11

Accessing market opportunities: quality and safety standards*

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Introduction

The importance of competitiveness of Caribbean agrifood sectors is related to the fact that trade liberalization would not result in growth in rural areas and increased food security unless domestic producers and traders are able to take part in increased trading opportunities. Quality and safety standards are among the many factors affecting competitiveness in agrifood trade, and have become increasingly important in the last decade as major dimensions of both trade policy and private marketing strategies.

On one hand, the trade policy of developed countries is increasingly providing legal ground for safety and quality standards, which are meant to protect consumer rights to safe food and accurate information about the characteristics of food products. These standards sometimes end up functioning as disguised trade barriers, discriminating against foreign providers, and there is a need for multilateral control over such rules and customs practices. On the other hand, the private sector – in particular, major retail chains – is developing and implementing private quality and safety standards, which can also function as entry barriers that are even more restrictive than trade policy measures. Furthermore, safety and quality schemes (based on, respectively, the World Trade Organization (WTO)

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Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) and the Agreement on trade-related aspects of intellectual property rights (TRIPS Agreement) are becoming benchmarks both for negotiating strategies in the context of multilateral trade negotiations (WTO and Economic Partnership Agreements (EPAs)) and for investment strategies in technology, organization and capacity-building for public administrations and private operators. These developments, along with the shift in market power towards retailing stages, call for new strategies to integrate multilevel negotiations (main trade players, non-governmental organizations (NGOs), private sector retail chains) and to build capacity at all points of the supply chain.

This chapter presents a description of various frameworks for addressing quality issues, especially as they might function as entry barriers in international agrifood trade. It also provides a reference for understanding features and implications of the most common food quality and safety regulations shielding developed markets. Specifically, the chapter: a) introduces the link between quality and safety standards and supply management issues; b) discusses current features of the multilateral institutional framework providing technical and legal references for national legislation relevant to quality and safety of agrifood products; c) introduces the major private quality assurance and certification schemes and discusses their relationships with multilateral arrangements; and d) facilitates awareness among institutions and operators of the growing relevance of quality and safety standards and provide essential references for dealing with them.

The next section introduces food quality dimensions and requirements, placing them in the context of an export product supply chain. Section 11.2 presents multilateral agrifood regulations and particularly SPS and geographical indications (GI) requirements, as determined by the WTO agreements and accredited benchmarking organizations. Section 11.3 considers the market-driven side of the same process, providing details on major food quality and safety assurance and certification schemes and the relationship between legal and private standards. The final section draws conclusions with reference to policy and institutional solutions in support of Caribbean exporting sectors.

11.1 Food quality dimensions and the supply chain[142]

The quality of food products is increasingly important to food industries, whether for food safety or other qualitative attributes. On the one hand, national legislation, with their sets of policies and infrastructures, are in place to protect consumer health and provide the legal bases for the differentiation

[142] The main source of this section is CARIRI/INEA (2006).

of products (e.g. extent to which they are authentic, ethical, healthy, safe, etc.). At the same time, international agreements and institutions try to make sanitary and quality standards objective and predictable in order not to harm trade. On the other hand, private health and quality standards are increasingly defining entry barriers to the richer markets of developed countries. The reality is that an agrifood industry wanting to engage international trade will have to deal with opportunities and constraints stemming from those standards. All in all, both national legislation and private standards spread responsibility across everyone in the supply chain, including farmers and growers, manufacturers and processors, food handlers and consumers.

Public regulations have strong legitimacy because people have the right to expect the food they eat to be safe and suitable for consumption. In addition, international food trade is increasing and, along with its social and economic benefits, can contribute to the spread of food-borne illness around the world. Food-borne illness and food-borne injury are at best unpleasant and can be fatal. There are also economic impacts when outbreaks of food-borne illness damage trade and tourism, leading to loss of earnings, unemployment and litigation. Food spoilage is also wasteful, costly and can adversely affect trade and consumer confidence. Effective hygiene control, therefore, is vital for avoiding the adverse human health and economic consequences of food-borne illness, food-borne injury and food spoilage.

Private standards serve agro-industry operators well. They can help meet health or other regulations (such as national SPS, geographic indications, organic or fair trade) and facilitate marketing strategies that emphasize product differentiation linked to higher or stricter product attributes. From the private sector standpoint, food quality can be considered a complex of characteristics that determines its value or acceptability to consumers, while food safety is a basic requirement of food quality. Food safety implies absence, or safe levels, of contaminants, adulterants, naturally occurring toxins or any other substance that could make food injurious to health on an acute or chronic basis. Quality attributes also include: nutritional value; organoleptic properties such as appearance, colour, texture and taste; functional properties and symbolic features (FAO, 2000).

Both public and private standards based on safety and quality can be considered entry barriers (Porter, 1980) when they create the possibility of higher revenues for firms capable of selling products consistently to the given standard; these firms can thereby define and benefit from new sources of competitive advantage. A summary representation of quality and safety standards commonly faced by agrofood supply chains for export markets is shown in **Figure 11.1**.

The emerging relevance of both public and private quality and safety standards increases pressure on the different actors of the supply chain. This is due mainly to increasing costs of complying with safety and quality

FIGURE 11.1
Quality dimensions and the supply chain

Production / Pre-harvest stages		Post -harvest stages	
Quality dimensions:	*Quality assurance/ certification schemes:*	*Quality dimensions:*	*Quality assurance/ certification schemes:*
Product attributes		**Product attributes**	
• Food safety	• Legal standards (SPS, TBT, Codex, National legislations)	• Food safety	• Legal standards ((SPS, TBT, Codex, National legislation)
• Commercial quality	• GAP, GAP based schemes (EurepGAP), GHP, other private standards (product), ISO 22000(2005), traceability	• Commercial quality	•GMP/HACCP, GMP based schemes (BRC) GHP, other private standards (packaging/ labelling/ storing/transport), ISO 22000(2005), traceability
Process attributes		**Process attributes**	
• Produce Origin	• Geographic Indications		
• Method of production	Organic, Fair trade		
• Ethical Issues (worker's welfare)	• SA 8000		
• Environmental issues	• GAP, GAP based schemes (EurepGAP)	• Environmental issues	• ISO 14001 (2004)
• Process information and documentation	• Traceability	• Process organization, information and documentation	• ISO 9001(2000), traceability

Source: CARIRI/INEA (2006)

standards. These costs arise from technical and managerial requirements and adaptation of strategies – that is, the need to comply with systems of *quality control* (for the detection of defects) and *quality assurance* (for the prevention of defects), within wider *quality management systems*.

Quality assurance (QA) covers a range of activities related to the life of the product: design, development, production, installation, servicing and documentation. It includes the regulation of the quality of raw materials, assemblies, products and components; services related to production; and management, production and inspection processes. According to quality management practice, the main goal of QA is to ensure that the product fulfils or exceeds customer expectations.

Moreover, the adoption of quality standards is increasingly documented through voluntary *certification* of a business. Certification indicates that, in the view of the certifying bodies, the business has a specific set of knowledge,

skills or abilities. Although voluntary, certification is often required by large retail chains operating in more developed markets. Certification needs to be renewed periodically (although for GIs certification may be permanent – see later section). Certification bodies are business organizations or, less often, professional bodies or non-profit organizations. (Sometimes the latter exist primarily to offer a particular certification.) Whatever its nature, the certifying body determines the policies of the certification programme. Legal and private standards, and their relationships with the multilateral framework provided by the WTO and accredited benchmarking organizations, are discussed in more detail in later sections.

11.2 Multilateral regulation of safety and quality standards

The Codex Alimentarius[143] and other WTO-accredited organizations (such as OIE[144], IPPC[145] and others[146]) elaborate benchmarking standards to guide governments in working out their own national standards in a harmonized way, so as to facilitate international trade in agricultural and food products. The Uruguay Round (UR) of General Agreements on Tariffs and Trade (GATT) negotiations (1994), and specifically the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) formally recognized the Codex standards and other recommendations as benchmarks for international harmonization. The Agreement on Technical Barriers to Trade (TBT Agreement) also recognizes Codex standards. These agreements contribute to defining standards relevant for food companies and also serve as the basic texts for resolution of trade disputes (FAO, 2000; FAO, 2005a).

The SPS Agreement deals directly with trade-related sanitary and

[143] The Joint FAO/WHO Codex Alimentarius Commission was set up in 1962 to protect the health of consumers and ensure fair practices in food trade. It is an intergovernmental body engaged in preparing international food standards and other relevant recommendations that promote quality and safety of food. Codex can be attributed with over 200 food standards; nearly 3000 maximum residue limits for pesticides, veterinary drugs, mycotoxins and environmental contaminants; codes of hygienic practices; a general standard for food labelling; a code of ethics for international trade in food; and a wide range of guidelines and recommendations for governments and industry.

[144] The World organization for animal health (OIE) is an intergovernmental organization created in 1924. To ensure transparency in the global animal disease situation, each Member Country undertakes to report the animal diseases that it detects in its territory.

[145] Intergovernmental Panel on Climate Change (IPCC) was established by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation. It is open to all Member States of the United Nations and the WMO.

[146] Although not mentioned in the Agreement on Agriculture (AoA), organizations such as the International Standards Organization (ISO) have achieved a similar status; see later section.

phytosanitary measures for protection of human health. Its principal objective is to minimize the negative effect on trade from the adoption and enforcement of SPS measures. WTO Member States are encouraged to adopt internationally recognized standards (if these exist), but are free to apply stricter standards. The latter are allowed conditional on the provision of scientific justification for the measures and the implementation of risk assessment mechanisms (FAO, 2005b; Wilson, 2003).

The TBT Agreement addresses "product characteristics or the related processes and production methods" reflected in technical regulations and requires that these regulations conform to basic principles of transparency and non-discrimination. It seeks to ensure that technical regulations and standards, including packaging, marking and labelling requirements, and analytical procedures for assessing conformity with technical regulations and standards, do not create unnecessary obstacles to trade. Relevant international standards developed by bodies such as the International Standards Organization (ISO), if they exist, must be used as the basis for technical regulations, unless this would be inappropriate because of climatic, geographic or technological factors (FAO, 2005b; Wilson, 2003). WTO-accredited standards set by OIE, IPCC, ISO, etc. are voluntary, becoming compulsory only when required by national legislation.

Other WTO-accredited standards are rooted in the UR Agreement on trade-related aspects of intellectual property rights (TRIPS), which call for application of some fundamental WTO principles (i.e. most-favoured nations (MFN) status) in that field. In the section on TRIPS, entirely devoted to protection of geographical indications (GIs), the aim is explained as providing institutional guarantees for the competitive advantages and revenues that a product derives from its reputation and traditions related mainly to geographic origin (De Filippis and Salvatici, 2006; WTO, 2000; WTO, 2002).

11.2.1 Sanitary and phytosanitary measures (SPS)

SPS regulations are an area of increasing importance in national trade policies and international efforts for harmonizing trade rules. Regulation of food safety, as well as animal and plant health, is evolving rapidly in all countries. While some trends in regulation are consistent with minimizing trade distortions, the general orientation towards more stringent regulation of a wider range of risks and quality attributes raises new potential barriers to agricultural trade. Food safety regulations and standards evolve differently around the world as countries respond to food safety crises and prepare for perceived exposure to emerging food safety risks. These differences in regulations and standards can lead to international trade conflicts or disputes and can ultimately affect global patterns of food demand and reduce trade. These trends are often entwined with increased consumer demand for

credence attributes of food products in general, because quality and safety are often jointly produced (Unnevehr and Roberts, 2003; Wilson, 2003; Buzby, 2003).

In addition, non-traditional agricultural exports from less developed countries – particularly of fresh and minimally processed products – to developed countries are growing rapidly. This trade arises in part from the decreased relevance of traditional protection (tariffs and quotas) for some of these commodities, such as seafood and tropical fruits. But such products frequently have high risks for certain SPS hazards, which may be exacerbated by trade over long distances. As developing countries work to meet higher and evolving food safety standards, they have raised concerns about whether the increasing standards will impede their participation in world trade (Unnevehr and Roberts, 2003; FAO, 2004a; Henson *et al*., 1999; Athukorala and Jayasuriya, 2003). Moreover, the private sector is evolving rapidly to meet demands for process attributes throughout the world, in many cases setting standards that are higher than public ones (Caswell *et al*., 1998; Lee, 2006). These efforts frequently affect international trade, especially exports from developing countries, exacerbating the other difficulties.

Taken together, these trends in the international food system pose continuing challenges to the SPS Agreement, as well as to efforts to reduce barriers to agricultural trade and improve the trade performance of developing countries. Although the WTO as a mechanism of last resort for disagreements over such technical barriers has made much progress since 1995, SPS measures are still a contentious field, due to the wide room left by SPS principles and WTO arrangements for governments to impose ad hoc measures restricting market access. Moreover, due to increasing multilateral constraints on traditional tariff and non-tariff barriers, the number of SPS measures is increasing while gains made on traditional trade policy measures are reducing.

For instance, phytosanitary controls imposed by importers are currently limiting developing country exports of fresh fruit and vegetables. These controls are particularly stringent in the United States, Australia and Japan. Between 1995 and 2000, nearly 270 SPS measures were introduced against imports of fresh fruit and vegetables worldwide (FAO, 2003a). Thus, a major hindrance to fresh produce trade is the lack of harmonized technical standards and treatments for exports. Some countries apply the Codex Alimentarius for maximum residue limits (MRLs) on pesticides, while others apply their own, often stricter MRLs that may only partially conform to the Codex. Another difficulty arises from setting MRLs at the laboratory limit of determination, as this often makes verification of compliance dependent on very costly modern analytical methods.

Quarantine regulations are another serious impediment and measures designed to prevent bio-terrorism are likely to increase the administrative

and regulatory burden on exporters of fresh fruits and vegetables in particular. Moreover, developing countries exporting tropical fruit face serious challenges in meeting the phytosanitary regulations of importing countries due to the uneven phasing out of methyl bromide.[147]

There are blurred profiles in the implementation of all the basic principles of the SPS agreement, which leaves room for their use as disguised trade barriers. These principles are:

1. *Harmonization of rules*. Members should use common criteria (international standards, guidelines and recommendations) to set up SPS measures and in all cases these measures should be justified scientifically. The above example referring to widely ranging restrictions on use of methyl bromide shows how countries can continue to establish requirements that are not in line with international guidelines.
2. *Equivalence of measures*. WTO members should recognize another country's SPS measures as equivalent to their own if those measures provide an appropriate level of protection. Inspections and accreditation by public officers from the importing country are often the only way around SPS barriers, no matter what the level of controls and eradication measures carried out by phytosanitary authorities in the exporting countries. Moreover, costs relating to inspections are usually borne by exporters.
3. *Appropriate level of protection*. This principle is often challenged because it is thought to be violated through the outright interdiction on all imports of certain fruits and vegetables applied by many countries, ranging from the United States, India, China, Japan and Australia, to Mexico and Chile, to many others including some Caribbean countries and other small island developing states (SIDS). These countries ban all foreign fruits and vegetables from their territories, unless a lengthy and costly "import risk analysis" or "pest risk analysis" has shown that the imports do not constitute a risk to consumer or plant health. This practice is tantamount to a reversal of the "burden of evidence". Rather than setting SPS requirements as a function of the risk presented by certain imports of plant products, these countries oblige exporters to demonstrate that their products are safe.
4. *Non-discrimination.* SPS measures must not unjustifiably discriminate between countries where similar conditions prevail, and imports should be treated no differently from domestic produce. However, a number of countries maintain differentiating requirements when dealing with

[147] Fumigation with methyl bromide greatly affects the quality and shelf life of produce and is still required by many countries for fruits and vegetables imported into their territory. Its use is in contradiction with international guidelines established though the Montreal Protocol (1987) signed by United Nations members, which foresees the total elimination of the use of methyl bromide by 2015, in view of its toxicity and harmful effects on the ozone layer.

domestic produce. For instance, the United States applies stricter maturity standards and tolerance levels to imported Italian blood oranges than for its domestically produced blood oranges: imported oranges must have an acidity level of at least 9° Brix, whereas the standard for domestic produce is set at 8° Brix.

5. *Transparency.* Countries should be required to notify trading partners of changes in their SPS measures to allow them to adapt to the new measures. Delayed notifications, and frequent and sudden changes in SPS requirements for imports, are common.
6. *Regionalization*. This principle stipulates that countries should not ban imports of plant or animal products from pest- or disease-free areas. However, there are frequent impediments to importing produce from pest- or disease-free areas within countries that are not entirely pest- or disease-free.

Despite the attempt in the Uruguay Round to provide a durable multilateral framework to regulate the use of food safety and quality regulations, a remarkable divergence of views has emerged about this framework in the Doha Round trade talks. Developing country proposals signal frustration with the increasingly exigent standards faced by their exports, or the new obligations to justify their own regulatory regimes, or both. The substantial costs facing some developing countries in meeting SPS standards in high-income markets reduces their potential gains from trade and confirms the concern about their further marginalization in international trade, regardless of progress made in reducing other trade barriers (Unnevehr and Roberts, 2003; Henson *et al*., 1999).

