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Accession to the WTO. Computable General Equilibrium Analysis: the Case of Ukraine

Igor Eromenko

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Abstract

This research studies the accession of a transition country to the World Trade Organization on the case of Ukraine. Quantitative results are obtained by building a Computable General Equilibrium model in the mathematical programming language General Algebraic Modelling System (GAMS). Four scenarios are simulated: 1) import tariffs reform; 2) improvement of exports access; 3) improvement of investment climate and 4) the scenario that combines previous three, or a full WTO accession. The results of the model show that in all scenarios there is growth of both exports and imports. By contrast, output and household consumption levels vary from scenario to scenario. The first two simulations, tariff reform and improvement of export access, show no significant change in domestic production and consumption. Thus, with expanded trade and practically the same output and consumption, Ukraine merely becomes more open and shifts to foreign trade. In the third scenario, improvement of investment climate has the most favourable results. Owing to better allocation of resources, both domestic production and consumption expand and the welfare of households increases by nearly 10% of consumption or 2% of Gross Domestic Product (GDP). The combined scenario shows a somewhat smaller but still significant improvement in welfare: over 8% of consumption or 1.8% of GDP.

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Chapter 1

Introduction

Ukraine has a very open economy and the role of the foreign trade sector is extremely important. The ratio of exports to GDP in Ukraine is around 60%, much higher than in many other countries. Despite this, Ukraine was one of the last large economies in the world that became a World Trade Organization (WTO) member.

The process of Ukraine's accession to the WTO system started in 1993, when the official application was submitted; later in 1994 a Memorandum on the Foreign Trade Regime of Ukraine was sent to the WTO Secretariat. Since that time until the end of 2007 sixteen Working Party meetings were held. Bilateral negotiations between Ukraine and WTO members started in 1997, fifty one countries had decided to conduct such negotiations; by the end of 2007 all protocols had been signed. In May 2008 Ukraine finally became a member of the WTO.

One possible reason for the slow accession process of Ukraine is the lack of a quantitative assessment of gains and losses from WTO membership. This uncertainty only amplifies fears of domestic producers of increased competition from abroad and the potential decline of their market share. This study aims to contribute to quantifying consequences of WTO membership for Ukraine.

WTO membership has an impact on all sectors of the economy and whilst modelling it, it is very important to capture inter-linkages between various economic agents. One of the most suitable approaches for this purpose is to build a Computable General Equilibrium model. This type of models is quite widely used for quantifying a variety of economic policy changes including international trade and WTO issues in particular and also called Applied General Equilibrium.

The model employed in this study is based on a standard general equilibrium framework, written in General Algebraic Modelling System (GAMS) software; it includes 38 sectors of the Ukrainian economy and 5 trade regions. Four scenarios are simulated in the model: 1) Change of import tariffs according to schedule, agreed with the WTO. 2) Improvement of export access for some industries. Being a WTO member, Ukraine should have instruments to curb antidumping and countervailing investigations, thus it will be able to increase volume of some exports. 3) Improvement of investment climate, which comes from two main sources: First of all, investors face fewer risks and costs of investment, since Ukraine should accept more pro-market regulation. Second, cost of capital should diminish along with lower prices for imports. This scenario is modelled via the recursive dynamics method. 4) Combined effect. This scenario includes decrease of import tariffs, improvement of exports access and improvement of investment climate. Scenarios 2, 3 and 4 include 3 sub-scenarios (least favourable; core and optimistic) with different rates of market access expansion and investment growth.

The results of the model show that in all scenarios there is growth of both exports and imports. By contrast, output and household consumption levels vary from scenario to scenario. The first two simulations, tariff reform and improvement of export access, show no significant change in domestic production and consumption. Thus, with expanded trade and practically the same output and consumption, Ukraine merely becomes more open and shifts to foreign trade. In the third scenario, improvement of investment climate has the most favourable results. Owing to better allocation of resources, both domestic production and consumption expand and the welfare of households increases by nearly 10% of consumption or 2% of Gross Domestic Product (GDP) in

the case of the core scenario. The combined scenario shows a somewhat smaller but still significant improvement in welfare: over 8% of consumption or 1.8% of GDP.

This study contributes to existing research in several ways.

First of all, there is a difference in the approach to modelling.

The model used in this research is written in the mathematical programming language General Algebraic Modelling System as a system of non-linear equations with explicit specification of functions and calibration of parameters. At the same time, most Applied General Equilibrium models are written in a subsystem for GAMS called Mathematical Programming System for General Equilibrium analysis (MPSGE). MPSGE is a library of functions that provides a compact non-algebraic representation of a model's nonlinear equations. There is no need to write model-specific functions and calibrate parameters; the modeller just has to specify the type of function.

Although MPSGE makes modelling easier, it has one significant drawback: this method hides the theoretical background and economic intuition behind the model and turns it into a “black box”. Thus, employing MPSGE may be more suitable for not-so-experienced users (such as policy-makers) or for building a model quickly, while explicit modelling of functions allows giving insight into the theory of the model and see its connection with its applied economic side. All CGE models known to the author that scrutinize accession of post-Soviet countries to the WTO (namely, Russia, Ukraine and Kazakhstan) use MPSGE; this model permits the opening of the “black box” of CGE analysis for these countries.

Next, having a quantitative assessment of Ukraine's accession to the WTO is useful for economists as scientists and for policy-makers in a more applied way.

Economist may find this research helpful for studying CGE as a branch of economic modelling. There are wide concerns about the dependence of CGE models on the specification of parameters, choosing functional forms and closure rules. Comparing results of this model with results of other similar models and studying differences in model formulation will lead to the shedding of some light on this problem.

Besides that, this model can be used as a basis for doing further CGE analysis. Scenarios can be changed and data rearranged to reflect other policy decisions either related to the WTO or going beyond this topic.

This model uses real data for Ukraine and was built with the intention of reflecting the structure of the Ukrainian economy as realistically as possible. So, results of the model have practical importance for those people who deal with economic policy. For instance, policy-makers can use results to see who is gaining and who is loosing from WTO accession and to undertake measures to promote gains and diminish losses.

Another contribution is a thorough review of existing literature on theoretical aspects of WTO related issues. Although there is a large number of empirical studies, theoretical examinations of the WTO are not so numerous and well known. To the best of author's knowledge, there were no previous attempts to combine and review such theoretical papers.

Finally, this research gives comprehensive description of the accession process to the WTO. It portrays not only the experience of some transition countries, but also gives deep insight into

accession using the example of one country - Ukraine. Thus, this research can be seen as a case study for those who are interested in the details of accession to the World Trade Organization.

The study is organized as follows:

A theoretical and empirical analysis of international trade agreements and GATT/WTO in particular is done in Chapter 2. This chapter commences with a general overview of history, main principles and agreements of GATT and WTO. Then, the theoretical part starts with explaining the reasons for entering an international trade agreement in general and refers to several theoretical studies of this issue. Next, specific features of GATT/WTO are scrutinized in theoretical light. It includes such GATT/WTO principles as reciprocity, non-discrimination, enforcement, safeguard measures, anti-dumping and countervailing measures and the potential impact of GATT/WTO on foreign direct investment. The chapter continues with an explanation of the accession process to this international organization and the accession experience of transition countries. Finally, the accession path of Ukraine is studied by reviewing the history of Working Party meetings, goods and services commitments.

The methodology of the research is explained in Chapter 3. First, the origins and nature of Computable General Equilibrium models are studied; this is followed by an overview of the classification of Computable General Equilibrium models and their advantages and disadvantages. Computable General Equilibrium models were extensively used for studies of trade policy and GATT/WTO in particular. First, early studies are overviewed, which cover modelling the different aspects of the Uruguay Round and Doha Round. This part is finalized with an examination of the studies devoted to the experience of transition economies such as China and some post-USSR countries.

Chapter 4 describes the Computable General Equilibrium model, which was built for Ukraine. It starts with a description of the macroeconomic state of affairs in Ukraine and also covers such areas as composition of industrial production, regional and sectoral breakdown of foreign trade and Foreign Direct Investment (FDI). This part will help the reader to understand why the model was built in a certain way and especially the reasoning behind the choice of scenarios. Next, a detailed algebraic formulation of the model is given with behavioural equations of all economic agents as well as equations showing calibration of certain parameters. This part also includes market clearance equations and the method of calculating the welfare of households through equivalent and compensating variation. Social Accounting Matrix, a database for the model, is overviewed next. The meanings of database entries and their sources are given. The main assumptions of the model and closure rules are then described. A depiction of four scenarios for simulation policy changes in the case of Ukraine's accession to the WTO concludes this chapter.

The results of the model are discussed in Chapter 5. Key macroeconomic variables, changes of output and foreign trade at sectoral level as well as changes in direction of foreign trade are presented. The results of four scenarios of policy changes are analyzed one-by-one with the help of graphical illustration. Finally, the robustness of model is checked with the help of sensitivity analyses. This is done by varying key input parameters (elasticities of substitution and transformation) and comparing the resulting output values of households' utility.

The concluding remarks on the results of the model, along with a comparison of those results with results of other models and possible further developments are presented in Chapter 6.

Chapter 2

Theory and Practice of GATT/WTO

2.1. Main Features of the WTO

The World Trade Organization (WTO) is an international body which deals with the rules of trade between nations. Established on January 1, 1995, as a result of the Uruguay Round, the WTO replaced the General Agreement on Tariffs and Trade (GATT) as a legal and institutional organization. The GATT was a multilateral agreement which has governed international trade since 1947 till creation of the WTO.

The World Trade Organization follows the core principles of the GATT, which include (WTO, 2005):

- Non-discrimination in trade;
- Free trade;
- Transparency and predictability;
- Assistance and trade concessions to developing countries.

The WTO addresses several new important issues which were not covered by the GATT:

- The General Agreement on Trade in Services (GATS);
- Trade in Intellectual Property Rights (TRIPs);
- Trade Related Investment Measures (TRIMs);
- Dispute Settlement;
- Trade Policy Review Mechanism.

As of the end of 2007 the WTO included 151 members, and 30 countries had the status of observers and were seeking membership. Its headquarters are situated in Geneva, Switzerland, there are over 600 secretariat staff, and the budget for 2007 was 182 million Swiss francs.

History

The idea of creating an organization to deal with international trade was dictated by desire to overcome the backlashes of the protectionist policy of the 1930s, which is believed to have been a significant cause of the Great Depression, and to boost world economy after World War II. Initially, it was driven forward predominantly by American and British efforts. Such an organization was expected to handle questions of international commerce and join the two “Bretton Woods” institutions: the International Monetary Fund and World Bank.

In 1946 the United Nations Economic and Social Council called for the establishment of an

International Trade Organization (ITO) during the UN Conference on Trade and Development in Havana, Cuba, in 1947. The concept of the ITO was very ambitious and included issues of trade in goods, services, regulation of investment and employment. At the same time, 23 participating countries were working on tariff negotiations. In the autumn of 1947, the General Agreement on Tariffs and Trade was signed, containing 45 000 tariff concessions and covering one fifth of world trade. Plans for the ITO were abandoned, mainly because of the refusal of US Congress to ratify the Havana Charter. Thus, the GATT was a treaty without the intended administrative organization and covered only part of its original scope (Suranovic *et al.*, 1998).

The basic legal text of the GATT remained much the same as it was in 1947, but it was extended by plurilateral agreements, special arrangements, interpretations, and voluntary agreements to decrease tariffs. For the most part negotiations were conducted within the framework of so-called “trade rounds” – multilateral talks. Since 1947 there have been eight trade rounds their basic features are listed in Table 2.1.

Table 2.1. Trade Rounds of GATT/WTO

Year	Place/Name	Subjects covered	Countries
1947	Geneva	Tariffs	23
1949	Annecy	Tariffs	13
1951	Torquay	Tariffs	38
1956	Geneva	Tariffs	26
1960- 1961	Geneva (Dillon Round)	Tariffs	26
1964- 1967	Geneva (Kennedy Round)	Tariffs and anti-dumping measures	62
1973- 1979	Geneva (Tokyo Round)	Tariffs, non-tariff measures, framework agreements	102
1986- 1994	Geneva (Uruguay Round)	Tariffs, non-tariff measures, rules, services, intellectual property, dispute settlement, textiles, agriculture, creation of the WTO, etc	123
2001-	Doha	Launching of a new round of trade talks	

Source: WTO Secretariat

Until the Kennedy Round in 1964-1967, the discussion was mostly around a further decrease of import tariffs in the form of bilateral negotiations. The Kennedy Round brought up approximately 50 per cent decrease of tariffs by major industrialized countries, inclusion of new industries in liberalization and a new GATT Anti-Dumping Agreement.

In addition to a significant reduction of tariffs, the Tokyo Round produced new important agreements, including those on Subsidies and Countervailing Measures, Technical Barriers to Trade, Import Licensing Procedures, Custom Valuation, Government Procurement, Bovine Meat Arrangement and Trade in Civil Aircraft.

The Uruguay Round was announced in September 1986 and lasted more than seven years. It was by far the most ambitious trade round and included virtually every aspect of trade policy. Traditionally, the GATT had dealt with trade in goods, but in the Uruguay Round it was proposed that it should extend to new areas, such as trade in services and intellectual property rights.

By 1998 negotiations had reached the stage of the “Mid-Term-Review” at the Ministerial

Meeting in Montreal, Canada. Ministers had assessed a progress of trade talks and agreed on several issues, including market access for tropical products, a Dispute Settlement Body and Trade Policy Review Mechanism. During the next Ministerial Meeting in Brussels in 1990, disagreements on how to proceed with agriculture reform (especially between the USA and European Community) led to a decision to extend the Round. During the following two years, participants in the talks deepened the discussion of demanding topics, including creation of a new organization. In 1992, the USA and European Community settled their disagreements over agricultural policy.

It took until the end of 1993 to resolve remaining issues and conclude negotiations on market access for goods and services. On April 15, 1994, most of the ministers from the 123 participating countries signed the draft charter of the WTO. On January 1, 1995, the WTO came into being. Whereas the GATT was a provisional multilateral agreement, covering trade in goods only, the WTO became a formal international organization and, besides GATT, included much broader issues, such as trade in services, intellectual property, Dispute Settlement, and a Trade Policy Review Mechanism.

The WTO keeps advancing trade negotiations. The most significant agenda so far was launched at the Fourth Ministerial Conference in Doha, Qatar, in November 2001. It concerns a wide range of issues, especially those of importance for developing countries, and is called the Doha Development Agenda (DDA).

Principles

The WTO has several important principles, lying at the heart of a free trading system: non-discrimination in trade, free trade, transparency and predictability, assistance and trade concessions for developing countries.

Non-discrimination in trade takes the form of two principles: the Most Favoured Nation and the National Treatment

Most Favoured Nation principle outlaws discrimination between goods, imported from different trade partners. According to it, “any advantage, favour, privilege or immunity granted by any contracting party to any product originating in or destined for any other country shall be accorded immediately and unconditionally to the like product originating in or destined for the territories of all other contracting parties”¹. Thus, if a country grants someone special treatment, for instance lower import tariffs, it must do the same for all other members. Besides stating the MFN principle in Article I of GATT, it is also written in Article II of GATS and Article IV of TRIPS, but with some differences.

National Treatment requires that once goods have entered the market, they must be treated no worse than domestically produced goods. Like the MFN principle, National Treatment applies to goods, services and intellectual property.

Free trade. WTO regards the liberalization of trade and reduction of tariffs and other trade barriers as important conditions for promoting a sustainable development. Countries who wish to participate in the WTO framework should make a commitment, directed at providing greater

¹ General Agreement on Tariffs and Trade 1994, Article I

market access to other members.

Transparency and predictability. The transparency principle obliges countries to inform the WTO and its members about policies and regulations within respective countries, especially about those concerning trade. Predictability implies that members should commit not to raise tariffs above the binding level, unless they are ready to compensate for such an increase.

Assistance and trade concessions to developing countries. Developing countries comprise two thirds of all WTO members and usually assume the same obligations as developed economies. Nevertheless, WTO regulations foresee more flexibility for developing countries, called Special and Differential (S&D) treatment provisions. S&D includes more time for transition, concessions from developed countries, and technical assistance.

Functions and organization

As stated in Article III of Marrakesh Agreement, which established the WTO, the main functions of the World Trade Organization are the following (GATT (1), 1994):

1. The WTO shall facilitate the implementation, administration and operation, and further the objectives of the WTO agreements.
2. The WTO shall provide the forum for negotiations among its Members concerning their multilateral trade relations.
3. The WTO shall administer the Understanding on Rules and Procedures Governing the Settlement of Disputes.
4. The WTO shall administer the Trade Policy Review Mechanism.
5. With a view to achieving greater coherence in global economic policy-making, the WTO shall cooperate, as appropriate, with the International Monetary Fund and with the International Bank for Reconstruction and Development and its affiliated agencies.

Decisions in the WTO are taken by member governments, either by ministers or by their delegates. The WTO agreements are usually reached by consensus, but in some cases voting is allowed as well.

The highest authority of the WTO is the Ministerial Conference, which takes place at least once every two years and can reach decisions on all matters. At the second level, day-to-day work is done by the General Council, which can meet as the General Council itself as the Dispute Settlement Body and as the Trade Policy Review Body. At the third level, three more councils report to the General Council: the Council for Trade in Goods, the Council for Trade in Services and the Council for Trade-Related Aspects of Intellectual Property Rights. Besides that, there are various committees, working parties, working groups, who report either to the General Council or to the Councils for Trade in Goods, Services or TRIPS.

Agreements

The legal texts of the WTO are a compound of more than 60 agreements, annexes, decisions and

understandings. The majority of these are the result of the Uruguay Round of multilateral trade negotiations. Agreements can be classified into six categories: an umbrella agreement, establishing the WTO; agreements for trade in goods, services and intellectual property rights; dispute settlement; reviews of trade policies (see Table 2.2). Agreements on goods and services include basic principles, additional agreements and market access commitments made by individual countries.

Table 2.2. Agreements of the WTO

Umbrella	Agreement Establishing WTO		
	Goods	Services	Intellectual Property
Basic principles	GATT	GATS	TRIPS
Additional agreements	<ul style="list-style-type: none"> • Agriculture • Application of Sanitary and Phytosanitary Measures • Textiles and clothing • Technical Barriers to Trade • Trade-Related Investment Measures • Anti-dumping measures • Customs valuation methods • Preshipment inspection • Rules of Origin • Import Licensing Procedures • Subsidies and Countervailing Measures • Safeguards 	<ul style="list-style-type: none"> • Annex on Movement of Natural Persons Supplying Services • Annex on Air Transport services • Annexes on Financial Services • Annex on Negotiations on Maritime Transport Services • Annex on Negotiations on Basic Telecommunications 	
Market access commitments	Countries' schedules of commitments	Countries' schedules of commitments; MFN exemptions	
Dispute settlement	Dispute Settlement		
Transparency	Trade Policy Review		

Source: WTO and Bacchetta, 2003

A brief description of these agreements is as follows:

The General Agreement on Tariffs and Trade (GATT).

The Uruguay Round resulted in new commitments to cut and bind tariffs in the framework of the GATT. Thus, developed countries increased the number of imports with "bound" tariffs to 99%,

and countries in transition to 98% (WTO, 2005).

The Agriculture Agreement envisages changes in rules concerning market access, domestic support and export subsidies. Market access rules require transition from quotas to tariffs only. Domestic support to agriculture is divided into three categories. “Green box”: measures which can be freely used (for instance research, infrastructure development). “Blue box”: support on a small scale: no more than 5% of total agriculture production for developed countries and 10% for developing (measures to limit production, rural development in developing countries). “Amber box”: direct support of production and exports; these measures have to be cut. Export subsidies are prohibited, unless the subsidies are specified in a member’s list of commitments.

The Sanitary and Phytosanitary Measures (SPS) Agreement sets out the basic rules for food, animal and plant safety and encourages countries to apply international standards.

The Agreement on Textiles and Clothing (ATC) gradually takes textiles to the general regulations of GATT by removing quotas.

The Antidumping Agreement and the Subsidies and Countervailing Measures Agreement give the legal definition of dumping and subsidies, and allow countries to take actions against them.

The Safeguards Agreement foresees cases when domestic industry is injured or threatened with injury caused by a surge of imports, and allows restriction of such imports for a certain period.

The General Agreement on Trade in Services (GATS).

The importance of services in international trade has grown enormously and accounts for one fifth of total international trade. The GATS is the first and only agreement regulating international trade in services. GATS functions according to the same principles as trade in goods: MFN treatment, national treatment and commitments on market access. The GATS annexes cover trade in four types of services: movement of natural persons, financial services, telecommunications and air transport services.

Trade in Intellectual Property Rights (TRIPS).

TRIPS cover five issues: 1) how to apply the basic principles of free trade to TRIPS; 2) how to protect intellectual property rights (copyrights, trademarks, geographical indicators, industrial designs, and patents); 3) how to enforce this protection; 4) how to settle disputes and 5) special transitional arrangements to adjust to TRIPS rules.

Dispute Settlement.

The Dispute Settlement Understanding (DSU) includes rules and procedures that allow the handling of trade disputes between countries. It is managed by the Dispute Settlement Body (DSB) consisting of all WTO members. DSU sets clear time frames for the dispute settlement process and establishes an appeal system. Dispute settlement includes a consultation phase, setting up the panel, delivering several reports on the case and possibly an appeal. The maximum time to view a dispute is equal to one year or one year and three months, in case of appeal.

Over 47 years of the GATT, only 200 cases have been disputed, while during 1995-2006 more

than 350 cases were considered. The increased number of disputes is believed to be attributed to an expansion of the world trade and a growing faith in the WTO system (WTO, 2005). The majority of cases did not reach the full panel process, but were settled “out of court”. Agriculture was the most frequent industry to evoke a dispute, followed by textiles, alcoholic beverages, and chemical industries. The majority of cases were brought by developed countries against other developed countries; the next group is developed countries against developing countries (Horn *et al.*, 2006).

Trade Policy Review Mechanism.

This mechanism is designed to increase the transparency of countries’ trade policy by regularly monitoring them. This is achieved in two ways: governments have to inform the WTO about its trade policies and regulations; and the WTO conducts regular trade policy reviews of individual countries.

2.2. Theory of Trade Agreements and GATT/WTO

Reasons for entering international trade agreements

This section will deal with the theoretical grounds of international trade agreements and GATT/WTO in particular. First, the motives for setting import tariffs will be considered. Second, the inefficiency of the unilateral trade policy will be discussed as well as how this inefficiency can be eliminated through trade agreement in its general form. Next, the debate will move specifically to GATT/WTO and how its core virtues can improve efficiency. The theoretical justification of such mechanisms as reciprocal tariff negotiations, Most Favoured Nations principle, enforcement through Dispute Settlement Procedure and safeguard, as well as antidumping and countervailing measures, will be reviewed.

Although economic theory suggests that free trade maximizes welfare, countries do set import tariffs, being ruled by several reasons. One of them, widely discussed by trade economists, is a terms of trade argument. It states that large countries which can influence world prices can gain by setting an import tariff, thus lowering the price of imports. Although such policy also distorts production and consumption, benefits can outscore losses if an optimal import tariff is introduced. This theory was first analyzed by Torrens (1833) and Mill (1844) and developed further by Edgeworth (1894), Bickerdike (1907), Johnson (1953-1954). The concept is important for further analysis and will be discussed later in this chapter.

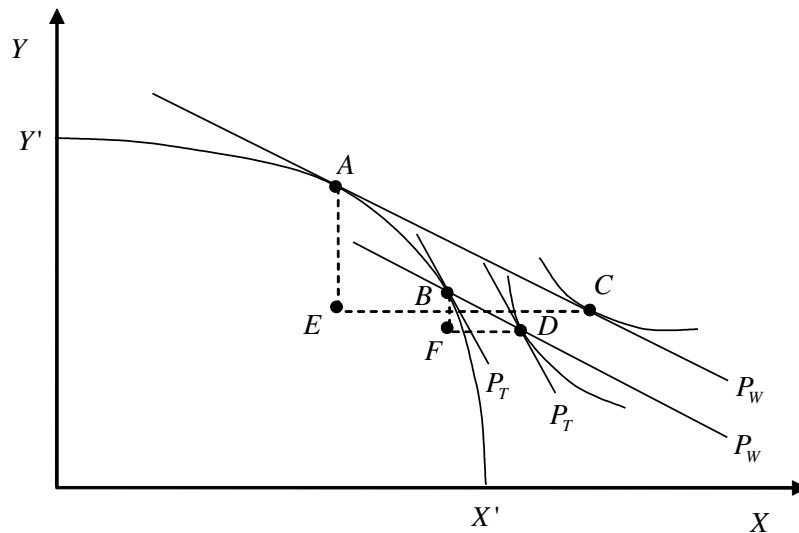
Another set of arguments was formalized by Richard Lipsey and Kelvin Lancaster in 1957, and received the name “theory of the second best”. It shows what will happen if optimal conditions are not satisfied in an economic model. If a domestic economy has some market failures, the government may need to intervene. In the particular case of international trade, this means deviation from free trade.

The influence of special interests groups on politics is yet another explanation for setting tariffs. As suggested by Mayer (1984) “political decisions on tariff rates are reflections of the selfish economic interests of voters, lobbying groups, politicians, or other decision makers in trade policy matters”. Magee (1989), Hillman and Ursprung (1988) model the process of tariff formation as a political competition among parties. Competing parties propose their tariffs and interests groups choose which party to support. Stigler (1971), Grossman and Helpman (1984) argue that parties set their policies in order to maximize their political support from different lobbies. Downs (1957), Mayer (1981) and others assume that parties try to meet the preferences of voters. They presume that different levels of tariffs favour different types of voters, depending on their occupation. Thus, political parties will set tariffs which will satisfy a median voter.

The terms of trade arguments for imposing tariffs are considered below for the cases of small and large economies.

Relatively easy and unambiguous is the case of a small open country. Imposition of import tariffs does not affect terms of trade, since the country is a price taker. Without tariffs, a country is able to trade more and improve its welfare. Thus, there is no advantage in setting an import tariffs. The intuition behind the effect of import tariffs is illustrated in Figure 2.1. There are two goods that are produced and consumed in every country: X and Y . The production possibility frontier is $X'Y'$. P_w are relative world prices and P_t are relative domestic prices, including tariffs. In the absence of tariffs production occurs at point A at the intersection of world prices and production

possibility frontier. Consumption is at point C , where the consumers' indifference curve is tangent to the world prices. Good X is imported and good Y is exported, resulting in foreign trade represented by triangle AEC . If an import tariff is imposed on good X , consumers and producers face relative prices P_T . Production is moved to point B , consumption to D and foreign trade diminishes to BFD , resulting in a lower welfare level.

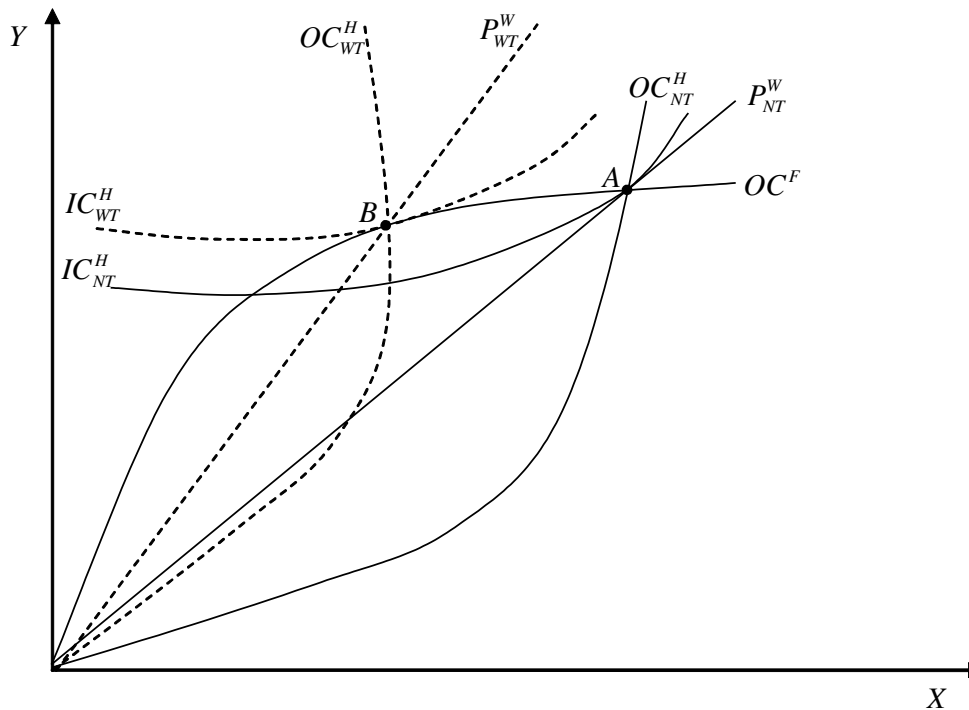


Analysis becomes more complicated if a country has influence on world prices – large country assumption. The theoretical backgrounds in this area were founded in the first half of the nineteenth century. Torrens (1833) and Mill (1844) argued that although countries will loose from diminished trade if import tariffs are imposed, they can also win if foreign countries lower prices in an attempt to secure market presence. Edgeworth (1894) and Bickerdike (1907) developed this theory further at the edge of the twentieth century. Edgeworth (1894) used offer curves for his analysis, and argued that if the offer curve of foreign country is not perfectly elastic, the domestic country can improve its welfare. Bickerdike (1907) developed a formula, relating an optimal tariff that maximizes welfare with export supply elasticity. The concept, stating that it is possible to conduct trade on more favourable terms by introducing an optimal tariff – the level of protection that maximizes domestic welfare taking into account the foreign offer curve - has acquired the name “optimal tariff theory”.

a tariff, the initial relative price line is denoted as P_{NT}^W ; offer curves of home and foreign countries are OC_{NT}^H and O^F respectively². Trade initially occurs at point A , where relative world prices and offer curves of both countries intersect. The graph also shows the initial trade indifference curve of the home country IC_{NT}^H .

The introduction of a tariff will change relative world prices and price line, and the home country offer curve will rotate leftward to P_{WT}^W and OC_{WT}^H respectively. Now trade will take place at point B and a higher domestic indifference curve IC_{WT}^H will be achieved.

Figure 2.2. Impact of an Import Tariff, Large Country



Source: Whalley (1985)

The analysis above assumed that the foreign country will not retaliate in response to the introduction of a tariff. Kaldor (1940) brought into discussion the possibility of retaliation from the exploited country. He argued that a country which can change terms of trade is acting like a monopoly, and the magnitude of possible change depends on the monopoly power of such a country, i.e. the elasticity of foreign demand. As he puts it: “Provided that the elasticity of foreign demand is less than infinite there is always some rate of duty which it is advantageous to introduce in the absence of retaliation; and if the elasticity of the country’s own demand for foreign products is markedly higher than the elasticity of foreign demand for its own products – an unusual case – this policy may be advantageous even if the “optimum degree of retaliation” of

² Here lower subscript NT denotes “No Tariff”, WT “With Tariff”; upper subscripts are W for “World”, H for “Home” and F for “Foreign”.

foreign countries is allowed for.”

