

CUSTOMS UNION WITH THE EU:
GTAP ANALYSIS FOR UKRAINE

by

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Abstract

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The thesis analyzes the possible consequences of Ukraine's integration into the large European economic structure – European Union. GTAP multi-country simulation model of Purdue University Center for Global Trade Analysis is applied. The welfare measure evaluated is change in equivalent variation (EV). As all incomes in the model accrue to representative household, EV in full assesses welfare benefit for Ukraine from bilateral tariff elimination on trade with the EU.

As the model includes Ukraine in Former Soviet Union region, EV is estimated for FSU and then disaggregated on industry level proportionally to trade shares. The results of simulations suggest that Ukraine's EV is sensitive to inclusion of agricultural sector into customs union. Due to highly protected nature of this sector in the EU, Ukraine is better off if agriculture is excluded from liberalization. In this scenario Ukraine gains \$91.7 millions.

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ABBREVIATIONS

CEECs - Central and Eastern European Countries

CEA – Central European Associates

CGE – computable general equilibrium

EU – European Union

EV – equivalent variation

FSU – Former Soviet Union

INOGATE - Interstate Oil and Gas Transport to Europe

IRTS - increasing returns to scale

GE – general equilibrium

CIF – cost, insurance, freight (INCOTERMS)

GTAP – Global Trade Analysis Project

NIS - New Independent States

NYOE - Number of years open economy

PE – Partial equilibrium

PHARE – Poland and Hungary: aid and economic reconstruction

PTA - Preferential Trading Arrangements

TOT – Terms of trade

TRACECA - Transport Corridor Europe Caucasus Central Asia

WTO - World Trade Organization

Chapter 1

INTRODUCTION

Ukraine passed a tremendous period of its history in the 20th century. And after collapse of Soviet Empire it recovered more slowly than did the Baltic States and still more slowly than what used to be called Central and Eastern European Countries (CEECs). Only in 2000 did GDP begin to rise after a decade of decline¹. Strong state regulation of foreign trade was obvious in 1994. In 1999, there still were no signs on the date Ukraine would join World Trade Organization (WTO) (see, e.g., Michalopoulos (1999)); and the country was treated as a non-market economy by this organization².

Some changes came in 2000. The European Union recognized Ukraine as a market economy in dumping treatment in October; and the WTO announced Ukraine could be accepted in 2001 if its Parliament approves changes to nearly 60 laws and provisions by that time (*Postup*, 2000d).

The way Ukraine's western neighbors followed has been to apply for acceptance into a large European integration structure – the European Union (EU). The EU puts the following requirements for potential candidates (Copenhagen European Council, 1993):

¹ The growth is reported at 6% for this year (*Postup*, 2001). See also Business Central Europe (2001).

² This means in considering dumping cases by its partners, costs of Ukrainian producers were not calculated from their actual costs but taken from comparable producer in other, market-economy country. The argument behind this is that non-market economy implicitly subsidises its producers, e.g. through supplying them with cheap energy. Such procedure of treating led to more judgements to detriment of Ukrainian producers.

- Democratic regime, protection of minorities' rights, respect for human rights
- Market economy, competitive industries capable to compete with European ones
- Readiness to accept *aquis communautaire* (about 80 000 pages of law, which regulates EC's life (Price and Landau, 2000))

Despite the fact that Ukraine has poor economic and, especially recently, political performance³, it is encouraged to integrate into international trade structures. So, in 1994 Partnership and Co-operation agreement with the EU was signed, which envisioned creation of customs union (CU) in 1998. As economic conditions were not appropriate then, CU was postponed. If Ukraine finds a way around its political crisis successfully and retains the trend in economic growth, CU will be of relevance again. That is my motivation for assessing its impact on welfare of Ukraine.

Economic theory suggests that there will be trade diversion after Ukraine's trade partners enter the EU, which means Ukraine's firms will lose ties with some of their counterparts in those countries. Further, Chang and Winters (1999) demonstrate that if a country enters Preferential Trading Arrangements (PTA) "other contracting parties [who fail to enter it] may be affected adversely, because they are compelled to reduce their prices to meet competition from the suppliers within the PTA" (pp.33). Two of Ukraine's top-5 trade partners are preparing to enter the EU – Poland and Turkey⁴. Besides, the EU is the largest of Ukraine's trade partners outside the

³ The EU provides a figure for Ukrainian GNP per capita for year 1999 \$700. Political situation was particularly worsened by restrictions to freedom of speech in connection with case of Gongadze.

⁴ The top-5 Ukraine's trade partners are ranging as follows (1998):
 Export – Russia, China (steel), Turkey, Germany, Belarus
 Import – Russia, Germany, US, Poland, Italy

Newly Independent States (NIS); and the trade volume with it is growing from year to year at the expense of the NIS.

In this thesis I want to show that Ukraine's acceptance into the EU not only will help to avoid trade diversion with some partners, but also will foster trade creation and increase in welfare (evaluated with equivalent variation (EV)). For this purpose, the GTAP multi-country simulation model of Purdue University Center for Global Trade Analysis is used. This is a perfect competition, constant returns to scale (CRTS) model with Armington style specification of imports and nested structure of demand and supply.