11.2.2 Geographical indications (GIs)

Definitions

Article 22.1 of TRIPS defines GIs as: "...indications which identify a good as originating in the territory of a member country or a region or locality in that territory, where a given quality, reputation or other characteristics of the good is essentially attributable to its geographical origin",[148] thus recognizing a direct link between quality of foodstuffs and their origin. A GI is usually the name of a specific location, although at times traditional names can be non-geographical, such as the Greek cheese "feta". Article 22 provides that GIs for all goods must be protected against misuse and establishes a minimum standard of protection for all GIs, whatever the nature of the good to which it is applied. Scope of such protection is limited to the prohibition of the use of GIs by producers not located in the region designated by the particular GI.

In line with marketing principles, from the standpoint of consumers, GIs are meant to prevent their being misled about the origin and production

[148] See, among others, WTO (2002) and EC Regulations 2081/92 and 2082/92.

methods (and therefore process attributes) of the product. Consumers are thus assured that they receive the genuine article they pay for. From the standpoint of producers, GIs are a means of branding outputs, which increases product diversification and producer income.[149]

Debate and initiatives on GIs

The WTO Doha meeting in November 2001 agreed to negotiate the establishment of a multilateral system of notification and registration of GIs for wines and spirits by the Fifth WTO Ministerial Conference. However, the Conference was held in Cancun in September 2003 without any formal discussion on the issue. WTO members cannot agree on whether negotiations were also mandated for extending protection to products other than wines or spirits and on the adoption of a multilateral register of protected GIs. Two proposals underpin the debate on this latter issue: a) a register with legal effects (European Union (EU) plus 17 WTO members (1998)); or b) a register for information purposes only (United States plus 16 WTO members (1999)) (De Filippis-Salvatici, 2006).

The EU, Switzerland and other WTO members strongly support the claim that unauthorized use of GIs is harmful to consumers and legitimate producers and that increased market access needs to go hand in hand with enhanced GI protection. EU objectives within the WTO debate on GIs are:

- to obtain effective protection against usurpation of names in the food and beverages sector;
- to make market access effective, by ensuring that products that have the right to use a certain denomination are not prevented from using such a name on the market; and
- to ensure consumer protection and fair competition through regulation of labelling.

Protection of GIs by the EU is ongoing and based on the conclusion of bilateral and regional agreements on protection of intellectual property rights for wines and spirits and prevention of fraud in the use of product names. Those agreements link concessions on access to the EU market from third countries with the protection of EU GIs in those countries.[150]

[149] As previously suggested, GIs help producers obtain a premium price for their products. According to a recent study of the French market, GI cheese prices hover around +30 percent and are up to +230 percent for wines. GIs can also positively affect the position of agricultural producers in sharing value added in the supply chain: according to the same study the price of milk for GIs is 100 percent higher than milk used for other cheeses.

[150] Examples of specific agreements on GIs are: EC–Australia (wines, 1994), EC–Mexico (spirits, 1997), EC–South Africa (wines and spirits, 2002), EC–Canada (wines and spirits, 2003). Examples of general agreements with specific section for GIs are EC–Chile (wines and spirits, 2002) and EC–Mercosur (Southern Common Market), which foresees improved access to EU market versus adequate protection of all EU GIs in Mercosur countries (negotiations still ongoing in 2006).

GIs can have several positive effects. They can be an excellent means to promote rural development, because they help producers obtain a premium price for their products, allow for a better distribution of the value added to agricultural producers, bring value to the region of origin and can increase production and create local jobs, thus preventing rural exodus. GIs can be an effective marketing tool, as they encourage variety and diversity of production, and allow producers to market differentiated products, with clearly identifiable features. They are a tool to preserve local know-how, natural resources and biodiversity and can play an important role in local culture, contributing to social cohesion (helping local producers work together) and raising the profile of local and national identity (making producers and consumers proud of their traditions). They can have other positive indirect effects, such as promoting tourism.

GIs can also have shortcomings and problems of implementation. Protecting traditional products through GIs is costly to governments, because they require more qualified extension services and more and better controls; to producers, because of increased costs for inspection systems; and to consumers because they have more information to gather and process. Moreover, problems of recognition of GIs arise on cultural grounds as many names of products have travelled with emigrants, who would like to continue to make the same products and use the same terms to identify those products.

11.3 Market-driven agrifood regulations and quality assurance and certification schemes

11.3.1 Private and legal standards

WTO agreements and accredited benchmarking organizations provide a reference not only for national regulations, but also for private, commercial standards. There are many reasons for retail chains and some producers to create or develop their own standards. Retail companies may require private food certification of their national and third-country suppliers to assure consumers that the products they sell are safe and to shield the business from liability in case of unsafe foods sold through their outlets. Specific good agricultural practices (GAPs) or good manufacturing practices (GMPs) standards, such as those of the Euro-Retailer Produce Working Group (Eurep) and British Retail Consortium (BRC) certification are cases in point. Producers can develop standards related to particular production processes, or to raw materials – often linked to local attributes of the production process or input, or to ethical values or health concerns. These quality standards target the willingness of customers to pay a premium price for "authentic", "traditional" or high-quality food products. They are based upon international agreements and/or national legislation protecting names of products belonging to particular regions, obtained by particular

production processes or marketed through contractual arrangements that protect small producers.

Private standards are part of commercial agreements between voluntary parties in a free market, and as such are not subject to state intervention and fall outside the jurisdiction of the WTO. This is the case of the Fair Trade standard of the NGO Fairtrade Labelling Organizations International (FLO-I) and the Eurep and BRC global standards. Whenever a voluntary standard is taken into consideration for (full or partial) inclusion within a country's legislation,[151] the standard should not conflict with SPS and TBT Agreements. In other words, it should not become a disguised barrier to trade (Wilson, 2003; FAO, 2004b; FAO, 2003b).

Private, voluntary standards can have a very strong impact on international trade as entry barriers, this because private sector often sets standards that supersede public ones (Caswell, Bredahl and Hooker, 1998). These private standards frequently affect exports from developing countries, exacerbating their problems for greater involvement in international trade. Costs of compliance with these private standards may be high, and many suppliers in developing countries, especially small farmers, cannot afford the luxury of private certification. Some developing countries have complained about private standards constituting de facto SPS barriers to more developed markets and ask the authorities of the United States, the EU and other countries to address this concern (Lee, 2006; Wilson, 2003; Unnevehr and Roberts, 2003; Henson *et al*., 1999).

More generally, food companies are finding it difficult to simultaneously manage overlapping quality standards, such as the ones discussed below.[152] They are either becoming too expensive or, as a result of "simplifying" efforts made by so-called global standards, may undermine the efficiency of the food companies' quality strategies and drive those strategies under the control of large, multipurpose retail chains.

11.3.2 Quality assurance and certification schemes

The hazard analysis and critical control point (HACCP)

The HACCP is a system that identifies, evaluates, and controls hazards significant for food safety. Its adoption is compulsory in some countries and voluntary in others.[153] HACCP implementation is meant to be guided by scientific evidence of risks to human health. It identifies specific hazards and measures for controlling them by focusing on critical control points (CCPs)

[151] Such as in the cases of the EU, the United States Department of Agriculture or Japan Agricultural Standard organic standards.

[152] French and German retailers have recently developed their own quality standard, the International Food Standard (IFS). Its management may be even more complex than for the standards reviewed below.

[153] For more details on the HACCP method, see Codex Alimentarius Commission, 2003.

along the production flow from primary production to final consumption.[154] Redesign of an operation should be considered if a hazard is identified but no CCPs are found. Any HACCP system is capable of accommodating change, such as advances in equipment design, processing procedures or technological developments.

HACCP is a tool to ensure the safety of food by focusing on prevention rather than relying mainly on end-product testing. HACCP can provide other significant benefits in terms of control and improvement of the production flow, improvement of working conditions and reduction of production costs. Moreover HACCP can aid inspection by regulatory authorities and promote international trade by increasing confidence in food safety. Successful application and implementation of the HACCP system to any stage of the food chain requires the full establishment of prerequisite programmes, such as good hygienic practices according to the Codex of General Principles of Food Hygiene, and the appropriate Codex practice and food safety requirements (Codex Alimentarius Commission, 2003). Successful implementation requires training and a multidisciplinary approach, including expertise as appropriate in agronomy, veterinary health, production, microbiology, medicine, public health, food technology, environmental health, chemistry and engineering. The application of HACCP is compatible with the implementation of quality management systems such as the ISO 9000 series (see later section), and is the system of choice in the management of food safety within such systems.

EurepGAP

EurepGAP is a quality standard that began in 1997 as an initiative of large European retailers belonging to Eurep to respond to consumer concerns about food safety, environmental protection, workers' health, safety and welfare and animal welfare (mad cow disease, use of pesticides, genetically modified organisms (GMOs), etc.). The objective was to develop voluntary standards and procedures for the global certification of GAPs. It works by:

- encouraging adoption of commercially viable Farm Assurance Schemes, which promote the minimization of agrochemical inputs;
- developing a GAP framework for benchmarking existing assurance schemes and standards, including traceability;
- providing guidance for continuous improvement and the development and understanding of best practice;
- establishing a single, recognized framework for independent verification; and
- communicating and consulting openly with consumers and partners, including producers, exporters and importers.

[154] CCP is a step at which essential controls can be applied to prevent or eliminate a food safety hazard or reduce it to an acceptable level.

Collaboration between retailers and producers resulted in a protocol for independent, recognized third-party certification of farm production processes, which farmers around the world can use to demonstrate their compliance with GAPs. EurepGAP certification covers fruit and vegetables,[155] flowers and ornamentals, integrated farm assurance, aquaculture and green coffee. The scheme covers the whole agricultural production process of the certified product, from before the plant is in the ground (seed and nursery control points) to non-processed end product (produce handling control points). It also works to establish awareness and responsibility regarding social issues and animal welfare criteria for farms. EurepGAP stresses the importance of residue screening, setting up a standard on MRLs and developing guidance notes to help farmers and growers be better able to demonstrate that their produce meets destination MRL requirements.

BRC global standards

The development of the BRC global standards was initially driven by the need to meet the legislative requirements of the EU General Product Safety Directive and the United Kingdom Food Safety Act. It established a standard for the supply of food products and acted as evidence for UK retailers and brand owners to demonstrate "due diligence" in the face of potential prosecution by the enforcement authorities.[156] The BRC standard is comprehensive in scope, covering all areas of product safety and legality, including such critical topics as the HACCP system, quality management, factory environment standards and product and process control. Major business benefits derive from customer confidence lent by the BRC certification.

Each standard is developed under the leadership of the BRC and its members; it is extensively revised to reflect changing EU legislation and continuously develops best practice requirements. The use of the BRC standard is legally voluntary, but strongly recommended for those food producers that are willing to supply the British multipurpose retail chains. The 2005 edition included changes in legislation related to:

- traceability of food components through the supply chain;
- ensuring that food components remain uncontaminated by other elements (important when allergens labelling is a statutory requirement);
- food product suppliers being able to advertise that farmed goods in their products come from a particular source;
- ensuring that guidelines governing various processes in the manufacture

[155] The normative document for *EurepGAP Fruit and Vegetables* certification was developed by a group of European representatives from the fruit and vegetables sector, with the support of producer organizations outside the EU. The standard covers all fresh, unprocessed agricultural products of plant origin grown for human consumption. It does not cover herbs or plants exclusively used for medicinal purposes or for their aromatic attributes. See EurepGAP, 2004.

[156] For additional details on BRC standard see Lee (2005) and the BRC Web site (www.brc.org.uk).

of food products are sufficiently robust; and
- what suppliers can say in their communications to inform the business community about their BRC certification.

The standard has become global and is now used by suppliers from around the world. BRC global standards have been designated for packaging and are being developed for identity-preserved non-genetically modified food ingredients and consumer products. The BRC and Institute of Packaging (IOP) developed the packaging standard, which provides a common basis for auditing companies supplying packaging for food products to retailers and assists retailers and food manufacturers in the fulfilment of their legal obligations.[157]

ISO standards

The International Standards Organization (ISO) is a network of the national standards institutes of 157 countries, with one member per country and a central Secretariat in Geneva. It occupies a special position between the public and private sectors: while many of its member institutes are part of the governmental structure of their countries, other members are firmly rooted in the private sector. This helps enable ISO to reach consensus on solutions bridging the requirements of business with the broader needs of stakeholder groups like consumers and associations.

The ISO 9000 and ISO 14000 families are among its most widely known standards, implemented by 760 900 organizations in 154 countries.[158] ISO 9000 helps organizations meet customer quality requirements and applicable regulatory requirements. ISO 14000 helps organizations to minimize harmful effects on the environment caused by their activities and to improve their environmental performance. While most ISO standards are highly specific to a particular product, material, or process, the ISO 9000 and ISO 14000 standards are "generic management system standards" because the same standards can be applied to a variety of organizations.

11.3.3 Food traceability

Definitions

ISO defines traceability as the "ability to trace the history, application, or location of that which is under consideration". Gellynck *et al*. (2005) refer to "the information necessary to describe the production history of a food crop and any subsequent transformation or process the crop might undergo on its

[157] The main sections of the standard are: a) scope; b) organization; c) hazard and risk management system; d) technical management system; e) factory standards; f) contamination control; g) personnel; h) risk category determination; and i) evaluation protocol.

[158] More details on the ISO network can be found at: http://www.iso.org/iso/en/aboutiso/introduction/index.html#two and http://www.iso.org/iso/en/iso9000-14000/index.html.

journey from the grower to the consumer's plate". Information on foods can be traced forward and back at each stage of the food chain, i.e. production, preparation/processing, distribution and sale. The "traceability of a product" relates to sources of materials and parts, as well as the history of processing, post-shipment delivery and existence of the product.[159]

The definition of traceability for food is necessarily broad because food is a complex product and traceability is a tool for achieving a number of different objectives. The logistics objectives of traceability (for example, procedures for withdrawing food products unfit for the market) can be linked to marketing objectives to allow targeting specific market segments and to assure consumers about the origin and quality of food. Food traceability is linked to both consumer safety issues (food safety, bioterrorism, consumer's right to know) and to the marketing and investment behaviour of producers.

Traceability can be divided into tracking and tracing. Tracking refers to the location of items as they move through the supply chain. Tracing relates to the role, composition and treatment of a food product during the various stages of production. Thus, "traceability can be described as a combination of the flow of substances and of information."[160]

A traceability system is composed of an organization, a system and a process, documented procedures, resource management (personnel, financial resources, machinery, equipment, software, technologies and techniques), rules and education, and training. Key concepts of traceability are:

- identification of supply chain participants and products along the various stages of the supply chain;
- recording of relevant information on manufacturing and distribution of a product;
- identification of consistent product batches; and
- in-factory tracing of relevant information that is related to the identified product batches.

Purposes

By tracking and tracing food and its information at each stage of the food chain, traceability systems can achieve the following purposes:

i) **Greater reliability of information.** Traceability systems can secure the transparency of distribution routes; the quick provision of information to consumers, customers and government agencies; and the match between the product and its label. As a result, the system helps prevent misidentification of labels and information and makes transactions fairer.

[159] More details on traceability systems can be found in Golan, Krissoff and Kuchler (2004).

[160] ISO 9000:2000 incorporates the previous ISO 8402:1994 standard and provides a specific section covering traceability and product identification related issues (ISO, n.d.).

In particular, the systems enable consumers to get correct information about food and its suppliers, make good use of this information when they buy food products and take steps to prevent risks. The systems also enable the customer and the competent government agencies to obtain accurate information for product and risk management purposes and help food business operators increase the reliability of their products.

ii) **Contribution to food safety.** Traceability systems can help trace quickly and easily the cause of accidents related to food safety and help remove a food product problem promptly by zeroing in on the product and tracing it to its destination. This helps minimize both damage to the consumer and economic loss along the entire food chain. In addition, the systems make it easier to collect data about unexpected impacts on health and long-term effects and help develop risk management techniques. Finally, they help define the responsibility of food business operators.

iii) **Contribution to achieving higher levels of business efficiency.** Traceability systems help increase the efficiency of product management (including inventory) and quality control by using identification numbers and by storing and offering information about the origins and characters of products. This contributes to cost-saving and improvement in quality.

In most cases, the purposes listed above are pursued simultaneously, but their priority may be different depending on product characteristics, state of the food chain or consumer demand. A food business operator will consider these factors when building a traceability system.

Costs and limitations

While traceability systems are effective tools, they may have limitations and problems. Traceability systems are generally too complex to be complete. Even a hypothetical system for tracking beef – in which consumers scan their packet of beef at the checkout counter and access the animal's date and location of birth, lineage, vaccination records and use of mammalian protein supplements – could be considered incomplete because it does not provide traceability of bacterial control in the barn, use of genetically modified feed or animal welfare attributes such as hours in the barn or at pasture. There are both technical and economic reasons for such limitations.

Technical reasons limiting traceability include the differing scope of applications according to the character of the product, work or sector, as well as the various factors determining efficiency losses. Applications are affected by the nature and state of raw materials, lot size, cargo collection, division and transportation method, production and manufacturing method, packing method, number of stages from production to retailing and scale and number of food business operators. Efficiency losses occur i) when the processes (e.g. order placement and receiving procedures) differ among the food business

operators concerned; ii) information is unreliable; iii) transmission of information between food business operators is difficult or interrupted; and iv) lots are non-uniform.