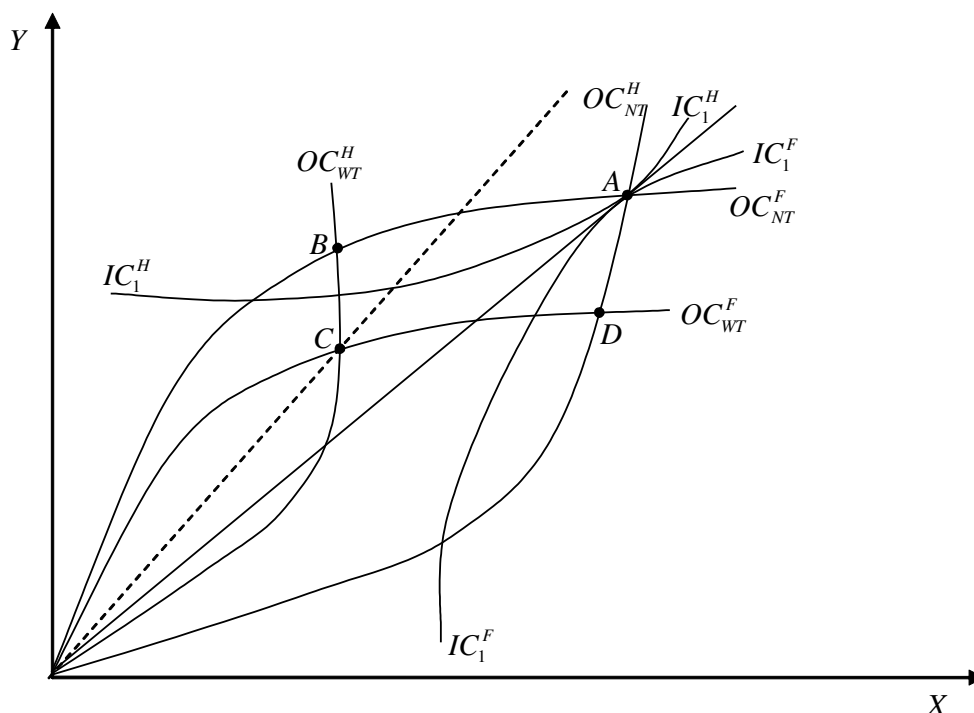
Johnson (1953-1954) in his now classical work “Optimum Tariffs and Retaliation” significantly developed the optimal tariff theory scrutinizing a two-good two-country general equilibrium model. He criticized Kaldor’s study for being “imprecise and almost meaningless” and proposed relating the optimal tariff to the elasticity of the foreign offer curve. The author shows that optimal home country tariff t^* should be set at the level $t^* = \sigma^f - 1$, where σ^f is the elasticity of the foreign offer curve. As was argued by Whalley (1985), since trade elasticities tend to be low, a high optimal tariff is implied.

More recent examinations of trade agreements going in line with the optimal tariff argument include those of Mayer (1981), Dixit (1987), Staiger(1994), Grossman and Helpman (2002). Ethier (2006) criticizes such studies for their incompleteness. According to him, trade agreements do not prevent countries from influencing terms of trade; phenomena, which he denotes as the Terms-of-Trade Puzzle. Although countries have bound import tariffs, they have not bound export taxes and still have some market power. The model he uses is two countries, two factors and three traded goods and includes political economy, which allows lobbies to support the trade policy they prefer. Ethier concludes that trade agreements do not prevent countries from changing their terms of trade on the export side and should also address export taxes.

Thus, if the optimal tariff theory holds true, certain countries can get better-off by imposing import tariffs and changing terms of trade. However, to realize their trade policy, countries have to interrelate between each other. The next section will examine the interactions between different countries and unilateral versus multilateral trade policy.

In the case of both countries imposing tariffs, equilibrium is set at point C , shown in Figure 2.3. If countries decide to move to free trade, new equilibrium is reached at point A with higher indifference curves IC_{NT}^H for the home country and IC_{NT}^F for the foreign one. If one country decides to abolish the tariffs, then, as was shown above, another country has incentives to keep the tariff effective and improve its terms of trade. In this case equilibrium is reached at point D , where the home country is worse off and the foreign country is better off. Likewise, if the foreign country cancels the tariffs, the home country will keep them, and at equilibrium point B the foreign country will be worse off and the home country better off.

Figure 2.3. Unilateral Versus Multilateral Trade Policy



Source: Whalley (1985)

Thus, countries are trapped in a “Prisoners Dilemma”, illustrated in Table 2.3. Both countries would be better off by choosing free trade (shown by payoffs 10 and 10). But knowing that unilateral abolishment of import tariffs will damage the home country (payoff -10) and make the foreign country better off (payoff 20), both countries move to protection, which brings losses to everyone (payoffs -5 and -5).

Table 2.3. Prisoners Dilemma of Unilateral Trade Policy

Country 1 / Country 2	Free Trade	Protection
Free Trade	(10; 10)	(-10; 20)
Protection	(20; -10)	(-5; -5)

Source: Bacchetta (2003)

As was argued in many studies, and discussed below, if unilateral trade policy does not allow the establishment of free trade while protection policy is not optimal, trade agreements between countries can foster free trade and make the participants better off. Before proceeding with a discussion, a definition of “trade agreement” is necessary. Staiger (1994) defines an “international trade agreement as a collection of rules regarding the conduct of trade policy to which compliance requires some form of enforcement mechanism, that is, where unilateral incentives to violate the rules of the agreement are kept in check by the desire to avoid punishments that are themselves specified in the agreement”.

Bagwell and Staiger in a number of studies (Bagwell and Staiger (1990), (1996), (1999), (2003))

developed a theoretical framework for the investigation of international trade agreements, specifically in the context of the GATT/WTO framework. A review of the trade agreement theory will be concentrated around their work.

To illuminate the inefficiency of a unilateral trade policy and possible remedies given by a trade agreement, Bagwell and Staiger (2003) developed a standard general equilibrium model with two countries and two sectors. Home and foreign countries (the latter is denoted with an asterisk) trade by goods x and y . Goods are normal and there is a perfect competition. Imports of home (foreign) country are respectively $x(y)$; then $p \equiv p_x/p_y$ ($p^* \equiv p_x^*/p_y^*$) are local relative prices, faced by home (foreign) producers and consumers. The home (foreign) ad valorem import tariff is defined as $t(t^*)$. Letting $\tau \equiv (1+t)$ and $\tau^* \equiv (1+t^*)$, the relation between prices becomes: $p = \tau \cdot p^w \equiv p(\tau, p^w)$ and $p^* = p^w/\tau^* \equiv p^*(\tau, p^w)$, where $p^w \equiv p_x^*/p_y$ is the “world” relative price. Terms of trade for the home (foreign) country are given by p^w ($1/p^w$).

Production is determined at a point on the production possibilities frontier where the marginal rate of transformation between x and y is equal to the local relative price. Domestic and foreign production functions are determined as $Q_i = Q_i(p)$ and $Q_i^* = Q_i^*(p^*)$ for $i = \{x, y\}$. Consumption is also a function of local relative prices as well as of tariff revenue $R(R^*)$, which is distributed to domestic (foreign) consumers. Thus, domestic and foreign consumption is $D_i = D_i(p, R)$ and $D_i^* = D_i^*(p^*, R^*)$ for $i = \{x, y\}$ respectively. Tariff revenue can be expressed as the amount of imports times difference between domestic and world prices: $R = [D_x(p, R) - Q_x(p)] \cdot [p - p^w]$ for home country and $R^* = [D_y^*(p^*, R^*) - Q_y^*(p^*)] \cdot [1/p^* - 1/p^w]$ for foreign country, alternately $R = R(p, p^w)$ and $R^* = R^*(p^*, p^w)$. Now, consumption in each country can be written as $C_i(p, p^w) \equiv D_i(p, R(p, p^w))$ and $C_i^*(p^*, p^w) \equiv D_i^*(p^*, R^*(p^*, p^w))$ for $i = \{x, y\}$.

Imports of home country are represented as $M_x(p, p^w) \equiv C_x(p, p^w) - Q_x(p)$, and exports as $E_y(p, p^w) \equiv Q_y(p) - C_y(p, p^w)$. For foreign countries these trade flows are denoted as $M_y^*(p^*, p^w)$ and $E_x^*(p^*, p^w)$.

Home and foreign country budget constraints require balanced trade and correspond to the following two equations:

$$p^w \cdot M_x(p, p^w) = E_y(p, p^w) \quad (2.1)$$

$$M_y^*(p^*, p^w) = p^w \cdot E_x^*(p^*, p^w) \quad (2.2)$$

The local price depends upon the tariff and world price; the equilibrium world price $\tilde{p}^w(\tau, \tau^*)$ is determined by the market-clearing condition for good y :

$$E_y(p(\tau, \tilde{p}^w), \tilde{p}^w) = M_y^*(p^*(\tau^*, \tilde{p}^w), \tilde{p}^w) \quad (2.3)$$

To sum up, the tariffs and market equilibrium condition (2.3) determine the world price. Next, the equilibrium world price and tariffs determine local prices. Finally, world and local prices determine production, consumption, trade volumes and tariff revenues.

There are two major approaches to represent the government welfare function. The traditional one states that the government maximizes national income and, thus, welfare is improved when terms of trade are improved. This approach was formalized by Edgeworth (1894), Bickerdike (1907), Johnson (1953-1954), Dixit (1987), Mayer (1981). A political-economy approach takes into account distribution of welfare and was analyzed by Feenstra and Bhagwati (1982) and Mayer (1984). The last formulated a model in which the government defends the interests of a medium voter.

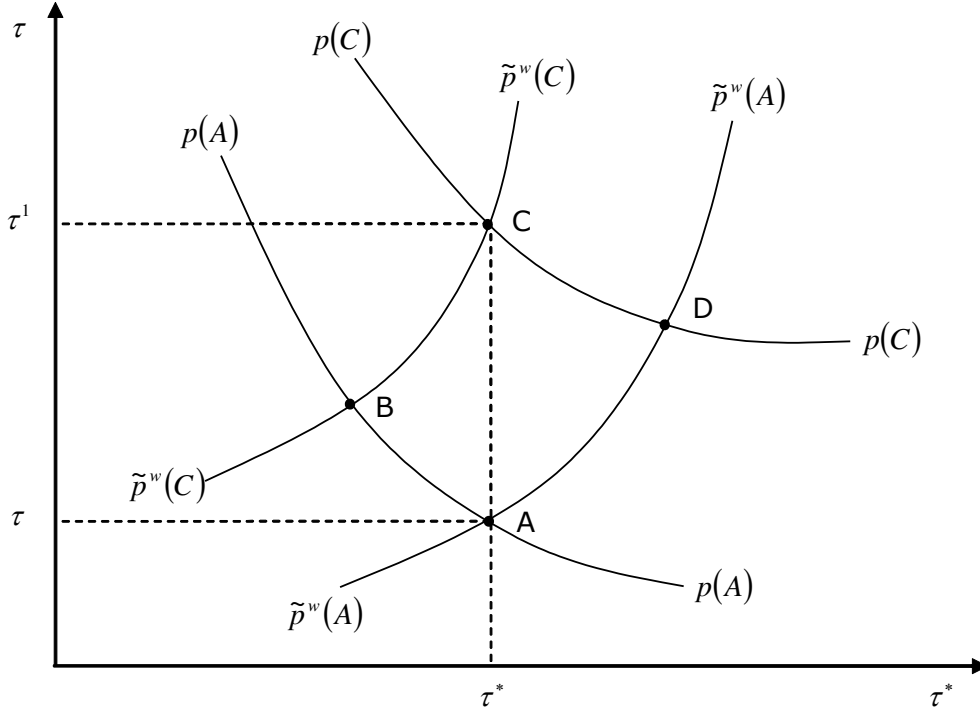
In their work, Bagwell and Staiger (2003) encompass both traditional and political economy methods. In order to do so, they do not represent payoffs directly in terms of tariffs, but rather in terms of local and world prices, induced by tariffs. Thus, the welfare functions of home and foreign government are $W(p, \tilde{p}^w)$ and $W^*(p^*, \tilde{p}^w)$.

Bagwell and Staiger (2003) do not impose restrictions on government preferences over local prices in order to allow different sets of political motivation. Indeed, an important assumption they make is that the government will increase welfare if terms of trade improve:

$$\partial W(p, \tilde{p}^w) / \partial \tilde{p}^w < 0 \text{ and } \partial W^*(p^*, \tilde{p}^w) / \partial \tilde{p}^w > 0 \quad (2.4)$$

This point can be demonstrated using Figure 2.4.

Figure 2.4. The World and Local Price Effect of a Tariff Change



Source: Bagwell and Staiger (2003)

Initial tariff pair is represented as point $A \equiv (\tau, \tau^*)$, which is formed at the intersection of the domestic iso-local-price locus $p(A) \rightarrow p(A)$ and an iso-world-price locus $\tilde{p}^w(A) \rightarrow \tilde{p}^w(A)$. Following an increase in domestic tariff, a new point $C \equiv (\tau^1, \tau^*)$ is achieved. This point is associated with a second pair of prices, corresponding to domestic iso-local-price locus $p(C) \rightarrow p(C)$ and an iso-world-price locus $\tilde{p}^w(C) \rightarrow \tilde{p}^w(C)$. At point C the world price is lower than at point A , reflecting improved market access for the home country.

Next, Bagwell and Staiger (2003) determine the unilateral trade policies of governments and show what kind of problem arises in the absence of a trade agreement. Each government sets its tariff policy in order to maximize its welfare, and taking the tariff policy of trade partners as given. Thus, reaction functions are implicitly defined as:

$$W_p [dp/d\tau] + W_{\tilde{p}^w} [\partial \tilde{p}^w / \partial \tau] = 0 \quad (2.5)$$

$$W_p^* [dp^*/d\tau^*] + W_{\tilde{p}^w}^* [\partial \tilde{p}^w / \partial \tau^*] = 0 \quad (2.6)$$

Let $\lambda \equiv [\partial \tilde{p}^w / \partial \tau] / [dp/d\tau] < 0$ and $\lambda^* \equiv [\partial \tilde{p}^w / \partial \tau^*] / [dp^*/d\tau^*] < 0$. Then, (2.5) and (2.6) can be rewritten as

$$W_p + \lambda W_{\tilde{p}^w} = 0 \quad (2.7)$$

$$W_p^* + \lambda W_{\tilde{p}^*} = 0 \quad (2.8)$$

As can be seen, the best-response tariff of each government includes induced local and world price movements. Figure 2.4 gives further insight. Suppose the home government unilaterally increases the tariff, moving from point $A \equiv (\tau, \tau^*)$ to $C \equiv (\tau^1, \tau^*)$. The new tariff pair τ^1 and τ^* results in higher local and lower world prices, compared with point A . This move can be broken into two stages: movement from A to B shows the effect of change in the world price and the corresponding change in welfare is represented in (2.7) by $\lambda W_{\tilde{p}^w}$. Movement from B to C holds the world price fixed and isolates change in local price; welfare is given by term W_p .

The authors argue that change from B to C is domestic in nature and reflects the balance between the cost of economic distortions in production and consumption and benefit of political support. The change from A to B has indeed international character: it captures the improvement of domestic terms of trade and the corresponding deterioration of foreign terms of trade, thus shifting costs of trade policy to the foreign government. In a Nash equilibrium, both governments are on their reaction curves and the Nash equilibrium pair of tariffs (τ^N, τ^{*N}) satisfies (2.7) and (2.8).

Next, the authors make several observations; formal proof is given in their previous work on the theory of GATT (Bagwell and Staiger (1999)).

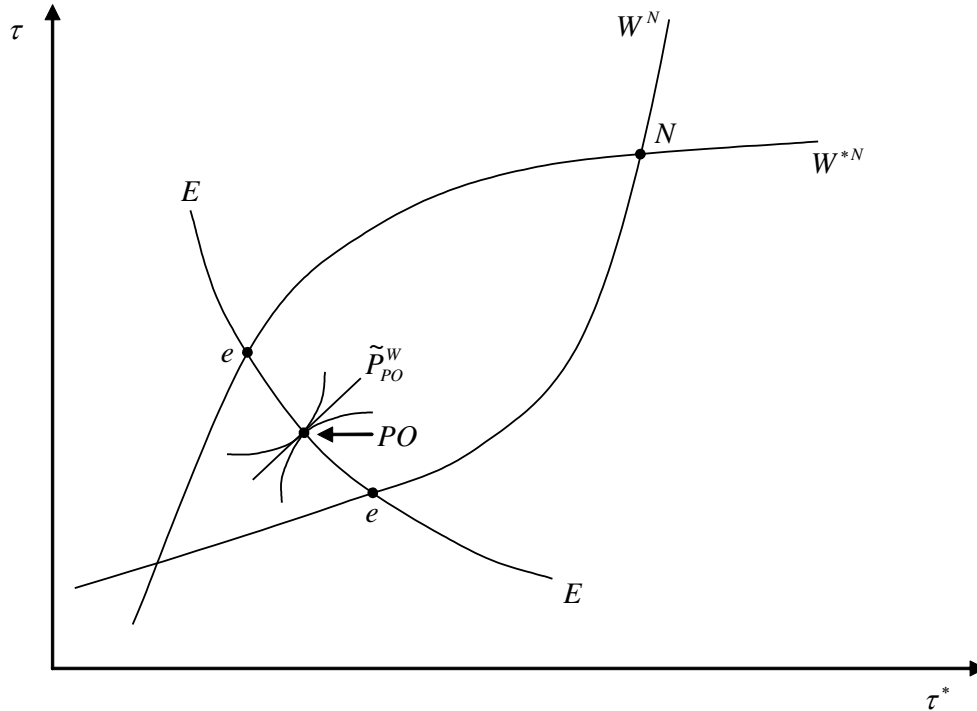
1. The Nash equilibrium is inefficient. If a government sets its trade policy unilaterally, it has incentives to shift the costs of such a policy to a foreign government. This results in too high tariffs and too low trade.
2. Both governments can achieve efficiency improvements relative to the Nash equilibrium only if they both agree to lower tariffs below the Nash equilibrium level. Otherwise they get stuck in the Prisoners Dilemma.
3. If governments do not try to shift costs to foreign partners and rather consider domestic costs and benefits, the resulting politically optimal tariffs are efficient.

These observations are illustrated in Figure 2.5. First, non-cooperative governments set their tariffs at point N . As was originally shown by Johnson (1953-1954), this is a non-cooperative Nash equilibrium of a tariff retaliation and counter-retaliation game. This point is inefficient, since the home and foreign iso-welfare contours are not tangent. As Johnson (1953-1954) argues, neither country could improve its welfare with a unilateral process, but both countries can be better off if they pursue a mutual tariff reduction.

Mayer (1981) points out that efficient tariffs would have to satisfy condition $\tau = 1/\tau^*$. Such tariffs make local prices across countries equal and achieve world-wide economic efficiency. Besides free trade between the countries ($\tau = \tau^* = 1$), there is an entire set of efficient tariff pairs, which lies on the efficiency locus (curve $E \rightarrow E$). The portion of this locus, denoted $e \rightarrow e$, is a contract curve: a combination of tariffs that are efficient and bring welfare, greater than Nash

welfare. Second, the Nash iso-welfare curves imply that greater than Nash equilibrium welfare can be achieved only if both governments can agree on a reduction of tariffs. Finally, politically optimal tariffs are at point PO , which lies on the efficiency locus.

Figure 2.5. The Purpose of Trade Agreement



Source: Bagwell and Staiger (2003)

Next, a discussion of how such an international trade agreement as GATT/WTO can eliminate the inefficiency of a unilateral trade policy follows. The review will start from the main pillars of GATT/WTO, namely reciprocity of negotiations and non-discrimination; next, it will move to enforcement, safeguard mechanisms, and antidumping and countervailing measures.

Reciprocity

Using the model discussed above and developing their previous work (Bagwell and Staiger (1999)), Bagwell and Staiger (2003) argue that trade agreement, in particular in context of GATT/WTO framework can give remedy to inefficiency of unilateral trade policy through mechanism of reciprocity. According to the Preamble of GATT, “reciprocal and mutually advantage arrangements directed to the substantial reduction in tariffs and other barriers to trade” should serve the main goals of GATT/WTO. This rule is confirmed in practice, as governments try to achieve a balance of concessions during negotiations.

First, concept of reciprocity is formalized. Let's suppose that initial tariffs (τ^0, τ^{*0}) are changed to a newly negotiated pair (τ^1, τ^{*1}) . Initial world and domestic prices are denoted as $\tilde{p}^{w0} \equiv \tilde{p}^w(\tau^0, \tau^{*0})$ and $p^0 \equiv p(\tau^0, \tilde{p}^{w0})$; succeeding prices are $\tilde{p}^{w1} \equiv \tilde{p}^w(\tau^1, \tau^{*1})$ and $p^1 \equiv p(\tau^1, \tilde{p}^{w1})$. Principle of reciprocity holds if tariff changes allow following:

$$\tilde{p}^{w0} [M_x(p^1, \tilde{p}^{w1}) - M_x(p^0, \tilde{p}^{w0})] = [E_y(p^1, \tilde{p}^{w1}) - E_y(p^0, \tilde{p}^{w0})] \quad (2.9)$$

Next, using trade balance condition (3.1) authors characterize reciprocity. Given balanced trade at initial tariffs, equation $\tilde{p}^{w0} M_x(p^0, \tilde{p}^{w0}) = E_y(p^0, \tilde{p}^{w0})$ should be true; thus, (2.9) may be rewritten as

$$\tilde{p}^{w0} M_x(p^1, \tilde{p}^{w1}) = E_y(p^1, \tilde{p}^{w1})$$

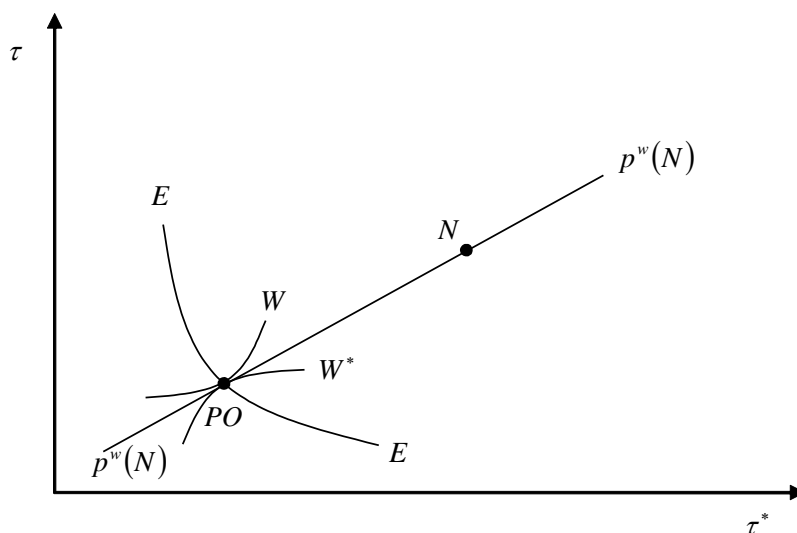
Consequently, balanced trade implies $\tilde{p}^{w1} M_x(p^1, \tilde{p}^{w1}) = E_y(p^1, \tilde{p}^{w1})$. Taking this into account, (2.9) may be further rewritten as

$$[\tilde{p}^{w1} - \tilde{p}^{w0}] M_x(p^1, \tilde{p}^{w1}) = 0 \quad (2.10)$$

This equation states that mutual changes in trade policy obey the rule of reciprocity if and only if world prices are unchanged. As was stated previously, governments can increase welfare by changing tariffs and passing costs to foreign state. This policy is inefficient and requires change of world price. Next, authors show how obeying reciprocity principle can increase mutual welfare without changing world price. At the Nash equilibrium point from equations (2.4), (2.7) and (2.8) follows that $W_p < 0 < W_p^*$. If governments decide to reduce tariffs in reciprocal way, than local price p would fall and foreign price p^* would rise; thus, domestic welfare would rise (since $W_p < 0$) together with foreign welfare (since $W_p^* > 0$). In other words, at the Nash equilibrium governments would like to increase trade if it does not require loss of terms of trade. Unilateral policy does not allow for this, so neither government would lower tariffs. But if tariffs are decreased reciprocally and decrease of tariffs in one country is balanced by decrease in other, terms of trade remain constant. Each government can increase welfare by expanding trade without terms of trade loss.

Figure 2.6 illustrates the central idea of Bagwell and Staiger (2003) arguments.

Figure 2.6. Reciprocal Trade Negotiations



Source: Bagwell and Staiger (2003)

The iso-world-price locus runs through the Nash point N as well as politically optimal point PO . If governments start trade negotiations, which result in reciprocal tariff decrease, they can move down the iso-world-price locus and experience welfare gains. Reaching politically optimum, they have no incentives for further negotiations.

Non-discrimination

The other pillar of GATT/WTO is the rule of non-discrimination, which takes the form of the Most Favoured Nation principle.

Bagwell and Staiger (1999) use a model similar to the one described above for reciprocity, but in multi-country settings. They show that politically optimal tariffs will be efficient if and only if they conform to the principle of non-discrimination. Otherwise countries will be seeking for imports which come from the country on which the higher import tariffs are placed. But, as was shown earlier, this policy leads to shifting costs abroad and is not efficient.

Another important feature of the MFN principle is giving more equal opportunities in trade negotiations to small economies vis-à-vis rich countries. Caplin and Krishna (1988) developed a three-country dynamic bargaining model and suggest that MFN has an important effect on equal distribution of bargaining power across countries. Ludema (1991) also investigates the three-country bargaining game and reaches the conclusion that bargaining under MFN will result in a Pareto efficient trade agreement. Moreover, he finds that all countries gain from negotiations under the MFN principle, but not necessarily in its absence.

Negative processes associated with the MFN principle are also studied. Rubinstein (1982) and Caplin and Krishna (1988) point out that the “free riding” of one country on the reciprocal

agreements of others may bring some costs. The latter two authors employ a static model of simultaneous bargaining, and argue that the MFN principle requires the lowering of tariffs to all countries, not only those involved in bargaining. In this situation, a simultaneous round of bargains under the MFN rule may result in higher tariffs, compared with the scenario when MFN is not applied. Ludema (1991), who uses the three-country non-cooperative dynamic bargaining model, arrives at a different conclusion. In his model, one country makes a proposal to the other two and they are free to accept or reject it. If both countries accept the offer, bargaining is over and an agreement is concluded; if both reject, then the negotiations are repeated. If one country accepts and the other rejects, the accepting country can reconsider its decision. Ludema argues that, in the latter case, the accepting country has incentives to change its decision and continue bargaining. Under this dynamic set of bargaining games countries will be bargaining until Pareto-efficient MFN tariffs are achieved and the “free rider” problem does not bring substantial costs.

Enforcement

Even if trade agreement has been achieved, individual countries have incentives to cheat on such agreements by raising tariffs and shifting costs to trade partners. Therefore, an enforcement mechanism should be established and should support existing international trade agreements, thus allowing escape from the Prisoners Dilemma. GATT/WTO established the Dispute Settlement System for this purpose.

Bagwell and Staiger (2000) model mechanism of Dispute Settlement System through infinitely-repeated tariff game of tariff formation. If deviation from the common tariff occurs, a retaliatory trade war starts. They conclude that enforcement should achieve and maintain a balance between short-term temptation to deviate from the agreed tariffs and enjoy a term of trade benefits from one side, and the long-term costs of future loss of cooperation from the other.

Maggi (1999) examined the role of the GATT/WTO in international trade cooperation and built a multi-country model in which governments repeatedly select import barriers. The author recognizes the further benefit of a dispute settlement mechanism, which occurs from aggregation of enforcement power. If governments join a multilateral enforcement mechanism, the combined punishment for deviating from a trade agreement will be much more serious and will prevent cheating.

Besides that, a dispute settlement may play an important role in gathering and disseminating information. Hungerford (1991) built a two-country model, and argued that although information gathering is costly, it allows the avoiding of even more costly trade wars. He argued that the “after” information on a certain case shows if there was a deviation from the agreement or not. Countries have incentives to start retaliation only if departure from an agreement is detected.

Kovenoch and Thursby (1992) showed that countries directly affected by deviation from a trade agreement facilitate monitoring and strengthen cooperation. They also argued that the very existence of a reliable dispute settlement system helps countries feel the obligations of a trade agreement and reduce incentives to step away from it.

Bown (2002) compared the dispute settlement process with safeguard measures. He argued that if countries need to deviate from a trade agreement, they may choose either a “legal” path – safeguard measures or an “illegal” one by unilaterally breaking an agreement and facing dispute settlement. The author showed that the WTO has high incentives to keep to “legal” behaviour, and only countries with a high potential to benefit from terms of trade change will choose an

“illegal” option. Also, Bown (2002) noted more efficient dispute settlement rules under the WTO than under GATT.

Safeguard measures

Although being a part of an international trade agreement, countries may need to step away from free trade and apply higher protection to avoid domestic industry being seriously injured. The GATT/WTO envisaged such occasions and put in Safeguard measures, providing set of rules to avoid maltreatment of higher protection. Several studies concerned areas where laws regulating safeguard measures may be of hand: application of special protection too frequently and for too long a time.

Bagwell and Staiger (1990) followed the work of Rotemberg and Saloner (1986) and showed that a weak international enforcement mechanism can lead to special protection when trade volumes decrease and governments have incentives to violate tariff bindings. Matsuyama (1990) and Mayer (1994) point out that if rules are not strong enough, special protection is likely to be over-utilized compared with a government’s optimal plan. Both authors argue that GATT rules can enforce commitment to adhere to the optimal plan.

Matsuyama (1990) investigated the possibility of transferring a temporary protection to a prolonged one. In his model, the structure of the game between government and firms is as follows: in the first period the government chooses between liberalization of the pre-existent tariff and keeping it. If it decides to extend protection, the game continues. Then, firms choose whether to prepare for trade liberalization in the next period or not. If the government lacks credibility, firms will believe that temporary protection will be applied in the next period as well and will never choose to prepare for liberalization. If international safeguard rules have enough enforcement power, they can reduce the length of temporary protection.

Antidumping and countervailing measures

GATT/WTO includes Antidumping Agreement and Subsidies and Countervailing Measures Agreement that define dumping and subsidies, and provide a set of rules for dealing with them and placing restrictions on excessive use of such actions. Below is a review of the literature dedicated to the need for regulation of antidumping (AD) and countervailing (CV) measures, and the negative consequences if such regulation is absent.

Staiger (1994) noted that, broadly, there are three adverse effects which can potentially arise from AD and CV misuse: measurement bias, unintended effect of “legitimate” use and abuse.

Measurement bias may occur from the way dumping and subsidy margins are calculated. Boltuck and Litan (1991) among others came to the consistent conclusion that there tends to be a strong bias in the methodology of dumping and subsidy calculations that allow authorities to find a positive margin or subsidy. Thus, international rules concerning the procedures of calculating dumping and subsidies should avoid this problem.

