rho = (r/P_c)$. In many cases it is assumed that $\theta = 0$, in which case
$\rho = (r_x + r_m)/P_c$.

This formula can be made to correspond to the formula in method 1 under some additional assumptions. For example, if P_i, the in-country price, is used for P_d, and P_f , the f.o.b. price, is used for P_w , then the methods yield almost the same results if all tariff rents are assumed to accrue to the importer (i.e. r_x also equals 0), and identical results if the ad valorem tariff is calculated based on the f.o.b. price rather than the c.i.f. price.

4. Bradford's method (2005):

The methods above often assume that the imports arise from a particular exporting country, for which the prices as delivered to the importing country, net of tariffs and tariff equivalents of NTMs, provide a basis for the "world price." The method described below uses prices from several countries simultaneously and

[52] This assumes the most common practice of applying the tariff to the c.i.f. value. For countries such as the United States, for which the customs value corresponds to the f.o.b. value, the term t_0 is removed from the definition of P_i and added to P_f . Australian data also permit imports to be valued on both the f.o.b. and c.i.f. basis.

use the minimum implied delivered price in a given location as a basis for the "world price." The notation is adapted for consistency with the above notation. Subscripts for products are omitted for convenience.

Bradford's method begins with retail prices for the same product for *N* countries, ($P_{r1,} P_{r2},\ldots, Prn$). It seeks to infer from these prices what the delivered price of goods to each other country would be. For simplicity, it is assumed that the low-price country imposes no NTMs.[53]

For each country *i*, the producer price (P_{pi}) is estimated to be

$$P_{pi} = P_{ri} / (1 + m)$$

where

m = the wholesale and retail margin $= (c_w + c_r) / P_{pi}$.

The value of m is drawn from input-output tables and includes internal transport costs and taxes. Algebraically, P_{pi} is equivalent to Deardorff and Stern (1998)'s in-country price P_i, except that P_i is constructed "forwards" from an import price and P_p is constructed "backwards" from a retail price. Thus, in practical application, P_{pi} and P_i may not in fact be equal.

The estimated producer price in each country *i* can be used to infer an f.o.b. export price for country *i*'s production:

$$P_{fi}^{*} = P_{pi}(1 + e_i)$$

where

i=1, 2,…, n
$e_i = c_s / P_{pi}$ = the ad valorem cost of moving goods from the factory to the loaded ship or plane. P_{fi}^{*} is distinguished from P_f in that P_{fi}^{*} is inferred from an estimated producer price while P_f represents an observed f.o.b. price.

Each market is assumed can be supplied from the minimum-cost import source, for which the implied c.i.f. price in country *i* is

$$P_{ci}^{*} = \min\{(P_{f1}^{*}, P_{fw}^{*}, \ldots, P_{fN}^{*})(1 + d)\}$$

The difference between P_{ci}^{*} and P_{pi} thus becomes a basis for estimating the effects of protection, which include both tariffs and the tariff equivalent of NTMs. Since the total amount of protection must at least equal the tariff (i.e. the tariff establishes a lower bound), the effects of NTMs are thus estimated as

$$PR_i = 1 + \rho_i = \max\{[P_{pi} / P_{ci}^{*}] - t_i, 1\}.$$

[53] Bradford (2005) justifies this assumption on the grounds that his original sample consisted of 9 OECD countries and that the low-price country is usually Australia, Canada, or the United States, which are "fairly free traders."

Annex 2. Relationship of a typical residual to the mean of the dependent variable

Define $R^2 = \frac{\sum (\hat{Y}_i - \overline{Y})^2}{\sum (Y_i - \overline{Y})^2}$ = *ESS/TSS* (expected sum of squares divided by total sum of squares).

Similarly, because *TSS* = *ESS* + *RSS* (total sum of squares = explained sum of squares + residual sum of squares) it follows that $1 - R^2 = RSS/TSS$.

Given the number of observations n in the sample, the variance of Y, σ^2_Y , is defined as *TSS/n*, and the standard deviation of *Y*, σ_Y , is defined as $(TSS/n)^{1/2}$, and the coefficient of variation (*CV*) is defined as $\sigma_Y / \overline{Y}$, the ratio of the standard deviation to the mean.

One can rewrite $1 - R^2 = (RSS/n)/(TSS/n) = (RSS/n)/\sigma^2_Y$, in which the numerator represents the root mean squared error (*RMSE*) of the regression.

After substitution, one may obtain the ratio of the root mean of the residuals (root mean squared error of the regression) to the mean of the dependent variable as

$$\frac{RMSE}{\overline{Y}} = \sqrt{\frac{1 - R^2}{CV^2}}$$

This expression can be used to evaluate the size of a "typical" regression residual relative to the size of the variable being explained. If the effect of NTMs is captured by a dummy variable which reflects the value of the residual for the country for which the dummy is equal to 1 in the country with the NTM, then $RMSE/\overline{Y}$ may also be used as a proxy for the extent to which the estimate of the NTM is well-determined, with small values of $RMSE/\overline{Y}$ corresponding to better determination of the NTM estimate.

The idea is a corollary of the observation of Deardorff and Stern (1998): even if the true sizes of the NTM effects are large, the indeterminacy in the regression is likely to be larger.

The presumptive advantage of price regressions over quantity regressions from this standpoint arises from the observation that the value of CV for a sample of bilateral trade flows for a product in large and small countries is likely to be much larger than the value of CV for a comparison of importing prices in the importing countries. This more than offsets any possible advantage in the goodness-of-fit of gravity models as compared to regression models for international price comparisons.