Attempts to track or trace food and its information more accurately may result in very high costs. The main costs involved in introducing and managing a traceability system include those for:

- drafting the basic idea and procedures necessary for construction of a traceability system;
- purchasing equipment (e.g. measuring apparatuses, information processing equipment);
- managing the system, such as identification, recording, arranging and storing information, education and training; and
- inspection by the third party to secure the system's reliability.

Food business operators must compare the objectives and effects to be achieved with the costs involved when they seek to establish a traceability system. In particular, small enterprises should devise effective strategies for accessing financial and human resources. They should collect information about traceability, define the objectives and scope of their system and consider cutting costs through joint efforts with other enterprises. The traceability system does not directly perform safety (sanitation) management, quality control and environmental management in the production process; these require separate systems.

11.3.4 The EU case

The relative strength of private standards in relation to public legal requirements has increased in many parts of the world. In the case of the EU, a recent report underlined the fact that private food standards are more stringent than EU legal requirements on food safety (Lee, 2006).

EU legislation on food safety stipulates legal requirements for suppliers in third countries. For food of non-animal origin, the EU requires "equivalence of risk-outcome" as laid out in the SPS and TBT Agreements of the WTO.[161] However, with the exception of MRLs for some specific products, it does not specify how to meet those legal standards and does not require specific certification. Only in the case of organic products may imports into the EU be facilitated by an initial certification obtained in the country of origin. Basically, as long as the final imported products pass official controls in member countries, the EU does not look into the process by which products are produced or processed in third countries.

[161] Regulation (EC) 882/2004 of the European Parliament and of the Council of 29 April 2004, on official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules.

Competent authorities in third countries are relied on to carry out inspections on farms. However, the inspection bodies of the import countries cannot oblige competent authorities in third countries to bring their systems in line with EU ones. There is no way to verify effective official controls of competent authority in third countries, with the exception of organic production. Also, many developing countries do not have sound national food safety systems, and some of them do not even have competent functioning authorities. Therefore EU business operators must resort to private certification to show due diligence and to protect themselves from legal claims.

Private certification based upon standards such as EurepGAP and BRC require "equivalence of systems", setting out specific measures with reference to EU legislation and that of member countries, to ensure that products imported into the EU are legally compliant. As such, they do not necessarily set higher standards on the safety of final products. Rather, they require tight controls over the *process* through which products are produced or processed. As a means to an end, it is claimed that private requirements on production processes assist developing-country suppliers to comply with legal requirements, which otherwise would involve a complicated process of aligning with both EU legislation on food safety and those of member countries.

The trend towards strengthening process control is also demonstrated by the growing body of legislation in the field,[162] which implies an institutional shift towards sector-oriented quality assurance schemes and away from enterprise-level quality management approaches (Schiefer, 2004). This trend also fuels networking or other forms of horizontal and vertical coordination of the supply chains, which become a relevant source of competitive advantage (Hanf and Hanf, 2005; Gellynck *et al*., 2005).

The debate continues on whether these standards based on equivalence of systems are a market opportunity for suppliers or disguised trade barriers.[163] On the one hand, their adoption may give operators better and easier access to developed markets. The retail industry, food manufacturers, importers,

[162] The introduction of the General Food Law in the EU made a move towards process-based controls for primary production, such as HACCP and traceability systems, to be implemented from 1 January 2005 in each food company in the EU.

[163] In the case of the EU, several Directorates General (DG) have been involved in queries related to this issue. The DG for Agriculture and Rural Development and the DG Joint Research Centre have run a pilot project on private food schemes. The European Aid and Cooperation Office was presented with requests for technical assistance in meeting private food standards, i.e. EurepGAP, from a number of countries in Asia. The DG for External Relations was posed with enquiries from third countries about private food standards. The DG for Health and Consumer Protection is concerned with reported confusion between official EU standards and private ones, in particular in developing countries. The DG for Trade has received complaints from developing countries in the WTO about private food schemes constituting SPS barriers to market access.

caterers, ingredient suppliers and the food service industry can all benefit greatly from global standards, such as BRC. On the other hand, there is no doubt that BRC adoption may become a supplier selection criteria in the hands of dominant market players (namely, multipurpose retail chains) and thus an entry barrier with significant trade impact. The independence of accredited certification bodies becomes particularly important to ensure producers sufficiently fair access to BRC-oriented markets.

It is in the EU's interest to become involved in the dynamics of private food schemes. Firstly, the European Commission (EC) should be the only legal body to set protection levels, and legal requirements should be adequate to guarantee food safety. Secondly, as a member of the WTO, the EU should ensure that SPS measures do not constitute barriers to trade. Finally, the EU should be aware that the trend of European retail chains to be more demanding on the safety and quality features of their developing country suppliers could end up seriously harming both the EU commitments on international development and its efforts to strengthen the capacity of developing-country farmers to export.

EC Regulation 882/2004 does open the possibility for public–private collaboration on controls of food safety. Although it is not advisable for the EU to recognize any private food schemes (unless the EU is willing to assume liability for what the private sector is doing), it could be appropriate to maintain a continuous dialogue with private standard-setting organizations and retailers, if only to sensitize them to the specific concerns of developing-country suppliers. The EU should also pay attention to the functioning of the market for certification to avoid price hikes that would undermine donors' efforts to assist developing countries. In terms of technical assistance, the EU may wish to make use of EurepGAP specifications to help developing countries upgrading their systems and meeting EU standards on food safety (even without referring specifically to EurepGAP).

11.4 Conclusions in a Caribbean perspective

Future challenges for Caribbean firms competing in foreign markets will involve fewer traditional trade policy barriers (tariffs, quotas) and more non-tariff barriers based on quality, safety and technology. SPS measures could play a prominent role in these. Additional challenges will arise from the segmentation of more demanding markets where entry barriers related to private safety and quality standards may be higher.

If not managed effectively, or left unattended, national regulatory systems of safety and quality standards can be impediments to maintaining and expanding trade, especially for developing countries. Managed successfully, they can be a stimulus to trade and enhance the opportunity to exploit comparative advantage to the mutual benefit of all.

In the multilateral arena, where the harmonization, transparency and appropriateness of safety and quality standards must be established, it is becoming increasingly complex and difficult for institutions to implement and regulate the quality and safety standards set. One of the most striking infractions against the SPS Agreement is the outright ban on imports of fruits and vegetables imposed by many countries. These countries shift the "burden of evidence": rather than setting SPS requirements in function of the risk presented by imports of certain plant products, these countries oblige exporters to demonstrate that their products are safe. Moreover, the capability of the current structures to deal with emerging issues (such as GMOs) or with the structural disadvantages of least developed countries (LDCs) is rather limited.

Thus, exporters from developing countries are facing a complex set of public and private rules, often considered by them to be managed in an unfriendly manner, which can pose organizational and technological challenges that can put them at a competitive disadvantage. On the one hand, national SPS regulations and related technical requirements are often an obscure and arbitrary device for selecting providers, usually in favour of national producers as opposed to foreign companies. On the other hand, while market power shifts towards big retail chains, the complicated terrain of overlapping private quality standards such as HACCP, BRC and ISO is becoming increasingly difficult and costly to manage. It has reached the point that many suppliers in developing countries – and especially small farmers– cannot afford the luxury of private certification and have raised the issue of private standards constituting de facto sanitary and phytosanitary barriers to trade.

We have seen that private, voluntary standards can have a very strong impact on international trade as entry barriers, as they sometimes supersede public standards. These private standards frequently affect exports from less developed countries, exacerbating the problems for developing country involvement in international trade. The issue of restrictiveness of public/private safety regulations in some cases could boil down to whether it is necessary to go further than "equivalence of risk outcome" to require "equivalence of systems" from third countries. One proposal is to allow controls on risk outcomes to be sufficient to ensure food safety; to establish public authorities as the only legal body entitled to set health protection levels, with legal requirements adequate enough to guarantee food safety.

It is necessary to recognize private schemes as a part of a commercial contract between suppliers in developing countries and retailers in more developed countries, and as such are not imposed on developing countries; their acceptance is a voluntary business decision. Business operators often argue that they require private certification to ensure food safety and reflect consumer concerns. The SPS Agreement is binding only for its member States, and not for business operators. Thus, for governments to intervene in

the free market to ensure that safety and quality requirements do not become impediments to developing country exports they will have to establish dialogue between states, NGOs and operators.

Although from the perspective of developing countries – and above all LDCs – the current system of food regulation and multilateral rules cannot be considered satisfactory, the rules are not bad for them *per se*. On the contrary, the rules can act as a catalyst for change, and by doing so increase developing countries' competitive advantage and contribute to more sustainable and profitable trade in the long term. In the consumer-driven, media-driven world of today – a world of food scares, single-issue campaigns and intense public scrutiny of issues affecting human health and food quality – rules are facts of life and will not go away. It is legitimate for consumers to insist on their entitlement to buy products that meet certain levels of sanitary, health and quality requirements, but countries should not allow their standards to be based on prejudice or to be established in response to pressure groups. In the long run, all countries must gain from closer international cooperation on these issues. This is of interest to Caribbean countries themselves and requires regional cooperation, use of international assistance for institutional building in these areas and collaboration with international standard-setting organizations.

Caribbean countries should consider quality and safety issues in the framework of regional strategies, comprising different components that are consistent with the overall objective of improving the quality of the region's agricultural supplies, improving recognition of regional quality products, increasing intra-regional trade and expanding appropriate niches in higher-income markets. The framework should also consider adoption of environmental quality standards to facilitate environmental management and certification of territories.

One starting point for a comprehensive regional approach to quality issues could be to broaden and strengthen regional agencies related to quality and safety of products and services, such as the Caribbean Regional Organisation for Standards and Quality (CROSQ). There are several reasons to recommend a regional approach. Firstly, exporters often find it very difficult to convince their national administrations of the importance of resolving SPS disputes. This is because agrifood exports are often fragmented across a wide range of destination countries, and even if they are concentrated, the value of these exports is too low to make it worth the effort of national governments entering into negotiations with one importing country. National governments in developing countries generally do not have the financial and human resources to engage in lengthy and costly negotiations of often very complex and technical SPS matters with importing countries. Secondly, as the set of quality dimensions relevant to international agrifood trade expands, the

costs of dealing with those dimensions increases. A regional approach would optimize the use of human and financial resources on a regional scale.

By gathering representatives of regional institutes (e.g. the Caribbean Agricultural Research and Development Institute (CARDI) and the Caribbean Food and Nutrition Institute (CFNI)); national institutions (e.g. ministries of agriculture and health, universities and research centres); parastatal organizations (e.g. the National Agricultural Marketing and Development Company (NAMDEVCO) and the Barbados Agricultural Development and Marketing Corporation (BADMC)); and private organizations (Agroempresarial, National Flour Mills Ltd, Guyana Manufacturers & Services Association, etc.), the operationalization of a regional agency may contribute to addressing the many aspects of quality and safety issues. The establishment and operationalization of the Caribbean Agricultural Health and Food Safety Agency (CAHFSA) could provide the Caribbean region with a wide-ranging agricultural health and food safety agency to deal with phytosanitary issues, policy-making regarding plant health issues, programme planning and implementation and obligations under the various international agreements. It could also assist in the development of common positions on plant health issues for Caribbean Community and Common Market (CARICOM) Member States to present at international fora.

On the export side, the regional quality agencies should define, in close cooperation with national governments, the quality policy and practices in the region, and should harmonize and coordinate efforts on SPS export dossiers. The critical areas that the regional quality agency should focus on are: development of supply chain practices, starting from negotiations with private global quality standard owners; detection of traditional products suitable for recognition of GIs; setting up of regional and sub-regional initiatives aimed at linking certified products to the operation of other sectors (trade, tourism); identification and launching of specific quality control programmes; and development of information technology tools for quality management in the region.

Improving the recognition of quality products can be important for Caribbean countries, especially as market access widens. In the context of both market strategies and negotiations this should emphasize the rich variety of Caribbean food products based on traditional know-how, or which have clear features attributable to their geographical origin. This approach has considerable potential for building market reputation and increasing revenues. Some examples of products that have acquired recognition and a reputation worthy of protection on external markets are: bananas from Grenada and St Lucia, peppers from Jamaica and Belize, coffee from Jamaica and sea island cotton from several of the Caribbean islands.

Caribbean countries could have much to gain from the EU's strong interest in supporting the extension of protection of GIs at a WTO level, as well as

the EU's need to build alliances in this field. By demanding an extension to all goods of the protection currently awarded under the TRIPS Agreement only to wines and spirits, and establishment of a related binding register of GI names, Caribbean countries could boost the commercial value of their traditional products, and could also build a negotiating ground with the EU, both for alliances in the WTO negotiations and exchanges in EPA negotiations.

Cooperation between developed countries, donor countries and developing countries can help shape a better trade environment through a number of avenues:

- Developed countries that genuinely pursue trade liberalization should adjust their cooperation schemes to help developing countries improve their capacity to meet SPS rules and requirements This is crucial if developing countries are to be properly and progressively integrated into the global trading system. Specific provisions for trade-related technical assistance in the field of SPS should be included in aid programmes (for example, cultivation or breeding programmes, food-chain integration programmes for slaughter houses, etc.).
- Developed countries should help developing countries identify and focus on products that can be more easily exported to higher income markets. For instance, the sensitivities of EU consumers are highest with some products such as meat, where developing countries face the most challenges in meeting hygiene and other requirements. In contrast, sensitivities are lower when it comes to plants and vegetables. There should also be greater efforts to increase transparency of EU, United States and other export buyers' regulatory systems. One example would be to accelerate the process of harmonization in the application of the EU's border inspection controls.
- Developed countries should put more effort into standard-setting at an international level and ensure effective participation of developing countries in the formulation of these standards. The definition of safety and quality regulations for higher-income markets would then take on board the specific needs of developing countries from the beginning and allow them to agree on specific carve-outs and transition periods where appropriate.
- Finally, the functioning of international organizations also matters. Improving coordination between international aid donors, as well as increasing coherence between WTO and other international organizations such as the International Monetary Fund (IMF) and the World Bank, would make aid in the field of safety and quality standards more effective. The issue of resources for international standard-setting organizations, such as the Codex Alimentarius, is relevant in this regard: they are not sufficiently equipped, given the importance of their task. Although the

Codex has made huge efforts to set up a Trust Fund to help its members participate in Codex standards, there is still a great need to continue the push for harmonization of SPS product and process requirements through the establishment of more and better international rules.

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12

Trade and food security policy analysis: a practical guide*

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Introduction

The consequences of policy decisions are becoming more complex and far-reaching every day, mostly as a result of the deepening of economic interactions among agents, activities and policies. These interactions are taking place within an increasingly wider trading environment, characterized by diverse technologies, infrastructures, resource endowments and consumer's preferences. A simple decision, like the establishment of a tariff or subsidy regime in a specific sector, or even a change in the implementation rule of one particular regime, may imply consequences that go well beyond the sector itself, and well beyond the trading parties more directly involved in that regime. This means that understanding the likely effect of a policy decision tends to require the conceptualization of complex linkages among a large number of variables, which is creating an increasing demand for policy analysis.

The interest of policy-makers is usually multifaceted. Often, changes in trade policies are assessed in terms of their likely consequences on the degree of exposure of the industry involved to foreign competition, on the related effects in terms of employment or on the balance of payments. Increasingly, the impacts on poverty and food security levels are investigated. Policy-makers' attention is primarily attracted by the short term impacts of reforms,

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however there are considerable longer term effects that also need to be evaluated. Policy analysis is useful in all these areas – for example, in assessing the current degree of competitiveness of an industry, or the possibilities of maintaining competitive advantages in a wider environment through time. In those contexts in which poverty and food security are important issues, the need to understand its linkages with policies and the farther-reaching consequences of reforms requires more complex analytical tools.

Most policy matters boil down to establishing the extent to which conveniently computed benefits outweigh costs. This calls for numerical estimates of the consequences of policy changes, computed on the basis of a set of explicitly postulated relationships reflecting the interactions involved.

In the specific area of global agricultural trade, a number of different quantitative models have proven to be potentially useful, particularly for demonstrating how specific reform packages might impact on different countries and commodities, and for helping to settle controversial issues such as trade disputes between countries. An interesting recent development in this area is the considerable degree of networking now undertaken by researchers and analysts around the world. Based on the potential offered by the growing power of computers and the Internet, increasingly often analysts share their conceptual approaches, analytical frameworks and tools, lowering significantly the start-up costs of the analyses in terms of data collection, organization and even model development. In turn, this is enhancing the degree of transparency and replicability of the results on key questions, and is widening the areas of analysis and the public involvement in the investigations, with beneficial feedback effects on the quality of the results themselves.

This chapter presents elements of common quantitative tools used in the investigation of the consequences of trade and agricultural policy changes. It is intended to be a practical introduction for agricultural and trade sector policy analysts in the Caribbean. Emphasis is placed on trade policy, and an attempt is made to show how the linkages with food security, agricultural development and rural development can be addressed. Particularly, the chapter aims to: a) show the potentials of quantitative analysis while highlighting the associated challenges and limitations; b) introduce different approaches and analytical frameworks; and c) facilitate awareness of the availability of databases and computer based tools that can be used as starting points.

The following section presents an overview of the major approaches, considering the two wide categories of *ex post* and *ex ante* evaluations and introducing modelling approaches and related policy representation issues. Section 2 deepens *ex post* approaches and explains and implements some of the most common descriptive indicators used for food security, trade and trade policy analysis. Section 3 deepens *ex ante* approaches by introducing

partial and general equilibrium frameworks and including references to some of the models and databases that can be accessed more easily to start using analytical tools. The appendices to the chapter present a glossary and more specific references to data sources and other resources for policy analysis.