An unintended effect of AD and CV may arise, even if there is no measurement bias and laws seem to serve their purposes. One such case was studied by Gruenspecht (1988). He built a two-country two-period duopoly model and scrutinized the implications of mutual antidumping enforcement. He reached the conclusion that mutual antidumping enforcement may limit output

and push prices and costs of firms in both first and second periods, leading to a situation similar to the Prisoners Dilemma. Bagwell and Staiger (1989) showed that the threat of antidumping investigation may induce foreign governments to rely on export subsidies, even though CV measures may be applied. Staiger and Wolak (1992) pointed out that non-transparent AD laws can lead to lower output and trade, even if these laws are not utilized.

The consequences of abusing AD and CV measures is similar to one identified by Staiger and Wolak (1992) and which occur as a result of loose antidumping laws, allowing too frequent use of them. Pusa(1992) argued that the fact that domestic firms may demand an investigation and withdraw before a decision is made can threaten foreign firms and give home producers more bargaining power in the limiting presence of foreigners. Finally, Staiger and Wolak (1992) stated that domestic firms may initiate an antidumping investigation even if they do not count on success in order to limit foreign competition. Once again, a clear set of international rules on AD and CV measures would help to combat unnecessary use of these mechanisms.

Foreign Direct Investment

Membership in the WTO potentially affects flows of capital through several channels. Below is a discussion of theoretical studies in this area.

Volume of FDI

Trade theory links FDI and volume of trade, but has two opposing points of view in this relation. Thus there are studies which state that trade and FDI are complementary, as well as those pointing out that trade and FDI are substitutes: i.e. an increase in trade is coupled by an increase (former) or decrease (latter) in FDI or vice versa. Before proceeding, it is worth noting that FDI is distinguished between horizontal and vertical. Horizontal Foreign Direct Investment goes to the production of the same goods and services abroad. Vertical FDI is directed at foreign production of goods and services at certain stages of making.

Studies in favour of substitution between trade and FDI can be classified into internalization theory, eclectic paradigm and horizontal investment theory. Internalization theory originates from the Coase theory of the firm (the fundamental article is Coase, 1937), which introduces the concept of transaction costs to explain the size of firms, and was elaborated further by Williamson. Buckley and Casson (1976) formulated internalization theory as follows: firms will prefer FDI if costs of internalization, consisting of such overheads as communication, administrative and other internal organization costs are less than expenses implied by exports.

Dunning (1980) developed a theory of eclectic paradigm, also known as the OLI framework. According to it, firms prefer FDI to trade if three advantages exist: Ownership, Location and Internalization. In case location advantage does not exist, firms prefer trade, so FDI and trade are two alternative strategies here.

The theory of horizontal investment goes back to the 1950s and was pioneered by Robert Mundell and his “tariff jump” notion (Mundell, 1957). Developed further by Hortsman and Markusen (1992) and Brainard (1993), it assumes the existence of scale economies at firm and plant level and trade costs. Thus, firms face a trade-off between concentration of production and proximity to consumers. If economies of scale are high and trade costs are relatively low, it is worth concentrating production at one location and supplying foreign markets with exports. On

the contrary, if trade costs are higher than the pay-off from economies of scale, it is better to supply foreign markets from plants located there. Thus, FDI and trade are substitutes and become more so if trade costs rise.

The theory of vertical investment makes use of differences in relative factor costs and was developed by Helpman (1984). According to this theory, firms split the production process to different groups which are relatively intensive in certain factors of production. FDI takes the form of separating headquarters and plants and placing each production segment in a country with relative abundance in the required factors. FDI creates trade since plants have to trade their output as intermediate input to other plants. In this case trade and FDI are complementary.

More recent models tried to combine vertical and horizontal FDI and were named Knowledge-capital models. Most known studies in this field are by Markusen *et al.* (1996), developed further by Markusen (1997), Markusen (2000) and Carr *et al.* (2001). According to Forte (2004), these models are based on three assumptions: first of all, headquarters activities such as research and development can be done in a separate location from production; second, headquarters activities require more qualified labour input relative to production; third, headquarters activities have a “public good” properties and can be used by several facilities. The first two assumptions imply vertical investment: headquarters are located where qualified labour is and production where non-qualified labour is cheap. The third assumption creates economies of scale and horizontal investment. Depending on such variables as trade costs, differences in factor endowments across countries, etc., combinations of vertical and horizontal investment are created, and FDI and trade can be complementary or substitutes.

“Quality” of FDI

Not only the volume of capital flows may change as a result of WTO accession, but “quality” of FDI as well. Bhagwati was the first to study theoretical connections between trade regime and gains from FDI (Bhagwati, 1978). This subject was also studied by Bhagwati (1985, 1994), Brecher and Diaz-Alejandro (1977), and Brecher and Findlay (1983). The main idea is that benefits from investment depend on whether the trade regime is import-restrictive or export-promoting. If a country pursues an import restrictive policy, then investment will go to industries with no comparative advantage. In this case, FDI will not bring much benefit or can even be counterproductive by keeping inefficient industries working and diverting resources from efficient ones. Moreover, under the import-restrictive policy FDI may be affected by rent-seeking activities. An export-promoting regime, on the other hand, creates incentives for investment in competitive industries and does not bring distortions. On top of this, in that case production is not limited by the domestic market, and investment may promote production for foreign markets, which can result in additional benefits from economies of scale. WTO membership makes the trade regime more open with less import restrictiveness and more export development, hence increasing benefits from foreign direct investment.

FDI and Intellectual Property Rights

Most researchers agree that a country with stronger Intellectual Property Rights (IPRs) protection will attract more foreign investment. The reason is that a smaller risk of imitation increases demand for protected products and investing firms will enjoy longer periods of profitability.

Thus, Mansfield (1994) argues that if a developing country has weak IPR protection,

multinational companies will be less eager to invest in such a country, and, if they do so, they would prefer to invest in a fully owned subsidiary or transfer outdated technology.

Maskus (2000) reviewed the theoretical studies of how intellectual property rights influence foreign direct investment. He concluded that stronger IPR protection should be positively connected to the inflow of capital, but this relationship varies across different industries. The author argues that investment in low-technology products (such as textiles, assembly of products, distribution) does not depend much on strong IPRs. Neither does investment in products, which are costly to imitate illegally. In contrast, firms that manufacture products which can be easily copied (such as pharmaceuticals, chemicals, software) are highly interested in an efficient IPRs system and would pay particular attention to protection for patents and trade secrets.

Conversely, Braga *et al.* (1998) identified two cases in which IPRs may have a negative effect on FDI inflow. First of all, strong IPR protection may give title holders excessive market power which can theoretically lead to a reduction of supply and higher prices. Second, being sure in a high level of protection, foreign producers might switch from foreign direct investment to licensing; the latter is less favourable for economic development in a recipient country, compared with inflow of capital.

2.3. Accession Process and Experience of Transition Countries

Accession Process

WTO accession is a complex and lengthy process and is becoming even more complicated as new WTO agreements and regulations come in force. Since the birth of the WTO in 1995 till the end of 2006, 21 countries have become members and 30 more are seeking membership (WTO, 2005).

Article XII of the WTO Agreement states: “Any state or customs territory having full autonomy in the conduct of its trade policies is eligible to accede to the WTO on terms agreed between it and WTO Members”.

To initiate the process of accession, a country should submit an official request for accession to the WTO Director General. This request is considered during the next General Council meeting, and, in the case of a positive decision, the applicant country receives observer status and a Working Party opens to all WTO members. In the case of a large accessing country, many members participate in the Working Party, if the candidate is small, usually only the “Quad” countries (Canada, the EU, Japan and United States) as well as neighbouring countries take part.

Next, the applicant should present a Memorandum on the Foreign Trade Regime. The Memorandum explains the policies and institutions of the acceding country and forms the basis for further negotiations. This document includes a description of economic policies and foreign trade in goods and services, the trade-related intellectual property regime, investment, economic integration agreements with third countries, the decision-making process as well as the statistical appendix. After the Memorandum has been circulated among the WTO members, the “question-answer” stage starts. Members ask questions in order to clarify indistinct points and wait for a reply from the applicant. This process is usually repeated several times until members are satisfied with the Memorandum. By the end of this stage, the Working Party issues a draft report, containing the Memorandum, the questions and answers and discussions of the Working Party.

At some point during the “question-answer” process, the acceding country should submit an initial offer on goods and services which consists of a tariff schedule with an indication of the “bound” level of tariffs and a commitment on market access for services.

Having completed the initial offer, the countries start bilateral negotiations. Members of the Working Party assess the initial offer and generally ask for further concessions and commitments. Negotiations continue until all sides are satisfied with the offer and result in signing a bilateral agreement. When the process of bilateral negotiations concludes, all commitments and concessions are combined in the Schedule of Concessions and Commitments on Goods and the Schedule of Specific Commitments on Services.

After that, the WTO Secretariat prepares the Accession Package, which consists of the following documents:

- The Working Party Report;
- The Protocol of Accession;
- The Schedule of Concessions and Commitments on Goods;

- The Schedule of Specific Commitments on Services.

This Accession Package should be adopted at the final Working Party meeting and passed for approval to the General Council or the Ministerial Conference. The Decision of the General Council or the Ministerial Conference should be adopted by consensus, or by two thirds in a case in which at least one country has objections. The applicant country signs the Protocol of Accession and 30 days after becomes a member of the WTO.

Overall, the policy and regulations of the acceding country should be consistent with 15 mandatory agreements of the WTO (USAID, 2004):

1. The General Agreement on Tariffs and Trade (GATT)
2. The Agreement on Agriculture
3. The Agreement on the Application of Sanitary and Phytosanitary Measures (SPS)
4. The Agreement on Textiles and Clothing
5. The Agreement on Technical Barriers to Trade (TBT)
6. The Agreement on Trade-Related Investment Measures (TRIMs)
7. The Agreement on Antidumping (AD)
8. The Agreement on Customs Valuation
9. The Agreement on Preshipment Inspection (PSI)
10. The Agreement on Rules of Origin
11. The Agreement on Import Licensing Procedures
12. The Agreement on Subsidies and Countervailing Duties (CVD)
13. The Agreement on Safeguards (SG)
14. The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs), and
15. The General Agreement on Trade in Services (GATS)

Accession experience of transition countries

The experience of transition countries in gaining membership in the WTO is discussed below. Table 2.4 presents the timeline of accession of the selected transition economies in Europe and Asia.

The oldest members are several former socialist countries, namely the Czech Republic, Hungary, Poland, Romania, Slovak Republic and Slovenia. They joined the GATT system prior to the WTO creation, and in order to become WTO members they just had to sign a draft charter on the WTO when it was established.

Bulgaria and China both applied in 1986, but the process of accession was quite lengthy, 10 and 15 years respectively. In fact, the accession of China is so far the longest one in the history of the WTO. The Baltic States applied in 1993-94 and it took them 5-6 years to gain membership.

Out of the 12 CIS countries, only 4 have completed the application process: Armenia, Georgia,

Kyrgyzstan and Moldova. Contrary to China, Kyrgyzstan has set another record: the shortest accession in the history of the WTO, less than 3 years. Other countries are at different stages of progress. Turkmenistan has yet failed to submit its official application in accordance with WTO rules. Tajikistan and Uzbekistan have made modest progress so far: Uzbekistan had only 3 Working Party meetings during its 12 years of accession. Kazakhstan has made substantial progress recently, but according to United Nations Economic and Social Commission, the course was practically stagnant for some time. This happened because Kazakhstan made an initial offer with rates much higher than the applied ones: for some sectors there was no binding. It also made few commitments to open the services sector. Thus, when Kazakhstan made a tariff offer on goods in 1997, the Working Party members did not accept it as a basis for further negotiations (ESCAP 2001).

Table 2.4. WTO Accession of Selected Transition Countries.

Country	Application	Membership	Country	Application	Membership
EU accession countries			Commonwealth of Independent States		
Bulgaria	11/1986	12/1996	Armenia	11/1993	05/2003
Czech Republic		04/1993	Azerbaijan	07/1997	
Hungary		(GATT)	Belarus	09/1993	
		09/1973	Georgia	07/1996	06/2000
		(GATT)	Kazakhstan	01/1996	
Poland		10/1967	Kyrgyzstan	01/1996	12/1998
		(GATT)	Moldova	11/1993	07/2001
Romania		11/1971	Russia	06/1993	
		(GATT)	Tajikistan	05/2001	
Slovak Republic		04/1993	Turkmenistan		
Slovenia		(GATT)	Ukraine	11/1993	
		10/1994	Uzbekistan	12/1994	
		(GATT)			
Estonia	03/1994	11/1999	Asia		
Latvia	11/1993	02/1999	Cambodia	12/1994	10/2004
Lithuania	01/1994	05/2001	China	07/1986	12/2001
Other CEC			Mongolia	07/1991	01/1997
Albania	11/1992	09/2000	The Lao PDR	07/1997	
Bosnia and Herzegovina	05/1999		Viet Nam	01/1995	01/2007
Croatia	09/1993	11/2000			
FYR Macedonia	12/1994	04/2003			

Source: WTO secretariat

In 1992, the Russian Federation inherited from the USSR the status of observer in GATT and applied for accession in the middle of 1993. In February 1994, Russia submitted a Memorandum of the Foreign Trade Regime in the Russian Federation. Two years were needed to proceed sufficiently to establish a Working Party consisting of 58 members. At the start, the Working Party concentrated on a multilateral discussion of economic regulations and trade policy in Russia. In 1998, Russia submitted its initial tariff offer on goods and offers on government support of agriculture. In 1999, it submitted the first draft of specific commitments on services

and a list of exemptions from MFN principle. Submission of these documents allowed bilateral negotiations to start. According to the Russian Ministry for Economic Development and Trade (www.wto.ru), over 50 countries are involved in trade negotiations on goods and over 30 countries in negotiations on services.

There are several issues which have provoked serious discussion between Russia and members of its Working Party: energy pricing, intellectual property rights, agriculture, sanitary and phytosanitary regulations, trade in services, civil aircraft, and other issues.

Russian-exported energy resources are sold at world prices, while domestic sales are regulated by the government, which has resulted in considerably lower domestic prices. Several WTO members have expressed concerns that such dual pricing gives Russian producers an unfair competitive advantage and disagrees with the WTO regulation on subsidies. In return, the Russian side argued that lower domestic prices reflect comparative advantage in the production of energy and do not contradict WTO stipulations on subsidies, since they are provided to all economy, and not just to selected enterprises or industries (Cooper, 2006).

Intellectual property rights in Russia are also raising concerns among WTO members, especially the USA. Although Russia has passed laws protecting intellectual property rights, and has become a member of major international conventions in this sphere, its enforcement of the laws is not sufficient. As estimated by the International Intellectual Property Rights Alliance, as a result of the violation of intellectual property rights in Russia losses of U.S. companies amounted to USD 1.7 billion in 2005 (IIPRA, 2006). At the end of 2005, Congress even threatened to call back its programme of Generalized System of Preferences for Russia if the latter did not enforce respective laws (Cooper, 2006).

Agriculture has evoked some controversy as well. First of all, WTO members are not satisfied with the high level of support envisaged for the Russian agricultural sector, and claim that it is not in line with the current round of negotiations, the Doha Development Agenda. Second, the decision taken in 2003 to restrict imports of meat to Russia is argued as contradicting the “standstill” principle that requires countries to abstain from imposing new trade barriers while negotiating accession.

Other significant disputed issues are the reluctance of Russia to allow the opening of branches of foreign banks and to sign the plurilateral WTO Civil Aircraft Agreement, which is approved by only 26 WTO members and requires elimination of the tariffs on trade in aircrafts, and some equipment (Cooper, 2006).

The Russian Federation has chosen to follow a protectionist strategy in negotiating tariff rates. As shown in Table 2.5, the weighted average rates of import tariffs on agricultural products was 14.7% in 2001, but Russian authorities planned to agree initial bound tariff rates at a level of 34.7%: it is intended that even the final bound rate after the transition period will stay at the level of 25%, which is even higher than prior to the WTO membership. The same picture is for industrial goods: the initial tariff rate is 14%, the final one almost 10%. Industries which are projected to receive a high level of protection are textiles, metallurgy, and machinery.

Table 2.5. Weighted Average of Applied and Bound Rate of Tariffs in Russia.

	Applied import tariff rate, % (as of Jan. 2001)	Initial bound rate of import tariff, %	Final bound rate of import tariff, %
Agricultural goods	14.70	34.71	25.11
Industrial goods	9.73	14.32	9.84
Including:			
Mineral products	5.43	11.06	5.43
Chemicals	8.48	10.22	6.09
Forestry, paper industry	8.73	14.62	7.85
Textiles	11.69	18.31	12.37
Metallurgy	11.35	19.29	11.70
Machinery	9.48	14.83	8.75

Source: www.wto.ru

The next table (Table A.1 in appendix) summarizes the commitments made by some of the new WTO members. Bound import tariff rates vary quite considerably among countries: from 10% to 35% for agricultural products and from 5% to 20% for industrial goods.

Bulgaria has the highest level of protection for agricultural products: the average import tariff rate is almost 35%, followed by that of Latvia, with 33.6%. Two other Baltic States, Estonia and Lithuania have also set high tariffs for agricultural imports: 17.7% and 15.6% respectively. Other countries, excluding Mongolia, are committed to an average 10-12% of import tariffs on agricultural goods. Mongolia negotiated on an 18.4% import tariff rate for agricultural products and 20% for industrial goods. Bulgaria, Latvia and Lithuania follow with 12.6%, 9.3% and 8.2% import tariffs rates for industrial products respectively. Other countries have agreed to set import tariffs for industrial goods at the 5-6% level. All countries are committed to cease export subsidies for agriculture and have agreed to keep the limit of the total aggregated measurement of support to agriculture at a level of agricultural production of either 5% or 10% depending on their income.

Several studies have concentrated on the peculiarities of accession to the WTO by transition countries. Thus, Michalopoulos (1998) pointed that transition countries have specific impediments on the way to the WTO membership. Michalopoulos (1998) has drawn attention to the fact that “(a) there are extensive legislative requirements that need to be met prior to accession and, legislative processes are inherently time consuming; (b) acceding countries have weak institutional capacities and sometimes even lack familiarity with the economic and legal issues that need to be addressed; (c) WTO members have been placing greater demands on acceding countries than the disciplines required from existing members; (d) ... compared with the IMF and the World Bank, the WTO provides much less technical assistance in support of accession; (e) accession requires that the specific commercial interests of all members are addressed, which requires extensive and time consuming negotiations.” The United Nations Economic and Social Commission (ESCAP, 2001) also point to the lack of analytical and policy-making experience of transition countries, especially during preparation of the Memorandum on the Foreign Trade Regime as well as the question and answer stage. Another significant barrier is constantly raising requirements to the new members, as WTO rules become more sophisticated.

2.4. Ukraine and World Trade Organization

The process of Ukraine's accession to WTO system started in 1993, when the official application was submitted; later in 1994 a Memorandum on the Foreign Trade Regime of Ukraine was sent to the WTO Secretariat. Altogether, 17 Working Party meetings have been held. The chronology of these meetings, agenda and decision of the Working Party are given below.

First meeting of the Working Party

February 27-28, 1995

Agenda	Decision of the Working Party
Monitoring of economic policies and import regulations and their compliance with GATT/WTO requirements In particular: <ul style="list-style-type: none">• Privatization;• Subsidies to goods manufacturers;• Tariff and non-tariff regulation;• Budget and monetary policy;• Standards;• Trade-related intellectual property regime;	WP requested additional information on trade regime
Reform of agricultural sector	Ukraine should set reform of agricultural sector as a main goal for preparation for the second WP meeting

Second meeting of the Working Party

December 11-12, 1995

Agenda	Decision of the Working Party
Review of the latest achievements in bilateral negotiations on market access of goods and services	Since Ukraine's economy is in transition, negotiations on market access should be based not on applied import tariff rates, but on Concept of Custom Rates Transformation
Reform of agricultural sector, in particular: <ul style="list-style-type: none">• Brining protection rules on accordance with the GATT/WTO system;• SPS measures, privatization;• Agricultural trade enterprises.	Conduct tariffication of non-tariff barriers
State of services market, degree of its compliance with the GATS	WP requested additional information on trade in services
State of intellectual property rights system, degree of its compliance with the TRIPS	Legislation should be changed to comply with the TRIPS requirements
Improvement of state trading system	Changes in legislature are required
Bilateral trade agreements of Ukraine	More information is needed.

Third meeting of the Working Party

December 11-12, 1995

Agenda	Decision of the Working Party
Harmonization of foreign trade legislation in accordance with WTO requirements	WP expressed concerns about official position of Ukraine's government to improve trade balance through decrease of imports
Study of schedule of commitments on services	More work is needed, especially concerning banking sector, telecommunications and sea transport
Analysis of standards, certification and licensing system	System of non tariff regulation does not correspond to the WTO requirements and aims at decrease of imports. This concerns a system of indicative prices, registration of contracts, certification. WP points at import-prohibitive nature of such barriers.
Analysis of Ukraine's trade preferential agreements	Ukraine should revise an agreement on industrial cooperation within the CIS countries, since it disagrees with nondiscrimination WTO requirements

Fourth meeting of the Working Party

May 6-7, 1997

Agenda	Decision of the Working Party
Discussion of first round of negotiations on market access for goods	WP pointed at negative consequences of specific import tariff, established at 1996
Discussion of first round of negotiations on market access for services	WP positively evaluated commitments made by Ukraine and proposed concentrating on financial and insurance markets
Analysis of standards, certification and licensing system	WP once again drew attention to non transparency of non-tariff barriers in Ukraine
Analysis of Custom Code project	Custom Code project is a good starting point, but more work is needed on customs valuation and rules of origin
Discussion of domestic support and export subsidies in agricultural sector	WP does not agree to set base period of agriculture support as in years 1986-1990

Fifth meeting of the Working Party

November 24-25, 1997

Agenda	Decision of the Working Party
Review of the latest achievements in bilateral negotiations on market access of goods and services	WP pointed to following positive developments intentions of Ukraine to:

	<ul style="list-style-type: none"> • Join Reference Paper on telecommunications; • Decrease import tariffs for IT goods to zero; • Do not apply export subsidies for agricultural products.
Review of domestic support and export subsidies in agricultural sector	<p>Following problems were noticed:</p> <ul style="list-style-type: none"> • Law “On State Regulation of agricultural imports”; • Excess requirements concerning certification of goods; • Minimal prices on agricultural import.
Review of Memorandum on taxation regime in Ukraine	WP expressed concerns about the Law “On support of car production in Ukraine”
Review of Memorandum on technical barriers to trade	There is a need to establish an information centre on standardization and certification; reciprocally recognize certificates.
Review of Memorandum on sanitary and phytosanitary measures	There is a need to establish an information centre on sanitary and phytosanitary measures; reciprocally recognize certificates.
Additional questions	Ukraine gave answers on additional questions of the WP concerning foreign trade regime

Sixth meeting of the Working Party

July 10, 1998

Agenda	Decision of the Working Party
Developments in the foreign policy of Ukraine	Worries were expressed concerning significant deterioration of trade and investment climate in Ukraine; discrimination during collection of VAT and excise tax; appliance of minimal prices.
Review of the latest achievements in bilateral negotiations on market access of goods and services	Considerable progress was noticed, some countries stated that they are close to signing bilateral agreement with Ukraine
Technical barriers to trade, sanitary and phytosanitary measures	WP again stressed the discrimination character of import control system, for instance requirements to obtain several certificates on one good, etc. Without significant improvement in technical barriers no further progress in accession is possible
Intellectual property rights	Ukraine disseminated Memorandum on intellectual property rights and requested 3 years transition period.

Seventh meeting of the Working Party

July 12, 2000

Agenda	Decision of the Working Party
Review of legislation	WP were interested in studying following laws: <ul style="list-style-type: none"> • Custom Code; • Law on custom valuation; • Law on state trade. Also, questions were raised concerning import quotas, TBT, SPS and preferential excise tax payment for domestic goods.
Privatization	Ukraine informed about privatization of its enterprises and clarified requirements to investment and its sources.
Agriculture	European Union stated that its companies had difficulties accessing Ukrainian agricultural market.
TBT	WP noticed positive changes in TBT and requested additional information about goods, subject to compulsory certification.
SPS	WP requested Ukraine to provide full information of adjusting legislature according to WTO requirements.
Support of domestic enterprises	Ukraine has a number of subsidies: support of domestic car production, free economic zones with tax privileges. Request was made concerning adjustment of legislature and state enterprises, functioning in free economic zones.
TRIPS	WP requested Ukraine to provide full information of adjusting legislature according to WTO requirements.
Trade with CIS countries	WP asked for information concerning trade benefits to CIS countries which constrain trade with other countries

Eighth meeting of the Working Party

June 13-14, 2001

Agenda	Decision of the Working Party
Review of the latest achievements in bilateral negotiations on market access of goods and services	WP noted that first bilateral protocols were signed with Mexico, Uruguay and New Zealand and several other countries are close to signing it.
Review of legislation	WP concentrated on legislation concerning import licensing, import taxes, custom

	valuation.
Further agenda of the WP	Adjustment of legislature according to WTO requirements is a prerequisite of further progress in accession

Ninth meeting of the Working Party

July 25-26, 2002

Agenda	Decision of the Working Party
Review of the latest achievements in bilateral negotiations on market access of goods and services	More bilateral protocols were signed. Ukraine provided revised tariff concession schedule.
Review of legislature	Ukraine provided WP with new schedule of adopting WTO-related legislature. It consisted of 20 laws, which were planned to be approved by March 2003.
Discussion of documents provided prior to WP meeting concerning TBT, SPS, intellectual property rights, tax regime.	WP acknowledged that Ukraine fulfilled its obligations, made during last meeting. More detailed study of legislation is needed, especially Custom Code, import licensing, and intellectual property rights.
Further agenda of the WP	WP made decision to prepare check-list of questions concerning trade regime of Ukraine. Answers to these questions will become a basis for draft Report of the WP
Multilateral meeting of WP members concerning agriculture	Ukraine disseminated document describing strategy of agricultural sector developments and grounds for defining level of domestic support

Tenth meeting of the Working Party

February 25-26, 2003

Agenda	Decision of the Working Party
Review of the latest achievements in bilateral negotiations on market access of goods and services	Considerable progress was made during bilateral negotiations; relatively few questions are left undecided.
Review of legislature	Ukraine approved 15 out of 20 laws, planned as a phase of adjustment. Such questions as sanitary and veterinary legislation have to be studied additionally.
Review of Ukraine's replies to a check-list of questions	During review of consolidated check-list of questions and answers main attention was drawn to following topics: <ul style="list-style-type: none"> • Privatization;

	<ul style="list-style-type: none"> • Licensing of imports; • Custom valuation, custom clearance (in particular rational for financial backing of transit goods); • Sanitary requirements (in particular necessity of sanitary control of transit goods, doubling of sanitary requirements by different branches of authorities); • Agriculture, rational for setting 2000-2003 as a base for calculation of total measurement of support.
Further agenda of the WP	<p>WP and Ukraine should:</p> <ul style="list-style-type: none"> • Continue bilateral negotiations; • Monthly monitor schedule of adopting legislature; • Prepare revised answers to Consolidated check-list of questions and answers; • Hold multilateral negotiations concerning state support of agriculture; • Start preparing first draft of WP Report.

Eleventh meeting of the Working Party

October 27-28, 2003

Agenda	Decision of the Working Party
Review of the latest achievements in bilateral negotiations on market access of goods and services	There are several unsettled questions in bilateral negotiations. The concern is import tariffs for sensitive sectors of economy, like agriculture, fishery, food processing.
Review of legislature	WP was informed about newly adopted legislature in spheres of technical regulations, intellectual property rights, and dissemination of audio and video records, software. WP requested additional work on laws concerning TBT and SPS.
Review of Ukraine's replies to a check-list of questions	<p>WP noted that more work is needed in following spheres:</p> <ul style="list-style-type: none"> • Foreign currency regulation; • Price regulation; • Privatization; • Licensing; • SPS.
Further agenda of the WP	<p>Ukraine should:</p> <ul style="list-style-type: none"> • Proceed with legislative reforms; • Prepare answers to additional

	questions concerning market access.
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Twelfth meeting of the Working Party

April 26-30, 2004

Agenda	Decision of the Working Party
Review of the latest achievements in bilateral negotiations on market access of goods and services	WP noticed progress in bilateral negotiations and admitted that Ukraine faces additional requirements that emerge from current multilateral trade round of the WTO
Review of domestic support and export subsidies in agricultural sector	WP requested additional information concerning proposition of applying tariff quotas on sugar
Review of foreign trade regime	WP requested additional information concerning export restrictions of some products, i.e.: cattle, leather, scrap of ferrous steel, sunflower seeds

Thirteenth meeting of the Working Party

September 20-21, 2004

Agenda	Decision of the Working Party
Foreign exchange regulations	Regulation, requiring obligatory sale of 50% of foreign exchange revenues should be ceased
Support of domestic enterprises	Subsidies to automobile sector should be eliminated without transition period; Minimum and maximum prices for imports and exports should be abolished; No quantitative restrictions on fish and fish products trade should be applied
Review of legislature	Concerns were raised resulting from VAT exemptions on certain imports from Russia, including crude oil and some agricultural products

Fourteenth meeting of the Working Party

March 22-23, 2005

Agenda	Decision of the Working Party
Support of domestic enterprises	Ukraine should abolish privileged VAT tax rate for domestic producers of automobiles; No discrimination should be practiced in Free Economic Zones.
Review of legislature	Custom Code should not violate geographical indications requirements;

	Export tax for steel scrap should be canceled
Review of domestic support and export subsidies in agricultural sector	Problems arise due to application of minimal prices for sugar

Fifteenth meeting of the Working Party

November 23-24, 2005

Agenda	Decision of the Working Party
Support of domestic enterprises	Ukraine should cancel: <ul style="list-style-type: none"> • Restrictions on automobile imports with regard of their age; • Subsidies for natural gas purchase to selected enterprises; • Restrictions on export of non-ferrous steel scrap; Export tax for ferrous steel should be 5% at the end of transition period
Review of domestic support and export subsidies in agricultural sector	Abolish minimal prices for sugar
Review of legislature	Laws in following spheres need additional work: <ul style="list-style-type: none"> • Import licensing of alcoholic beverages; • Veterinary regulations

Sixteenth meeting of the Working Party

June 15-16, 2006

Agenda	Decision of the Working Party
Review of the latest achievements in bilateral negotiations on market access of goods and services	WP was pleased that bilateral negotiations were concluded with all countries, besides Kyrgyzstan. The issues which were raised by Kyrgyzstan may be politically motivated
Review of domestic support and export subsidies in agricultural sector	Ukraine should eliminate price control over agricultural commodities; Import quotas on sugar should be cancelled and transparent procedures for tariff quotas should be set;
Review of legislature	Changes should be made to: <ul style="list-style-type: none"> • The law on banking activities to allow establishment of foreign banks branches; • The Value Added Tax law remaining national treatment violations; • The Law on Government

	procurement
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Seventeenth meeting of the Working Party

January 25, 2008

Agenda	Decision of the Working Party
Review of Ukraine's progress with regard to becoming a WTO member	Progress of Ukraine was acknowledge as sufficient to become a WTO member
Review of commitments in goods and services	Final commitments of Ukraine with regard to trade in goods and services were agreed
Draft decision concerning accession of Ukraine to the WTO	Ukraine may accede to the WTO Agreement on the terms and conditions agreed during this Working Party

Bilateral negotiations between Ukraine and WTO members started in 1997. There are 51 countries which decided to conduct such negotiations; by the end of 2007, all 51 protocols had been signed (Table 2.6).