12.1 Approaches to quantitative trade policy analysis and main models' characteristics

Among the number of ways of classifying the approaches employed in the analysis of policy changes, a broad and convenient distinction can be made between *ex ante* and *ex post* methods. The former include those studies aimed at answering a "what-if" type of question, that is, at providing comparative information on a counterfactual scenario built by making assumptions on the value of a policy variable. For instance, given that the tariff on sugar in the European Union (EU) is €400/metric ton (tonne), one may want to analyse how trade and prices would look like in the sugar market should the tariff be €200/tonne. This requires a credible representation of the sugar market as it is, with the tariff at €400/tonne, making it possible to analyse comparatively the effect on trade and prices under a scenario in which the tariff is €200/tonne.

By contrast, *ex post* studies are based on the analysis and comparison of current and past data with the aim of assessing the effects of trade policy measures on trade, welfare, food security and other dimensions of interest, which occurred following implementation of the given policies. Such studies can be based either on econometric techniques, or on computation of sets of descriptive indicators.

The results of econometric exercises can rely upon statistical tests, indicating the existence of a statistically significant relation between a change in a policy variable and the change of a given indicator. For instance, one may wish to analyse the extent to which the implementation of a free trade agreement between two countries has brought about an increase in the volume of trade. An econometric test would then be run on data encompassing both the period prior to the implementation of the agreement and the period after it. This can indicate the extent to which the volume of trade is related to the lowering of the tariffs, and, under given assumptions, also provide indications on the causal direction.

If the same exercise is conducted on the basis of descriptive indicators, instead, there are no measures of the statistical reliability of the evidence proposed. This approach has the advantage of simplicity and is far less demanding in terms of data and technicalities; but it also involves a cost in terms of more limited analytical content. However, one of the methods introduced in the chapter, the PAM, shows a considerable analytical content despite being based mostly on a set of descriptive indicators.

12.1.1 Models and their features

Both *ex ante* and *ex post* approaches to quantitative analysis are based on sets of functional relation, which are commonly referred to as "models". Models are sets of equations aimed at representing in a stylized way the behaviour of economic agents and their interaction, and can be classified in a number of ways; useful summary reviews are available in van Tongeren and van Meijl (1999), and FAO (2006). For the purposes of this chapter, the criteria to look at are:

- the extent of the representation of the economy;
- the presence/absence of a time dimension;
- the nature and origin of the parameters, and the availability of measures of the statistical reliability of the results;
- the type of functional form; and
- the type of closure rule.

One possible model classification divides partial equilibrium (PE) and general equilibrium (GE) models, depending on the first of the criteria listed above. PEs are those models in which the analysis excludes at least some markets, assuming that they will not be affected by what happens in the market analysed. In contrast, GE models include the entire economy by definition.

The second criterion yields another model classification by dividing static from dynamic models. Static models are those in which the time dimension is absent; they compare two alternative states of the world without observing the adjustment path between them. In contrast, dynamic models include a time dimension, so that the values of the variables can depend upon past and future values; they adjust to changes through more than one period.

Depending on the origin of the parameters, models can be classified as "econometric". Econometric models are those in which parameters are estimated, allowing a statistical validation of the results. Parameters are the numbers that shape the behavioural relations. In *ex post* analyses parameters can constitute an output of the analysis, since the objective of deriving a statistically-controlled measure of the relationship between two or more variables is achieved through one or more tests upon the "soundness" of the parameters computed by means of available data. In other words, in the above example, the existence of a relation between the level of the tariffs and the volume of trade between two countries is analysed on the basis of the statistical reliability of the parameter that can be computed to represent this relation.

In contrast, in *ex ante* analyses, parameters can constitute one of the inputs: whatever their origin (*ad hoc* estimation, literature, or calibration[164]) they

[164] Calibration implies fitting the unknown parameters to the values that reproduce the data in the base period.

embed assumptions about the behaviour of the variables employed to describe the existing environment, based on which the counterfactual experiment will be run. Returning to the above example, a credible representation of the sugar market implies an assumption on the elasticity of demand and supply in the EU, if we want to consider comparatively the effects on the prices and volume of trade of reducing the tariff from €400/tonne to €200/tonne. Under both scenarios we shall assume that the behaviour of producers and consumers is unchanged with respect to prices, incomes and inputs in production.

In *ex ante* analyses, however, the availability of a measure of the statistical reliability of the parameters constitutes an important advantage, as it allows for checking the reliability of the results. Other types of tests can also be run to check the performance of *ex ante* simulation models, such as computation of data from past periods for which the observed value of the variables is known. Such tests can measure the stability of the results, which allows for verifying the reliability of dynamic models.

The mathematical functional form of the equations is another key feature of the models, which embeds assumptions about the behaviour of economic agents. Models can be based either on reduced form equations (in which it is implied that optimizing behaviour is modelled through the restrictions on the parameters, such as those of adding-up, homogeneity or symmetry) or on structural form equations (in which optimization is explicit). Models employed in *ex ante* analysis tend to be based on relatively simple functional forms, such as the linear or log-linear, the constant elasticity, the log-log, or the Cobb Douglas. In contrast, more sophisticated and theoretically sound functional forms are found in econometric exercises, which are more suitable for *ex post* analyses.

Finally, the closure rule is an important characteristic for equilibrium models. This differentiates variables into exogenous and endogenous, therefore determining the criteria used to solve the model. As will be shown in Section 3, the closure rule is particularly important because it implies assumptions about the functioning of the market represented.

To conclude this section, it may be useful to recall six basic "rules of thumb" valid for model-based analyses, which however commonsensical they may appear, are still very important and often overlooked.

Firstly, no model is suitable for analysing all types of problems, and it is more usual that a model is suited for only one particular problem. Adapting a model built for one purpose to a totally different problem is seldom a successful strategy. Secondly, no model can be better than the data on which it is based. Data are always one of the most important parts of any analysis and often a major source of the limitations of the results; they should be carefully considered and extensively discussed. Thirdly, the credibility of the assumptions is important, but not always nor necessarily a value *per se*; models can sometimes capture essential and pertinent aspects of reality even

by starting from very unrealistic assumptions. Fourthly, generating numbers is important, but understanding how they are generated, and under which assumptions and limitations, is more important. Therefore time needs to be spent on understanding the numerical results that are generated. Fifthly, the results of models usually indicate at best a sign and an order of magnitude. Finally, results seldom speak for themselves, and more often require interpretation based on deep knowledge of the problem analysed.

In all cases, results of models are the mere outcome of the interaction among exogenous assumptions, behavioural hypotheses and parameters, and should be strictly considered as such. However, they can assist policy-makers in building "menus" of policies and their consequences, to support a given choice and to communicate with other policy-makers, especially in the context of trade negotiations.

12.1.2 Policy representation

Policies are difficult to represent in a model, for at least two main reasons. Firstly, they are specified at a far higher level of detail than is normally used in a model. For instance, policy normally specifies a tariff at a far more detailed product level than it is possible to adopt in a model, given data availability and the need to avoid making the model unmanageable. Representing policy in a model requires aggregations, which implies making a number of assumptions.

Secondly, it is often difficult if not impossible to represent policies *explicitly*. An explicit representation is one in which the model includes as an exogenous variable (that is, a variable that can be shocked) the same variable operated by the policy-maker (Anania, 2001). In the practice of policy analysis, this is seldom possible. More often a one–to–one representation of policy measures is not possible, due both to the difficulty associated with capturing the details of the decision-making process, and to the presence of policies that imply similar and cumulative effects that cannot be separated in a stylized setting.

As an example, consider the representation of a fixed tariff in a model in which tariffs are defined in percentage terms. The analyst will need to convert the fixed tariff into an *ad valorem* tariff, on the basis of some relevant price. Suppose, further, that the tariff is coupled with a domestic price support mechanism that operates in conjunction with the tariff. The analyst will need to find some measures capable of capturing the effects of both policies, avoiding double-counting and without giving up the possibility of simulating changes in only one of the two policies.

These problems call for the calculation of some kind of "equivalent" measure, capable of aggregating over policies implemented on different products, and aggregating over different types of measures operated on the same (group of) product. This equivalent measure would be capable

of capturing those policies that are in fact put in place and changed. For tariffs, a standard approach employed in trade policy analysis is the computation of some "tariff equivalent", based on the difference between a world market price and the comparable domestic price.[165] Problems with this type of measures arise both in the aggregation across tariffs defined for different specific goods (where theoretical foundations are absent in common calculations) and in aggregation across types of tariffs, due to the distortion of world market prices, which complicates the identification of a convenient price to be adopted in the conversion.

The level of complication increases when more articulated policy measures are taken into account. For instance, quantitative restrictions cannot be meaningfully represented through a tariff equivalent, nor it is it possible to represent other common non-tariff measures in these terms, such as tariff-rate quotas or multiple and variable tariffs. Wider discussions on these topics can be found in Laird (1997), Anania (2001) and Cipollina and Salvatici (2006).

12.1.3 Linkages with poverty

Authoritative efforts have been made recently to shed light on the key matter of linkages between changes in trade policy and poverty outcomes.[166] It has been observed that the analytical tools employed for this purpose need to address a number of linkages involving the following variables:[167]

- price and availability of goods;
- factor prices, income and employment;
- taxes, subsidies and the availability of public resources for financing them;
- investment and innovation for long-term growth;
- external shocks, particularly from price; and
- short-run adjustment costs.

A partial representation of the economy is sufficient to assess the first of such linkages, while a more satisfactory representation is needed to analyse the second and third ones. The fourth and sixth are usually studied in ad hoc frameworks (such as non-structural cross-country analysis or aggregated GE approaches) while the fifth can be analysed within several approaches.

In many cases, a key starting point on the linkage between changes in trade policy and poverty outcomes is the modelling of the labour market. As highlighted recently by Ackerman (2005), one of the major gaps in current

[165] A common method to derive tariff equivalents is to use Producer Support Estimates (PSE). These comprise price distortions or market price supports (transfer from consumers to producers) as well as transfers from government to producers. A similar concept exists for Consumer Subsidy Equivalents (CSE). See also the Policy Analysis Matrix approach in Chapter 10.

[166] One example, covering a variety of approaches, is a book edited by Hertel and Winters (2006) and published by the World Bank.

[167] Hertel and Reimer, 2005.

trade policy analysis literature is that representation of the labour market tends to be poor. This is one important drawback of the results of several models, and it may significantly affect the conclusions of many trade liberalization studies, particularly those on developing countries. This lack clashes with the importance that policy-makers rightly attach to the labour market.

12.2 *Ex post* trade policy analysis: the Policy Analysis Matrix and the descriptive indicators

Ex post evaluations assess the effects of trade policy measures on trade, welfare, food security and other dimensions of interest to policy-makers, which occur following implementation of the given policies. These approaches use various kinds of statistical and econometric tools, ranging from descriptive analyses of trends to econometric models.

Econometric models are the standard way to control for and analyse factors affecting the trade pattern. These approaches typically estimate world trade flows by defining a simplified explanatory hypothesis, and ascertain whether the estimated relationships change as a consequence of implementing a certain policy. The main strength of these models is the possibility of statistically validating hypotheses about various variables affecting trade. Weaknesses include the lack of details in the definition of variables relevant for policy analysis, the need for a great deal of data and the impossibility of treating the structural break determined in the model when large policy changes take place (Taylor, 2004; Lucas, 1976).

On the other hand, non-parametric approaches (such as the indices discussed in this section) avoid the problem of defining a model for trade flows. They can provide first-glance *ex post* assessments of the impact of both trade and food security policy measures, as well as preliminary pictures of realities to be modelled. By using descriptive indicators, analytical procedures are faster and less demanding in terms of data. This makes them particularly suitable for providing quick answers to policy questions, especially for phenomena occurring on a world scale and involving a large number of commodities. The main weakness of this approach is that its descriptive nature does not allow for detailed analysis of various factors (not necessarily policy factors) affecting the trade pattern, nor of the level of food security; nor does it allow statistical validation of hypotheses (Hoekman, English and Matoo, 2003; Drysdale and Garnaut, 1982).

The third framework introduced is the policy analysis matrix (PAM) (Monke and Pearson, 1989). The PAM is a tool that constructs two enterprise budgets, one valued at market prices and the other at economic/social prices; the impact of policy is then assessed as the divergence between the market and economic values. The PAM, once assembled, provides a convenient method of measuring policy effects, competitiveness and comparative advantage.

This section provides definitions and examples of indicators relevant for trade policy, food security and vulnerability analysis, with special reference to: the contribution of trade to food security, the analysis of trade flows, the openness and dependence of the trade regime and the exposure of exports and imports in thinly-traded markets.[168] It then introduces the PAM tool.

12.2.1 Indicators of dependency, vulnerability and food security related to trade

There are numerous general indicators for each of these three concepts, but most are not necessarily related to trade and therefore not mentioned here. The relationship focused on here can be illustrated through an example of how the three concepts are linked: dependency on food imports is linked to foreign exchange generation, which can make a country very vulnerable to price declines in export markets (especially in those markets where it is a price taker). Depending on the particular national context the analyst would identify one indicator as being more relevant than another.

Cereal supply indicator (SI) uses cereals as representative of food needed and is measured by dividing the total supply for domestic utilization (production + imports – exports + changes in stocks) by the population. An example **(Table 12.1)** of this indicator (cereal supply/kg per capita) for three Caribbean countries over three years indicates three very different outcomes:

$$SI_r = \frac{y_r + m_r - x_r + \Delta_r}{pop_r} * 100$$

where:
y_r = cereal production
m_r = cereal imports
x_r = cereal export
Δ_r = changes in stocks of cereals
pop_r = country r's population

TABLE 12.1
Cereal supply indicator

	1995	2000	2003
Saint Vincent/Grenadines	97.6	113.3	118.9
Grenada	100.8	90.2	88.6
Jamaica	104.4	98.4	103.7

Source: FAOSTAT, 2006

[168] Other policy indicators of agricultural support and trade competitiveness are defined within the Policy Analysis Matrix approach (see section 12.2.3) and applied to CARICOM countries/products in Chapter 10.

At a very general level SI provides a snapshot of how much food has been available domestically on average. One word of caution is to pay attention to how supply is defined (total supply is production plus imports minus decreases in stock), another is to remember that the supply is not evenly distributed, and still another is to notice, for example, that it is not clear (without going back to the base data) whether Saint Vincent and the Grenadines' supply is increasing because of domestic production or due to a greater reliance on imported food. Conclusions need to be made with care.

Food import capacity indicator (ICI) is the ratio of the food import value to the total export value (excluding services):

$$ICI_r = \frac{M_r}{X_r} * 100$$

where:
M_r = value of the country r total import (excluding services)
X_r = value of the country r total export (excluding services)

This could also be measured more directly and easily using cereal imports as a proxy for food imports and it is also often compared to total agricultural export earnings as opposed to total merchandise trade. The table below **(Table 12.2)** shows food import values over total agricultural export earnings and again reveals three very different situations.

TABLE 12.2

Food import capacity indicator

	1995	2000	2004
Barbados	1.59	1.66	1.52
Belize	0.32	0.38	0.36
Haiti	10.33	10.83	22.10

Source: FAOSTAT, 2006

Belize's (stable and considerable) agricultural export capacity, which allows it to purchase food imports, can be contrasted with the vulnerability of Haiti, both in terms of foreign exchange earnings from the agricultural sector and of natural disasters and their impacts on agricultural production and exports. (Haiti was hit by severe hurricanes in 2003 and 2004.) Changes in the type of food consumed (for example more processed food or higher-value food imports) can lead to an increase in the indicator, but is not necessarily a sign of increasing food insecurity. In addition, the capacity to import based on an expanding service industry may not be reflected, depending on the variables used in the indicator.

Food import coverage indicator (FIC) compares the foreign exchange reserve balances of the country (at end of year) with the food import bill value (annual) and indicates how vulnerable the country's food security could be to severe shocks that might disrupt either its domestic supply (which would have to be replaced) or lead to a loss of foreign exchange earning capacity through price or export supply shocks.

$$FIC_r = \frac{Fb_r}{Fib_r} * 100$$

where:
Fb_r = foreign exchange reserve balances of country r
Fib_r = food import bill value (annual) of country r

Table 12.3 shows four very different situations; it reflects effects of positive and negative economic (international price) or political shocks on the changing capacity of a country to cover the imports of its food from its foreign exchange reserves in the case of a crisis.

TABLE 12.3
Food import coverage indicator

	1995	2000	2004
Guyana	5.18	4.23	3.41
Suriname	2.93	0.87	1.86
Trinidad and Tobago	1.62	5.38	10.03
Haiti	0.65	0.68	0.31

Source: FAOSTAT, 2006 and IMF, 2006

Guyana's foreign exchange reserve coverage of food imports increased five times between the 1990 level, where there was a ratio of .86 (less than one year's food import coverage), and 1996 (potentially a five-year coverage). In Guyana, 1990 was the beginning of a period of significant economic growth that also coincided with major political change. Rice and sugar exports increased substantially in the first half of the 1990s and suffered from declining growth rates and prices thereafter. Suriname was similarly affected by declining rice prices. The healthy Trinidad and Tobago situation reflects clearly an expansion of oil revenues while Haiti's consistently high vulnerability position worsened. Several factors in addition to global commodity prices affect this ratio, such as changing food import levels, performance of the economy as a whole and, in many Caribbean countries, the performance of the tourism sector. In several countries, tourism receipts have been a major factor in improving results when this indicator is the measuring rod.

12.3.2 Trade shares and indicators of trade structure and performance
Coverage ratio (XC) indicates how much of the value of imports is financed by export. It is given by the percentage ratio of export over import:

$$XC_r = \frac{X_r}{M_r} * 100$$

where:
X_r = value of the country r total export
M_r = value of the country r total import

The index varies between 0 (import fully covered by entries of the balance of payments other than export) to +∞, with a value of 100 indicating that export is fully capable to cover import. Over time the index can monitor the development of sectoral surpluses or deficits of export over import. In the case of the Caribbean countries, this index tend to show an excess of export over import with the rest of the world for bananas and sugar, determined by the preferential trading ties with the EU15.

Normalized trade balance (NB) is the net trade indicator used most often. It is the ratio of the trade balance of a country/industry over a dimensional measure of the flows (i.e. the total value of trade, measured as a sum of import and export):

$$NB_i = \frac{(X_i - M_i)}{(X_i + M_i)} * 100$$

where:
X_i = value of exports of country/industry i
M_i = value of import of country/industry i

The index varies in the range $-100 \leq NB_i \leq 100$. Negative values mean that the country/industry i is a net importer, to the extreme value of -100, which signals that only import takes place in the country/industry considered. Positive values have the opposite meanings (net export positions).

Trade balances give a synthetic measure of the degree of disequilibrium of trade flows, while their normalization is meant to make them suitable for comparisons. The improvement, over time, of the NB suggests improved trade performance of the sector even when the trade balance worsens. This can happen, for example, when we start from a sizeable trade deficit, and the export growth is higher, in percentage terms, than that of imports. In this sense, NBs can show more accurately than simple trade balances the changes that occurred in trade performance.

Moreover, in disaggregated analysis, the normalized trade balance is often interpreted as an indicator of trade specialization. High and positive NBs are recorded for commodities in which either market or policy determinants, or both, make national production competitive in both foreign and domestic markets. Therefore, the NB may be considered an *ex post* synthetic indicator of the competitive success of national products.

The NB for Caricom's agrifood trade performance is expected to be generally negative, and strongly negative for agricultural products.

Trade/GDP ratio (O) is a conventional measure of openness, given by the percentage share of GDP traded:

$$O_r = \frac{X_r + M_r}{GDP_r} * 100$$

where:
X_r = value of the country r total export
M_r = value of the country r total import
GDP_r = gross domestic product of country r

Evaluating the "degree of openness" to trade of economies or sectors is a rather common approach for assessing the impact of trade policies. Although econometric attempts to estimate measures of openness have often been inconclusive, the idea that the share of GDP (or consumption) traded can detect changes in openness of the country/sector have made those ratios the conventional measures of openness.

Due to its shortcomings,[169] the trade–to–GDP ratio is used to describe broad changes in openness over a long time or, at times, to compare degrees of openness before and after implementation of trade agreements. In fact, this index gathers more information than it should in order to be a refined measure of openness. It is not able to differentiate historical, geographical, economic and political factors affecting the share of agricultural GDP traded; therefore it is affected by many factors not directly involving trade policies and policy-determined openness. Also, the index is negatively correlated with the size of an economy, because large countries, with larger and more diverse stocks of resources, are better able to match demand and supply domestically, and transportation costs are likely to favour domestic producers for a range of products that widens as the size of the country increases (Perkins-Syrquin, 1989). This implies that the ratio is not comparable among different countries.

Trade shares (S) are useful indicators of the structure of trade, trade performance and its evolution over time. Most of the indicators introduced in this section are trade shares, or a combination involving them.

Trade shares can be calculated in several ways, according to the purpose of the analysis. For instance, the share in world export of a country (or a single industry of the country) is the ratio of a country's (or country's single industry) export to the world over world export (or world's single industry export):

[169] A discussion of limitations of the trade–to–GDP ratio and an attempt of an econometric estimate of this measure of openness are available in Leamer (1988).

$$S_i = \frac{x_i}{X}$$

where:
x_i = exports of country i
X = world export

The index ranges between $0 \leq S \leq 1$ (or $0 \leq S \leq 100$, if we prefer the index to be expressed in percentage terms and therefore multiply it by 100), where higher values indicate greater importance of the country in world exports. On the demand side, for share in world imports, the same meaning may be obtained by switching export with import in the previous definition.[170]

In the case of CARICOM, shares of world market are expected to be negligible, however important the products are for the local economy. This indicates that CARICOM countries are not expected to be able to affect world prices. However, shares can be higher in a specific target market and/or product. For instance, if we compute the share for the EU, expressed as

$$S_i = \frac{m_{EU,i}}{M_{EU}}$$

where:
$m_{EU,i}$ = EU import from country i
M_{EU} = EU import from the world

This will turn out to be significant, especially for certain products, such as sugar, rice or bananas, while still not significant for the whole agrifood sector as a whole. In general, CARICOM agrifood trade shares are expected to be relatively higher for beverages, sugar, prepared cereals and fruit and vegetables.

Trade shares can also be computed to evaluate the relevance of a specific sector on the total export or import of a country. For example, e_i is the export (import) of the i sector of country j, while E is the total export (import) of the same country:

$$S_i = \frac{e_i}{E}$$

where:
e_i = export of product i by country j
E = total export of country j

Or, to evaluate the relevance of a specific sector on the export to (import from) a given country, e_i is the export (import) of the i sector of country j to the partner k, while E_i is the export (import) of sector i of country j:

[170] It must be noted that exports to a partner country are generally expressed in free on board (f.o.b.) price, whereas imports usually include costs of insurance and freight (c.i.f. price). Therefore, the value of *exports* from country A towards country B differs from the value of *imports* into B from A (the value of imports expressed in c.i.f. price will be greater than the value of exports expressed in f.o.b. price). Care must be applied when gathering import and export flows in the same indicators in order to avoid inconsistency in the data.

$$S_{i,k} = \frac{e_{i,k}}{E_i}$$

where:
$e_{i,k}$ = export of product *i* from *j* to *k*
E_i = total export of product *i* by country

In percentage terms, in the first case, the closer the indicator is to 100 the higher the relevance of the sector in the structure of export (import) of country *j*. In the second case, the closer the indicator is to 100 the higher the relevance of partner country *k* in the structure of export (import) of country *j*.

Revealed comparative advantage. Balassa (1965) suggested measuring comparative advantages as they are revealed by trade data using a specialization indicator, often called the index of revealed comparative advantage (RCA). RCA is the ratio between the share of product *j* in country *i*'s export (numerator of RCA) and the share of product *j* in world export (denominator of RCA). In practice, it detects the relative specialization of country *i* in exporting product *j* on the basis of *j*'s importance in world trade.

$$RCA_{ij} = \frac{x_{ij} / X_{it}}{x_{wj} / X_{wt}} * 100$$

where:
x_{ij} = country *i*'s export of product *j*
X_{it} = country *i*'s total export
x_{wj} = world export of product *j*
X_{wt} = world total export

RCA_{ij} is always positive (≥ 0) and, by being expressed in percentage terms, RCA > 100 signals a revealed comparative advantage of country *i* in product *j*. The index can be adjusted for examining comparative advantages in reference areas other than the world (i.e. a single CARICOM country with reference to total CARICOM export).

RCA deals with the difficulties of measuring comparative advantages by observing the relative specialization in export of product *j*. Since prices cannot be observed in conditions of autarky, measuring comparative advantages for the purpose of defining a country's position in the international division of labour becomes rather arduous[171]. Even if one expects, following the traditional neoclassical approach, that a country's international specialization is determined by its relative endowment of production factors, significant problems arise that hamper the quantitative evaluation of such endowments.

For the Caribbean it is expected that the RCAs are significant for products such as bananas, rice and cane sugar, given that preferential trade policies meant that the area is engaged significantly more than the world average in these products.

[171] See also Chapter 10.

Concentration index (HX). This indicator measures the degree of concentration of the export structure of a country. This feature makes it interesting for many developing countries, whose structure of export is often highly dependent on relatively few primary commodities. The HX index is based on the Hirschman Index, calculated using the shares of the various products in the export structure of a given country,

$$HX = \left(\sum_{i \to n} s_i \right)^2$$

where:
S_i = share of product i in the export of country j
n = number of product exported

The smaller the value of the index, the less concentrated the structure of country *j*'s export. In this version the index ranges from 1 to ∞, which makes it difficult to compare among countries. However, this index can be normalized (i.e. forced to assume values between 0 and 1) by dividing it by the number of different products that, theoretically, could be exported (n). This implies that the values the index will assume are dependent on the nomenclature and the digit level adopted for the analysis (i.e. if the calculation is performed for agrifood sector by using 2-digit level HS nomenclature, then there would be 24 products considered, and $n = 24$).

$$HX_{norm} = \frac{\left(HX - \frac{1}{n} \right)}{\left(1 - \frac{1}{n} \right)} \Rightarrow \frac{\left[\left(\sum_{i \to n} s_i \right)^2 - \frac{1}{n} \right]}{\left(1 - \frac{1}{n} \right)}$$

In this new version the HX index is comparable among countries and takes the value 1 for maximum concentration (one product covers all exports).

Indicators of trade similarity. Some trade specialization indicators measure the merchandise similarity between the export flows of two countries in the same reference market. The export structure similarity index (ES) compares the relative dimension of the export shares for a given merchandise aggregate between two countries towards a specific target market. For each item the share of total agrifood exports is considered for each of the two countries compared.[172]

In math:

[172] Starting from the original *export structure similarity index* (ES), other related indicators were developed, such as the *product similarity index* (PSI) and the *quality similarity index* (QSI) (Grubel and Lloyd, 1975; Finger and Kreinin, 1979). In this chapter we go into detail on the ES only.

$$ES = \sum_{i} [\min (x_{iA}, x_{iB})] * 100$$

where x_{iA} and x_{iB} are the shares of total agri-industrial exports of country A and country B (respectively), regarding item *i.*

The use of these indices as an analytical instrument for evaluating competition between agrifood exports towards a specific market is based on the idea that the more similar the structures and features of two countries' exports are toward a common reference market, the stronger the competition between those two countries in relation to those goods.

The index varies between 0 and 100: in the first case the similarity is null, while in the opposite case the structures of the two flows (in terms of trade shares) are identical. The results, however, depend heavily on the level of disaggregation adopted[173].

12.2.3 The policy analysis matrix (PAM)

As mentioned, the PAM is an analytical framework aimed at examining the impact of policies based on two enterprise budgets: one valued at market prices, and the other at economic or social prices. The divergence between the market and economic values indicates the static impact of the policy setting, and constitutes a convenient way to shed light on the competitiveness of the economic sector(s), and their comparative advantage.

The enterprise budgets used to construct the PAM comprise revenue and cost data for the production and marketing of a specific commodity organized into two accounting identities. One calculates profit as the difference between revenues and cost. The other calculates the value of the divergence (distortion) induced by policy as the difference between economic and market values.

The structure of the PAM matrix is presented in **Table 12.4**. It allows for viewing the two accounting identities and readily calculating the profits and divergences. The first column displays data on revenue. The next two columns separate the cost items into tradable and non-tradable components, with "value" as a sum of quantity and price. (Intermediate inputs such as seeds, fertilizers, pesticides and transportation are separated into tradable and non-tradable components.) The final column is calculated as *profits = total revenue – total costs*.

The first two rows of the PAM value the revenues and costs (and thereby the profits) using different valuation methods. The first row uses market prices, which captures the effects of policies (distortions). The second row uses economic prices, which are the efficiency prices, devoid of distortions.

[173] Understandably, the higher the level of disaggregation, the higher the accuracy of the comparison between trade structures, but also the lower the probability of having "similar" trade shares.

The final row reinforces the second identity, using *distortion = market price – economic price*; it captures the distortion (or divergence) in revenues, costs, and profits.

TABLE 12.4
The Policy Analysis Matrix (PAM)

	Benefits	Costs		Net profit
	Gross revenue	Tradable inputs	Domestic factors	
Budget at market prices	**A** = *Pid * Qi*	**B** = *Pjd * Qj*	**C** = *Pnd * Qn*	**D**
Budget at economic prices	**E** = *Pib * Qi*	**F** = *Pjb * Qj*	**G** = *Pns * Qn*	**H**
Divergences	I	**J**	**K**	**L**

Where:

Pid = *domestic market price of output i*
Pjd = *domestic market price of tradable input j*
Pib = *economic price of output i*
Pjb = *economic (parity) price of tradable input j*
Pnd = *domestic market price of non-tradable input n*
Pns = *domestic economic (shadow) price of non-tradable input n*
Qi = *quantity of output i*
Qj = *quantity of tradable input j*
Qn = *quantity of non-tradable input n*

The PAM provides a visually appealing way of capturing and presenting the data on divergences and profits, which may be labelled as follows:

private profits: D = (A – B – C)
social profits: H = (E – F – G)
output transfers: I = A – E
input transfers: J = B – F
factor transfers: K = C – G
net transfers: L = D – H; or L = I – J – K

The PAM allows for calculation of the indicators of policy effects, competitiveness and comparative advantage. Indicators of the effects of policies on the farm system include the nominal protection coefficient (**NPC**), the effective protection coefficient (**EPC**) and the producer subsidy equivalent (**PSE**). The NPC measures the impact of policies on production process and output prices. The EPC measures the effects of policies on valued added (revenue less value of traded inputs). The PSE measures the net contribution of policies to farm revenues, that is, the net value of transfers as a percent of farm revenues valued in private prices. The private profit is a measure of international competitiveness. In effect competitiveness means that the production units have profitable production with the policy support provided.

The Domestic Resource Cost (DRC) is a measure of comparative advantage and implies that the production units can have profitable production even in the absence of policy support. The indicators of policy effects, competitiveness and comparative advantage may be calculated from the PAM as follows:

nominal protection coefficient (NPC)	=	A/E
effective protection coefficient (EPC)	=	(A–B)/(E–F)
producer subsidy equivalent (PSE)	=	(L/A)
private profits	=	D = (A – B – C)
social profits	=	H = (E – F – G)
domestic resource cost ratio (DRC)	=	G/(E–F)

The major limitation of the indicators (NPC, EPC, PSE, DRC) and the PAM is that they typically use fixed input–output coefficients. As a result, it is not possible to use them directly to indicate producer or consumer responses to policy changes that reduce distortions.

12.3 *Ex ante* policy analysis and equilibrium models

As pointed out above, *ex ante* policy analysis constitutes an attempt to anticipate the likely result of a policy change, through the building of a counter-factual scenario that is compared with a status quo scenario capable of answering a "what-if" question. The analysis involves the comparison of two different states of the world on the basis of some variables of interest. One state represents reality during a given period of time, usually called the baseline (or base case or benchmark), and the other state represents reality under a different policy option, usually referred to as the counter-factual or policy scenario.

Models considered here are economic equilibrium models, in which the solution corresponds to (at least some) market clearing conditions. Among the classes of models available, computable partial equilibrium (PE) and general equilibrium (GE) models are those based on the interaction among endogenous variables, which is absent in the analyses based on simple statistical indicators. The large number of microeconomic details involved makes these models suitable for predicting changes in production, demand, trade, prices, incomes and welfare.

The variables utilized in these types of models are classified as exogenous and endogenous. Exogenous are those whose value is determined outside the model, while endogenous are those whose value is determined by solving the model. Examples of typical exogenous variables in policy analysis models are the population, the rate of technical change and the policy variables themselves. Examples of typical endogenous variables include prices, consumption, production and trade.

Dynamic models can be classified as "recursive dynamic", when the solution is based on the forecasted value of the exogenous variables and on

the values of the endogenous variables in the previous period. In this kind of models, agents' behaviour is optimal within each period, but not through time[174]. On the contrary, fully dynamic models can be based on dynamic optimization, in which solutions are provided in the form of an optimal behavioural path, and behaviour is optimized through time.

One last remark is in order on the nature of the results of models used in *ex ante* analyses. The only additional information that such exercises can convey is the outcome of a policy experiment, indicating how the world would look with, for instance, a different tariff or a different subsidy. By no means should this be confused with a provisional exercise, which tells how some phenomenon may evolve in the future. The confusion arises particularly with the results of dynamic models, which often need to utilize the outcome of some provisional exercises – typically for exogenous background variables such as the population, GDP, productivity factors – in order to build a credible representation of the world through time. Provisional exercises, however, pertain to the building of a baseline against which the policy experiment will be run. Therefore it would be misplaced to judge the "soundness" of the policy analysis on the basis of its capacity to produce correct forecasts that are normally not a product of the analysis, but are rather the product of different exercises employed as a starting point in policy analysis.