Table 2.6. Signature of Bilateral Protocols between Ukraine and WTO Members

2001	Mexico Uruguay New Zealand	2004	Switzerland Argentina Malaysia Paraguay Lithuania Turkey Mongolia Sri Lanka
2002	Canada Republic of Korea Slovenia Georgia Latvia India	2005	El Salvador Japan Norway Indonesia Moldova Croatia Iceland Peru Ecuador China Honduras Dominican Republic Morocco Romania
2003	Hungary European Union Czech Republic Slovakia Bulgaria Cuba	2006	USA Armenia Panama Australia Egypt Columbia

	Israel Poland Brazil Estonia Thailand		Chinese Taipei
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Source: Ministry of Economy of Ukraine

During bilateral negotiations, WTO members raised the following issues:

Lithuania	Goods: machinery, import duty on mineral oil products.
Argentina	Goods: geographical indications, in particular wine and cheese. Domestic support of agriculture
Turkey	Goods: metal scrap
El Salvador	Goods: market access of cane sugar
Japan	Goods: certification of electronic goods; Services: enforcement of intellectual property rights protection; market access of foreign banks' branches and insurance companies.
Norway	Goods: Norway required larger concessions on fish, canned fish, and navigation equipment. Services: market access for sea transport and telecommunications.
Moldova	Goods: questions concerning Ukraine's trade regime, i.e.: transit, licensing; Services: presence of natural persons
Croatia	Goods: agricultural products.
Iceland	Goods: fish, food processing machinery
China	Goods: textiles Services: sea transport
USA	Goods: agricultural products (poultry, fish); Services: enforcement of intellectual property rights protection; market access of foreign banks' branches and insurance companies.
Australia	Goods: market access for cane sugar; increase of quota for cane sugar; abolishment of minimal prices for sugar; commitments concerning reforms in sugar industry; geographical indications
Chinese Taipei	Goods: fish;

Services: sea transport, financial services

Kyrgyz Republic Goods: agricultural products, textile, machinery; (signed in late 2007)
Other: dispute over state debt

There are five types of WTO commitments which Ukraine had to make: goods commitments, services commitments, legal, rules, and notification ones.

Goods commitments

This type of commitment refers to binding import tariff rates and agricultural subsidies commitments.

As mentioned earlier, prior to WTO accession, Ukraine applied Most Favoured Nation (MFN) tariffs (applicable to 45% of imports in 2002), full import tariffs (relevant to only 3% of imports), as well as Free Trade Agreements with a number of significant trade partners (53% of imports came from them in 2002).

The first consolidated tariff offer was submitted to the WTO in 1999 and was revised for several times afterwards. Table 2.7 presents the MFN, full tariffs, as well as the WTO tariff commitment of Ukraine for key sectors. In general, bound tariffs under WTO are quite low: around 11.1% for agricultural products and 4.6% for industrial goods.

Table 2.7. Import Tariff Commitments of Ukraine

	MFN Tariff	Full Tariff	Post-WTO
Agriculture	26.7	78.7	19.4
Fishery	21.2	57.2	10.0
Mining of coal and peat	0.0	0.0	0.0
Production of non-energy materials	1.1	7.2	1.1
Food-processing	50.5	68.2	18.9
Textiles and leather	8.2	20.2	4.0
Forestry, wood working, paper industry	8.1	24.0	4.9
Petroleum refinement	0.0	0.0	0.0
Chemicals	7.9	17.4	5.8
Other non-metallic mineral products	11.1	23.0	10.0
Metallurgy	3.8	9.8	1.5
Machinery	7.3	19.8	3.5
Miscellaneous	9.8	30.6	8.5

Source: WTO, IER (2006) calculations Dutch Grant # TF 050270

To define the bound level of domestic support, Ukraine proposed to choose the base period of 1994 – 1996. The Aggregate Measure of Support (AMS) constitutes 5% of agricultural production, or roughly USD 1.4 bn.

Services commitments

There are four modes of transactions identified by GATS classification depending on the territorial presence of supplier and consumer at the time of the transaction (WT/ACC/10, 2001):

- Mode 1 refers to cross-border trade (the supply of a service from the territory of one member into the territory of any other member);
- Mode 2 to consumption of services abroad (the supply of a service in the territory of one member to the service consumer of any other member);
- Mode 3 to commercial presence (the supply of a service by a service supplier of one member, through commercial presence in the territory of any other member); and
- Mode 4 to the presence of natural persons (the supply of a service by a service supplier of one member, through presence of natural persons of a Member in the territory of any other member).

Limitations based on these classifications are:

- limitations on the number of service suppliers;
- limitations on the total value of service transactions and assets;
- limitations on the total number of service operations as the total quantity of service output;
- limitations on the total number of natural persons employed; restrictions on specific types of legal entity as joint venture;
- ceilings on foreign equity participation.

Partial commitments of Ukraine, i.e. those which have some limitations, are presented in Table 2.8 below.

Table 2.8. Partial Services Commitments of Ukraine.

Sectors	Limitations on market access	Limitations on national treatment
Horizontal commitments		
Land ownership	No limitations	3), 4) Foreigners cannot acquire agricultural purposes land. No limitations on renting land.
Subsidies	No limitations	Only citizens of Ukraine have the right to obtain subsidies.

Movement of natural persons	4) Foreigners should obtain work permits.	No limitations
Sectoral commitments		
Notary services	1), 3), 4) Only citizens of Ukraine are permitted to supply notary services	No limitations
Auditing services	1) Requirement of a compulsory confirmation by an auditing firm of Ukraine of a foreign auditor's conclusion	No limitations
Medical and dental services	3) Professional qualification requirements according to Ukrainian legislation	3) Foreigners must speak Ukrainian.
Services provided by midwives, nurses, physiotherapists and paramedics	3) Professional qualification requirements according to Ukrainian legislation	3) Foreigners must speak Ukrainian.
Postal services	1), 2), 3) Licensing systems may be established for some sub-sectors.	No limitations
Education services	3) Only a citizen of Ukraine may be the head of an educational institution.	No limitations
Insurance services	3) Five years transition period is required	No limitations
Reinsurance and retrocession services	1) Foreign re-insurer should have a continuous experience in the insurance activity not less than three years.	No limitations
Money market instruments	3) Requirement to register as a legal entity	No limitations
Services related to derivative products	3) Requirement to register as a legal entity	No limitations
Other negotiable instruments, including gold bars	3) Requirement to register as a legal entity	No limitations
Securities emission	3) Only legal persons engaged exclusively in issuance of securities, and banks;	No limitations
Asset management	3) Requirement to register as a legal entity	No limitations
Hospital services	3) Professional qualification requirements according to Ukrainian legislation	4) Foreigners must speak Ukrainian
Other human health services	3) Professional qualification requirements according to Ukrainian legislation	4) Foreigners must speak Ukrainian
News agency services	3) Foreign investment is	No limitations

	limited to 30%	
International transport	4) Unbound, except as provided in the horizontal section	No limitations

Source: Ministry of Economy of Ukraine, WTO Secretariat

Legal commitments

Legal commitments concern laws, regulations, etc. which have to be adopted prior to accession to the WTO. Some important laws which had to be implemented or changed are:

Law on cancellation of export ban for metal scrap to replace export ban for metal scrap with export duty for these products and to reduce such duties gradually.

Law on tariff rate quota for raw cane sugar to eliminate quotas on imports of cane sugar and replace it with tariff rate quotas in order to meet bilateral commitments of Ukraine.

Law on banks and banking activities to allow for establishing of foreign banks' subsidiaries in Ukraine according to a WTO member's request.

Law on state support of agriculture in Ukraine to eliminate minimum import prices and other WTO-inconsistent provisions.

Law on alcohol and tobacco and some articles of Law on the taxation system to bring import licence fees in line with GATT 1994 and eliminate discriminatory fees for spirits, alcohol and tobacco products.

Law on procurement of goods, services, and works to indicate that state enterprises are subject to the Law on government procurement only when procuring for governmental use.

Law on some issues of imports of vehicles into Ukraine - to eliminate age limit on import of used vehicles.

Rules commitments

The main aim of the rules commitments is to establish whether Ukraine's policy conforms to WTO rules and, in particular, how it should be changed if necessary. State bodies should confer with these commitments before making decisions, which would affect foreign trade regime.

There are different types of rules commitments (WT/ACC/10, 2001):

- Statements of fact rather than commitments;
- Obligations to stand by existing WTO rules, sometimes specifying national measures to be amended to bring them into conformity with WTO provisions on the subject in question, sometimes elaborating on the WTO provisions on the subject in question;
- Obligations not to have recourse to specific WTO provisions, e.g. those relating to transitional periods. These most often relate to customs valuation and TRIPS;

- Specific identification of transitional periods that may be used, e.g. customs valuation. These relate to right of appeal, other duties and charges, subsidiaries and trade-related investment measures;
- Authorisation to depart temporarily from WTO rules or from commitments in the Goods Schedule. These are related to internal taxes, import licensing, technical barriers to trade and agricultural support;
- Obligations to abide by rules created by the commitment paragraph and not contained in WTO Multilateral Agreements. These relate to an obligation to comply with "WTO obligations and other international obligations", privatisation, sub-central governments, government procurement, trade in civil aircraft and publication.

The selected rules commitments of Ukraine are listed below.

State ownership and privatization

Ukraine would provide periodic reports to WTO Members on developments in its programme of privatization.

Pricing policies

Ukraine introduced changes to the Law "On State Support of Agriculture in Ukraine" which would cancel the provisions on minimum purchase prices applied to imports, as well as the provisions on the introduction of quotas on imports or exports.

Customs duties

Ukraine committed not to change the staging of the tariff reductions, as indicated in its tariff offer. Ukraine would not list any "other duties and charges" in its Schedule of Concessions and Commitments on Goods, binding such charges at zero from the date of accession.

Tariff rate quotas, tariff exemptions

From the date of accession, Ukraine would allocate its only tariff rate quota on raw cane sugar in conformity with the WTO requirements. Allocation methods would not have trade-restrictive or distortive effects on imports. Ukraine would introduce a process of consultation with trading partners, importers and exporters prior to the amendment of the tariff quota.

Application of Internal Taxes on Imports

Ukraine would apply its domestic taxes, including the excise taxes and value added taxes, in full compliance with provisions of the WTO, including the Agreement on Subsidies and Countervailing Measures. Ukraine would amend the Laws on VAT and taxation of agricultural producers to ensure full conformity with the provisions of WTO upon accession.

Import licensing systems

Ukraine will eliminate the ban on imports of buses, trucks and cars older than eight years. From the date of accession, Ukraine would eliminate and would not apply quantitative restrictions on imports such as licensing, quotas, bans, etc., that cannot be justified under the WTO provisions.

Anti-dumping, countervailing duties, safeguard regimes

Ukraine would not apply any anti-dumping, countervailing or safeguard measures until it had implemented appropriate laws in conformity with the provisions of the WTO Agreements on Subsidies and Countervailing Measures, and on Safeguards.

Export restrictions

Ukraine is committed to eliminate the export ban on non-ferrous scrap by the date of accession, and to substitute it by export duties.

Export subsidies

From the date of accession Ukraine will not maintain export subsidies.

TBT

Ukraine would ensure that only technical regulations meeting WTO requirements would be mandatory. Ukraine would not use standards and technical regulations in a manner that would be restrictive to international trade, prohibitive to imports, and discriminatory of individual exporters and suppliers.

SPS measures

The Enquiry point on SPS measures would be in operation from the date of Ukraine's accession to the WTO. Ukraine would apply all its SPS measures consistently with the requirements of the corresponding WTO Agreements without any transitional arrangements.

State-trading entities

State owned enterprises would make purchases of goods and services, which were not intended for governmental use and sales in international trade in accordance with commercial considerations, and would give enterprises of other WTO members adequate opportunities.

Transparency

From the date of accession, all legislation related to trade would be published promptly in a manner that fulfils WTO requirements. Therefore, no law or regulation related to international trade would become effective prior to such publication in an official source of information.

Notification commitments

Ukraine, along with other members, agreed to comply with notification commitments. The purpose of such commitments is to prevent WTO member states from creating obstacles to international trade through national measures, which sometimes may be non transparent for other members. Under these commitments, Ukraine is obliged to report all proposed changes in regulations which affect the operation of the WTO system.

Ukraine is committed to notify changes in all major fields which fall under WTO agreements: trade in goods and services, agriculture, SPS and TBT, TRIMS, antidumping, subsidies, safeguard measures, etc. Notification commitments state in what cases Ukraine should notify WTO; to whom exactly it should send notification; terms, during which notification should be made; what kind of information should be provided; and the proposed format of notification.

Hence, in the case of safeguard measures, Ukraine should inform about: (a) initiating an investigatory process relating to serious injury or threat to domestic industry and the reasons for it; (b) finding a case of serious injury or threat caused by increased imports; (c) taking a decision to apply or extend a safeguard measure.

Notification should be made to the Committee on Safeguards. Information has to be sent as soon as Ukraine arrives at any of the three cases pointed above. In the case of a provisional safeguard measure Ukraine should notify before taking this measure. Notification should contain evidence of serious injury or threat caused by increased imports, a precise description of the product involved and the proposed measure, the proposed date of introduction, the expected duration and timetable for progressive liberalization. In case of an extension of a measure - evidence that the industry concerned is adjusting shall also be provided.

Chapter 3

Methodology of Research

3.1. Computable General Equilibrium Models

A Computable General Equilibrium model is a model of fundamental economic links between incomes of various groups, demand pattern, multisector production structure, and foreign economies. The model incorporates behavioural equations describing the economic actions of agents, and the technological and institutional constraints facing them (Thissen, 1998). In line with Dixon (2006), it is useful to give further insight into the definition of Computable General Equilibrium models by looking at each word that forms its name.

CGE models include explicit specification of the behaviour of several economic agents and captures inter-linkages between those agents, thus these models are *general*. Households maximize utility, while producers either maximize profits or minimize costs and make decisions on consumption and production based on optimizing assumptions. There are also behavioural equations for other agents, such as government, foreign sector participants, etc.

Demand and supply decisions of economic agents define the level of prices and production such that demand is equal to supply for all commodities and factors; markets are in *equilibrium*.

CGE models are solved using special software and produce numerical results, so they are *computable*.

CGE models can be used for real-world applications with actual input data and relevant output. This feature makes the CGE method extremely useful for policy analysis of many issues, including changes in trade regime, tax reform, agricultural policy, regional development, etc. Because of this, such a model is also called an Applied General Equilibrium model.

CGE models have their roots in the Walrasian general equilibrium theory, which was re-formalized in the 1950s. The study of Arrow and Debreu (1954) is one of the fundamental studies which states that the situation exists when all markets are in equilibrium and demand does not exceed supply. In the applied sense, CGE modelling starts with the Leontief input-output analysis described in Leontief (1936, 1941). The central idea of this approach is to consider inter-linkages between different industries and economic agents. The output of each industry is used as an input for other industries or goes to final consumption, making all agents dependent on each other.

The first empirical CGE models were built by Johansen (1960) and Harberger (1962). Johansen used a model with 20 cost-minimizing production sectors and utility-maximizing consumer to identify sources of economic growth in Norway. Harberger built a two-sector model to investigate tax policy issues in the USA. Neither author has checked for the presence of multiple equilibrium and the existence of a unique equilibrium near the benchmark equilibrium. A breakthrough in solving a general equilibrium model was reached by Scarf in 1967. He developed an algorithm for the solution of general equilibrium problem which was quite general in its nature. This algorithm assured finding an equilibrium set of prices under the most general conditions and did not require special constraints on specification of the model. Although the algorithm has been substantially augmented since that time, it was a breakthrough in the sense of

giving researchers the opportunity to build more detailed and complex models than before.

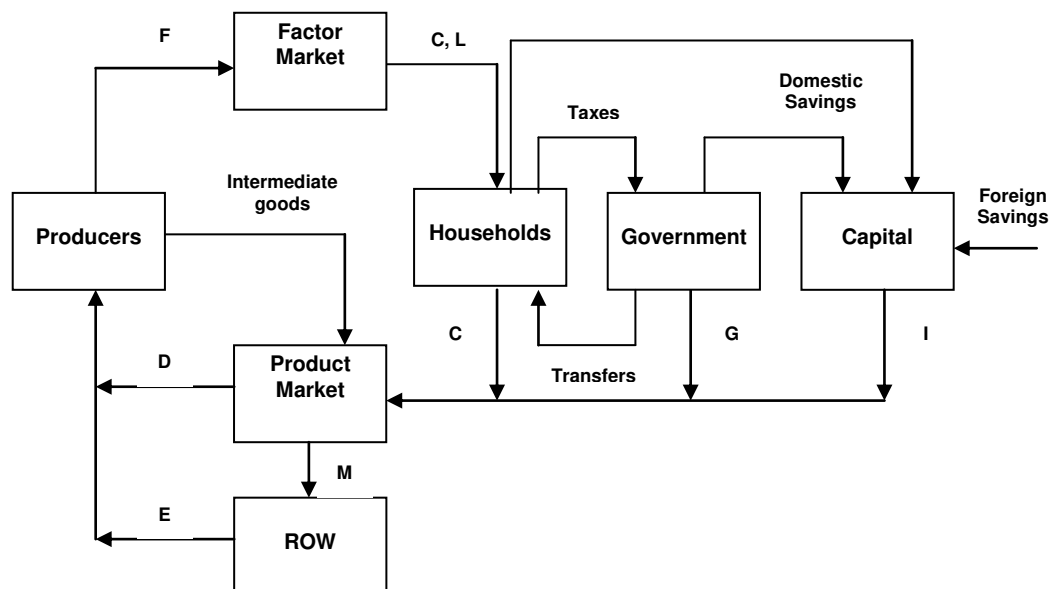
According to Iqbal *et al.* (2001), for several years following Scarf's advance CGE modelling did not receive much attention. Then, one of the earliest policy-oriented general equilibrium models was devised by Shoven and Whalley (1972), Whalley (1975, 1977), Shoven (1976) who studied different aspects of fiscal reform and Miller and Spencer (1977) with the model of the UK joining the European Economic Community.

As mentioned earlier, CGE models are being applied to a wide variety of issues and there are several literature surveys on this topic. Thus, Shoven and Whalley (1984) reviewed two issues: applied general equilibrium tax models and models of international trade. de Melo (1988) discussed models for trade policy analysis in developing countries. Nielsen (2003) covered the literature on CGE models of regional and preferential trade agreements. Piermartini and Teh (2005) discussed applications of general equilibrium to trade policy, placing accent on GATT/WTO issues. Decaluwe and Martens (1988) reviewed the peculiarities of modelling developing economies and included 73 applications to 26 countries. Bandara (1991) surveyed CGE modelling of development policies in Least Developed Countries. Pereira and Shoven (1988) surveyed studies of dynamic CGE models of tax policy evaluation. Devarajan (1988) discussed the application of general equilibrium models to energy issues. Bhattacharyya (1996) reviewed CGE studies of energy and environmental issues. Robinson (1991) surveyed "micro-macro" CGE models with financial variables. Kraybill (1993) as well as Partridge and Rickman (1998) reviewed CGE models of regional economies and their application to regional policy issues. In 2004, Partridge updated his review of regional modelling. Kraev (2003) reviewed literature on general equilibrium models of stabilization and adjustment packages. Some other general reviews on CGE literature are by Shoven and Whalley (1992), Dixon and Parmenter (1996), and Ginsburg and Keyzer (1997).

A fundamental principle of Computable General Equilibrium modelling is captured by a circular flow of income in economy; a typical one is presented in Figure 3.1. Households are owners of factors of production (in this case, labour and capital) and receive income from them; additional income is the form of transfers from the government. Households spend their revenues on consumption and taxes and save the rest. The government redistributes income from taxes to transfers, consumption and savings. Domestic savings coupled with foreign savings form the capital market. Household consumption, government consumption and investment all go to the product market, which is made from domestic goods and imports. Producers receive income from domestic sales and exports and spend it on domestic and foreign intermediate consumption as well as factor payments.

Circular flow of income implies three conditions of equilibrium. First of all, for a given commodity a quantity produced is equal to quantity demanded and there is a market clearance. Second, revenues from production of goods are allocated to households as payment for factors of production, to intermediate demand and to government as taxes, thus a condition of zero profit holds. Finally, returns of households from factor endowments are spent on purchases of goods, taxes and savings and there is an income balance.

Figure 3.1. Circular Flow of Income



Source: adopted from Piermartini *et al.* (2005)

In practice, circular flow of income is captured by organizing data in the Social Accounting Matrix. Data are represented in a form of matrix where columns show the expenditure of each agent and rows show costs of output; each entry is an income for some agent and expenditure for another. Given that there is a market clearance, income balance and zero profit, the sum of the entries in i^{th} row must be equal to a sum of entries in i^{th} column. Figure A.2 shows an example of Social Accounting Matrix (given in Appendix). Rows and columns contain the same title entries: activities, commodities (one activity can produce more than one commodity), factors of production, enterprises, households, government, capital account and foreign sector. Thus, in the commodities' row intermediate demand, household consumption, government consumption, investment and exports sum up to aggregate demand on a given commodity. In the commodities' column, gross domestic output and imports constitute the aggregate supply of a commodity. Aggregate demand is equal to aggregated supply for each commodity. Household income is the sum of income from factors of production, transfers from government and foreign remittances. Expenditure is directed at consumption, taxes, savings and transfers abroad. The same logic is applied to receipts and expenditure in other rows and columns.

Building a CGE model usually requires undertaking several steps:

1. Clearly define the topic of the model. This stage is very important, since other steps, such as data aggregation or choice of functional forms, may be subordinated to the issue of investigation.
2. Build analytically consistent mathematical model.

3. Chose functional forms for production, transformation, and utility functions; specify constraints.
4. Collect data and construct consistent Social Accounting Matrix. Missing data have to be calibrated.
5. Write a code in software. This usually involves software for optimizing systems of non-linear equations. The most widely used are GAMS (General Algebraic Modelling System), GEMPACK (General Equilibrium Modelling PACKage), HERCULES.
6. Benchmark simulation. The model should be consistent and reproduce the input data.
7. Counter-factual experiments.

There are several classifications of CGE models, based on their theoretical background, historical development and modelling technique.

First, a distinction is made according to the theoretical schools of general equilibrium modelling between neoclassical and structuralist models. Neoclassical models, also called “Walrasian” by Thissen (1998) and “fundamental” by Robinson (2003), have their roots in the Walrasian model of competitive economy and Solow’s model of economic growth. The purpose of these models is to analyze the effect of exogenous shocks on optimal allocation of resources, efficiency and welfare. A distinguishing feature of these models is sound theoretical foundations; any attempt to step aside from the theoretical background or to add macro features is considered to be corrupting the model. As was argued by Willenbockel (1994) and Bergman (1990), neoclassical models do not try to represent actual economy, but instead try to construct logical framework for analyzing policy changes. In practice, neoclassical models assume full capacity utilization, full employment and prices determined by marginal productivity. As a result of full employment, adjustment is made through the reallocation of labour from unproductive sectors to productive ones without considerable change in output. According to Robinson (2003), during the last decade neoclassical models have tended to shift away from strict theoretical regulations and include macro features.

Another type of CGE models, is the structuralist model, originating from the work of Keynes (1936), Kaldor (1957), Kalecki (1971) and lately analyzed by Taylor (1990, 1991). The prime idea of these models is to capture institutional specifics of the economy under consideration. In contrast to neoclassical models which focus on resource allocation, structuralist models aim to study income distribution, sectoral growth, trade balance changes, etc. This branch of models may use *ad-hoc* estimates and trade off theoretical strictness for empirical relevance. According to Taylor (1991), structuralist models share some common features: Economic actors, such as state, enterprises, and workers are not price takers and can influence prices or quantity changes. There is no assumption of full employment or full capital utilization. The money supply is often endogenous and adjusts to the level of output.

Second, models vary depending on closure rule – the decision on which variables are endogenous and which are exogenous (this concept was first introduced by Sen (1963)). Some of the most widespread closures, listed by Kraev (2003) are the following:

Neoclassical closure assumes that investment is equalized with savings at a level that guarantees

full employment. This rule is fundamental for neoclassical models, but rarely used in structuralist models.

In neo-Keynesian closure nominal wages are fixed. This closure is based on the forced saving model by Kaldor. The price level adjusts to bring a balance between savings and investment through a change in income distribution.

The Kaleckian closure keeps returns to labour constant, and share of wages in output is fixed. If the economy reaches full capacity, closure is switched to a forced savings one.

Loanable funds closure proposes that investment is negatively related to the interest rate, whilst savings are positively related; the interest rate is a balancing variable here.

Pigou/real balance closure assumes that the savings ratio depends on real money supply (the ratio of money supply to the price level). Money supply is exogenous and price level adjusts to bring equilibrium.

Thissen (1998) suggests one more classification according to the determination of the parameters of the model: by calibration or by econometric technique. The vast majority of CGE models use calibration in order to determine parameters. The econometric method was initiated by Jorgenson (1984); in his study he built a general equilibrium model with stochastically specified submodels. Among the advantages of calibration is the relative simplicity of finding the parameters' values. Few data are needed and one set of observations can be used. Calibration uses data for only one period of time, which can be both, an advantage and a disadvantage. In case the economy experiences significant changes in its structure, the calibration method is superior to the econometric one. Econometrics use data for several years, which may not be similar to the year of consideration, while calibration is done with the same data as used in the model. At the same time, if no considerable structural changes have taken place, econometrics can give better estimates. Besides that, econometric models incorporate stochastic disturbances in order to capture the effect of omitted variables and errors, while calibration assumes that this stochastic disturbances term is zero and does not include this information. Finally, econometric models give indicators of accuracy of determined variables, while calibration does not give information on reliability of parameters.

Like any modelling method, General Equilibrium has its advantages and disadvantages; a discussion of the main ones following the study of Borges (1986) is given below.

Probably the most prominent advantage of CGE models is their solid microeconomic foundation. General Equilibrium models specify the behaviour of agents using standard theoretical approaches to optimization and choice, hence receiving the name "theory with numbers".

Another strength related to theoretical foundation, is the internal consistency of CGE models. These models capture circular income flow in the economy and include all key agents. Then, the behaviour of all agents is systematized and should reach equilibrium in a benchmark scenario. Missing information or inconsistency would be instantly detected.

The possibility of keeping complex interrelations transparent allows having a high degree of data disaggregation and takes into account linkages between different economic agents and sub-

agents. Such a feature makes CGE models extremely useful for analysis of complicated policy issues and, as mentioned above, the tool is widely applied for this purpose. CGE models are particularly helpful for studies of structural changes in a given economy: although the total effect of external shock could be relatively small, structural changes can be significant.

A major weakness of CGE methodology is its dependence on choice of model type, functional forms, and parameter specifications. The results of the model can vary: if for example the Cobb-Douglas function is used instead of Constant Elasticity of Substitution, calibration is made with data, which are not inherent to the economy under consideration, or the modeller makes a wrong guess about closure rule.

The assumption of general equilibrium, which is rarely observed in the real world, has its drawbacks as well. First of all, this implies that CGE models do not actually forecast reality, but rather show long-term tendencies in the economy. This limits the usage of CGE models and excludes the possibility of checking the historical development and validity of the model. Second, it does not allow the simulation of some policy decisions. In certain cases, the economy is not in equilibrium and problems such as a stabilization policy can not be modelled by CGE.

CGE models show the long-term consequences of external shock and demonstrate results as if an economy immediately adjusts to it. Thus, CGE methodology is not useful for studying the adjustment process and costs associated with it, although for some policy decisions transition is very crucial and even may be more important than long-term equilibrium.

3.2. Modelling GATT/WTO with CGE

The first widespread application of CGE models for studying GATT/WTO issues was modelling different aspects of the Uruguay Round. This Round was launched in 1986, lasted more than seven years and resulted in the creation of the WTO. Beyond the traditional GATT topic of trade in goods, the WTO included much broader issues, such as trade in services, intellectual property, Dispute Settlement, Trade Policy Review Mechanism. Some of the CGE studies of the Uruguay Round are described in Table 3.1.

Table 3.1. CGE Studies of Uruguay Round

Publications	Data/ Evaluation	Model Structure	Sectors Liberalized	Results
Brown, Deardoff, Fox and Stern (1996)	Data and evaluation at 1990	<ul style="list-style-type: none"> • Michigan model • 29 sectors • 8 regions • Perfect competition, CRS, Armington elasticities in agriculture • Monopolistic competition and IRS in manufacturing • Static 	<ul style="list-style-type: none"> • Industrial tariffs cut according to schedule. Multi-Fibre Agreement (MFA) not covered. • Agriculture tariffs including NTB-equivalents cut according to commitments • Services: NTBs cut by 25 per cent 	<ul style="list-style-type: none"> • GDP growth: USA 0.9%, EU 0.9%, Japan 1.4%, Australia and New Zealand 3.6%, Mexico 2.8%, emerging Asian countries 3.6%, ROW 1%
Francois, Mc Donald and Nordstrom (1996)	Data version 1992	<ul style="list-style-type: none"> • GTAP model • 19 sectors • 13 regions • Model 1: CRS, perfect competition • Model 2: IRS, monopolistic competition • Dynamic model 	<ul style="list-style-type: none"> • Industrial tariffs cut according to schedules, MFA quotas lifted • Agriculture tariff cuts according to commitment, subsidies cut by 36% and 24% in developed and developing countries respectively 	<ul style="list-style-type: none"> • GDP growth: World 0.45% (Model 1) 0.9% (Model 2) USA 0.6%, EU 0.5%, Japan 0.4%, Australia and New Zealand 0.9%, Latin America 1.9%, East-South Asia 1.8% • Decomposition of welfare effect: 10% from agriculture, 50% textile and clothing, 40% other manufacturing • Trade growth: increase by 6%

				(Model 1), approximately 15% (Model 2)
Goldin and van der Mensbrugghe (1996)	Data 1985-93 Projections are made for the period 1993-2002	<ul style="list-style-type: none"> • RUNS model • 20 sectors (15 of which agricultural sectors) • 22 countries • Perfect competition • Static 	<ul style="list-style-type: none"> • Industrial tariffs cut according to schedules • Agricultural reforms: tariffs including NTBs cut according to schedules. Subsidies cut by 36% in OECD and 24% in other countries 	<ul style="list-style-type: none"> • GDP growth: USA 0.1%, EU 0.6%, Japan 0.4%, Australia and New Zealand 0.1%, Upper Income Asia 1.3% • Decomposition of welfare effect: 85% per cent from agriculture
Hertel, Martin, Yanagishima and Dimaranan (1996)	Data 1992, Evaluation 2005	<ul style="list-style-type: none"> • GTAP model • 10 sectors • 15 regions • CRS, perfect competition, Armington trade elasticities 	<ul style="list-style-type: none"> • Industrial and agricultural tariffs cut according to schedules. MFA quotas are lifted. 	<ul style="list-style-type: none"> • GDP growth: World 0.89%, USA and Canada 0.4%, EU 0.7%, Japan 1.04%, Latin America 3.8% • Trade growth: World 59%, USA and Canada 48%, EU 42%, Japan 22% • Decomposition of welfare effect: agriculture 5%, industrial tariff 81%, MFA 14%
Harrison, Rutherford and Tarr (1995)	1992 data and evaluation	<ul style="list-style-type: none"> • GTAP model • 22 sectors • 24 regions • Model 1: CRT, perfect competition, Armington • Model 2: IRT, monopolistic competition intraregional, Armington-based trade • Model 1 both static and dynamic 	<ul style="list-style-type: none"> • Industrial and Agriculture tariff cut according to schedule • Export (domestic) subsidies cut by 36% (20%) and 24% (13%) in developed and developing countries respectively 	<ul style="list-style-type: none"> • GDP growth: World 0.4% (Model 1 static), 0.7% (Model 1 dynamic), 0.42% (Model 2 static) • Model 1 regional results: US 0.4%, EU 0.7%, Japan 0.7%, Latin America 1.7%, South-East Asia 2.5% • Decomposition of welfare effect: Model 1 static: agriculture 68%,

				industrial tariff 18%, MFA 15% • Model 1 dynamic: agriculture 38%, industrial tariff 49%, MFA 12% • Model 2 static: agriculture 61%, industrial tariff 23%, MFA 17%
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There are differences in the simulation results of different models, and Piermartini and Teh (2005) proposed the following explanation for such discrepancies: first of all, different models studied different aspects of the Uruguay Round. Some scrutinized general issues, while some focused on specific parts of the Uruguay Round. Hence, the Rural Urban North South (RUNS) model looked at agriculture, and 15 out of 20 sectors included in this model were agricultural ones. Another factor is the degree of regional aggregation. For instance, results differ, depending on whether sub-Saharan Africa was included in the simulation of agricultural reform or not. Model specifications had an important influence on results as well. A key difference across the models is the assumption about market structure. Some models assume perfect competition and constant returns to scale, while others assume imperfect competition and increasing returns to scale. Finally, models have different results owing to the assumption about dynamics. Models with fixed capital have lower estimates than those which allow for capital accumulation.