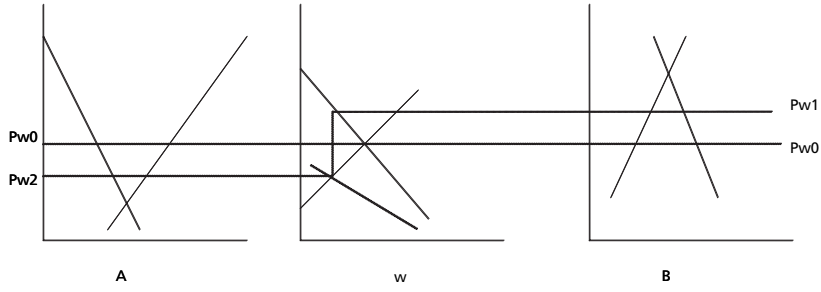
General and specific limitations of equilibrium models (from modelling assumptions, to data quality, to policy representation) were discussed above. This section provides an introduction to PE and GE approaches as applicable to trade policy and food security analysis.

12.3.1 An introduction to partial equilibrium (PE) models

Our focus here is on large global PE models that include multiple regions and countries, and multiple product markets, and that are employed in macro-level analysis of agricultural policy (particularly agricultural trade policy). Usually, these tools include the main agricultural markets only, while no factor markets are considered. (Their features are supposedly taken into account by the value of the parameters.) Demand, supply and trade for agricultural commodities are generated simultaneously with equilibrium prices, given a number of exogenous macroeconomic assumptions – such as the GDP, the exchange rate, the consumer price index and technical change – and the level of policy variables. The rest of the economy is assumed not to be affected by, and not to affect. what happens in agriculture. A basic textbook reference for this type of analysis is Francois and Reinert (1997).

[174] It should also be noted that in recursive dynamic models, which are considerably more frequent in agricultural trade policy analysis, the endogenous variables of period *t* behave in fact as exogenous variables with respect to the solution of period *t+1*. They are sometimes referred to as "pre-determined" variables, since they are endogenously computed in one period, but employed as exogenous in the following one.

FIGURE 12.1
A partial equilibrium net trade model



Country A is an exporter, while country B is an importer. The graph in the middle shows the transaction in the world market. If country B imposes an *ad valorem* tariff raising the price from P_{w0} to P_{w1} the world price will be reduced from P_{w0} to P_{w2}, and trade will be reduced accordingly.

In the past, goods were often assumed to be perfectly homogeneous; this has changed in some of the more recent contributions, several of which assume some degree of differentiation across the same good in different markets. In general, the partial equilibrium approach has been employed extensively for commodity markets, under the assumption that all markets represented are linked by (at least some) degree of transmission between prices.

This type of model assumes the presence of a representative agent, while it does not provide indications about possible underlying distributional effects. Agent behaviour is assumed to be maximizing, if restrictions are imposed on the parameters, and models are calibrated on a base year, in order to run counter-factual scenarios (if comparative, static) or paths (if recursive, dynamic).

Figure 12.1 offers a schematic illustration of the functioning of a PE model for one individual product.

A *typical* partial equilibrium model[175] consists of a set of behavioural equations, a set of equilibrium relations between supply and demand, and a set of identities that aggregate variables. Equations can be grouped into a supply component, a demand or utilization component, and a foreign trade component; this pattern is repeated for each region and product included. In addition, there are price transmission equations, linking world prices to

[175] The following can be referred to a number of models, such as the Cosimo-AGLINK model of the Organisation for Economic Co-operation and Development (OECD) and FAO, or the FAPRI model of the Center for Agricultural and Rural Development (CARD), or the European simulation model (ESIM) built by the University of Bonn. A review of some of these exercises can be found in van Tongeren and van Meijl (1999).

BOX 12.1

The structure of a standard partial equilibrium agricultural model

Crop products	*Livestock products*
	supply
(1) $s_{i,n} = s(p_{v,i,n}, p_{v,j,n}, Pols)$	(8) $c_{i,n} = c(p_{z,i,n}, p_{z,j,n}, Polc)$
(2) $r_{v,i,n} = r(p_{v,i,n}, PR)$	(9) $AL = al(p_{v,i,n}, p_{v,j,n})$
(3) $Qo_{v,i,n} = s_{i,n}\ r_{v,i,n}$	(10) $r_{z,i,n} = r(p_{z,i,n}, AL, PR)$
	(11) $Qo_{z,i,n} = c_{i,n}\ r_{z,i,n}$
demand	
(4) $Cu_{v,i,n} = cu(p_{v,i,n}, Y_n, POP_n)$	(12) $Qd_{z,i,n} = qd(p_{z,i,n}, Y_n, POP_n)$
(5) $AA_{v,i,n} = aa(Qo_{z,i,n})$	
(6) $SE_{v,i,n} = se(s_{v,i,n})$	
(7) $Qd_{v,i,n} = Cu_{v,i,n} + AA_{v,i,n} + SE_{v,i,n}$	

price transmission

(13) $p_{i,n} = p(p_{i,w}, tc, Polp)$

trade

(14) $(E_{i,n} - I_{i,n}) = Qo_{i,n} - Qd_{i,n}$

closure

(15) $\Sigma\ (E_{i,n} - I_{i,n}) = 0$

where:

i, j = products
v = crops
z = livestock
n = country
and
s = land (hectares)
c = heads (number)
AL = index of feed cost
r = yield (per hectare or per head)
$Polp$ = policies directly affecting prices
$Pols$ = policies based on land
$Polc$ = policies based on livestock heads
Cu = demand for human consumption
E = exports
I = imports
tc = exchange rate
PR = yield trend
Y = GDP
POP = population
p_n = price in country n
p_w = world price
AA = demand for feed
SE = demand for seeds
Qd = total demand
Qo = supply

domestic prices, and world market equilibrium conditions that closes the model.

A simplified representation of the standard structure of the models considered is shown in **Box 12.1**.

The supply component consists of equations for crops and for livestock; supply is obtained as the product of a yield per hectare of land or per head, times the number of hectares employed or the herd size. Yields depend on a trend variable (which is used to represent technical change) on output prices and on feed costs for livestock. These are included in an aggregate feed price index. Land and heads allocation depends on relative output prices, and on the policies directly affecting their allocation.

This type of modeling is simplified in several respects. First, production is entirely deterministic: no uncertainty factors, such as climatic variability, are accounted for. No assumptions are made concerning farmers' attitude toward risk, unless they are included in the parameters. Input demand is included only for land, herds and where primary products are employed as inputs in the production of other (processed) goods included in the model, as is the case with feed crops, oilseed (where seeds are inputs for mealcakes and oils) and in dairy production, where milk is the input of butter, cheese casein, etc. The demand for non-agricultural inputs, such as fertilizers, pesticides and machinery is not included. Land use and herd size depend solely on the price obtained for agricultural products, rather than on the prices of land and heads themselves.

The demand component for crops consists of an aggregation, by means of an identity, of the amount used for human consumption, for feed and for seeds. For livestock, only feed is included, along with the prices of products, the demand for human consumption includes the prices of a few more direct substitutes, together with the GDP level and the population as exogenous shifters. The demand for feed is directly related to the number of livestock, through technical coefficients. By the same token, the demand for seed is directly related to the number of cultivated hectares.

The typical partial equilibrium model considered here is comparative static, and does not include stock formation. This choice is usually justified by considering that stocks cannot be increased or depleted after a given point, and thus, their variation must add up to zero. Nonetheless, the absence of stocks from the model can be a problem, especially in modeling those markets where they may assume a structural character and may significantly affect the behaviour of economic agents.

In the more standard applications the trade component is made up of excess supply equations. Goods produced in different countries are assumed to be perfectly homogeneous, and world markets are treated as a single arbitrage mechanism of excess supplies. All markets influence prices throughout the

model, that is, price changes occurring in one market are always transmitted to all the others. The closure rule is defined by the sum of the excess supplies in all markets, which have to add up to zero. The solution generates countries' net trade positions, but it does not include information on bilateral trade flows.

A popular alternative to this approach in the trade component is the so-called Armington assumption, which is based on the idea that substitutability between domestic and foreign products in each market is less than perfect. Francois and Hall (1997) offer a simple treatment of this approach within a PE setting. This assumption allows the endogenous generation of bilateral trade flows, so that the market clears through the sum of total exports and total imports in the model.

The possibility of generating endogenously bilateral trade flows is indeed a very important feature of the model in the exercises aimed at analysing discriminatory trade policies, such as preferential trading schemes, or any other provision which does not apply multilaterally. Hence the popularity of the Armington approach, whatever its limitations. An extensive discussion of the limitation of this approach and of the models capable of handling satisfactorily bilateral trade and discriminatory policies may be found in Anania (2001).

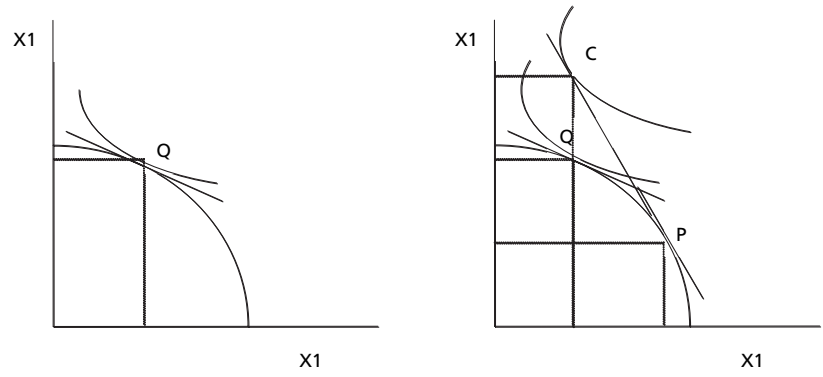
12.3.2 An introduction to general equilibrium (GE) models

The basic structure of a GE model can be described through blocks of relations dealing with production, consumption, factors market, savings/investment and the balance of payments. Basic references for this modelling approach are in Ginsburgh and Keyzer (1997) and Devarajan *et al.* (1997). De Muro and Salvatici (2001) offer a useful review of the different types of models within this approach, highlighting relevant matters related to its potential and actual uses in the analysis of agricultural and trade policy.

GE models are characterized by the fact that they take into account all activities and institutional entities (such as households, government and firms) without assuming absence of feedback effects for any of them within the economy. In principle, this characteristic is totally independent from the details included in the model: even if it is formulated for one single good, one producer and one consumer, these will be representative of the entire economy.

A very basic representation can be provided with the graph shown below, with reference to one consumer who is also a producer. Given an initial factor endowment which defines the production possibility frontier of goods X_1 and X_2, and the utility function parameters which define the structure of the indifference map, an autarky equilibrium is found in Q, where the indifference curve and the production possibility frontier are tangent to the isocost line. If we allow for trade (within a small, open economy setting), the represented country will have access to a consumption level of C, while

FIGURE 12.2
A general equilibrium model



producing in P, given exogenously-defined terms of trade, and will be trading the difference between these two points defined in terms of the two produced goods X_1 and X_2.

In more realistic settings, GE models include three sets of relations, determining real flows, expenditure and income, respectively. Moreover, equilibrium conditions make it possible to "close" the model, by defining endogenous and exogenous variables. A set of identities ensures that income does not exceed expenditure and equals that of the factors of production.

A very simple example, with only initial factor endowments and utility function parameter being exogenous (while all the rest is calculated by the model), is given in **Box 12.2** (adapted from Magnani and Perali, 2002).

In their more standard setting, GE models are solved by imposing the equilibrium condition in all markets, following the so-called Walras law. It is important to highlight that the closure rule acquires a fundamental meaning, which is that of defining the beliefs of the analyst on the ultimate mechanism that regulates the economy. A "neo-classical" closure will therefore attribute a propulsive role to savings, and assume that the level of investment varies to ensure equivalence between the two. A "Keynesian" closure, instead, will permit the existence of unemployment, and ensure equilibrium through its presence with an endogenous labour demand. In other exercises, in which a decisive role is attributed to investment, these will be adjusted to savings, and consumption will be determined by sales. In other exercises, it is assumed that factors of production are not paid for according to their marginal productivity, and equilibrium is achieved through a redistribution of income, which influences the savings rate. By representing the entire economy, therefore, GE models make all assumptions more explicit.

BOX 12.2

The basic structure of a general equilibrium model

Production

Goods – sectors	*Production function*
agriculture	XSagr = f (L, K)
textiles	XStex = f (L, K)

Consumption

Agents	*Utility function*
rural	Urur = f (Xagr, Xtex)
urban	Uurr = f (Xagr, Xtex)

Factors of production

	Endowments
labour	L = L
capital	K = K

Variables

endogenous		***exogenous***	
p_i	price of good *i*	L^S_h	Labour endowment of consumer *h*
w	wage	K^S_h	Capital endowment of consumer *h*
r	Return to capital	a_{hi}	Utility function parameter
X^S_i	Supply of sector *i*		
$_hX^D_i$	demand for *i* of consumer *h*		
$_DL_i$	Labour demand of sector *i*		
$_DK_i$	Capital demand of sector *i*		
Y^h	Income of consumer *h*		

The trade component can be specified either as a residual of the domestic market – which is especially the case in those exercises involving one country where the small, open economy assumption is often adopted – or through an Armington structure, as for PE frameworks. The Armington has gained popularity in GE modelling also.

In order to become "computable", general equilibrium models (the common acronym is CGE) require:

- a database describing the flows of resources in the economy, at the level of aggregation considered in the model; and
- a set of parameters for the behavioural relations of the model.

BOX 12.2
Continued

Equations

real flows

$X^S_i = f({}_D L_i, {}_D K_i)$ supply of good i

$w = (\partial X^S_i / \partial X_i {}_D L_i)\, p_i$ labour demand

$r = (\partial X^S_i / \partial X_i {}_D K_i)\, p_i$ capital demand

expenditure

${}_h X^D_i = a_{hi} (Y^h / p_i)$ demand for i

equilibrium conditions

$X^S_i = \sum_h {}_h X^D_i$ demand equals supply

$\sum_i {}_D L_i = \sum_h L^S_h$ demand for labour equals labour endowment

$\sum_i {}_D K_i = \sum_h K^S_h$ demand for capital equals capital endowment

income flows

$Y^h = w\, L^S_h + r\, K^S_h$

identities

$P_i\, X^S_i = {}_D L_i\, w + {}_D K_i\, r$

$Y^h = \sum_i {}_h X^D_i\, p_i$

Adapted from Magnani and Perali (2002).

The database on which a CGE is based is known as Social Accounting Matrix (SAM): it is a consistent set of accounts describing resource flows between consumers, producers, the government and foreign economies.

Parameters can be obtained through calibration or estimation. In the latter case, once the database to be employed as a benchmark equilibrium for the economy has been constructed, the model will be solved in "reverse" mode, so that the solution will determine the values of the parameters that are compatible with the known values of the exogenous variables, and of the endogenous variables of the benchmark equilibrium. Given that the benchmark period is normally represented by one observation – either the

reference year or some average of a few years – it is clear that the calibration procedure generally does not make it possible to assess the statistical reliability of the parameters obtained.

To avoid this problem one solution is the estimation of parameters, which involves calculating them through econometric techniques. While desirable, this is usually unfeasible. Firstly, the average size of a CGE model implies the need to estimate a high number of parameters, which increases with the number of sectors and households considered. In turn, this implies that a large number of consistent observations must be available, especially if parameters are to be estimated simultaneously. Separate estimations for model blocks – such as one for production, one for demand, or one for each product – still would not take into account all the equilibrium conditions considered in the model.

12.3.3 Which model is better?

Compared to the PE approach, the GE approach removes one major simplifying assumption. In fact, when some activities are excluded from the analysis, it is assumed that what happens in one activity does not affect demand and supply in the sectors that are considered. This also applies to the factor market, which is seldom included in the PE models employed in *ex ante* analysis of policies for agricultural products. The extent to which this is an acceptable assumption defines the extent to which a PE analysis can be suitable for a particular problem at hand. The possibility of including a higher level of detail, which has frequently been considered as a driver of the choice in favour of PE models – tends to be an increasingly misplaced argument, since the power of computational tools seems not to prevent the specification of relatively large-size models.

Instead, it is a question of the focus of the analysis. In general terms, PE and GE models fare better at representing redeployment of resources than at capturing productivity and growth. If the aim is to understand changes in agricultural supply and demand, a PE framework can provide useful answers, especially if the analysis includes many policy details. If the focus is more general, and answers have to be provided in terms of changes in income, factor allocation or distributional consequences, then the model must address the linkages between trade and these aspects, and a GE appears more appropriate. In this respect, a GE approach may be a more effective choice when analysing issues in which it is important to highlight the existence and the effects of a general "budget constraint" in the economy, so that changes in the resource allocation imply significant feedback effects to be taken into account; and when considering the second-round effects of policy changes.

Dealing with these aspects within a GE framework requires:

- more data to be assembled and made coherent;

- more parameters to be either estimated or derived through calibration; and
- more explicit hypotheses on the functioning of the economy and on all markets represented.

Moreover, given that an accurate representation of all these aspects usually requires an increase in the number of non-linear relations included in the models, a more complex representation may involve more difficulties in solving the model using standard algorithms.

In summary, "it may be difficult to justify devoting otherwise scarce resources to more complex and less transparent models, when they may yield only marginal extensions of the basic insights taken from simpler approaches" (Francois and Hall, 1997, p. 122). In fact, among the models employed in the analysis of agricultural policies GE approaches have been used more frequently in those cases in which agriculture forms a large share of the economy; and in those cases in which the focus is more on intersectoral effects rather than on the peculiarities of single products. However, in recent years, given the increased power of computers and the easier exchange of information among analysts, the use of GE models has become more common.

12.3.4 Where to begin?

As mentioned earlier, policy analysts around the world are benefiting increasingly from networking, and a number of initiatives have been undertaken aimed at sharing data, modelling codes and other resources that can contribute to lowering significantly the costs involved in starting quantitative trade policy analysis. Here we present some key networking experiences, with the aim of providing the reader with practical starting points. For PE models, reference will be made to a number of networking experiences, including those related to the Agricultural Trade Policy Simulation Model (ATPSM), jointly built by the United Nations Conference on Trade and Development (UNCTAD) and FAO; and to the Cosimo-AGLINK model, jointly developed by the Organisation for Economic Co-operation and Development (OECD) and FAO. Concerning GE models, reference will be made to the experience of the Global Trade Analysis Project (GTAP), which is probably the case in which networking has developed the most.

ATPSM

The Agricultural Trade Policy Simulation Model (http://r0.unctad.org/ditc/tab/atpsm.shtm) is a deterministic, comparative, static, partial equilibrium model of world agricultural markets, built by UNCTAD and FAO. The model and database are publicly available. The model is intended to serve as a tool for quantifying the economic effects at the global and regional levels of recent changes in national trade policies, and to analyse potential changes

that would result from future policy reforms in individual countries. It provides estimates of changes in trade volumes, prices and welfare indicators associated with changes in trade policies.

Domestic supply and demand equations are specified as functions of farm and wholesale prices (respectively) in proportional terms, allowing for cross-effects in production and substitution in consumption. Export supply is proportional to production, while imports are derived as a residual of the domestic market. The trade component of the model is essentially a residual of the domestic markets, and therefore the model can be employed to compute changes in the net trade positions of the countries. Concerning policies, the model includes *ad valorem* tariff equivalents, export subsidies and the domestic subsidy component which exceeds trade protection, in order to avoid double counting the trade-distorting effect. Where tariff-rate quotas are implemented, the domestic price is computed on the basis of the out-of-quota tariff.

Given the nature of the trade component, the model has been used mainly to study the impact of multilateral trade agreements; a recent application is in Poonith and Sharma (2004). The results are easily accessible, and the associated software is particularly simple and intuitive (an Excel version is also available), which also facilitates its use in capacity-building.

AGLINK and Cosimo-AGLINK

AGLINK is a partial equilibrium dynamic model of world agriculture built by the OECD Secretariat in cooperation with its member countries and a number of independent consultants. Results, which are generated on the basis of member-country responses to questionnaires, are employed in the preparation of the OECD *Medium-term Outlook*, the periodical reporting the medium-term forecasts on the market development for main agricultural commodities in OECD countries and their main trading partners. The model was also used for several policy experiments run by the OECD Secretariat. The model assumes perfect competition in all markets, and perfect homogeneity for products from different countries. For most products and countries, trade is the residual of the domestic market, and therefore the model does not generate bilateral flows. AGLINK is very rich in the representation of policies; it explicitly takes into account tariffs, export subsidies, domestic subsidies and taxes, and complicated mechanisms like floor prices and tariff-rate quotas. The model is available to the OECD and a network of authorized co-operators.

Cosimo is a partial equilibrium dynamic agricultural model, built as a complement to the AGLINK model of the OECD[176]. The two models can be solved simultaneously, and Cosimo contains both the countries and regions included in AGLINK, plus the details for countries which were originally

[176] See http://www.fao.org/docrep/meeting/009/J4756e.htm.

included in the "Rest of the World" region of AGLINK. Like AGLINK, Cosimo is aimed at generating medium-run market outlooks (jointly published by FAO and the OECD) and at conducting policy simulations.

Cosimo was developed by considering a slightly different product space than AGLINK, reflecting the production and consumption mixes of the countries involved. The product structure of the model is flexible, based on a number of aggregated products for which market clearing conditions are specified, which are made up of different individual products specific to each country module. Therefore, for instance, the aggregate "coarse grains" might be made up of maize, barley and sorghum in one country, while it may include millet and oats in another country.

Concerning policies, the model includes both bound and applied *ad valorem* tariffs in the price transmission equations. Other policies considered are some of the more important tariff rate quotas (TRQs), through conditional statements; intervention prices, which are also introduced as conditional statements; and direct payments, which are modelled as subsidies affecting the returns per hectare in the land allocation system.

Parameters are derived from a number of sources, including available estimates from the literature (particularly from the World Food Model, the Food and Agricultural Policy Research Institute (FAPRI) and the USDA model), calibration through the constraints imposed on the system, ad hoc estimation and model validation with historical simulation. All are checked and validated by specialized commodity analysts.

Cosimo is currently employed to produce the medium-term outlooks on key agricultural markets, within a joint exercise with the OECD Secretariat, and is not publicly available. However, databases on which the model is based are available from the OECD website, and the working group of the Commodities and Trade Division of FAO can be contacted to verify the possibility of extending/detailing the model for some regions, and of running particular policy simulation experiments. Being essentially a net-trade model, Cosimo is more suited for analysing phenomena that involve the global markets and non-discriminatory policies, such as MFN tariffs reductions, and less suitable for analysing discriminatory policies, such as preferential trade schemes.

The Global Trade Analysis Project (GTAP)

The GTAP (https://www.gtap.agecon.purdue.edu/) was launched in the 1990s with the idea of building a global general equilibrium model and database for analysing trade policies. The initiative gradually evolved into a worldwide network of paying users, sharing a common starting point in global general equilibrium analysis. The database and the associated standard models are available for a fee, which varies according to the degree of participation in the project.

The GTAP was initiated by Purdue University in the United States, in cooperation with other research institutions around the world, which formed a consortium. The project has developed considerably over the years, due in part to the active participation of a large pool of institutions which includes, among others, the World Bank, the WTO, UNCTAD, FAO, the International Food Policy Research Institute (IFPRI), the Massachusetts Institute of Technology, and a large number of national agencies. Several very influential analyses have been carried out on the basis of the database and the associated model.

The GTAP standard model is a perfectly competitive, comparative, static, general equilibrium computable framework (Hertel, 1997). A standard dynamic version has been made available recently. The structure of demand and supply, which is homogeneous across regions and products, is built upon the social accounting matrices of individual countries and regions, while parameters are drawn mostly from the literature and calibrated on the reference database period. The model assumes the presence of representative consumers and producers together with a government sector, and all incomes are assumed to accrue to a single "regional" household. Therefore, all distributional aspects are overlooked, and all consumers are assumed to purchase all goods. By the same token, government costs and revenues do not need to balance, as it is assumed that any discrepancy accrues directly to the households (i.e. the single "regional" household). Government's consumption behaviour is endogenous, while policies are exogenous (Hertel, 1997).

Substitutability among primary factors and with intermediate consumption is modelled through a set of nested constant elasticity of substitution systems, while the production of final goods is aggregated through a fixed coefficient function of the Leontiev type. On the demand side the representative agent allocates his or her income among savings, government and private consumption through a Cobb-Douglas utility function, while allocation within different private goods is modelled through a constant difference of elasticity demand system. Bilateral trade flows are modelled through product differentiation on the demand side, with the assumption of imperfect substitutability between similar goods produced in different countries and regions. Transaction costs are also accounted for in the model, as transport services are explicitly considered among the activities in the economy. The standard model adopts the Walrasian closure rule, by which investment at the global level is adjusted to global savings, and the balance of payments is endogenous in individual countries and regions.

The most recent publicly available database version (Version 6) includes data on up to 92 regions and countries, 57 industries and 5 endowments, and refers to year 2001 as a base period. In general, there are two groups of data which are of particular relevance for global models: those on border protection and those on bilateral trade flows. The GTAP database is built

from the COMTRADE data, supplied by the United Nations Statistical Office, through an ad hoc reconciliation procedure based on a reliability indicator of the information supplied by each importing and exporting country. Trade policy data are retrieved from the MacMaps database (Bouët *et al.*, 2001), while data on domestic support in agriculture is based on the OECD and USDA producer support estimates. Export subsidies are directly derived from countries' notifications to the WTO.

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Appendix 12.1

Glossary of trade terminology[177]

***AD VALOREM* TARIFF**	A tariff calculated on the value of the dutiable item and expressed as a percentage of the value of goods; for example, 10 percent *ad valorem* means 10 percent of the value of the entered merchandise.
AGREEMENT ON AGRICULTURE (AoA)	A WTO agreement establishing rules and commitments to ensure a fair and market-oriented system for trade in agricultural goods and products. The Agreement on Agriculture consists of rule-based commitments to reduce protection and support of agricultural goods and products over a specified implementation period. The Uruguay Round of Agreement on Agriculture signed in 1994 was the first major international agreement on agriculture.
AGREEMENT ON RULES OF ORIGIN	A WTO agreement addressing the rules that determine the country of origin of an imported product. Usually applicable among members in a Free Trade Agreement. A decision by a customs authority on origin can determine whether a shipment falls within a quota limitation, qualifies for a tariff preference or is affected by an anti-dumping duty.
AGREEMENT ON SUBSIDIES AND COUNTERVAILING MEASURES	The agreement permits signatories to impose specific duties on imports to offset – or "countervail" – the benefits of subsidies to producers or exporters provided by the government of the exporting country.

[177] This glossary draws some of its definitions from the following sources: FAO, UNCTAD, USAID and World Bank.

APPLIED TARIFF	The tariff actually applied by a country at its border. When the country belongs to WTO, applied tariffs respect the ceiling defined by the *bound tariffs* agreed upon (MFN rates). Many countries actually apply tariffs lower than MFN rates. A larger set of countries applies tariffs lower than MFN under preferential agreements (free trade agreements, system of generalized preference, preferential access for certain countries or regions, special agreement with developing countries, etc.). Applied tariffs also include the lower-than-MFN tariffs agreed upon in the WTO framework that are applied within tariff rate quotas (called, in general, the "in-quota tariffs").
ARBITRATION	An arrangement through which two parties to a dispute agree to the appointment of an impartial chairperson or a group of competent persons to decide the disputed issue and agree in advance to abide by the decision rendered.
BALANCE OF PAYMENTS	The difference between the funds received by a country and those paid by a country for all international transactions.
BALANCE OF TRADE (BOT)	The value of a country's exports minus the value of its imports.
Base tariffs	The base tariffs were the 1995 MFN tariffs, which had to be decreased over the implementation period of the Uruguay Round agreement. A number of developing countries were free to decide the base tariff on which the reduction commitments were applied. The resulting tariff is called the **bound tariff**, i.e. a ceiling tariff at the end of the implementation period (2005).
Binding overhang	Expression used when a country has set a **bound tariff** at a level higher than the tariff applied in practice (often, in order to maintain a margin for a possible increase in **applied tariff** up to the bound tariff).

Border price	Can be based on **FOB** (free on board) or **CIF** (cost, insurance and freight) prices. FOB are usually adopted for export values, while CIF values are usually adopted for imports.
BOUND TARIFF (BINDING)	Maximum tariff rates resulting from GATT negotiations that are incorporated into a country's schedule of concessions and enforceable as an integral element of the WTO regime. Binding is a provision in a trade agreement that no tariff rate higher than the rate specified in the agreement will be imposed during the life of the agreement.
CAIRNS GROUP	A group of agricultural-exporting nations established to develop a common negotiating position for the Uruguay Round. It comprises Australia, Argentina, Brazil, Canada, Chile, Colombia, Fiji, Hungary, Indonesia, Malaysia, New Zealand, the Philippines, Thailand and Uruguay.
CARIBBEAN BASIN INITIATIVE (CBI)	A preferential trading arrangement that came into effect on 1 January 1984 and provided several tariff and trade benefits to many Central American and Caribbean countries exporting into the United States market.
CIF	A commercial term meaning that the selling price includes all "costs, insurance and freight" for any goods sold. The seller arranges and pays for all relevant expenses involved in shipping goods from their point of exportation to a given point of importation.
COMMON AGRICULTURAL POLICY (CAP)	A system of EU agricultural subsidies and levies. These subsidies work by guaranteeing a minimum price to producers and by direct payment of a subsidy for particular crops planted.
COMMON EXTERNAL TARIFF (CET)	A tariff rate uniformly applied by member countries of a common market or customs union, such as the European Community, to imports from countries outside the union.

COMPETITION POLICY	Legislation and regulations designed to protect and stimulate competition in markets by outlawing anti-competitive business practices such as cartels, market sharing or price fixing.
COMPOUND TARIFF	A combination of an *ad valorem* tariff plus a specific tariff. Also called a "mixed tariff".
Current access	The 1994 Marrakech (Uruguay Round) Agreement on Agriculture specified that after tariffication, current market access (i.e. the level of imports that existed during the reference period) had to be maintained or increased. For some countries, this was achieved by the opening of tariff rate quotas, called "current access" quotas (as opposed to quotas open under **minimum access**).
CUSTOMS UNION	A group of countries that adopt free trade (zero tariffs and no other restrictions on trade) on trade among themselves, and that also agree to levy the same tariff (on a given product) on imports from outside the group.
De Minimis	In the WTO Uruguay Round Agreement on Agriculture this refers to the rules permitting exemption of notification of assistance from Aggregate Measurement of Support (AMS), related to domestic subsidies - if that support is below a certain threshold - the total must make up no more than 5% of the total value of agricultural production of that product or where it is not product specific, it should not be more than 5% of the value of agricultural production -for developed countries. The values are 10% for developing countries.
Dirty tariffication	Tariffication is the conversion of non-tariff barriers that existed for agricultural products before the Uruguay Round into tariffs meant to bring an equivalent level of protection. Some countries, however, are said to have set base tariffs at a level higher than the one actually provided by the measures they replaced. This practice is called "dirty tariffication".

EFFECTIVE TARIFF RATE	The concept that "effective tariff" protection for a product depends on tariff and other non-tariff barriers on both its inputs and outputs.
ENABLING CLAUSE	Enables WTO members to accord "special and differential treatment" to developing countries, without according such treatment to other contracting parties.
EXPORT SUBSIDY	The incentives paid by the government to an exporter based on the quantity of commodity exported.
Fill rate	The proportion of imports during a given year, relative to the commitment in terms of import quantity as defined by the **tariff rate quota (TRQ)**.
FOB	The "free on board" price of a product, that is, after loading onto a ship but before shipping, thus not including transportation, insurance and other costs needed to get the product from one country to another.
FREE TRADE AREA AGREEMENT	An agreement between two or more countries to eliminate tariff and non-tariff barriers on trade among themselves, while each participating country applies its own independent schedule of tariffs to imports from countries that are not members of the agreement.
GENERALIZED SYSTEM OF PREFERENCES (GSP)	The GSP is a system through which industrialized high-income countries grant preferential access (mostly lower tariffs) to their markets to developing countries.
HARMONIZED SYSTEM (HS)	A complete product classification system developed by the International Customs Organization that is organized in a particular framework and that employs a numbering or coding system consistent with its organizational arrangement. For example HS 2002 has 97 codes for all merchandise products at the most aggregated level of product grouping.

IMPORT-SENSITIVE PRODUCTS	See **sensitive products**
IMPORT QUOTAS	Import quotas are quantitative restrictions that control the amount or volume of various commodities that can be imported into a country during a specified period of time.
INTERNATIONAL/ WORLD PRICE	Represents what the commodity can earn as an export or what it costs to the economy as an import. It is the (foreign) opportunity cost for a country for a particular commodity.
LINEAR REDUCTION OF TARIFFS	A reduction by a given percentage in all tariffs maintained by countries participating in a round of trade negotiations.
MARGIN OF PREFERENCE	The difference between the duty payable under a given system of tariff preferences and the duty that would be assessed in the absence of preferences.
MARKET ACCESS	The conditions that govern the entry of foreign goods into a domestic market. The extent to which the foreign market is accessible generally depends on the existence and extent of trade barriers, including tariff and non-tariff barriers.
MINIMUM ACCESS	The WTO Marrakech Agreement specified that, for developed countries, starting in 2001, access to domestic markets had to be open to imports for up to 5 percent of the domestic consumption over the period 1986–1988. For countries that still maintained high tariffs, this was achieved by the opening of tariff rate quotas. These quotas are called "minimum access quotas".
MOST-FAVOURED NATION (MFN) TREATMENT	The policy of non-discrimination that applies to all WTO members, providing all WTO trading partners with the best customs and tariff treatment given to any other partner.
MULTILATERAL AGREEMENT	An international compact involving three or more parties.

MULTILATERAL TRADE NEGOTIATIONS (MTN)	Negotiations held under the auspices of the GATT from 1947 to 1994 and thereafter of the WTO, aimed at mutually beneficial agreements for reducing barriers to world trade.
NOMINAL TARIFF RATE	The rate of duty charged on the gross value of a given product, rather than on the value of its components (i.e. inputs and outputs). Contrasts with **effective tariff rate**.
NON-TARIFF BARRIERS (NTBs)	Measures other than tariffs that restrict imports or that have the potential for restricting international trade. These include quotas, licensing and voluntary export restraints.
NOTIFICATIONS	GATT rules specify that, under the obligations of transparency, member countries must notify as to the way they fill their obligations and implement their commitments under the market access provisions. A set of documents is submitted to the WTO on a regular basis. It includes modifications in the Schedules, the way tariff rate quotas are filled and administered, etc.
PREFERENCES	Special advantages extended by importing countries to exports from particular trading partners, usually by admitting their goods at tariff rates below those imposed on imports from other supplying countries.
PROGRESSIVE TARIFF	See **tariff escalation**
PROTECTION	Government measures including tariff and non-tariff barriers that raise the cost of imported goods or otherwise restrict their entry into a market and thus strengthen the competitive position of domestic goods.
PROTECTIONISM	The policy of restricting imports through measures such as tariffs, quotas, etc. in order to protect the domestic producers of the product.
QUOTA FILL RATE	Describes the proportion of imports, during a given year, under a committed and notified quota amount.