The second large wave of modelling GATT/WTO issues was directed at the Doha Round. It was launched at the Fourth Ministerial Conference in Doha, Qatar, in 2001 and concerns a wide range of issues, especially those of importance for developing countries thus it is called the Doha Development Agenda (DDA). Table A.3 presents some of the studies. Welfare gains differ across models as well and range from USD 170 bn in the OECD model to over USD 2000 bn in the outlying model of Brown, Deardoff and Stern, but tend to predict approximately USD 250 bn gains on average. According to Piermartini and Teh (2005), there are five factors influencing results: baseline data and level of protection; assumption about nature of the models (whether they assume perfect or imperfect competition); assumption about dynamics; the depth of liberalization (full or partial); and scope of liberalization (whether services and trade facilitation are included or not).

A large number of CGE studies was devoted to examining individual countries in the context of GATT/WTO, in particular accession to this organization. Probably the greatest efforts of the modellers were directed at examining China's accession to the WTO. Studies were carried out with the help of global trade models, such as GTAP, by Yang (1996) and Hertel (1997), G-CUBED World Model by McKibbin and Tang (1998), PRCGEM by Fan and Zheng (2000), Mai *et al.* (2003), Mayes and Wang (2003) as well as other purpose-built models, such as those of Wang and Li (1998), Zhai and Li (2000), Walsmley et al. (2006). Results differ significantly from 0.5% of GDP growth to more than 10% of GDP growth. This is explained by a wide variety of scenarios and assumptions.

Several models have studied WTO accession of post-USSR transition countries, a description of these is given below.

Jensen, Rutherford and Tarr (2004a) studied the economy-wide and sector-specific effects of Russia's accession to the WTO.

There are 35 sectors in the model. The underlying input-output table is for 1995 and originally had 22 sectors but was disaggregated. Primary factors of production in all sectors are: unskilled labour, skilled labour and capital. There are three types of sectors: competitive, imperfectly competitive goods sectors and imperfectly competitive business services sectors.

The authors argue that there are four major sources of gains of Russia's membership in the WTO:

1. Improved market access. For metallurgy and chemicals it is assumed to be 1.5% increase in market access, for light and food industry 0.5%.
2. Import tariff reduction. Tariffs are reduced by 50%.
3. Liberalization of barriers to foreign direct investment in services. The authors estimate that ad valorem equivalence of barriers to foreign direct investment is 90% for air transportation, 95% for maritime transportation and 33% for other sectors.
4. Improvement of the investment climate, which is modelled by an increase of capital stock.

Estimated total gains from WTO accession are 7.2% of consumption or 3.3% of GDP in the medium run; liberalization of FDI is the most important source of gains.

This model served as a basis for several more specific applications studying Russia's accession to the WTO, namely: detailed model of liberalization of barriers against FDI in Jensen, Rutherford and Tarr (2004b); telecommunications reform within Russia's accession in Jensen, Rutherford and Tarr (2004c); the poverty effect of accession with very detailed decomposition of households in Rutherford, Tarr and Shepotylo (2005); the regional impact of accession in Rutherford and Tarr (2006).

Jensen and Tarr (2007) have built a model for Kazakhstan. The model has 56 sectors, uses 2003 input-output table and is similar to that of Jensen, Rutherford and Tarr (2004a). Sectors are either competitive or subject to increasing returns to scale.

Scenarios are as follows:

1. Improved market access. Market access is improved by 1.5% for basic metals and 1% for metals.
2. Import tariff reduction. This is modelled by decreasing tariffs by 50%.
3. Reduction in barriers against multinational service providers. Discriminatory tax for multinationals is decreased by 50%.
4. Elimination of local content policies in the oil sector and simultaneous exemption of the VAT for multinational oil company purchases of Kazakhstan inputs. Multinationals are obliged to buy some inputs locally. To model elimination of this policy, local input prices are increased by 20%.

5. Improvement of investment climate. This is modelled by an increase of capital stock.

Total welfare gains to Kazakhstan are equal to 6.7% of Kazakhstan consumption or 3.7% of GDP. The largest gains come from a reduction in barriers against multinational service providers.

Pavel, Burakovsky, Selitska and Movchan (2004) constructed a model for Ukraine. It has 20 sectors; the input-output table is for 2001. Households are disaggregated into unskilled, skilled and highly skilled; there are seven trading regions: EU15, 10 new members (by 2004), Russia, other CIS, Asia, North America and Rest of the World. The model is static and has a perfect equilibrium structure.

The policy experiments are as follows:

1. Tariff reduction. New tariffs are taken from Ukraine's official proposal to reduce tariffs according to the results of negotiations.
2. Improved market access. Agricultural products will receive a 10% increase in market access to the EU and North America markets; steel products 5% to the same markets and chemicals 1% to all markets.
3. Adjustment of domestic taxation. All direct subsidies are eliminated; direct taxes are set at 5%.

Total gains from Ukraine's accession to the WTO are a 3% increase of consumption, GDP increases by 1.9%, exports and imports growing by approximately 14% each.

Pavel and Tochitskaya (2004) analyzed the economic impact of Belarus' accession to the WTO. They built a CGE model with 23 sectors based on the 2001 input-output table. It has constant return to scale and perfect competition. The external sector is divided into CIS countries and all others.

The authors take into account the dependence of Belarus' economy on imported gas and model four sets of policy simulations:

1. Increased price for gas imports by 25%.
2. Tariff reduction. Tariffs are assumed to decrease by 60% (there is no specific information about Belarus' WTO commitments).
3. Improved market access. Exports of chemical products obtain a 10% increase of access to non-CIS markets.
4. Domestic tax reform. The direct taxes on all activities were set to 5%. For agriculture, a 5% direct subsidy was maintained. A VAT at equal tax rates without any privileges was set as the only indirect tax on commodities. All export taxes were reduced by 50%.

The authors estimate that increased prices for imported gas will have a negative effect: welfare will drop by 1.5% of consumption and GDP will decrease by 1.2%. Nevertheless, if all scenarios of WTO accession are taken into account, the Belarusian economy will benefit and consumer welfare will rise by about 1.6% after WTO accession, and GDP will rise by 3.4%.

Chapter 4

CGE Model for Ukraine

This part will start with a description of Ukraine's economy; it is followed by formal outline of the model; next, data will be described; this will be concluded by key assumptions of the model and an outline of policy simulation scenarios.

4.1. Economic Situation in Ukraine³.

By the end of the 1980's, the economy of Ukraine was the second largest after that of Russia among all USSR republics, producing three times the output of the next-ranking republic. Ukraine occupied only 3% of USSR territory and was inhabited by 18% of its population, but produced around 17% of total USSR industrial output and 25% of agricultural output (Ukraine has the most fertile land in Europe and is in possession of 30% of world's black soils). Such factors, as well as a relatively well developed infrastructure, close to 100% literacy and skilled labour force could have led to a quick transition to a market economy, but instead Ukraine experienced a 10-year lingering drop into recession, showing first positive signs only in 2000.

Key economic indicators of Ukraine for 2001-2008 are presented in Table 4.1 below.

Table 4.1. Key Economic Indicators of Ukraine

Key Economic Indicators		2001	2002	2003	2004	2005	2006	2007	2008
Nominal GDP	UAH bn	204.20	225.80	264.20	345.90	441.45	544.15	720.73	948.06
Nominal GDP	USD bn	37.80	42.60	49.50	65.10	86.10	107.80	142.70	180.30
GDP growth (real)	% yoy	9.20	5.20	9.40	12.10	2.60	7.30	7.90	2.30
Industrial production	% yoy	14.20	7.00	15.80	12.50	3.10	6.20	10.20	-3.10
Agricultural production	% yoy	10.20	1.20	-11.00	19.10	0.00	2.50	-6.50	17.10
CPI	% yoy eop	6.10	-0.60	8.20	12.30	10.30	11.60	16.60	22.30
PPI	% yoy eop	0.90	5.70	11.20	24.10	9.60	14.10	23.30	23.00
Exports (gs, USD)	% yoy	9.50	10.70	24.00	42.60	7.50	13.20	27.40	33.80
Imports (gs, USD)	% yoy	14.10	4.90	28.70	31.30	20.40	21.90	35.40	38.50
Current account	USD bn	1.40	3.10	2.90	6.90	2.50	-1.60	-5.30	-12.70
Current account	% GDP	3.70	7.60	5.90	10.60	2.90	-1.50	-3.70	-7.00
FDI (total)	USD bn	3.88	5.47	6.79	9.04	16.89	21.61	29.54	35.72
International reserves	USD bn	3.09	4.42	6.94	9.52	19.39	22.36	32.48	31.54

³ The data will be given mostly for 2008, a year when Ukraine accessed the WTO

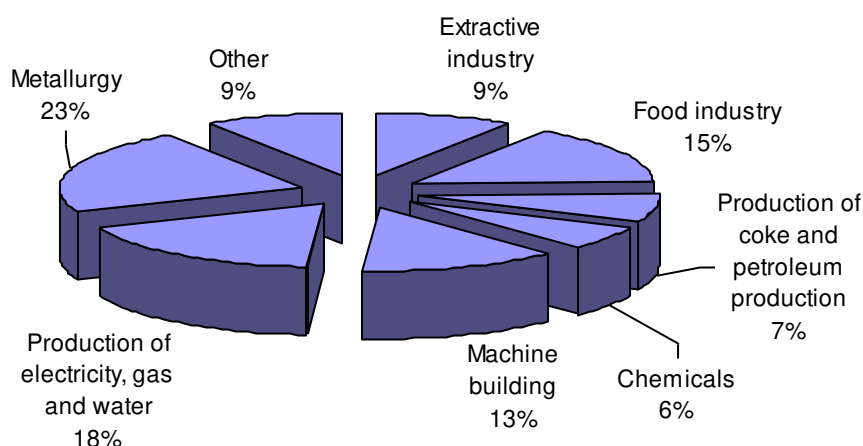
Fiscal balance	% GDP	-1.90	0.80	-0.20	-3.40	-1.90	-0.70	-1.10	-1.80
Exchange rate	USD eop	5.30	5.33	5.33	5.31	5.12	5.05	5.05	7.70

Source: State Statistical Committee of Ukraine

Value added is dominated by industry: it contributes almost one-third of all value added. The next important sectors are trade – around 15% of value added, and transport – more than 10%. Agriculture accounts approximately for 10% of value added, but employs 25% of the total labour force, which is a legacy of the Soviet Union total employment policy and should indicate inefficiency.

Figure 4.1 presents composition of industrial production in Ukraine as of 2008.

Figure 4.1. Distribution of Industrial Output in Ukraine by Sectors, 2008



Source: State Statistical Committee of Ukraine

As can be seen, metallurgy is the major contributor to the aggregate industrial production. Ukraine is one of the largest steel producers in the world; it is ranked as the 7th steel producer after China, Japan, USA, Russia, Germany and South Korea. During USSR times the lion share of steel was supplied to former Soviet Republics. After obtaining independence, Ukraine was left with a high-capacity metallurgical sector well exceeding the internal demand of the country. Such factors have led to the significant export orientation of the metallurgy: over 80 % of production is supplied to foreign markets.

Next important sector is generation of electricity. Ukraine's power sector is the twelfth largest in the world in terms of installed capacity, with 54 gigawatts (GW). It means that Ukraine has more than enough generating capacity to produce twice its electricity needs.

The food industry is one of the most vibrant sectors in Ukraine's economy. Its share in total industrial production is around 15%. While domestic sources played an important role in increasing the output of food products, foreign direct investment (FDI) played a crucial role as

well. The most important products are beverages – 20% of total food industry output, milk products – 17%, meat – 11%, tobacco products – 9%, vegetable oils – 6%, grain mill products – 5%.

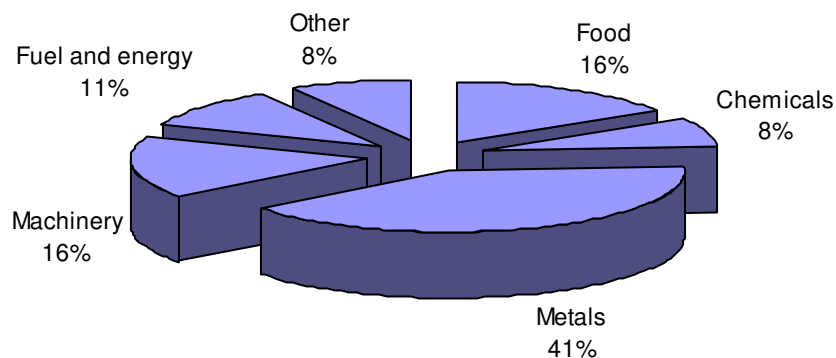
In machine building leading sub-sectors include production of equipment for the food industry, agriculture and construction (especially tractors, excavators), auto plants (cars, buses and trucks), electronic equipment, air plants, and space equipment. Ukraine's machinery managed to maintain highly competitive production in some sectors: for instance most of the equipment for the Sea Launch project is produced in Ukraine.

Ukraine is quite an open economy and role of the foreign trade sector is extremely important.

The regional distribution of Ukraine's foreign trade in goods is roughly the same for exports and for imports. Russia remains a strategic partner for Ukraine and accounts for more than 20% of both, exports and imports. European Union continuously reinforces its importance in Ukraine's foreign trade. Exports to the EU accounted for 17% of total Ukraine's exports in 2008, while imports from the EU constituted 26%. Asian countries are important market for Ukrainian metallurgy. This region amounted to roughly 15% of both, exports and imports. Trade with ex-USSR countries, other than Russia made around 10% of exports and imports.

Goods structure of Ukraine's exports is skewed to primary goods (see Figure 4.2). A major item of exports are steel products, which accounted for more than 40% of total exports of goods in 2008. The next largest group is machinery and equipment (16%), food (16%), fuel and energy products (10%) and chemicals (almost 8%).

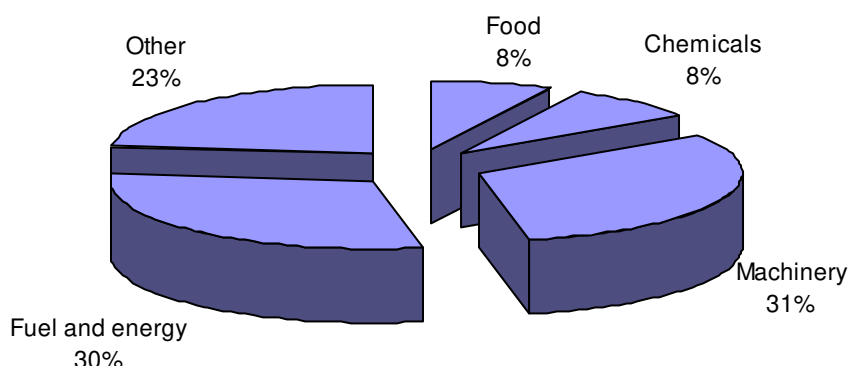
Figure 4.2. Commodity Composition of Ukraine's Exports of Goods, 2008



Source: The Economist Intelligence Unit

In imports, energy resources accounted for around one third of total imports (see Figure 4.3.). It is worth noting that although dependence on imported energy is still high, it has gradually been reducing; for example in 1996 energy imports accounted for half of all imports of goods. Machinery and equipment made another third of total imports. Food industry as well as chemicals are also important items of imports.

Figure 4.3. Commodity Composition of Ukraine's Imports of Goods, 2008

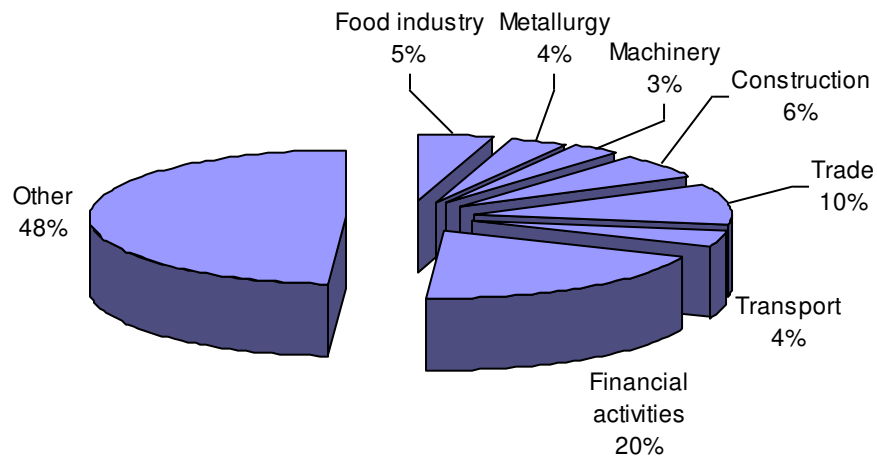


Source: The Economist Intelligence Unit

Volume of trade in services is significantly lower than that of trade in goods: turnover of services is roughly 5 times less than turnover of goods. Ukraine is conveniently situated in the centre of Europe, which creates opportunities for the transport sector: three quarters of total exports of services is transportation. More than one third of total exports of services is a pipeline transit of energy products between Russia and Turkmenistan and Western Europe. Rail and sea transport account for around 10% each. Imports of services are quite diverse; tourism is the biggest sector, accounting for 15% of total imports of services.

Concerning sectors, which received the most FDI inflow, the major was banking sector, around 20% of total FDI in 2008. This figure should be taken with caution, since it is connected to the sale of several large banks to foreign investors. For instance, in 2005, metallurgy received one third of total FDI. It was due to privatisation of the Krivorozhstal steel plant and resulting USD 4.8 bn FDI inflow. On the contrary, trade and production of food are stable recipients of the FDI over many years.

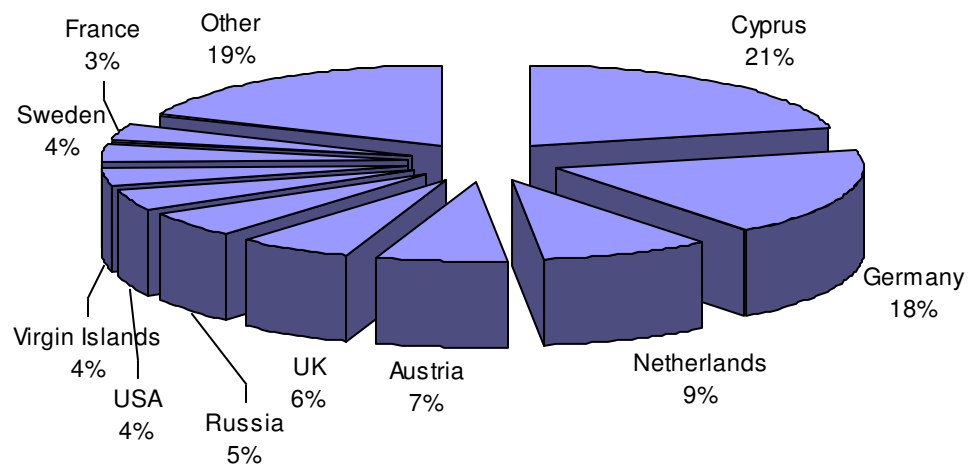
Figure 4.4. FDI in Ukraine by sectors, 2008



Source: National Bank of Ukraine

In 2008, the countries which invested the most to Ukraine were Cyprus (21% of total FDI), Germany (18%), and the Netherlands (9%). It is worth mentioning that such regions as Cyprus and Virgin Islands are off-shore zones, and this capital should probably not be counted as “foreign” but rather as a repatriated domestic one.

Figure 4.5. FDI in Ukraine by country, 2008



Source: National Bank of Ukraine

4.2. Algebraic Formulation of the Model

This section outlines the basic structure of the CGE model in algebraic formulation. Full list of variables is given in appendix in Table A.4.

Production

Producers maximise their profits subject to the technology available and taking prices as given, acting in perfectly competitive conditions. Equation (4.1) shows this profit-maximisation task as maximising the difference between revenues from activities (net of taxes) and costs of intermediate inputs and primary factors.

Profit-maximisation:

$$QD_i - \sum_j IO_{ij} - K_i - L_i - TRID_i \quad (4.1)$$

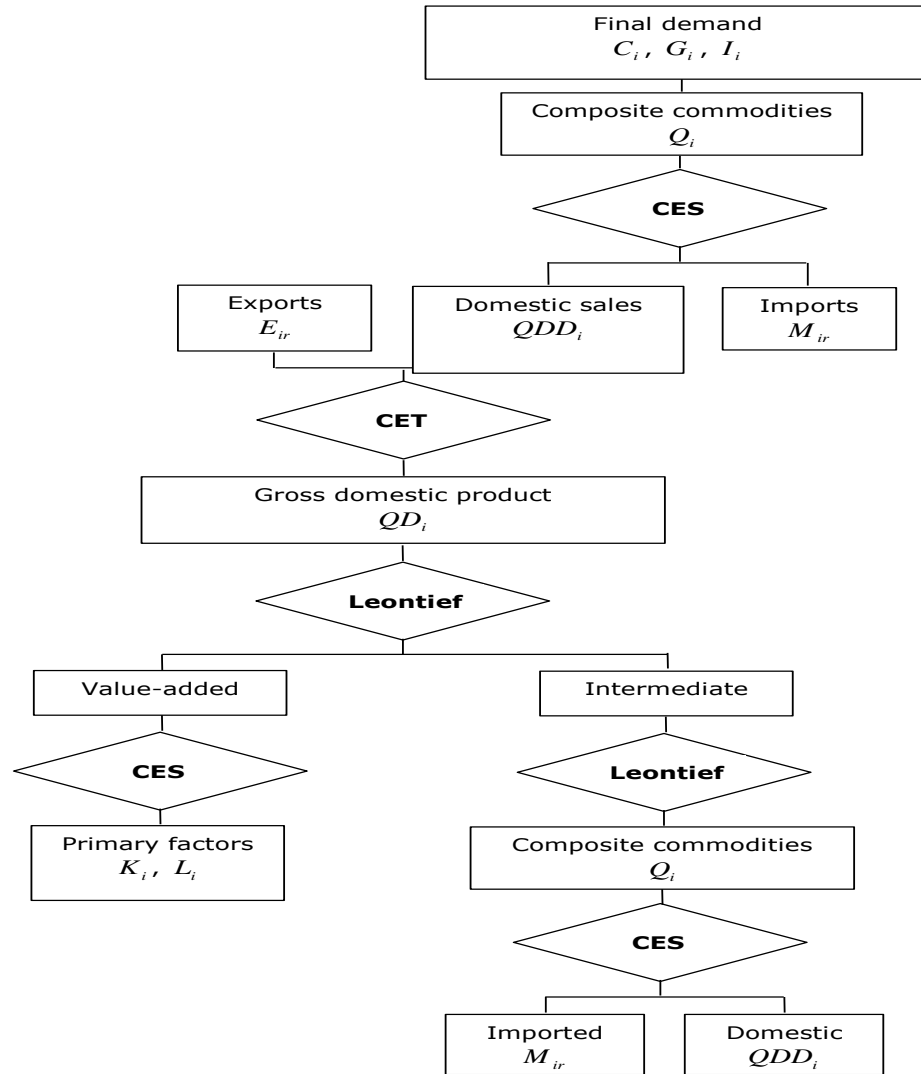
where

QD_i	gross domestic output
IO_i	intermediate commodity demand
K_i	capital demand
L_i	labour demand
$TRID_i$	taxes on commodities

The production technology tree has several levels, presented in Figure 4.6.

At the top producers choose the optimal bundle between value added and aggregate intermediate inputs, which is modelled by the Leontief function. In this case the level of value added and intermediate inputs are defined by equations (4.2) and (4.3) correspondingly.

Figure 4.6. Production and Allocation Tree



Leontief technology: demand for aggregate value-added

$$VA_i = b_i \cdot QD_i \quad (4.2)$$

where

VA_i value added demand

b_i share coefficient of value added in output

Leontief technology: demand for aggregate intermediate input

$$IO_i = (1 - b_i) \cdot QD_i \quad (4.3)$$

where

$(1 - b_i)$ share coefficient of intermediates in output

At the next level of the production tree, further disaggregation of demand inside value added and intermediate inputs branches are defined.

For each activity the quantity of value-added is a CES function of disaggregated factors, as shown in equation (4.4).

CES technology, demand for aggregated value added, exponent

$$QD_i = \alpha_i^F (\gamma_i^F \cdot K_i^{-\rho_i^F} + (1 - \gamma_i^F) \cdot L_i^{-\rho_i^F})^{-1/\rho_i^F} \quad (4.4)$$

where

α_i^F CES efficiency parameter in the production function of firms

γ_i^F CES share parameter in the production function of firms

ρ_i^F CES function exponent

The optimal mix of value added factors is determined by their relative prices, also known as tangency condition (equation (4.5)).

Tangency condition, exponent

$$\frac{\gamma_i^F}{1 - \gamma_i^F} \cdot \left(\frac{K_i}{L_i} \right)^{-(1 + \rho_i^F)} = \frac{PK}{PL} \quad (4.5)$$

where

PK return to capital

PL return to labour

The CES function exponent ρ_i^F is the transformed elasticity of substitution between different factors: $\sigma_i^F = \frac{1}{1 + \rho_i^F}$. The higher the elasticity of substitution, the smaller the value of the exponent and the larger the necessary shift between demand for different factors in response to their price change. Using the expression for elasticity of substitution of the CES production function, equations (4.4) and (4.5) may be rewritten as follows:

CES technology, demand for aggregated value added, elasticity of substitution

$$QD_i = \alpha_i^F (\gamma_i^F \cdot K_i^{-(1-\sigma_i^F)/\sigma_i^F} + (1-\gamma_i^F) \cdot L_i^{-(1-\sigma_i^F)/\sigma_i^F})^{-\sigma_i^F/(1-\sigma_i^F)} \quad (4.6)$$

where

σ_i^F CES capital-labour substitution elasticities

Tangency condition, elasticity of substitution

$$\frac{\gamma_i^F}{1-\gamma_i^F} \cdot \left(\frac{K_i}{L_i} \right)^{-1/\sigma_i^F} = \frac{PK}{PL} \quad (4.7)$$

Finally, demand equations for capital and labour take the following form:

Capital demand

$$K_i = \gamma_i^{F\sigma_i^F} \cdot PK^{-\sigma_i^F} \cdot \left(\gamma_i^{F\sigma_i^F} \cdot PK^{1-\sigma_i^F} + (1-\gamma_i^{F\sigma_i^F}) \cdot PL^{1-\sigma_i^F} \right)^{\sigma_i^F/(1-\sigma_i^F)} \cdot (QD_i / \alpha_i^F) \quad (4.8)$$

Labour demand

$$L_i = (1-\gamma_i^{F\sigma_i^F}) \cdot PL^{-\sigma_i^F} \cdot \left(\gamma_i^{F\sigma_i^F} \cdot PK^{1-\sigma_i^F} + (1-\gamma_i^{F\sigma_i^F}) \cdot PL^{1-\sigma_i^F} \right)^{\sigma_i^F/(1-\sigma_i^F)} \cdot (QD_i / \alpha_i^F) \quad (4.9)$$

Demand for disaggregated intermediate inputs is defined by the Leontief function as a product of intermediate input use and the fixed intermediate input coefficient (equation (4.10)).

Leontief technology: demand for intermediate input

$$QD_{ij} = io_{ij} \cdot QD_j \quad (4.10)$$

where

io_{ij} technical coefficients

Calibration

First, using equation (4.2), it is possible to calibrate b_i , the fixed coefficient of value added in output:

Fixed coefficient of value added

$$b_i = \frac{VA_i}{QD_i} \quad (4.11)$$

In a similar manner, input-output coefficients are defined using equation (5.10)

Input-output coefficients

$$io_{ij} = \frac{QD_{ij}}{QD_j} \quad (4.12)$$

It is necessary to determine values of σ_i^F , γ_i^F and α_i^F in order to proceed with the CES function. Elasticity of substitution σ_i^F is assumed to be known and will be used for calibration of γ_i^F and α_i^F . From the tangency condition, equation (4.7), it is possible to derive the CES share parameter in the production function of firms:

CES share parameter

$$\gamma_i^F = \frac{1}{1 + \frac{PL}{PK} \cdot \left(\frac{K_i}{L_i} \right)^{-1/\sigma_i^F}} \quad (4.13)$$

Having values of σ_i^F and γ_i^F , α_i^F is calibrated using equation (4.6)

CES efficiency parameter

$$\alpha_i^F = QD_i / (\gamma_i^F \cdot K_i^{-(1-\sigma_i^F)/\sigma_i^F} + (1-\gamma_i^F) \cdot L_i^{-(1-\sigma_i^F)/\sigma_i^F})^{-\sigma_i^F/(1-\sigma_i^F)} \quad (4.14)$$

External Sector

Exports

Firms allocate their output to domestic and foreign markets and try to maximise revenues, this is represented by equation (4.15).

Maximisation of revenues

$$PD_i \cdot QD_i + \sum_r PE_{ir} \cdot E_{ir} \quad (4.15)$$

where

PD_i	domestic producer price of commodities in sector i
E_{ir}	exports
PE_{ir}	export price of commodities in sector i delivered to region r in national currency

The optimal distribution between domestic and foreign markets is defined through the Constant Elasticity of Transformation (CET) function, presented in equation (4.16).

Output transformation (CET) function

$$QD_i = \alpha_i^T \cdot \left(\gamma_i^T \cdot E_i^{\rho_i^T} + (1 - \gamma_i^T) \cdot QDD_i^{\rho_i^T} \right)^{1/\rho_i^T} \quad (4.16)$$

where

QDD_{ir}	domestic output delivered to home market
γ_i^T	CET share parameter regarding destination of domestic output
α_i^T	shift parameter in the CET function of firm
ρ_i^T	a CET function exponent

Here ρ_i^T is transformed elasticity of transformation. The latter is defined as in equation (4.17).

The CET function repeats the CES function, except for the signs at function exponent ρ_i^T .

Elasticity of transformation in the CET function

$$\sigma_i^T = \frac{1}{1 + \rho_i^T} \quad (4.17)$$

where

σ_i^T	elasticities of transformation in CET function
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The optimal mix between domestic sales and exports is defined by the ratio of corresponding prices at equation (4.18). The export price is defined in equation (4.19).

Export-domestic supply ratio

$$\frac{E_i}{QDD_i} = \left(\frac{PE_i}{PDD_i} \cdot \frac{1 - \gamma_r^T}{\gamma_i^T} \right)^{\frac{1}{\rho_i^T - 1}} \quad (4.18)$$

where

PDD_i price of domestic output delivered to home market

Export price

$$PE_{ir} = PWE_{ir} \cdot ER \quad (4.19)$$

where

PWE_{ir} world export price

ER exchange rate

Equation (4.20), also known as the zero profit CET function equation, specifies the quantity of domestic output as sold on the domestic market and abroad and allows the solving of the producer maximisation problem, given export and domestic prices and subject to the CET function and fixed quantity of domestic output.

Zero profit CET

$$PD_i \cdot QD_i = \sum_r PE_{ir} \cdot E_{ir} + PDD_i \cdot QDD_i \quad (4.20)$$

Thus, domestic sales and exports are defined by equations (4.21) and (4.22) respectively.

Domestic sales

$$QDD_i = (1 - \gamma_i^T)^{\sigma_i^T} \cdot PDD_i^{-\sigma_i^T} \cdot \left[\gamma_i^{T\sigma_i^T} \cdot PE_i^{1-\sigma_i^T} + (1 - \gamma_i^T)^{\sigma_i^T} \cdot PDD_i^{1-\sigma_i^T} \right]^{\frac{\sigma_i^T}{(1-\sigma_i^T)}} \cdot (QD_i / \alpha_i^T) \quad (4.21)$$

Exports

$$E_i = \gamma_i^{T\sigma_i^T} \cdot PE_i^{-\sigma_i^T} \cdot \left[\gamma_i^{T\sigma_i^T} \cdot PE_i^{1-\sigma_i^T} + (1 - \gamma_i^T)^{\sigma_i^T} \cdot PDD_i^{1-\sigma_i^T} \right]^{\frac{\sigma_i^T}{(1-\sigma_i^T)}} \cdot (QD_i / \alpha_i^T) \quad (4.22)$$

The destination of exports is differentiated by regions and represented by the CES function:

Exports by region

$$E_i = \left(\sum_r E_{ir}^{\rho_i^T} \right)^{1/\rho_i^T} \quad (4.23)$$

Imports

According to Armington's assumption, imports and domestic output are not perfect substitutes and both enter the production of certain commodities as inputs. Producers try to minimise costs by combining domestic and imported inputs

Minimisation of costs

$$PDD_i \cdot QDD_i + \sum_r PM_{ir} \cdot M_{ir} \quad (4.24)$$

where

M_{ir} imports of commodities to sector i from region r

PM_{ir} import price of commodities in sector i delivered from region r in national currency

Equation (4.25) presents the Armington function of producing a commodity using domestic and imported inputs, while equation (4.26) shows the ratio of domestic and imported goods. The price of imports is defined in equation (4.27).

Composite supply (Armington) function

$$Q_i = \alpha_i^A \cdot \left(\gamma_i^A \cdot M_i^{-\rho_i^A} + (1 - \gamma_i^A) \cdot QDD_i^{-\rho_i^A} \right)^{1/\rho_i^A} \quad (4.25)$$

where

γ_i^A Armington share parameter in the production function of commodities

α_i^A Armington efficiency parameter in the production function of commodities

ρ_i^A Armington function exponent

Q_i domestic sales composite commodity

Import-domestic demand ratio

$$\frac{M_i}{QDD_i} = \left(\frac{PDD_i}{PM_i} \cdot \frac{\gamma_i^A}{1 - \gamma_i^A} \right)^{1/(1 + \rho_i^A)} \quad (4.26)$$

Import price

$$PM_{ir} = PWM_{ir} \cdot (1 + tm_{ir}) \cdot ER \quad (4.27)$$

where

PWM_{ir} world import price
 tm_{ir} tariff rate on imports

Here ρ_i^A is an Armington function exponent, while elasticity of substitution is given by following equation:

Elasticity of substitution in the Armington function

$$\sigma_i^A = \frac{1}{1 + \rho_i^A} \quad (4.28)$$

where

σ_i^A Armington substitution elasticities

Total absorption, or zero profit Armington function equation (4.29), is given as the sum of domestic sales of goods and imported commodities and.

Zero profit Armington

$$P_i \cdot Q_i = \sum_r PM_{ir} \cdot M_{ir} + PDD_i \cdot QDD_i \quad (4.29)$$

These equations allow the solving of the cost minimisation problem of producers given domestic and imports prices and subject to the Armington function and fixed quantity of the composite commodity.

Domestic sales and imports are defined as follows:

Domestic sales

$$QDD_i = (1 - \gamma_i^A)^{\sigma_i^A} \cdot PDD_i^{-\sigma_i^A} \cdot \left[\gamma_i^{A\sigma_i^A} \cdot PM_i^{1-\sigma_i^A} + (1 - \gamma_i^A)^{\sigma_i^A} \cdot PDD_i^{1-\sigma_i^A} \right]^{\sigma_i^A / (1-\sigma_i^A)} \cdot (Q_i / \alpha_i^A) \quad (4.30)$$

Imports

$$M_i = \gamma_i^{A\sigma_i^A} \cdot PM_i^{-\sigma_i^A} \cdot \left[\gamma_i^{A\sigma_i^A} \cdot PM_i^{1-\sigma_i^A} + (1 - \gamma_i^A)^{\sigma_i^A} \cdot PDD_i^{1-\sigma_i^A} \right]^{\sigma_i^A / (1-\sigma_i^A)} \cdot (Q_i / \alpha_i^A) \quad (4.31)$$

Sources of import are also differentiated by regions shown by the following CES function:

Imports by region

$$M_i = \left(\sum_r M_{ir}^{\rho_i^T} \right)^{1/\rho_i^T} \quad (4.32)$$

Finally, trade balance is represented by equation (4.33).

Trade Balance

$$\sum_{ir} M_{ir} \cdot PWM_{ir} = \sum_{ir} E_{ir} \cdot PWE_{ir} + SF \cdot ER + TRFH \cdot ER + TRFG \cdot ER + FR \cdot ER \quad (4.33)$$

where

SF	foreign savings
$TRFH$	foreign transfers to household in foreign currency
$TRFG$	foreign transfers to government in foreign currency
FR	foreign remittances in foreign currency

Calibration

Calibration for CET and Armington functions is done in a manner similar to that for the CES function.

First, if estimates for elasticity of transformation σ_i^T in CET function are given, it is possible to determine γ_i^T , the CET share parameter regarding destination of domestic output and α_i^T , the shift parameter in the CET function of firm.

Using equation (4.17), it is necessary to substitute elasticity of transformation, σ_i^T for ρ_i^T and solve equation (4.18) to find the CET share parameter:

CET share parameter

$$\gamma_{ir}^T = \frac{1}{1 + \frac{PDD_i}{PE_{ir}} \cdot \left(\frac{E_{ir}}{QDD_i} \right)^{-1/\sigma_{ir}^T}} \quad (4.34)$$

Then the known parameter should be plugged into equation (4.22) to find the shift parameter.

CET shift parameter

$$\alpha_{ir}^T = QD_i / (\gamma_{ir}^A \cdot E_{ir}^{-(1-\sigma_{ir}^T)/\sigma_{ir}^T} + (1-\gamma_{ir}^T) \cdot QDD_i^{-(1-\sigma_{ir}^T)/\sigma_{ir}^T})^{-\sigma_{ir}^T/(1-\sigma_{ir}^T)} \quad (4.35)$$

Calibration for the Armington function is quite the same. Substituting elasticity of substitution for the exponent in equation (4.26) allows the finding of the Armington share parameter.

Armington share parameter

$$\gamma_{ir}^A = \frac{1}{1 + \frac{PDD_i}{PM_{ir}} \cdot \left(\frac{M_{ir}}{QDD_i} \right)^{-1/\sigma_{ir}^A}} \quad (4.36)$$

Using equation (4.31), the Armington Function shift parameter is found

Armington shift parameter

$$\alpha_{ir}^A = Q_i / (\gamma_{ir}^A \cdot M_{ir}^{-(1-\sigma_{ir}^A)/\sigma_{ir}^A} + (1-\gamma_{ir}^A) \cdot QDD_i^{-(1-\sigma_{ir}^A)/\sigma_{ir}^A})^{-\sigma_{ir}^A/(1-\sigma_{ir}^A)} \quad (4.37)$$

Households

Each household maximises a “Stone-Geary” utility function, namely maximising consumption of commodities above their minimal subsistence consumption:

Households’ Stone-Geary utility function

$$U^H = \prod_i (C_i - \mu_i^H)^{\alpha_i^{HLES}} \quad (4.38)$$

where

U^H	utility level of households
C_i	consumer demand for commodities
α_i^{HLES}	power in nested LES household utility function
μ_i^H	subsistence household consumption level

The maximisation task is subject to expenditure constraints. Equation (4.39) shows that consumption spending for households is the income net of savings and taxes.

Subject to:

Household consumption expenditures

$$CE = Y - TRY - SH \quad (4.39)$$

where

CE	consumer expenditures
Y	household income
TRY	income tax revenues
SH	household savings

Spending on individual commodities is a Linear Expenditure System (LES) since it is a linear function of total household consumption expenditure.

Household LES (linear expenditure system) function

$$P_i \cdot C_i = P_i \cdot \mu_i^{HLES} + \alpha_i^{HLES} \cdot \left(CE - \sum_i P_i \cdot \mu_i^{HLES} \right) \quad (4.40)$$

where

P_i	price of composite commodities in sector i
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Next, a more detailed description of income, taxes, savings and unemployment is given.

Households’ income is equal to revenues from capital, labour, transfers from government and from abroad as well as foreign remittances.

Income

$$Y = PK \cdot KS + PL \cdot (LS - UNEMP) + TRGH + TRFH \cdot ER + FR \cdot ER \quad (4.41)$$

where

KS	capital supply
LS	labour supply
$UNEMP$	involuntary unemployment
$TRGH$	transfers from government to households

Savings are determined by marginal propensity to save as a fraction of disposable income.

Savings

$$SH = mps \cdot (Y - ty \cdot Y) \quad (4.42)$$

where

mps	household's marginal propensity to save
ty	tax rate on income

Consumer Price Index is defined as follows:

CPI

$$CPI^t = \frac{\sum_i PD_i^t \cdot C_i^0}{\sum_i PD_i^0 \cdot C_i^0} \quad (4.43)$$

where

CPI	consumer price index
PD_i^0	“benchmark” domestic producer price of commodities
PD_i^t	domestic producer price of commodities after change
C_i^0	“benchmark” consumer demand for commodities

In order to make unemployment endogenous, a Phillips curve is employed which shows the relationship between the rate of change in real wage rate and the rate of change in unemployment rate.

The real wage rate is defined as follows:

PL^0 / CPI^0	real wage in the benchmark
PL^t / CPI^t	real wage after the shock

While unemployment rate is:

$UNEMP^t / LS^t$	unemployment rate in the benchmark
------------------	------------------------------------

$UNEMP^0 / LS^0$ unemployment rate after the shock

Then, the Phillips curve equation takes following form:

Unemployment

$$\left(\frac{PL^t / CPI^t}{PL^0 / CPI^0} - 1 \right) = \textit{phillips} \cdot \left(\frac{UNEMP^t / LS^t}{UNEMP^0 / LS^0} - 1 \right) \quad (4.44)$$

where

$\textit{phillips}$ Phillips parameter

Calibration

First, α_i^{HLES} , power in the nested LES household utility function should be calibrated. Assuming that estimates for income elasticity are known, it is possible to derive α_i^{HLES} from equation (4.40). Dividing it by price P_i , :

Consumption

$$C_i = \mu_i^{HLES} + \alpha_i^{HLES} \cdot P_i^{-1} \cdot \left(CE - \sum_i P_i \cdot \mu_i^{HLES} \right) \quad (4.45)$$

Next, income elasticity is equal to:

Income elasticity

$$\varepsilon_i^Y = \frac{\partial C_i}{\partial Y} \cdot \frac{Y}{C_i} = \frac{\alpha_i^{HLES} \cdot P_i^{-1} \cdot Y}{C_i} \quad (4.46)$$

where

ε_i^Y income elasticity of demand for commodity

From this equation α_i^{HLES} can be defined:

Power in LES household utility function

$$\alpha_i^{HLES} = \varepsilon_i^Y \cdot P_i \cdot C_i / CE \quad (4.47)$$

In order to calibrate the subsistence household consumption level it is necessary to refer to a concept of marginal utility of expenditure.

One of the first-order conditions in maximizing the Stone-Geary utility function takes the following form:

First-order condition

$$\alpha_i^{HLES} \cdot (C_i - \mu_i^H)^{-1} \cdot U^H = \lambda^{HLES} \cdot P_i \quad (4.48)$$

where

λ^{HLES} Lagrange multiplier

The Lagrange multiplier in this equation can be transformed into marginal utility of expenditure by substituting equation (4.45) into equation (4.48) and solving for λ^{HLES} :

Marginal utility of expenditure

$$\lambda^{HLES} = U^H (Y - \sum_i PD_i \cdot \mu_i^{HLES})^{-1} \quad (4.49)$$

where

λ^{HLES} marginal utility of household expenditures

From equation (4.49) the Frisch parameter is derived, which is expenditure elasticity of the marginal utility of expenditure.

Frisch parameter

$$\phi = \frac{\partial \lambda^{HLES}}{\partial Y} \cdot \frac{Y}{\lambda^{HLES}} = - \frac{Y}{(Y - \sum_i \mu_i^{HLES} \cdot P_i)} \quad (4.50)$$

where

ϕ Frisch parameter in nested HLES utility function

If the value of the Frisch parameter is known, it is possible to calibrate the subsistence household consumption level.

Subsistence household consumption level

$$\mu_i^{HLES} = C_i + \alpha_i^{HLES} \cdot CE / (P_i \cdot \phi) \quad (4.51)$$

Investment

Investment is modelled through the representative financial institution agent, which maximises a Cobb-Douglas utility function:

Cobb-Douglas utility function of representative banks

$$U^I = \prod_i I_i^{\alpha_i^I} \quad (4.52)$$

where

U^I	utility level of financial institutions
I_i	investment demand for commodities
α_i^I	Cobb-Douglas power in investment institution utility function

It is constrained by total savings equal to the sum of household, government and foreign savings.

Subject to

$$S = SH + SG + SF \cdot ER \quad (4.53)$$

where

S	total savings
SG	government savings

Maximising the utility function, the demand equation for investment commodities is obtained. This equation says that investment demand is a fixed fraction of total savings.

Demand equation for investment commodities

$$P_i \cdot I_i = \alpha_i^I \cdot S \quad (4.54)$$

Calibration

To calibrate the Cobb-Douglas power in an investment institution utility function, equation (4.54) should be inverted.

Cobb-Douglas power in investment institution utility function

$$\alpha_i^I = P_i \cdot I_i / S \quad (4.55)$$

Government

Government consumption demand is similar to investment demand: it is defined through the Cobb-Douglas utility function.

Government Cobb-Douglas utility function

$$U^G = \prod_i G_i^{\alpha_i^G} \quad (4.56)$$

where

U^G	utility level of government
G_i	public demand for commodities
α_i^G	Cobb-Douglas power in government utility function

Subject to

$$GOVR - TRGH - SG \quad (4.57)$$

where

$GOVR$	government revenues
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By maximising the utility function, government demand for commodities is derived, given in equation (4.58).

Government demand for commodities

$$P_i \cdot G_i = \alpha_i^G \cdot (GOVR - TRGH - SG) \quad (4.58)$$

Government revenue is a sum of households' income tax, indirect tax on commodities, import tariff revenues, capital revenues of the government as well as transfers from abroad.

Government revenues

$$GOVR = ty \cdot Y + \sum_i tid_i \cdot PD_i \cdot QD_i + \sum_{ir} tm_{ir} \cdot M_{ir} \cdot PWM_{ir} \cdot ER + KRG + TRFG \cdot ER \quad (4.59)$$

where

tid_i	indirect tax rate
KRG	government capital revenues

Government balance has government revenues on one side and government expenditure on commodities, transfers to households and government savings on the other. Government savings may be negative.

Government balance

$$GOVR = \sum_i P_i \cdot G_i + TRGH + SG \quad (4.60)$$

Calibration

To calibrate Cobb-Douglas power in the government utility function, equation (4.58) should be solved for α_i^G .

$$\alpha_i^G = P_i \cdot G_i / (GOVR - TRGH - SG) \quad (4.61)$$

Market Clearance

Next, the market clearance equations are summarised. First two equations impose equality between the total quantity demanded and supplied for capital and labour net of unemployment.

Factor market balance

Labour

$$\sum_i L_i = LS - UNEMP \quad (4.62)$$

Capital

$$\sum_i K_i = KS \quad (4.63)$$

Equation (4.64) imposes equality between commodity supplied and demanded. Quantity supplied (left-hand side) is equal to intermediate demand, household, government and investment consumption (right-hand side).

Composite commodity market balance

$$Q_i = C_i + I_i + G_i + \sum_i io_{ij} \cdot QD_i \quad (4.64)$$

The current account balance (equation (4.65)) imposes a balance on inflow and spending of foreign currency. Import spending is equal to export revenue, foreign savings, transfers from the rest of the world to households and government and foreign remittances.

Current account balance for ROW

$$\sum_{ir} M_{ir} \cdot PWM_{ir} = \sum_{ir} E_{ir} \cdot PWE_{ir} + SF \cdot ER + TRFH \cdot ER + TRFG \cdot ER + FR \cdot ER \quad (4.65)$$

Government balance has government revenues on the left-hand side and government commodities expenditures, transfers to households and savings on the right.

Government balance

$$GOVR = \sum_i P_i \cdot G_i + TRGH + SG \quad (4.66)$$

The next equation balances savings and investment in the economy. Savings are equal to non-government savings, government savings and foreign savings. Investment is a sum of fixed investment over different production sectors.

Saving-investment balance

$$\sum_i P_i \cdot I_i = SH + SG + SF \cdot ER \quad (4.67)$$

Welfare

Welfare change caused by economic shock is calculated through two monetary measures: Equivalent Variation (EV) and Compensating Variation (CV). Equivalent variation measures the income change in current prices (i.e. before the economic shock takes place) that would be equivalent to the income after the economic shock. The compensating variation measures the income change in prices after the economic shock that would be necessary to compensate to the consumer for the price change.

There is a distinction between cases of “benchmark equilibrium” and equilibrium after change. In the first case the consumer faces income Y^0 and prices PD_i^0 . In the second case, income and prices are Y^t and PD_i^t respectively.

Then, price indices for these two cases and change in price level will take following form:

“Benchmark equilibrium” price index

$$PLES^0 = \prod_i PD_i^0 \alpha_i^{HLES} \quad (4.68)$$

Price index after change

$$PLES^t = \prod_i PD_i^t \alpha_i^{HLES} \quad (4.69)$$

Change in price level

$$\Delta PLES = \frac{PLES^t}{PLES^0} \quad (4.70)$$

In the equations above $PLES^0$ and $PLES^t$ are the geometric average of the prices of the commodities.

Next, the supernumerary income should be defined, i.e. income net of subsistence households' consumption level for the “benchmark equilibrium case (SI^0) and the case after changes take place (SI^t).

“Benchmark equilibrium” supernumerary income

$$SI^0 = Y^0 - \sum_i PD_i^0 \cdot \mu_i^H \quad (4.71)$$

Supernumerary income after change

$$SI^t = Y^t - \sum_i PD_i^t \cdot \mu_i^H \quad (4.72)$$

Finally, it is possible to determine the measures of change in welfare

The equivalent variation is the difference between the supernumerary income after the change has been deflated by the change in price level and the supernumerary income of the “benchmark equilibrium”.

Equivalent variation

$$EV = \frac{SI^t}{\Delta PLES} - SI^0 \quad (4.73)$$

The compensating variation is the difference between the supernumerary income after the change and the supernumerary income of the “benchmark equilibrium” multiplied by the change in the price level.

Compensating variation

$$CV = SI^t - SI^0 \cdot \Delta PLES \quad (4.74)$$

4.3. Data, Key Assumptions and Scenarios

Data

The basis for the model is the Social Accounting Matrix (SAM) for Ukraine. SAM is a composite of the Input-Output table and National Accounts for 2002. The Input-Output table gives disaggregation into 38 sectors of the economy (the full list is in the attached table A.5.). Foreign trade is disaggregated into 5 trade regions; mechanism of division is described below. Table A.6. shows the Social Accounting Matrix for Ukraine which is used in the model, but aggregated to 3 sectors and one foreign trade region.

In order to explain meaning of entries, a description of those entries is given by the row (income) basis⁴:

Production

Commodities-Commodities: Intermediate demand

Commodities-Households: Households consumption

Commodities-Government: Government consumption

Commodities-Investment: Investment demand

Commodities-ROW: Exports. Total exports are disaggregated into exports to five trade regions: Russia, rest of CIS, EU25, Asia and Rest of the World. This is done by calculating the export shares of corresponding regions and multiplying total exports by these shares.

Factors of production

Capital-Commodities: Valued added of capital

Labour-Commodities: Value added of labour

Labour-ROW: Foreign remittances of Ukrainian workers, employed abroad

Institutions

Households-Capital: Income received by households from owning capital

Households-Labour: Income of households from wages

Households-Government: Transfers to households from government

Households-ROW: Transfers to households from abroad

⁴ Sometimes production is divided into activities and commodities, since one activity can produce several commodities. This is not the case for Ukrainian data and production entries will be denoted as “Commodities”.

Government-Commodities: Taxes on production and imports. These taxes are calculated in three steps: first, taxes on production and imports are summed with subsidies, given to corresponding industries (subsidies have a negative sign). Second, import taxes are calculated by multiplication of applied import tax rates by value of imports, sector by sector. Import tax rates are taken from the “Law on Custom Tariffs of Ukraine”. Third, taxes on production are determined by subtracting import taxes from total taxes on production and imports.

Government-Capital: Income from state enterprises

Government-Households: Income tax received from households. Income tax rate is found by dividing the amount of income tax receipts by the income of households

Government-ROW: Transfers to government from abroad

Savings-Households: Savings of households

Savings-Government: Savings of government

Savings-ROW: Current Account balance

ROW

ROW-Commodities: Imports. As well as exports, imports are disaggregated into imports to five trade regions: Russia, rest of CIS, EU25, Asia and Rest of the World. This is done by calculating the import shares of corresponding regions and multiplying total imports by these shares.

Assumptions

Key assumptions of the model are as follows:

- The model is static and uses data for one year only (2002)
- There are Constant Returns to Scale in production structure
- It is assumed that WTO accession should not have an explicit impact on the Current Account: for instance, a larger amount of imports/exports should be compensated by a corresponding increase in exports/imports. Thus, the Current Account is fixed, and the exchange rate fluctuates instead to balance foreign trade.
- Since in CGE models all prices are relative, the initial wage rate is used as numeraire and other prices change relative to this variable.

Scenarios

There are four scenarios simulated in the model; scenarios 2, 3 and 4 have 3 sub-scenarios each with different export expansion and investment growth rates.

- Scenario 1. Tariff reform according to schedule, agreed with the WTO

This is done by lowering import tariffs to the level negotiated with the WTO members. The Ukrainian proposal for import tariffs is outlined in Decree #255/96 of the President of Ukraine “About the Conception of Transformation of the Custom Tariff of Ukraine for 1996-2005 According to the GATT/WTO”.

Ukraine has a Free Trade Agreement with CIS countries, which will remain after WTO accession as well, thus there are no changes in the trade regime with these countries. Ukraine applies MFN and full tariffs for other trade partners. Since full tariffs affect only 3% of imports, EU25, Asia and ROW are all assumed to have an MFN regime. Post-WTO import tariffs for EU25, Asian and ROW countries are shown in the last column of Table 4.2.

Table 4.2. Ukraine’s Import Tariffs Prior and Post WTO Accession, %

	Russia	CIS	EU25	Asia	ROW	Post-WTO
Agriculture	0	0	26.7	26.7	26.7	19.4
Forestry	0	0	8.1	8.1	8.1	4.9
Fishery	0	0	21.2	21.2	21.2	10.0
Coal	0	0	0	0	0	0
Hydrocarbons	0	0	0	0	0	0
Non-energy materials	0	0	1.1	1.1	1.1	1.1
Food-processing	0	0	50.5	50.5	50.5	18.9
Textile	0	0	8.2	8.2	8.2	4.0
Wood working	0	0	8.1	8.1	8.1	4.9
Coke products	0	0	0	0	0	0
Petroleum refinement	0	0	0	0	0	0
Chemicals	0	0	7.9	7.9	7.9	5.8
Other non-metallic mineral products	0	0	11.1	11.1	11.1	10.0
Metallurgy	0	0	3.8	3.8	3.8	1.5
Machinery	0	0	7.3	7.3	7.3	3.5
Other	0	0	9.8	9.8	9.8	8.5

Source: WTO

- Scenario 2. Improvement of export access

Being a WTO member, Ukraine will have instruments to curb antidumping and countervailing investigations, thus it will be able to increase its volume of exports. Figures for market access expansion are chosen in accordance with the frequency of AD and CV investigations in corresponding industry and region, reported by the Ministry of Economy of Ukraine. Thus, between 1997 and 2001 there were 5 AD cases from the Russian side concerning the food-processing industry and 2 cases relating to the machine building sector; 7 cases were filed by the EU in relation to chemical products; 5 and 7 investigations regarding metallurgy started by EU

and Asia region respectively. Besides that, Ukraine faced quotas on exports of light industry products to the EU.

Core, least favourable and optimistic sub-scenarios respectively propose the following export expansion rates:

By 5% (3% and 7%) for food processing to Russia

By 5% (3% and 7%) for light industry to EU25 region

By 5% (3% and 7%) for chemicals to EU25

By 5% (3% and 7%) for metallurgy to EU25 and Asia

By 5% (3% and 7%) for machinery to Russia

- Scenario 3. Improvement of investment climate

This will come from two main sources: first of all, investors will face fewer risks and costs of investment, since Ukraine will accept more pro-market regulation. Second, the cost of capital will diminish along with lower prices for imports.

Annual 3% growth of investment for the core sub-scenario, 1% for least favourable sub-scenario and 5% for an optimistic one during 5 years is assumed. This is modelled through the recursive dynamics method: after calculating the first increase in investment and finding new equilibrium changes in the next period are calculated on the basis of this new equilibrium and so on.

- Scenario 4. Combined effect

This scenario includes decrease of import tariffs, improvement of exports access and improvement of investment climate. The three sub-scenarios have the following combination of growth rates: 5% export expansion and 3% yearly investment growth in the core sub-scenario case, 3% export expansion and 1% yearly investment growth in the least favourable case and 7% export expansion and 5% yearly investment growth in the optimistic sub-scenario option.

Chapter 5

Results of the Model

Table 5.1 presents the results of simulating four scenarios with the core development assumption on key macroeconomic variables⁵. As can be seen, the results for simulating tariff reform and the improvement of export access do increase foreign trade, but there are no dramatic changes in output and household consumption. Scenario 3, improvement in investment climate, is the most favourable and brings significant gains for households. The combined scenario mixes the results of the previous three policy simulations.

Table 5.1. Results of the Model, Key Macro Variables, % change from benchmark

	Scenario1	Scenario2	Scenario3	Scenario4
	Tariff reform	Improvement of export access	Increase of investment	Combined
Welfare, % of GDP	0.17	0.09	2.01	1.83
Welfare, % of consumption	0.82	0.43	9.57	8.77
Gross domestic production	0.55	1.20	6.11	6.57
Consumer demand	0.50	0.23	5.33	4.86
Investment demand	2.48	2.01	2.47	4.11
Government demand	-5.62	0.29	3.72	0.17
Exports demand	2.82	4.95	3.40	5.63
Imports demand	3.06	5.38	3.69	6.12
Unemployment	-0.34	-0.12	-4.88	-3.60
Real wage	0.00	0.00	0.05	0.04

A detailed analysis of policy simulations is given below.

The results of the model can be interpreted with the help of the graphical illustration developed by Devarajan *et al.* (1994).

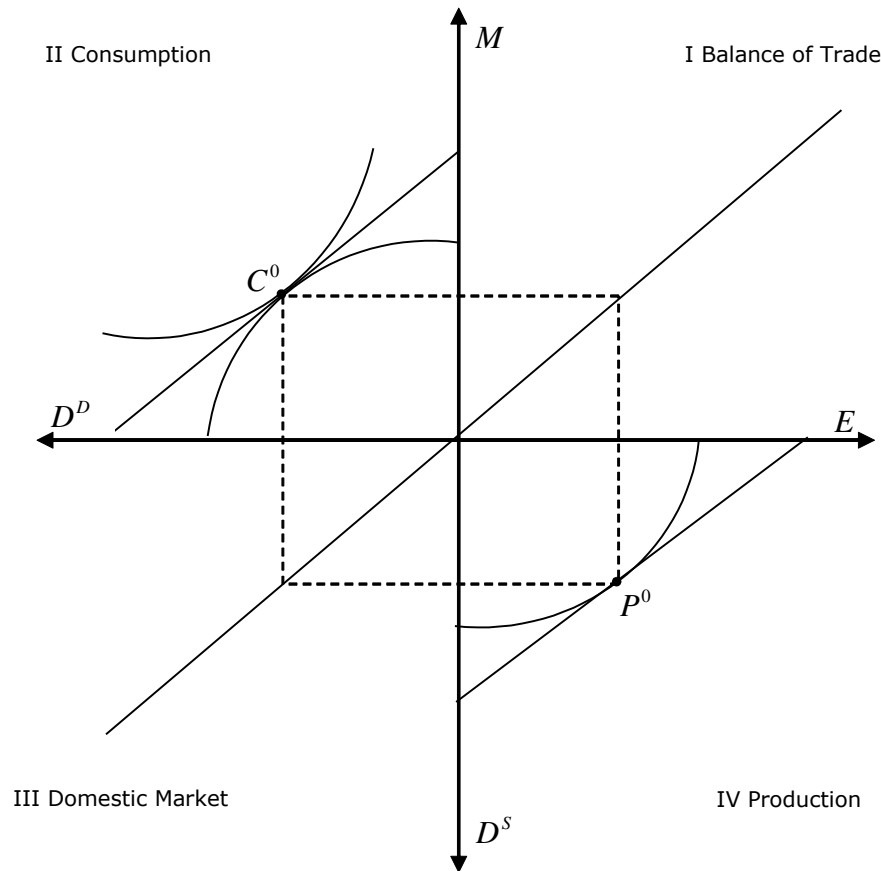
Figure 5.1 presents a stylized economy with one representative producer and consumer and three types of goods: produced locally and supplied domestically (D^S), exports (E) and imports (M).