RECIPROCITY	The practice by which governments extend similar concessions to each other, as when one government lowers its tariffs or other barriers in exchange for equivalent concessions from a trading partner on barriers affecting its exports (a "balance of concessions").
RETALIATION	The suspension of concessions or other obligations under a trade agreement, or the imposition of other barriers to trade, by a government in response to the violation of a trade agreement or the imposition of other unfair trade barriers by another government.
RULES OF ORIGIN	See Agreement on Rules of Origin.
Safeguards	The Marrakech Agreement on Agriculture allows for special temporary safeguard mechanisms for products subject to **tariffication**. They are imposed if increase in volume or drop in import prices exceed certain trigger levels.
SANITARY AND PHYTOSANITARY MEASURES (SPS)	Measures applied to ensure food safety and protection of human or animal health.
SCHEDULES	The official tariff commitments for WTO members are specified in the Schedules, which are legally binding documents defining the **bound tariffs** (**MFN**) for a list of commodities.
SENSITIVE PRODUCTS	In trade negotiations and agreements, countries often identify lists of particular sensitive products that they regard as especially vulnerable to import competition and that they wish to exempt from trade liberalization.
SPECIAL AND DIFFERENTIAL TREATMENT (SDT)	The principle that developing countries should be given favourable treatment such as preferential access to markets of developed countries and that developing countries participating in trade negotiations need not fully reciprocate concessions they receive.

SPECIFIC TARIFF	A customs duty assessed as a stated monetary amount per unit of physical quantity, such as US$1000 on each imported vehicle or US$50 on each metric ton (tonne) of wheat.
STANDARD INTERNATIONAL TRADE CLASSIFICATION (SITC)	A classification of goods to enable comparison between countries and for reporting trade. It was established by the International Customs Organization and is similar to the HS nomenclature (see harmonized system).
TARIFF	Customs duties on merchandise imports. Tariffs can be levied either on an *ad valorem* basis (percentage of value) or on a specific basis (e.g. US$10 per 100 kg), or on both forms simultaneously for the same tariff line.
TARIFF CUT DILUTION	The Marrakech Agreement specified that tariffs had to be reduced by a given average (36 percent for developed countries) over the implementation period. The term "tariff cut dilution" refers to the fact that many countries have reached this objective by higher percentage cuts on less politically sensitive tariffs, and minor cuts (often 15 percent) on more sensitive products.
TARIFF ESCALATION	Tariffs increasing with the degree of processing. It occurs when tariffs on processed forms of a commodity are higher than the tariffs on the primary form of the commodity.
TARIFF PEAKS	Very high (often prohibitive) tariff lines, significantly higher than the average.
TARIFF-RATE QUOTA or TARIFF QUOTA (TRQ)	A combination of an import tariff and an import quota in which imports below a specified quantity enter at a low (or zero) tariff and imports above that quantity enter at a higher tariff.

TARIFFICATION	Tariffication is the conversion of non-tariff barriers that existed for agricultural products before the Uruguay Round into tariffs meant to bring an equivalent level of protection. During the tariffication process, developed countries used current bound rate for products that were previously bound. In the case of developing countries, if the tariff was previously unbound, the country could offer a ceiling binding.
TECHNICAL BARRIERS TO TRADE (TBT)	Technical regulations or standards such as testing requirements, labelling requirements, packaging requirements, marketing standards, certification requirements, origin marking requirements, health and safety regulations, and sanitary and phytosanitary regulations that restrict trade flows.
Terms of trade	Usually refers to the relationship between the average price of a country's exports and the average price of its imports. It indicates the relative profitability of exports *vis-à-vis* exports.
WATER IN THE TARIFF	When used in generic terms, refers to a situation when a cut in the tariff will not lead to an effective increase of market access and covers the cases of binding overhang, large preferential margins and prohibitive tariffs. In more restrictive terms the expression implies a difference in tariff rate levels between applied and bound tariffs. (For example, if applied tariff on a product is 20 percent and the bound rate on the same product is 100 percent, the water in the tariff is 80 percent.)

Appendix 12.2
Trade data bases

FAOSTAT TradeStat

FAOSTAT is an agricultural information data base maintained by the Food and Agriculture Organization of the United Nations (FAO). It provides access to over 3 million time-series and cross sectional data relating to food and agriculture. FAOSTAT contains data for 200 countries and more than 200 primary products and input items. The core thematic areas around which the FAOSTAT database is organized are agricultural **production**, **consumption**, **trade**, **prices** and **resources**.

FAOSTAT has several different modules, including TradeStat, PriceStat, ProdStat, ResourceStat, AquaStat, FIGIS, **Food Security Stat** and CountryStat.

The new FAOSTAT **TradeSTAT** module contains agricultural trade data from 1986 to 2005. The agricultural trade data are detailed official data, provided electronically (CD-ROMs, etc.) by over 100 countries/ territories on an annual basis. The national commodity classification (usually the Harmonized System) is converted to the FAO commodity classification to cover over 600 food and agriculture commodities. All trade data displayed is converted (standardized) from detailed trade (including transformed commodities) into primary equivalents. TradeStat can be accessed from the main FAOSTAT Web page or directly at http://faostat.fao.org/site/534/default.aspx .

The main uses of the FAOSTAT TradeStat data base are to download data series on primary equivalent food and agriculture exports and imports in terms of quantity, unit price, value, agricultural trade shares and net trade for comparative analysis across countries and time, and importantly for use with other analytical approaches/tools.

WORLD INTEGRATED TRADE SOLUTION (WITS)

WITS is a widely used "hub" that contains a number of important trade and trade policy databases and analytical tools. Its notable features include wide geographic (number of countries), period (times series data) and product (all merchandise products) coverage. WITS is a free software. However, access to its databases can be fee-charging depending on user status. For more information, see http://wits.worldbank.org/witsweb/Faq/default.aspx.

The following are the databases and analytical tools available in WITS:

COMTRADE: Global merchandise trade flows including agricultural flows are contained in this database. It has information on exports, imports and re-exports (quantity and value) for more than 140 countries. Useful for seeking data on, for example, main exported commodities, main suppliers of these commodities and main importers of these commodities. Information can be obtained for a number of internationally recognized trade and tariff classifications such as SITC, ISIC, MTN and HS. The HS (Harmonized System) classification is the most common and data for products can be obtained at the 2-, 4- and 6-digit level (2 digits is the most aggregated level of a product group while 6 digits is a highly disaggregated level). The time series data availability goes back as far as 1962 for some countries.

TRAINS: Trade Analysis Information System (TRAINS) contains information on imports, applied tariffs, para-tariffs and non-tariff measures for 119 countries. The data on applied tariffs, para-tariffs and non-tariff measures are available at the most detailed commodity level of the national tariffs (i.e. at the tariff line level). The data are recorded according to three internationally recognized trade and tariff classifications. Optional information includes *ad valorem* equivalents of specific, mixed and compound duties and preferential duties.

IDB and CTS: The Integrated Data Base (IDB) contains imports by commodity and partner country and MFN applied tariffs for over 80 countries at the most detailed commodity level of the national tariffs and the **Consolidated Tariff Schedule** (CTS) data base contains chiefly WTO bound tariffs. The CTS is the official source for bound tariffs, which are the concessions made by countries during a negotiation (e.g. the Uruguay Round of multilateral trade negotiations). The data are recorded according to two internationally recognized trade and tariff classifications.

AMAD: The Agricultural Market Access Database (AMAD) contains information on tariffs (bound and applied) and tariff rate quotas (TRQs) (scheduled quantities, country allocations, out-of-quota and in-quota tariff rates). It also contains supplementary information on imports (volumes and value), supply utilization, world unit values and exchange rates. The coverage of countries in it is lower than the WTO CTS and TRAINS databases. However, its most important contribution is the information on TRQs. It is freely available at www.amad.org.

SMART: The System of Market Analysis and Restrictions on Trade (SMART) is one of the analytical tools in WITS for simulation purposes. SMART is a

simulation model containing in-built analytical modules that support trade policy analysis such as effects of multilateral tariff cuts, preferential trade liberalization and ad hoc tariff changes. The underlying theory behind this analytical tool is the standard partial equilibrium framework that considers dynamic effects constant. Like any partial equilibrium model, it has the strong assumptions allowing the trade policy analysis to be undertaken a country at a time. WITS/SMART can help estimate trade creation, diversion, welfare and revenue effects.

MARKET ACCESS MAP (MacMap)

Market Access Map is an interactive database of tariffs and market access barriers. It contains the market access conditions applied at the bilateral level by over 170 importing countries to the products exported by over 200 countries and territories. Market Access Map's strength lies in its wide geographical coverage; its taking into account of almost all multilateral, regional and bilateral trade agreements; the integration of *ad valorem* equivalents of specific tariffs; as well as certificates and rules of origin. Market Access Map allows users to analyse the protection of any geographic grouping and sectoral aggregation. It also offers the possibility of simulating tariff reductions using various negotiation formulae. Developed by ITC in collaboration with CEPII, UNCTAD and WTO, Market Access Map aims to enhance market transparency, support international trade promotion and facilitate the analysis of related trade policy issues. Market Access Map is available online at www.macmap.org. The ITC software is available to the public but only against a contribution that is used to fund the ongoing data and software development work.

ECONOMIC RESEARCH SERVICE (USDA)

A useful source for information on trade policies viz., domestic support and export competition is the Economic Research Service (ERS) of the United States Department of Agriculture (USDA). The publicly available free Web site (**http://www.ers.usda.gov/db/wto/)** contains information on domestic support (expenditure on aggregate measurement of support (AMS), Green Box, *de minimis*, etc.) and export subsidies (quantity of subsidized exports and expenditure on export subsidies) as notified by WTO members.

CARIBTRADE

CARIBTRADE is a merchandise trade and transportation database maintained by the Economic Commission for Latin America and the Caribbean (ECLAC) Subregional Headquarters for the Caribbean. Apart

from answering queries on direction of trade, the database provides analysis options through indicators listed on the site that enable the evaluation of recent trends in trade and in the performance of items traded. Access to the database at the Web site (http://celade.eclac.cl/redatam/CARIBTRADE/index.html) has been designed at two levels. The first level of access accommodates the queries of a wide variety of users and is provided up to the third digit of the SITS Rev. 3 and HS classifications. Another level of access is accorded to a limited number of personnel at national level. The chief statisticians of the contributing countries have access to their data at the most disaggregated level of data supplied. Researchers wishing the use of data at a lower level of disaggregation than 3 digits may contact the chief statisticians of the countries for that level of data. The database contains external trade and transportation statistics for 16 Caribbean countries. The data series begins in 1995 and extended to 2003 (at the end of 2005). The countries whose data are included in the present database are: Anguilla, Antigua and Barbuda, Aruba, Barbados, Belize, British Virgin Islands, Dominica, Grenada, Guyana, Jamaica, Montserrat, the Netherlands Antilles, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago.

FREE TRADE OF THE AMERICAS

HEMISPHERIC TRADE AND TARIFF DATABASE

The information in the Hemispheric Trade and Tariff Data Base for Market Access consists of **n**ational customs tariffs based on the Harmonized System (HS) at the most detailed tariff line level, with corresponding product description. For each tariff line, the following information is available, as applicable: MFN applied tariff rates; preferential tariff rates and the countries to which they apply; tariff lines for which agricultural tariff rate quotas (TRQs) may apply; and agricultural exports for which export subsidies may apply; import and export statistics by partner country, in value and volume, at the most detailed level of the national custom tariff. The data in the data base are compiled by the Inter-American Development Bank from the official submissions by countries participating in the FTAA initiative. The data base is updated on an annual basis with tariffs available in the second quarter and trade flows in the fourth quarter of each year. The data base can be accessed at http://www.ftaa-alca.org/NGROUPS/NGMADB_e.asp.

EUROPEAN COMMISSION HELP DESK FOR DEVELOPING COUNTRIES

The Export Helpdesk is an online service, provided by the European Commission, to facilitate market access for developing countries to the European Union. It can be found at **http://exporthelp.europa.eu**.

The Web site covers the following categories:

- The **requirements and taxes** section enables users to get access to detailed information on EU and member countries' import requirements as well as internal taxes applicable to products.
- The **import tariffs** section enables users to get access to detailed information concerning import tariffs and other measures that apply to a particular product.
- The **customs documents** section provides information concerning the documents to be produced by an exporter in order to qualify for preferential duty treatment under the different trade regimes available for developing countries.
- The **rules of origin** section provides information on the conditions that need to be met for goods to qualify for advantageous tariff treatment under the GSP and ACP systems.
- The **trade statistics** section provides detailed trade statistics covering imports and exports for the 25 EU member countries collectively and individually, and intra-EU trade.

Appendix 12.3
Product nomenclatures and WITS utilities

Since 1988, OECD member countries provide data according to the Harmonized System (HS or more detailed classification). The *International Trade by Commodity database* of OECD stores data in HS. Data are then converted to different nomenclatures using a correlation table.

The harmonized system (HS) is an international 6-digit commodity classification developed under the auspices of the International Customs Cooperation Council. Some countries have extended it to 10 digits for customs purposes, and to 8 digits for export purposes.

In the harmonized system goods are classified by what they are, and not according to their stage of fabrication, use or origin. The HS nomenclature is logically structured by economic activity or component material. For example, animals and animal products are found in one section; machinery and mechanical appliances (grouped by function) are found in another. The nomenclature is divided into 21 sections, while additional sections (i.e. Section 22 and 23) are used for country-specific special purposes. For example, South Africa uses Section 22 for items such as postal articles, ship stores and platinum and Section 23 for Original Equipment Manufacturer motor vehicle components.

Each of these sections group together goods produced in the same sector of the economy. Each section consists of one or more chapters, with the entire nomenclature being composed of 99 chapters. Some chapters are reserved for special purposes or future use. Chapters of sections I to XV (except section XII) are grouped by biological similarity or by the component materials from which articles are made. For those chapters in which goods are grouped by raw material, a vertical structure is used in which articles are often classified according to their degree of processing. For example, Chapter 44 contains items such as rough wood, wood roughly squared and some wooden finished products such as wooden tableware. Articles may also be classified according to the use or function. This classification (by function) mainly occurs in section XII and sections XVI to XXI. For example, section XVII contains chapters on motor vehicles (87), aircraft (88) and ships (89).

The Standard International Trade Classification (SITC) has been developed by the United Nations with the purpose of classifying traded products not only on the basis of their materials and physical properties, but also

according to their stage of processing and economic functions in order to facilitate economic analysis.

As SITC has been developed principally for statistical purposes, it has to maintain a correlation with the tariff nomenclature, given that customs declarations are the principal source of trade data. For this reason, SITC has undergone three revisions, to align itself with the development of the tariff nomenclatures.

The latest revision of SITC (Rev.3) establishes a correlation with the HS, while the previous revisions were related to BTN (SITC Rev. 1) and CCCN (SITC Rev. 2), respectively.

SITC Rev. 3 was adopted in 1988 and maintains the basic 10-section structure of the previous editions; the sections are subdivided into 67 two-digit divisions, 261 three-digit groups, 1 033 four-digit groups, and 3 118 five-digit headings.

A useful characteristic of WITS is that it makes it possible to work with different product classifications. Product classifications, or "nomenclatures", are ways of aggregating data for a specific purpose. (For example, the GTAP nomenclature aggregates trade data up to a level compatible with the input–output tables used to build the model.) The possibility of linking different nomenclatures is useful particularly in those cases in which more than one database, using different classifications, is required to obtain a complete data set.

WITS also allows for checking the composition of commodity classes when working with different nomenclatures. For instance, when working with a GTAP database, where aggregated data are based on the original HS nomenclature, we can check the WITS tool "Nomenclatures concordances" (accessible through "Help and Information") in order to find out which HS goods are included in the GTAP category of "paddy rice". The tool helps find the concordances between the GTAP code and the HS 2002 nomenclature. Under "paddy rice" we find two HS lines, paddy rice (100610) and husked rice (100620).

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Promoting **CARICOM/CARIFORUM** Food Security

FAO Trust Fund for Food Security and Food Safety – Italian Contribution

This book is largely a result of work implemented under the trade policy component of the project "Promoting CARICOM/CARIFORUM Food Security". The financial contribution of the Italian Directorate for International Cooperation to the FAO Trust Fund for Food Security and Food Safety funded the project. Italy's National Institute of Agricultural Economics (INEA) was actively involved in capacity-building activities under the trade policy component, particularly in organizing and carrying out training in the areas of trade policy analysis and negotiations and quality and safety requirements in international trade and marketing. The book examines various dimensions of trade policy and related issues of relevance to the countries in the CARICOM/CARIFORUM region and presents policy instruments to address trade and food security and rural development linkages. It will serve as a useful guide and reference document for agricultural trade policy analysts, trade negotiators, policy-makers and planners in both the public and private sectors.

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