Quadrant I shows the balance of trade. Under a simplifying assumption, prices of imports and exports are equal to one, so the slope of balance of trade constraint is a straight line going through the origin under 45° . Quadrant II represents consumption with choice between domestically produced and consumed goods (D^D) and imports (M). It shows the consumption possibility frontier as well as relative import and domestic prices and indifference curve. As a result of balanced trade and equal world prices, the consumption possibility frontier is a mirror image of production possibility frontier, depicted at Quadrant IV. The production quadrant includes the production transformation curve and line depicting relative domestic and foreign prices, and

⁵ Scenarios 1 and 2 show that GDP and household consumption fluctuate very slightly. CGE models show general directions of changes and numbers should not be taken too literally. Thus, further analysis will assume “no change” as the most likely outcome, although what happens if alterations do take place will also be shown.

shows division of total domestic production to domestic sales (D^S) and exports (E). Finally, Quadrant III presents the domestic market and balance between goods supplied (D^S) and demanded (D^D) at the domestic market. The dotted square shows the balance on all markets.

Figure 5.1. Benchmark State of Economy



Scenario 1. Import tariff reform

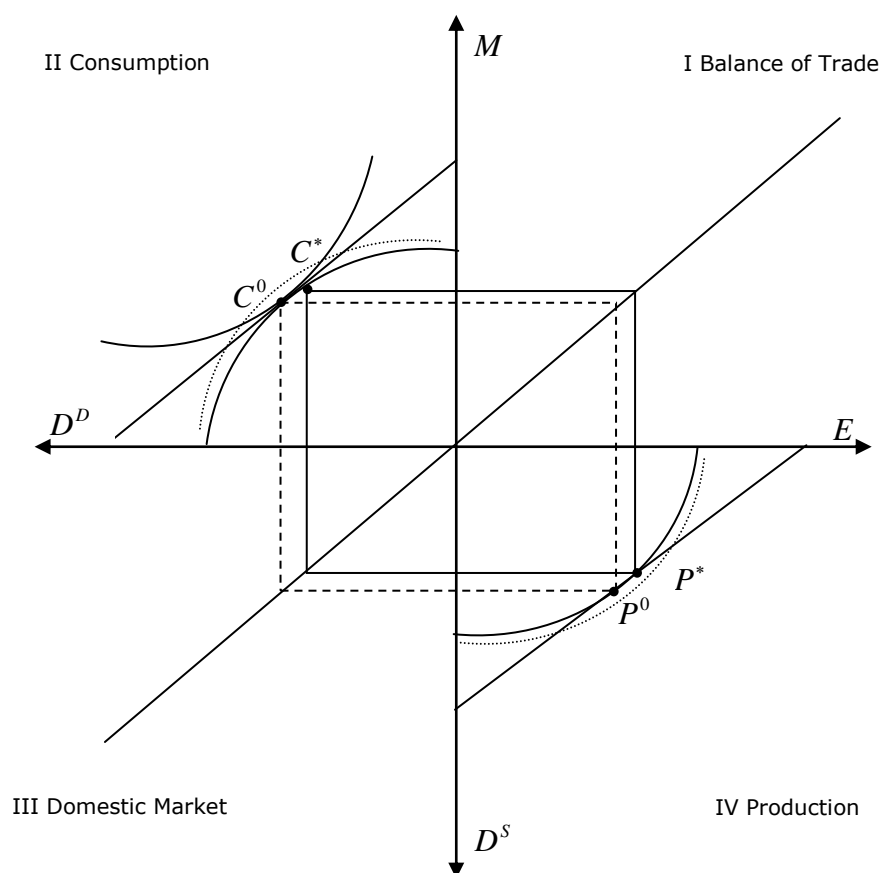
In this scenario Ukraine faces lower import tariffs, thus prices of imports become lower and the volume of imported goods increases. The model predicts that imports will grow by approximately 3%. In order to balance increased imports, exports rise as well and demonstrate 2.8% growth. Domestic production and household consumption do not change significantly: the model predicts GDP growth of 0.55%, and consumption increases by virtually the same amount. Thus, without dramatic changes in production and consumption but quite a considerable increase in foreign trade, Ukraine's economy merely becomes more open and shifts towards the external sector. Producers will supply more of their goods to foreign markets and less to the domestic one, whilst households will shift to the consumption of imported products at the expense of local ones.

Table 5.2. Results of the Model, Scenario 1; % change from benchmark

Key Macro Variables		Breakdown by Sectors			
			Output	Exports	Imports
Welfare, % of GDP	0.17	Agriculture	-0.19	3.19	9.46
Welfare, % of consumption	0.82	Coal mining	2.33	3.70	1.66
Gross domestic production	0.55	Food-processing	-0.62	3.24	40.38
Consumer demand	0.50	Textile and leather	1.29	2.77	5.76
Investment demand	2.48	Chemical industry	0.02	1.90	1.30
Government demand	-5.62	Metallurgy	2.74	3.09	4.15
Exports demand	2.82	Machinery	1.01	2.99	4.80
Imports demand	3.06	Construction	2.63	3.90	2.00
Unemployment	-0.34	Transport	0.73	3.06	-1.05
Real wage	0.00	Post and telecommunications	-0.61	3.03	-2.44
		Financial intermediation	5.70	5.89	5.61

The square which shows market balance shifts up and to the right from benchmark graphically to reflect the increase in foreign trade. Under the assumption that there are no considerable changes in production and consumption, the square moves along the original production transformation curve and consumption possibility frontier. If there is a small increase in production and consumption, the corresponding curves (shown by dotted arcs) will shift outwards. The new equilibrium is reached at points C^* for consumption and P^* for production. From quadrant I, it can be seen that more foreign trade is occurring, while quadrant III shows a decline in demand for and supply of domestically produced goods.

Figure 5.2. Scenario 1



The model predicts some increase of household welfare: 0.17% of GDP or 0.8% of consumption. This occurs as a result of the rise in consumption and decrease in unemployment.

From breaking down the results by sectors of economy, it can be seen that sectors with high initial protection are likely to suffer from a decrease of import tariffs. It can be agriculture: the model shows a small decrease of output by almost 0.2%, and there is a slightly more significant decline of 0.6% in food processing. The latter will drastically increase imports by 40%. By contrast, other sectors will increase their production: metallurgy is a leader with a 2.7% boost in output, followed by coal-mining with 2.3% growth and textile products with a 1.3% output increase. On the services side, financial intermediation is expected to gain and expand by 5.7% to support greater foreign trade activity.

Exports will increase fairly uniformly for all trade regions, but imports will grow for regions which faced import tariffs previously; namely imports from ROW countries will grow by roughly 9%, from Asia by 6.5% and EU by almost 6%. At the same time imports from CIS countries will show a decrease.

Table 5.3. Changes in Foreign Trade by Regions, Scenario 1; % change from benchmark

Region	Exports	Imports
Russia	2.77	-0.98
CIS	2.93	-1.54
EU25	2.73	5.98
Asia	2.94	6.56
ROW	2.89	8.92

A sensitivity analysis is done by changing the elasticities of substitution and transformation to lower and upper levels, and comparing the values of key variables. The initial values for elasticities are taken from the CGE studies of Russia's accession to the WTO, discussed earlier in the text. Key variables which are traced are GDP, exports, imports and welfare. In this scenario, the changing substitution elasticity of the Armington function has the highest effect on predicted exports and imports.

Table 5.4. Sensitivity Analyses, Scenario 1

	Parameter value			Variable value, % change from benchmark		
Parameter	Lower	Level	Upper	Lower	Level	Upper
				GDP		
Substitution elasticity of Armington function	1.5	2	2.5	0.45	0.55	0.65
Transformation elasticity of CET function	-3	-4	-5	0.51	0.55	0.58
				Exports		
Substitution elasticity of Armington function	1.5	2	2.5	2.23	2.82	3.65
Transformation elasticity of CET function	-3	-4	-5	2.62	2.82	2.97
				Imports		
Substitution elasticity of Armington function	1.5	2	2.5	2.42	3.06	3.97
Transformation elasticity of CET function	-3	-4	-5	2.85	3.06	3.23
				Welfare, % of consumption		
Substitution elasticity of Armington function	1.5	2	2.5	0.85	0.82	0.53
Transformation elasticity of CET function	-3	-4	-5	0.79	0.82	0.82

Scenario 2. Improvement of exports access

In this case, exports enjoy greater access to the foreign markets, and the final effect is almost the same as in Scenario 1, but now comes from the exports side, not from imports.

With better tools to fight antidumping and countervailing investigations, Ukraine will be able to increase the exports of some goods. In the case of central sub-scenario, the model shows that total exports will grow by 4.95%. Since the trade balance should be restored, imports will increase by more than 5%. Again, changes of production and consumption are relatively small, but changes in output are larger than in Scenario 1: GDP grows by 1.2%, while consumption expands less, by 0.2%.

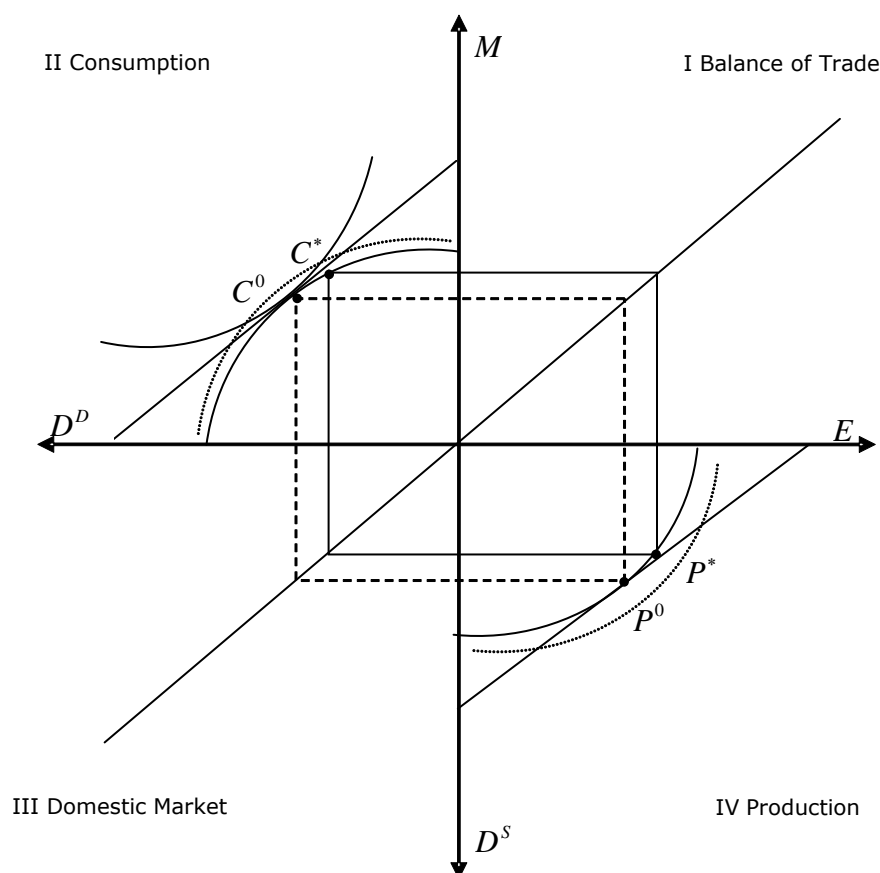
Thus, as the model shows, it becomes more profitable to export goods compared with selling them on the domestic market, and the economy is shifting away from the domestic market to the foreign sector.

Table 5.5. Results of the Model, Scenario 2; % change from benchmark

	Improved market access, 5%	Improved market access, 3%	Improved market access, 7%
Welfare, % of GDP	0.09	0.19	0.14
Welfare, % of consumption	0.43	0.91	0.68
Gross domestic production	1.20	0.69	1.57
Consumer demand	0.23	0.39	0.39
Investment demand	2.01	1.47	3.10
Government demand	0.29	-0.01	0.17
Exports demand	4.95	2.99	7.01
Imports demand	5.38	3.25	7.62
Unemployment	-0.12	-0.34	0.01
Real wage	0.00	0.00	0.00

Figure 5.3 illustrates this point. A new equilibrium is found by shifting the balancing square up and to the right along the production transformation curve and consumption possibility curve. If predicted growth of production and consumption holds true, both curves will move outwards, as shown by the dotted arcs. Since output is expected to grow more than in Scenario 1, the production transformation curve will shift out more. Equilibrium consumption and production are denoted by points C^* and P^* respectively.

Figure 5.3. Scenario 2



The model estimates a small increase in welfare: in the central case it is 0.09% of GDP or 0.4% of consumption; this comes from a minor decrease in unemployment and an increase of consumption. It is worth noting that sub-scenarios with lower (3%) and higher (7%) improvement in export access bring a matching increase in foreign trade (around 3% and 7% respectively), but welfare shows a different pattern and in both cases it is higher than in the core sub-scenario. A peak increase in welfare happens in the least favourable sub-scenario: by 0.9% of consumption; in the optimistic sub-scenario it is almost 0.7%. One possible explanation is that when exports do not expand so much in the least favourable case, the economy does develop and production increases, but there is no considerable shifting to foreign trade. Rather, there is a progress in the domestic market and consumption. The optimistic sub-scenario shows a greater increase in both output and foreign trade, but increase of consumption is the same as in the least favourable case. This, coupled with a small increase in unemployment, brings a lower enlargement of welfare.

Among the most important sectors of the Ukrainian economy, only transport and telecommunications show a decline in production: in the central case there is a 1.8% and 3.6% decrease respectively. Metallurgy gains the most from better market access, and increases production by 5%. Textiles and chemicals expand by 4.8% and 4.6% respectively. Amid the service sectors, financial intermediation will grow the most: by nearly 9.5%. The least favourable

and optimistic sub-scenarios mirror core one from two sides, and show respectively a lower and higher increase of output and trade.

Table 5.6. Results of the Model, Impact by Sectors, Scenario 2; % change from benchmark

	Improved market access, 5%			Improved market access, 3%			Improved market access, 7%		
	Output	Exports	Imports	Output	Exports	Imports	Output	Exports	Imports
Agriculture	1.12	4.65	-0.75	0.46	2.86	-0.83	0.48	6.41	-2.60
Coal mining	2.12	4.48	0.98	1.56	2.86	0.92	4.02	6.73	2.71
Food-processing	1.29	5.08	-0.72	0.38	3.06	-1.06	1.74	7.12	-1.09
Textile and leather	4.82	5.02	4.64	2.71	3.04	2.43	6.46	7.08	5.92
Chemical industry	4.60	5.02	4.27	2.98	3.00	2.97	7.03	7.00	7.05
Metallurgy	5.00	5.00	5.00	3.00	3.00	3.00	7.00	7.00	7.00
Machinery	3.50	5.11	2.41	1.77	3.09	0.87	4.99	7.14	3.54
Construction	1.00	5.01	-0.94	0.86	3.23	-0.30	1.39	7.25	-1.42
Transport	-1.75	3.18	-5.46	-0.91	2.21	-3.28	-2.32	5.53	-8.11
Post and telecommunications	-3.63	1.41	-6.12	-2.56	0.74	-4.22	-3.77	3.32	-7.22
Financial intermediation	9.43	9.58	9.36	5.28	5.43	5.21	14.30	13.44	14.74

Exports to key trade regions are expanding close to the modelled exogenous increase rate. On the imports side, Ukraine will be trading relatively more with Rest of the World group of countries (8% imports increase in the central case) and EU25 (6% increase).

Table 5.7. Changes in Foreign Trade by Regions, Scenario 2, % change from benchmark

	Improves market access, 5%		Improved market access, 3%		Improved market access, 7%	
	Exports	Imports	Exports	Imports	Exports	Imports
Russia	4.43	4.83	2.78	2.73	6.38	5.75
CIS	5.28	5.02	3.18	2.57	7.35	5.67
EU25	5.15	5.98	3.04	3.35	7.22	8.05
Asia	5.03	4.43	3.01	2.46	7.10	5.78
ROW	5.10	8.16	3.11	6.09	7.26	16.54

The sensitivity analysis shows that varying substitution and transformation elasticities do not change the central values of output, exports and imports very much. By contrast, welfare experiences significant swings around its central value of a 0.43% increase: from 0.33% growth to 1.69%. This is the result of high reliance of welfare and underlying consumption on whether Ukraine shifts to the foreign sector or develops the domestic market.

Table 5.8. Sensitivity Analysis, Scenario 2

	Parameter value			Variable value, % change from benchmark		
Parameter	Lower	Level	Upper	Lower	Level	Upper
				GDP		
Substitution elasticity of Armington function	1.5	2	2.5	1.08	1.20	1.18
Transformation elasticity of CET function	-3	-4	-5	1.28	1.20	1.12
				Exports		
Substitution elasticity of Armington function	1.5	2	2.5	5.03	4.95	4.87
Transformation elasticity of CET function	-3	-4	-5	4.93	4.95	5.00
				Imports		
Substitution elasticity of Armington function	1.5	2	2.5	5.47	5.38	5.29
Transformation elasticity of CET function	-3	-4	-5	5.36	5.38	5.43
				Welfare, % of consumption		
Substitution elasticity of Armington function	1.5	2	2.5	0.98	0.43	1.69
Transformation elasticity of CET function	-3	-4	-5	0.33	0.43	0.82

Scenario 3. Improvement of investment climate

Foreign investments will increase the productivity of Ukrainian firms and bring better allocation of resources. In the central sub-scenario, output increases by a significant 6.1% along with 5.3% consumption growth. Exports and imports increase as well, but less than in previous scenarios and less than GDP growth: exports grow by 3.4%, imports by 3.7%. Even if a modest 1% increase in investment inflow is modelled, predicted output and consumption expansion outperform the results of the first two scenarios. In the case of an optimistic assumption about investment growth rate, GDP impressively expands by nearly 11% and household consumption by 9%.

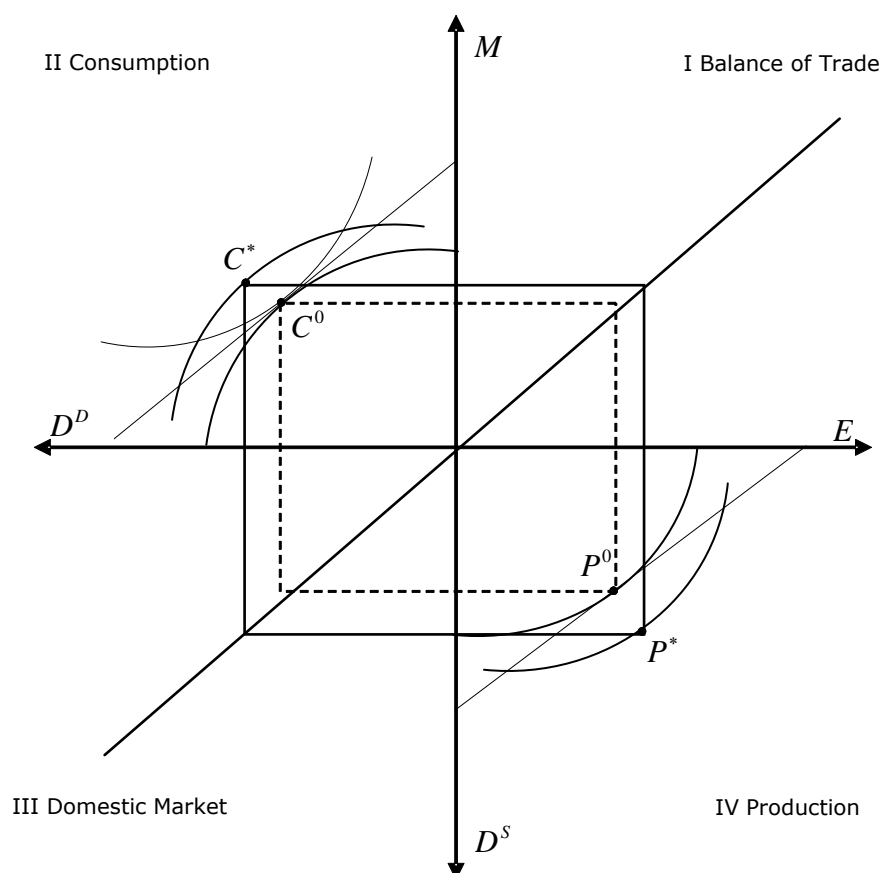
Therefore, in this case, the Ukrainian economy develops not so much through foreign trade, but through domestic improvement in efficiency.

Table 5.9. Results of the Model, Scenario 3; % change from benchmark

	Increased investment, 3% growth for 5 years	Increased investment, 1% growth for 5 years	Increased investment, 5% growth for 5 years
Welfare, % of GDP	2.01	0.69	3.18
Welfare, % of consumption	9.57	3.25	15.26
Gross domestic production	6.11	1.95	10.59
Consumer demand	5.33	1.78	8.83
Investment demand	2.47	0.72	4.49
Government demand	3.72	1.16	7.20
Exports demand	3.40	0.95	6.46
Imports demand	3.69	1.03	7.02
Unemployment	-4.88	-1.68	-7.60
Real wage	0.05	0.02	0.08

As shown in Figure 5.4, there will be upgrading in all four quadrants. Reflecting growth of output, household consumption and foreign trade, the balancing square will expand outwards in all directions. Since output and consumption are growing by a faster pace than exports and imports, quadrant I of the balance of trade will see less expansion than domestic production and consumption. There will be an outward movement of the consumption possibility curve from the initial point to new equilibrium C^* and production transformation curve to point P^* (the latter will move out further than the former).

Figure 5.4. Scenario 3



There is a significant increase in household welfare: 2% of GDP or 9.6% of consumption in the central sub-scenario. If the optimistic sub-scenario holds true, welfare can increase by as much as 15% of consumption. Better allocation of resources and growth of production cause a massive decrease of unemployment, by almost 5% in the core sub-scenario and some improvement in real wages.

All sectors of Ukrainian economy enjoy growth of output. Sectors which are commonly feared to lose from WTO accession are actually enjoying higher output as a result of investment inflow and consequent increased efficiency. These sectors are coal mining, agriculture and food-processing. In the central scenario, coal mining wins the most and expands its output by 5.2%. Food-processing follows with a 5.07% increase of output and agriculture grows by 3.6%. Metallurgy and the textile industry are also enlarged by roughly 3%.

The model points at the vital importance of investment and better allocation of resources for agriculture: if a 5% increase of investment inflow is assumed, agriculture becomes a leader of growth amid the non-service sectors, showing a 10% increase of output. It is worth noting that it

is the only sector to contract exports. Instead, growing domestic output and imports are directed at saturation of the Ukrainian market.

Telecommunications and the financial sector are leaders among services. Financial intermediation expands by almost one-third and telecommunications by 13%. Transport also demonstrates significant growth rate of 6% to keep up with the enlarged economy.

Table 5.10. Results of the Model, Impact by Sectors, Scenario 3; % change from benchmark

	Increased investment, 3% growth for 5 years			Increased investment, 1% growth for 5 years			Increased investment, 5% growth for 5 years		
	Output	Exports	Imports	Output	Exports	Imports	Output	Exports	Imports
Agriculture	3.60	-3.60	7.71	1.14	-1.52	2.61	10.60	-2.71	18.52
Coal mining	5.20	5.47	5.06	1.43	1.51	1.40	8.32	9.31	7.83
Food-processing	5.07	2.17	6.69	1.75	0.59	2.39	7.60	4.64	9.25
Textile and leather	2.89	2.00	3.69	0.73	0.43	1.01	5.25	3.94	6.43
Chemical industry	1.33	2.12	0.69	0.03	0.48	-0.33	3.76	4.71	2.99
Metallurgy	3.02	3.01	3.04	0.89	0.88	0.90	6.08	6.10	6.05
Machinery	2.47	4.11	1.35	0.09	1.05	-0.57	5.14	7.38	3.62
Construction	1.19	3.56	0.03	0.26	0.99	-0.10	2.70	6.44	0.87
Transport	5.97	4.27	7.29	1.82	1.16	2.34	10.77	7.59	13.28
Post and telecommunications	12.92	7.62	15.74	4.51	2.62	5.49	22.38	12.68	27.68
Financial intermediation	27.08	23.46	28.92	7.97	7.38	8.26	47.71	38.90	52.30

Ukraine is starting to export relatively more to Russia compared with other regions, but imports from Russia and other CIS countries are not growing as much as imports from other trade partners of Ukraine. Imports from EU25, Asian and ROW countries are growing considerably more, compared with Russia and the rest of CIS. This may indicate a more efficient trade structure: major items of incoming trade with CIS are energy resources and materials with low degree of procession, whilst imports from other regions, first of all from the EU, have a high proportion of machinery and other goods, which allows for an increase in productivity.

Table 5.11. Changes in Foreign Trade by Regions, Scenario 3, % change from benchmark

	Increased investment, 3% growth for 5 years		Increased investment, 1% growth for 5 years		Increased investment, 5% growth for 5 years	
	Exports	Imports	Exports	Imports	Exports	Imports
Russia	4.06	2.16	1.16	0.73	7.29	4.89
CIS	3.16	0.37	0.88	0.15	6.13	2.90
EU25	3.32	6.85	0.93	2.15	6.36	10.68
Asia	3.41	5.76	0.95	1.48	6.59	9.66
ROW	2.84	4.73	0.77	1.06	5.69	8.88

Changing elasticities do not significantly affect key variables, except for one case. If the initial value of substitution elasticity of the Armington function is increased, exports and imports growth rates more than double.

Table 5.12. Sensitivity Analyses, Scenario 3

	Parameter value			Variable value, % change from benchmark		
Parameter	Lower	Level	Upper	Lower	Level	Upper
				GDP		
Substitution elasticity of Armington function	1.5	2	2.5	6.01	6.11	7.25
Transformation elasticity of CET function	-3	-4	-5	6.14	6.11	6.05
				Exports		
Substitution elasticity of Armington function	1.5	2	2.5	3.91	3.40	7.50
Transformation elasticity of CET function	-3	-4	-5	4.06	3.40	4.03
				Imports		
Substitution elasticity of Armington function	1.5	2	2.5	4.24	3.69	8.15
Transformation elasticity of CET function	-3	-4	-5	4.41	3.69	4.37
				Welfare, % of consumption		
Substitution elasticity of Armington function	1.5	2	2.5	8.98	9.57	12.67
Transformation elasticity of CET function	-3	-4	-5	9.30	9.57	9.08

Scenario 4. Combined effect

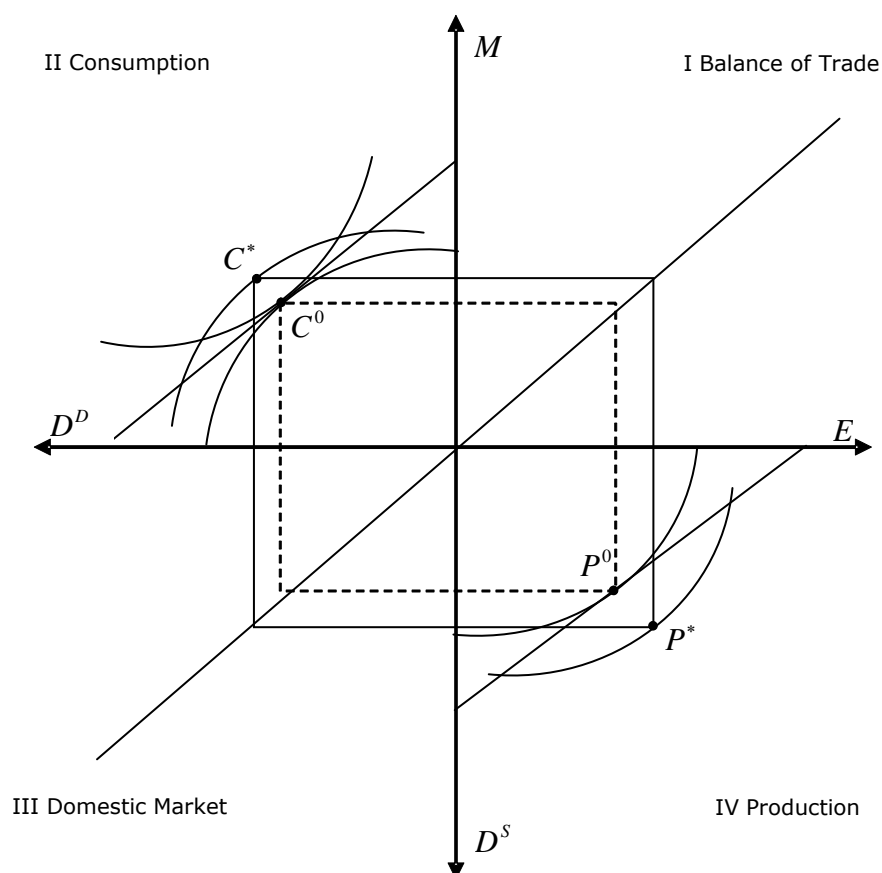
This scenario embraces all other options, and the model shows that the new equilibrium is a mixture of previous ones. GDP is predicted to grow quite considerably: by 6.6% in the core sub-scenario; ranging from 2.5% in the least favourable to 11.6% in optimistic sub-scenarios. Although output grows more, compared with the previous scenario (6.6% against 6.1% in the central case), consumption increase is lower: 4.9% versus 5.3% in the preceding scenario. It can be explained by the fact that Scenario 4 includes all scenarios with different simulations behind them: Scenario 1 models lower import tariffs, hence it stimulates imports (and exports, which must balance trade). Scenario 2 has a similar effect, but acts from the exports side. Scenario 3 mainly increases output and consumption in the domestic market. Thus, in Scenario 4 there is growth of output principally as a result of Scenario 3, but there is also growth of foreign trade as a result of Scenarios 1 and 2. Hence, there are more incentives to trade with foreign countries, compared with domestic sales. The model shows that foreign trade is expanding quite considerably: exports are growing by 5.6% and imports by 6.1%.

Table 5.13. Results of the Model, Scenario 4; % change from benchmark

	Improved market access 5%; increased investment 3%	Improved market access 3%; increased investment 1%	Improved market access 7%; increased investment 5%
Welfare, % of GDP	1.83	0.78	3.66
Welfare, % of consumption	8.77	3.71	17.53
Gross domestic production	6.57	2.49	11.60
Consumer demand	4.86	1.94	9.96
Investment demand	4.11	2.67	7.08
Government demand	0.17	-3.80	3.82
Exports demand	5.63	3.05	7.38
Imports demand	6.12	3.32	8.02
Unemployment	-3.60	-1.44	-8.16
Real wage	0.04	0.02	0.08

The solid square in Figure 5.5 shows a new equilibrium. As in the previous case, the new equilibrium square expands in all directions, but to a different extent than in Scenario 3. Foreign trade sees fairly the same growth as output, so the new equilibrium square is spread quite the same to quadrant I and quadrant III. Since output grows by 6.6% and consumption by 4.9%, the production possibility curve shifts outwards more than the consumption possibility curve.

Figure 5.5. Scenario 4



Welfare of households is also growing to a less extent than in Scenario 3: by 1.8% of GDP or 8.8% of consumption. This is explained by a lower level of domestic consumption and a relatively less significant drop in unemployment: by 3.6% compared with 4.9% in Scenario 3.

At sectoral level, the only industry which experiences stagnation (in the central sub-scenario) or decline (in the least optimistic sub-scenario) in output is food processing. If the core sub-scenario holds true, production of this sector is virtually not changing, or as the model shows is growing by 0.09%. The least favourable case predicts a drop of output by slightly more than 1%; although the optimistic sub-scenario predicts 3.6% growth. At the same time, this sector is significantly increasing imports (around 40% in all sub-scenarios) and it could mean that although the level of production is lower, consumers can gain from a larger variety of food products.

In this scenario, agriculture becomes a leader of output growth among non-services sectors, and increases its production by 7.4% in the central sub-scenario. It is worth noting that, although exports of agricultural production do not grow substantially in either sub-scenario, imports do increase quite considerably, which also can point at a larger utility of households owing to the

diversity of agricultural products available for domestic consumption.

The textile industry is the second-largest grower, with almost 6% increase of output. Important sectors of Ukrainian economy such as the chemical industry and metallurgy grow by a decent 5.8% and 5% respectively. At the services side, financial intermediation has impressive growth of nearly 20%, followed by such service sectors as telecommunications, with 15% expansion, and transport, with 8.7% growth.

Table 5.14. Results of the Model, Impact by Sectors, Scenario 4; % change from benchmark

	Improved market access 5%; increased investment 3%			Improved market access 3%; increased investment 1%			Improved market access 7%; increased investment 5%		
	Output	Exports	Imports	Output	Exports	Imports	Output	Exports	Imports
Agriculture	7.35	1.30	23.68	1.18	1.50	12.79	14.49	1.83	36.17
Coal mining	4.88	7.58	3.59	2.36	4.46	1.34	8.49	11.47	7.06
Food-processing	0.09	5.11	40.55	-1.12	3.09	39.41	3.59	7.08	46.74
Textile and leather	5.83	4.89	12.82	2.49	3.07	7.86	7.77	6.89	14.81
Chemical industry	5.75	4.97	9.42	4.57	2.94	8.95	11.37	6.83	18.45
Metallurgy	5.00	5.00	6.85	3.00	3.00	4.82	7.00	7.00	8.89
Machinery	3.81	5.08	8.24	1.55	3.10	5.67	5.51	7.11	9.80
Construction	2.86	6.54	1.07	2.43	4.26	1.53	5.67	9.07	4.01
Transport	8.70	6.88	10.13	3.91	3.97	3.86	13.17	8.52	16.86
Post and telecommunications	15.35	10.98	17.66	5.89	6.07	5.80	20.37	11.46	25.22
Financial intermediation	19.73	19.80	19.70	10.22	9.88	10.39	21.07	21.97	20.62

The direction of trade flows between Ukraine and its partners is predicted to face some reorientation. Exports to CIS countries are growing by fairly the same pace as to other trade regions. On the other hand, imports from Russia and other CIS countries contract, whilst imports from other trade regions expand by between 12.5% and 14.5%. Major expansion is occurring at imports of chemical products and machinery.

Table 5.15. Changes in Foreign Trade by Regions, Scenario 4, % change from benchmark

	Improved market access 5%; increased investment 3%		Improved market access 3%; increased investment 1%		Improved market access 7%; increased investment 5%	
	Exports	Imports	Exports	Imports	Exports	Imports
Russia	6.00	-1.13	3.29	-2.72	7.97	-1.75
CIS	5.31	-2.19	2.96	-4.10	7.02	-4.80
EU25	5.83	12.63	2.99	8.24	7.45	16.77
Asia	5.73	13.13	3.29	8.95	7.86	16.97
ROW	4.95	14.56	2.73	11.46	6.39	21.71

As can be seen from Table 5.16, in Scenario 4 changing the elasticity's parameter values does not bring significant modification to the key variables under scrutiny.

Table 5.16. Sensitivity Analyses, Scenario 4

Parameter	Parameter value			Variable value, % change from benchmark		
	Lower	Level	Upper	Lower	Level	Upper
				GDP		
Substitution elasticity of Armington function	1.5	2	2.5	6.57	6.94	6.52
Transformation elasticity of CET function	-3	-4	-5	6.79	6.94	6.79
				Exports		
Substitution elasticity of Armington function	1.5	2	2.5	5.63	5.50	5.40
Transformation elasticity of CET function	-3	-4	-5	5.36	5.50	5.42
				Imports		
Substitution elasticity of Armington function	1.5	2	2.5	6.12	5.98	5.87
Transformation elasticity of CET function	-3	-4	-5	5.82	5.98	5.88
				Welfare, % of consumption		
Substitution elasticity of Armington function	1.5	2	2.5	8.77	9.87	8.68
Transformation elasticity of CET function	-3	-4	-5	9.96	9.87	9.77

Chapter 6

Concluding Remarks

This research scrutinises the accession of a transition country to the World Trade Organization on the evidence of Ukraine. Quantitative results are obtained by building a Computable General Equilibrium model in the mathematical programming language General Algebraic Modelling System (GAMS). The model is static with perfect competition and Constant Returns to Scale. The economy of Ukraine is disaggregated into 38 sectors and there are five trade regions.

Four scenarios are simulated: 1) import tariffs reform; 2) improvement of exports access; 3) improvement of investment climate and 4) the scenario that combines previous three, or a full WTO accession. The first scenario is modelled by changing import tariffs according to the WTO tariff schedule; the second one assumes an increase of exports to selected trade regions; the third one presumes growth of investment with a certain rate for five years and is calculated through the recursive dynamics technique. In order to achieve better flexibility, scenarios 2, 3 and 4 have 3 sub-scenarios, each with different rates of exports access improvement and investment inflow. Scenarios with 3% market access improvement and 1% investment increase are denoted as “least favourable”; “core” or “central scenarios” stands for a 5% market access expansion and 3% investment growth; 7% market access increase and 5% investment growth are called “optimistic scenarios”.

In the case of full WTO accession scenario, the model predicts that welfare of households will increase significantly: in the central sub-scenario by nearly 8.8% of consumption or 1.8% of GDP. Output will increase by more than 6.5%, while exports and imports will grow by 5.6% and 6.1% correspondingly. Unemployment is expected to fall by 3.6%.

In order to understand how these results are obtained, it is worth studying the results of scenarios separately and comparing them.

In the first scenario, tariff reform according to the WTO schedule does not bring significant changes either to production or to welfare of households. Lower import tariff barriers stimulate inflow of imports, which grow by 3%. In order to restore a trade balance, exports increase by 2.8%. GDP and households consumption both rise by an insignificant 0.5% which can be broadly considered as “no change” at all. These figures point at shifting to more trade with foreign countries, but without noticeable effect on domestic production and consumption. As a result, household welfare does not change considerably: the model shows welfare growth of 0.17% of GDP or 0.8% of consumption.

The improvement of export access allows Ukrainian producers to increase the volume of some exports to those regions which applied antidumping and countervailing measures to these products before. Thus, outgoing trade will grow, and the model predicts an increase of almost 5% of exports in the central sub-scenario. Imports are growing as well, since more intermediate goods are needed and a trade balance has to be kept. As in the previous scenario, this does not have significant influence on production: GDP grows by 1.2%. The story here is similar to the one with tariff reform, but first of all comes from the exports side; second, it has an even smaller effect on household consumption and welfare. Consumption is growing by a negligible 0.2%, while welfare is growing by 0.09% of GDP or 0.4% of consumption. Although production expands more compared with preceding case, welfare and domestic consumption is twice as small which comes from higher reorientation of producers to foreign markets at the expense of the domestic

market.

Modelling the improvement of the investment climate shows a large expansion of the economy and an increase in household welfare. Investment brings better allocation of resources and GDP grows by more than 6% in the central sub-scenario. The foreign sector expands as well, but by a comparatively smaller amount: exports grow by 3.4% and imports by 3.7%. Greater output without redistribution of sales to foreign countries means greater domestic consumption: it increases by 5.3%. Coupled with an almost 5% drop in unemployment and some real wage growth, this allows for household welfare to increase by a remarkable 2% of GDP or 9.6% of consumption.

Thus, it can be seen that the results of modelling Scenario 4 incorporate the outcomes of the three scenarios described above. Stimulation of foreign trade comes from modelling scenarios 1 and 2 and results in the highest exports and imports growth among all four cases. Improvement of investment climate and better efficiency lead to a considerable increase of GDP, also higher than in any of the other three scenarios. Parameters such as household consumption growth, drop of unemployment rate and household welfare improvement are a mixture of those factors. They show less progress than from modelling Scenario 3, but are much larger than from simulating scenarios 1 and 2.

Another appealing aspect is to analyze how different sectors will react to modelled shocks. It is worthwhile breaking major sectors of the Ukrainian economy into three major groups: 1) agriculture and food-processing; 2) sectors which are considered to be a backbone of economy, namely metallurgy, the chemical industry and machinery; 3) service sectors, specifically: transport, telecommunications and financial intermediation.

Agriculture, and even more so, food-processing have quite high initial import tariffs, which have to be lowered considerably. Thus, Scenario 1 results in a significant increase of agricultural and food products imports: by 10% and 40% respectively. At the same time, there is either a small drop or stagnation of output in these sectors. In Scenario 2, improvement of export access allows these two sectors to increase exports by roughly 5% each in the central sub-scenario, with a rather small increase of output (around 1%) and drop of imports (about 0.7%). Augmentation of investment climate brings better efficiency and both sectors increase their production: food processing leads with 5% growth, whilst agriculture expands by 3.6%. Exports are growing as well, by 6.7% and 7.7% respectively. Remarkably, agriculture is contracting exports by a figure similar to its output growth: 3.6%. The combined scenario shows different development paths for the industries under consideration. In Scenario 4, agriculture becomes a leader of growth among non-service sectors with a 7.4% increase; imports are also significantly increased by 24%. Imports of food products boost by almost the same amount as in Scenario 1 (41%), but investment inflow cannot compensate for higher competition, and output of food-processing industry is not changing.

Among the key industrial sectors, metallurgy is predicted to be a stable although not record-breaking winner, while the chemical industry and machinery show more modest results. In Scenario 1, metallurgy's output increases by 2.7% in the central sub-scenario. Machinery grows by 1%, whilst the chemical sector does not change its output. Respectively, foreign trade turnover of these sectors changes in a similar way, which can be connected to the initial tariff structure: a larger decrease for metallurgy and machinery and a relatively smaller one for the chemical sector. In Scenario 2, the core sub-scenario, exports of all three industries grow by roughly 5%. Again, metallurgy is a leader of growth with a 5% output boost, followed by the chemical industry

(4.6%) and machinery (3.5%). Production growth corresponds to the volume of exports markets, to which Ukrainian producers will get better access. For the metallurgy, machinery and chemical sectors, improvement of investment climate proved to be relatively not as important a source of growth as for, say, agriculture and food-processing. Although the production of core industrial sectors increases, it does so to a lesser extent compared with the scenario with increased export access. Finally, full WTO accession scenario brings quite optimistic prospects for these three industries: enjoying combined effects of better exports access and investment inflow, the chemical industry increases its output by 5.6%, followed by metallurgy (5%) and machinery (3.8%).

When it comes to services sectors, financial intermediation is clearly a winner in all four scenarios. Its growth rates are increasing from scenario 1 to 3: 5.7% in Scenario 1; 9.4% in Scenario 2; a remarkable 27% in Scenario 3. Scenario 4 brings more balanced growth of nearly 20%. Imports and exports of financial services repeat the growth path of output in corresponding scenarios on an almost one-to-one basis. This suggests that the financial sector will be an important player in servicing both domestic and international transactions. Transport and telecommunications demonstrate a different picture from that of the financial sector, but are similar between themselves. In scenarios 1 and 2, these sectors are showing either signs of stagnation or some decline. By contrast, improvement of the investment climate proves to be a very important factor in developing these infrastructure sectors: in scenarios 3 and 4, transport grows by 6% and 8.7% respectively, while telecommunications grow by 13% and 15%.

From an examination of the distribution of trade flows across the partners of Ukraine, one can see two different cases concerning exports and imports. Exports are growing quite uniformly to all major trade partners of Ukraine. By contrast, imports from Russia and the rest of the CIS countries underperform, compared with imports from EU25, Asian and ROW countries. In the case of a full WTO accession scenario, imports from Russia and the rest of the CIS countries decline by 1% and 2.2% respectively. On the other hand, imports from other trade partners grow by 12.5% – 14.5%. This can signify a more efficient and energy-saving structure of economy, since major items of imports from former USSR countries are energy resources. On top of this, imports from well-developed partners like the EU to great extent are machinery and other goods, which allow in increase in productivity.

One important factor highlighted by modelling Ukraine's accession to the WTO is the importance of investment for sustainable economic development. The model shows that, although such aspects as amendment of tariff schedule or improvement of exports access do promote foreign trade, they have limited, if any, effect on other parameters. Expansion of foreign trade does not lead to a significant increase in production, but rather reallocates sales from the domestic market to foreign markets. Household consumption does not see much growth either and welfare changes only slightly. By contrast, if the inflow of investment is modelled, the picture changes drastically. Being able to increase efficiency, producers expand their output and are capable of spreading out both foreign and domestic sales. There is a drop in unemployment rate, while consumption and household welfare increase. Thus, it is crucial for Ukraine to concentrate not only on promotion of foreign trade, but on the development of an attractive investment climate as well.

There are several policy implications which can be made.

First of all, there are broad concerns among Ukrainian policy-makers, producers and the general public regarding a possible drop of output in certain sectors which will face higher imports and competition after WTO accession. Most anxiety is related to the agriculture and food-processing

industries. This CGE study confirms that such a point of view is not ungrounded. Changing the tariff schedule to the one agreed with the WTO members does significantly increase imports and leads to a decline or stagnation of output in these industries. At the same time, the model shows that investment can be a very important positive factor, allowing the turning of WTO accession into favouring agriculture and food-processing. Thus, Ukraine should make the most out of opportunities granted by “green” and “blue boxes”, and create an encouraging investment environment.

Scenario 2 shows that improvement of export access will be favourable for those industries which suffered from restrictions prior to WTO accession. It is true that WTO membership gives clear rules of dealing with antidumping and countervailing suits, but improvement of export access does not come automatically. It is a matter of country and producers to use this opportunity by organizing a highly qualified legal framework.

Scenario 3 demonstrates the strong potential of increasing investment inflow. Again, this will not come after the WTO accession as granted. In order to obtain investments, Ukraine should form a favourable investment climate. This can be done through the creation of transparent regulations, establishing political and macroeconomic stability, and fighting high inflation and corruption.

It would be an interesting exercise to compare the results of this model with those of other known studies of this topic for Ukraine, Russia and Kazakhstan. Unfortunately, direct comparison is not possible, since models are either built for different countries, use a different base year for their database or incorporate different functional specification. Nevertheless, it is possible to make a rough comparison and see whether results are of the same direction and similar magnitude.

The model for Ukraine constructed by Pavel *et al.* (2004) is dissimilar to this model in several ways. To mention some of them, it has a different base year (2001 in that of Pavel *et al.* and 2002 in this model), different aggregation of sectors, trade regions and households. There are two similar policy experiments in both models: tariff reform and improved market access.

In the case of Pavel *et al.*, tariff reform brings a small and positive effect on output (1.3% growth) and welfare (1.2% of consumption). This model also shows some output and welfare growth, but of a smaller scale: GDP grows by 0.55%, welfare of households by 0.8%. In the second comparable scenario, improvement of market access, the similarity in welfare change is quite close: in the model of Pavel *et al.*, welfare grows by 0.3%, while in this model it is 0.4%. Output expansion numbers are more different: 0.3% in the model of Pavel *et al.* and 1.2% in model of this research. Since the results of the CGE simulations should be viewed as pointing to the general trend, those figures show quite high convergence.

A study of Russia’s accession to the WTO by Jensen *et al.* (2004) is interesting owing to the similar usage of the recursive dynamics approach to quantify improvement of an investment climate. The study for Russia shows that investment will have a major impact and will account for two-thirds of total gains from WTO accession in the long run. This model also demonstrates the importance of investment.

The model which was built for this research is not a rigid product, and there are many extensions

which can be done depending on purpose of study.

First of all, this model has a standard general equilibrium framework and assumes perfect competition and Constant Returns to Scale. One possible extension is to introduce for some industries monopolistic behaviour and Increasing Returns to Scale. This will make it possible to reflect the actual structure of economy better and to obtain more realistic results. In the case of imperfect competition, welfare of households is expected to be higher as a result of gains from a larger variety of consumed goods and services. In order to make this extension, the software code has to be changed in parts, describing production functions.

Another potential fundamental extension is the introduction of dynamics and intertemporal optimization. This model is static; although it employs the recursive dynamic method, capturing intertemporal behaviour would open the door to a much wider variety of modelling opportunities. This augmentation also requires alteration of the code, but on a much greater scale compared with introducing monopolistic competition, since behaviour of all agents in the model is changing.

There are also several other extensions which do not require significant changes in the model structure, but rather data work or additional research outside the model. For instance, it is possible to estimate non-tariffs barriers in Ukraine and to widen the analysis from manufactured goods to service sectors as well. A technique which is used for this purpose is conducting a large-scale survey among producers (among thousands of respondents) considering their perception of non-tariff barriers. Using the results of such a survey, it is possible to quantify non-tariff barriers and introduce them to the model in a similar way as import tariffs. Another opportunity is to make some data disaggregation in order to concentrate on some specific topics. For example, it is possible to disaggregate households by income level or education, or to break down aggregation of certain sectors of economy to study them in greater depth. To accomplish this, additional data on the economic agent or sector are required.

On May 16th, 2008 Ukraine became a 152nd member of the WTO, 15 years after the application was made. Now the ball is in Ukraine's court and it is the responsibility of Ukraine to use it wisely.

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Appendix

Table A.1. WTO Commitments of Transition Countries

Country	Year of accession	Commitments concerning agricultural products		Commitments concerning non-agricultural products		Total Aggregated Measurement of Support to agriculture	Export agriculture subsidies
		Import tariff rate, %	Transition period	Import tariff rate, %	Transition period		
Bulgaria	1996	34.9	6 years	12.6	15 years	5% of agricultural production;	Nil since year 2000
Mongolia	1997	18.4	No	20.0	No	10% of agricultural production	Nil
Latvia	1999	33.6	9 years	9.3	9 years	5% of agricultural production	Nil
Estonia	1999	17.7	5 years	6.6	6 years	5% of agricultural production	Nil
Lithuania	2001	15.6	8 years	8.2	4 years	5% of agricultural production	Nil
Georgia	2000	12.1	5 years	5.8	5 years	10% of agricultural production	Nil
Moldova	2001	12.4	4 years	5.7	4 years	10% of agricultural production	Nil
Kyrgyzstan	1998	11.7	No	6.7	7 years	5% of agricultural production	Nil
Albania	2000	10.6	7 years	6.0	9 years	10% of agricultural production	Nil
Croatia	2000	10.4	5 years	5.0	5 years	5% of agricultural production	Nil

Table A.2. Example of Social Accounting Matrix

	Activities	Commodities	Factors	Enterprises	Households	Government	Capital Account	ROW	Total
Activities		Gross output							<i>Total sales</i>
Commodities	Intermediate demand				Household consumption	Government consumption	Investment	Exports	<i>Aggregate demand</i>
Factors	Value added							Factor service exports	<i>Factor income</i>
Enterprises			Gross profits			Transfers			<i>Enterprise income</i>
Households			Wages	Distributed profits		Transfers		Foreign remittances	<i>Household income</i>
Government	Indirect taxes	Tariffs	Factor taxes	Enterprise taxes	Direct taxes				<i>Government revenues</i>
Capital Account				Retained earnings	Household savings	Government savings		Cap. trans. from abroad	<i>Savings</i>
ROW		Imports	Factor service imports		Transfers abroad	Transfers abroad	Capital transfers abroad		<i>Foreign exchange payments</i>
Total	<i>Total costs</i>	<i>Aggregate supply</i>	<i>Factor expenditures</i>	<i>Enterprise expenditures</i>	<i>Household expenditures</i>	<i>Government expenditures</i>	<i>Investment</i>	<i>Foreign exchange receipts</i>	

Table A.3. CGE Studies of the Doha Round

Publications	Data	Baseline	Model Description	Measures Liberalized	Simulation Scenarios
Anderson, Martin and van der Mensbrugghe (2005)	GTAP Database version 6	2015, extrapolated from 2001	<ul style="list-style-type: none"> • LINKAGE model • 25 sectors • 27 regions • recursive dynamic model • Constant returns to scale and perfect competition 	<ul style="list-style-type: none"> • Agriculture - Tariffs - Export subsidies - Domestic subsidies (cut by 28% for the US, 18% for Norway, 16% for the EU and 10% for Australia) • Manufacturing goods - Tariffs 	<p>(i) elimination of all merchandise trade barriers over the 2005-2010 period</p> <p>(ii) a progressive reduction formula with a marginal agricultural tariff rate reduction of 45, 70 and 75 % cuts for developed countries; 35, 40, 50, and 60 % for developing countries for the respective bands. No cut for LDCs.</p> <p>(iii) adds to Scenario (ii) the “Sensitive Products” option (2% of agricultural tariff lines for developed countries and 4% for developing countries, subject to just a 15% cut)</p> <p>(iv) adds to Scenario (iii) a tariff cap of 200% for agricultural products</p> <p>(v) add to Scenario (ii) liberalization of non-agricultural products (50% cut of bound rates for developed countries and 33% for developing countries)</p> <p>(vi) like (v) but developing countries also cut bound tariffs by 50%</p>
Anderson, Dimaranan, Francois, Hertel, Hoekman and Martin (2003)	GTAP Database version 4	2005 - extrapolated from 1995 Standard GTAP trade elasticities were doubled given the long-term nature of the simulations.	<ul style="list-style-type: none"> • Standard GTAP model • 4 sectors • 19 regions • Constant returns to scale and perfect competition 	<ul style="list-style-type: none"> • Agriculture - Tariffs • Manufactured goods - Tariffs 	Elimination of all tariffs in agricultural and manufactured goods
Brown, Deardorff and Stern (2003)	GTAP Database version 4	2005 - extrapolated from 1995	<ul style="list-style-type: none"> • Michigan model • 18 sectors • 20 regions 	<ul style="list-style-type: none"> • Agriculture - Domestic subsidies - Export subsidies - Tariffs 	<p>(i) 33% reduction in agricultural tariffs, production and export subsidies</p> <p>(ii) 33% reduction in manufactured goods tariffs</p> <p>(iii) 33% reduction in services barriers</p>

			Increasing returns and monopolistic competition in manufactures but perfect competition and constant returns in agriculture	<ul style="list-style-type: none"> • Manufactured goods - Tariffs • Services - Barriers 	(iv) Scenarios (i)+(ii)+(iii) (v) Global free trade in agricultural and industrial goods and services
Cline (2004)	GTAP Database version 5	1997 but agricultural tariff data is updated to 1998	<ul style="list-style-type: none"> • Harrison-Rutherford-Tarr model • 22 sectors • 25 regions • Constant returns to scale and perfect competition 	<ul style="list-style-type: none"> • Agriculture - Tariffs - Export subsidies - Input subsidies • Manufacturing goods - Tariffs - Textile quotas 	Complete elimination of tariffs applied to agriculture and manufactures, export subsidies and input subsidies on agriculture, and textile quotas
Francois, van Meijjn and van Tongeren (2003)	GTAP Database version 5.2	1997 Protection data is modified using tariffs in WTO IDB and WITS. Services barriers are estimated using a gravity equation	<ul style="list-style-type: none"> • 17 sectors • 16 regions • Increasing returns and monopolistic competition in manufactures but assumes perfect competition and constant returns in agriculture • Dynamic 	<ul style="list-style-type: none"> • Agriculture - OECD Domestic subsidies - Export subsidies - Tariffs • Manufactured goods - Tariffs • Services - Barrier • Trade facilitation 	(i) Linear: 50% reduction in agricultural and manufactured tariffs, export subsidies, OECD domestic support and services barriers. Trading costs are reduced by 1.5% (ii) Swiss: reduction in agricultural and manufactured tariffs is based on the Swiss formula with a coefficient of 25. 50% reduction in OECD domestic support, export subsidies and services barriers. Trading costs are reduced by 1.5% (iii) Complete liberalization and a reduction in trading costs of 3%
OECD (2003)	GTAP Database version 5	1997 but protection data benchmarked to 1998 using data in OECD tariffs database	<ul style="list-style-type: none"> • Standard GTAP model with perfect competition and constant returns to scale • 10 sectors 	<ul style="list-style-type: none"> • Agricultural - Tariffs • Manufactured goods - Tariffs • Trade facilitation 	(i) Linear tariff reduction by all regions - free trade in agricultural and manufactured goods and trade facilitation - free trade only in manufactured goods and trade facilitation

			<ul style="list-style-type: none"> • 10 regions 		<ul style="list-style-type: none"> - 50% reduction in tariffs on agricultural and manufactured goods and trade facilitation (ii) Differential participation in liberalization - Cuts of 100% and 50% respectively in manufactured and agricultural tariffs by developed countries only and trade facilitation - free trade by developed countries; 50% cut by developing countries; trade facilitation (iii) Swiss formula - Swiss formula coefficient of 25 and trade facilitation - Swiss formula coefficient of 15 and trade facilitation - Swiss formula coefficient of 5 and trade facilitation
UNCTAD (2003)	GTAP Database version 5	1997 Modified using TRAINS to take preferences into account	<ul style="list-style-type: none"> • Standard GTAP model with perfect competition and constant returns to scale • 6 sectors • 2 regions 	<ul style="list-style-type: none"> • Agriculture - Tariffs - Export subsidies 	<ul style="list-style-type: none"> (i) 50% reduction in agricultural tariffs (ii) Elimination of export subsidies in agriculture (iii) 50% reduction in processed agriculture tariffs (tariff escalation)

Table A.4. List of Variables

Endogenous:	
Q_i	domestic sales composite commodity in sector i
QD_i	gross domestic output
QDD_{ir}	domestic output delivered to home market
P_i	price of composite commodities
PD_i	domestic producer price of commodities
PDD_i	price of domestic output delivered to home market
IO_i	intermediate commodity demand
VA_i	value added demand
E_{ir}	exports
M_{ir}	imports
PE_{ir}	export price of commodities in sector i delivered to region r in national currency
PM_{ir}	import price of commodities in sector i delivered from region r in national currency
PWE_{ir}	world export price
PWM_{ir}	world import price
ER	exchange rate
K_i	capital demand
L_i	labour demand
PK	return to capital
C_i	consumer demand for commodities
I_i	investment demand for commodities
G_i	public demand for commodities
CE	consumer expenditures
Y	household income
CPI	consumer price index
$UNEMP$	unvoluntary unemployment
U^H	utility level of households
U^I	utility level of financial institutions
U^G	utility level of government
$PLES$	price index for welfare calculations
SI	supernumerary income
EV	equivalent variation
CV	compensating variation
S	total savings
SH	household savings

SF	foreign savings
$GOVR$	government revenues
TRY	income tax revenues
$TRIM_i$	revenues from indirect and import taxes
$TRID_i$	indirect tax revenues
TRM_{ir}	import tax revenues
$TRICK$	artificial objective function
Exogenous:	
KS	capital supply
LS	labour supply
PL	return to labour
SG	government savings
KRG	government capital revenues
$TRGH$	transfers from government to households
$TRFH$	foreign transfers to household in foreign currency
$TRFG$	foreign transfers to government in foreign currency
FR	foreign remittances in foreign currency
Parameters:	
io_{ij}	technical coefficients
ϕ	Frisch parameter in nested HLES utility function
λ^{HLES}	marginal utility of household expenditures
$phillips$	Phillips parameter
tid_i	indirect tax rate
tm_{ir}	tariff rate on imports
ty	tax rate on income
b_i	share coefficient of value added in output
σ_i^F	CES capital-labour substitution elasticities
γ_i^F	CES share parameter in the production function of firms
α_i^F	CES efficiency parameter in the production function of firms
ρ_i^F	CES function exponent
σ_i^A	Armington substitution elasticities
γ_i^A	Armington share parameter in the production function of commodities
α_i^A	Armington efficiency parameter in the production function of commodities
ρ_i^A	Armington function exponent
σ_i^T	elasticities of transformation in CET function

γ_i^T	CET share parameter regarding destination of domestic output
α_i^T	shift parameter in the CET function of firm
ρ_i^T	CET function exponent
ε_i^Y	income elasticity of demand for commodity
α_i^{HLES}	power in nested LES household utility function
μ_i^H	subsistence household consumption level
α_i^G	Cobb-Douglas power in government utility function
α_i^I	Cobb-Douglas power in investment institution utility function

Table A.5. List of Sectors

1.	Agriculture, hunting
2.	Forestry
3.	Fishery
4.	Mining of coal and peat
5.	Production of hydrocarbons
6.	Production of non-energy materials
7.	Food-processing
8.	Textile and leather
9.	Wood working, pulp and paper industry, publishing
10.	Manufacture of coke products
11.	Petroleum refinement
12.	Manufacture of chemicals, rubber and plastic products
13.	Manufacture of other non-metallic mineral products
14.	Metallurgy and metal processing
15.	Manufacture of machinery and equipment
16.	Other production
17.	Electric energy
18.	Gas supply
19.	Heat supply
20.	Water supply
21.	Construction
22.	Trade
23.	Hotels and restaurants
24.	Transport
25.	Post and telecommunications
26.	Financial intermediation
27.	Real estate transactions
28.	Renting
29.	Informatisation activities
30.	Research and development
31.	Services to legal entities
32.	Public administration
33.	Education
34.	Health care and social assistance
35.	Sewage, cleaning of streets and refuse disposal
36.	Social activities
37.	Recreational, entertainment, cultural and sporting activities
38.	Other activities

Table A.6. Social Accounting Matrix for Ukraine

	Activities			Commodities			Factors of production		Institutions			ROW	
	Agriculture	Industry	Services	Agriculture	Industry	Services	Capital	Labor	Households	Government	Investment	Exports	Total
Agriculture	23756												
Industry		122271											
Services			93486										
Agriculture				23756	15707	938			21550	1195	2095	7769	73010
Industry				9090	122271	43620			75431	775	25056	93097	369340
Services				7307	65091	93486			31805	39569	21427	23526	282211
Capital				24144	20158	51760							96062
Labor				5198	29435	67476						373	102482
Households							89668	102482		30873		4705	227728
Government				1968	18031	10624	6394		48167			2069	87253
Savings									50775	14841		-17038	48578
Imports				1547	98647	14307							114501
Total				73010	369340	282211	96062	102482	227728	87253	48578	114501	