The Computable General Equilibrium (CGE) model GTAP is applied to calculate results of bilateral tariff reduction. Ukraine is still not disaggregated in version 4 of this model; that is why computation is actually done for the Former Soviet Union (FSU). Then EV is disaggregated proportionally to each Ukrainian industry's share in total trade of FSU industries.

The thesis outline is as follows. The next chapter elucidates the state of literature on economic integration, trade, growth, and Ukraine. This includes overview of writings on theory as well as empirical methods and previous studies. Chapter three should familiarize the reader with progress in the EU-Ukraine relations. It also includes the background of the EU-Candidate countries negotiations and description of accession criteria. Subsequently, Chapter four is designed to present analytical model of Purdue University Center for Global Trade Analysis. Also, it shows theoretical underpinning of consequences of formation of customs union and step-by-step derives change in EV from bilateral tariff elimination. Chapter five gives an assessment of results obtained, sensitivity analysis, and suggestions for future work. Finally, the last chapter draws a conclusion to the work.

Chapter 2

LITERATURE REVIEW

This chapter presents a review of the recent literature on economic integration, followed by a survey of studies on growth and trade. It concludes by assessing the relevant literature on Ukraine.

There are two approaches to estimation of gains from liberalization. The first is to assess static gains (Kose and Riezman, 2000; Chang and Winters, 1999). The second is to approximate dynamic benefits. The first approach is more elaborated and, actually, less sophisticated.

Kose and Riezman (2000) use a computable general equilibrium (CGE) model to analyze two large and one small country case. They are interested in finding better policy choices for the small country. The options that each of the countries faces are Free Trade Agreement (FTA), Customs Union (CU), and free trade (FT). The findings suggest that the best outcome for the small country is FT. Under FTA setting the country prefers to be an “innocent bystander”. This means that the country favors being left out of the FTA to forming coalition with one of the large countries. Finally, costs of being “bystander” become harder if FTA between two large countries is substituted for CU. Now, the small country would prefer CU with one of two large countries to staying alone.

This work is valuable to my thesis because it suggests handy methodology – CGE – and sets theoretical grounds for expected implications for welfare of CU for small country. Albeit, it uses compensating variation (CV) for welfare measurement, while I employ equivalent variation (EV). The difference is that I intend to assess how much country gains in current prices, while CV shows welfare benefit in new equilibrium prices.

Another study on CU is Chang and Winters (1999) that deals with the problem of trade distortions in MERCOSUR, a customs union of Argentina, Brazil, Paraguay, and Uruguay. The authors develop a two-firm Bertrand pricing game – with an insider and an outsider. The first benefits from his/her country inclusion into a customs union because of possibility of increasing prices (no tariffs and higher demand), while the latter loses from exclusion and lower demand. The empirical study, based on the model, revealed losses of Brazil's main importers (countries that export to Brazil) in 1996 - USA (\$624.1 million), Japan (\$58.8 million), Germany (\$236 million), Chile (\$17.3 million).

This study is useful for my research in that it states the fact that left out of CU country not only has opportunity costs – foregone increase in welfare – but also real damage from losing export markets.

Harrison *et al* (1996) employ a CGE model of their own to assess implications for Turkey of customs union with the EU. Their model contains three regions – Turkey, the EU, and rest of the world. The model has nested structure, CRTS, and CES function for description of private consumption. The novelty of the model consists in disaggregating capital (5 types) and labor (8 types). The authors find that Turkey should gain about 1 to 1.5 % of GDP, mainly due to improved access to third countries markets. At the same time, it is supposed to lose about 1.4 % in decreased tariff revenues. The replacement tax the authors propose is value-added tax (VAT), applied uniformly to all agents. The study is useful for my work, because the authors provide a comparable research to what I intend to do, although for different country.

Hertel *et al* (1997) present a CGE model that is publicly available. In contrast to Kose and Riezman (2000), their GTAP model is based on real data for the world. Version 4 of it incorporates 45 regions and 50 industries with input output (IO) tables and trade flows reported by countries. The model has nested structures of demand and supply, includes government sector and

employs constant difference of elasticities (CDE) function for treating private expenditures. My research bases mostly on this theory, which is why it is important to include it here.

The second approach, dynamic in nature, is represented by econometric techniques and CGE model. This approach is mostly concerned with assessing changes in growth rate of liberalizing regions.

Wacziarg (1998) is an example of recent investigation on whether trade liberalization influences growth. The author develops a new index of trade policy openness and uses it in simultaneous equation system for a panel of 57 countries to confirm strong positive relationship between trade liberalization and economic growth. The article is criticized by Rodrigues and Rodrik (1999) because of averages constructed over just 5 years (the authors would prefer 10 year horizon). They also argue it would be more interesting to see results, based on indicators of trade policy like tariffs or non-tariff barriers (NTB).

These articles as well as the next three papers are interesting for me, because they show recent advances in literature to the question of trade liberalization effects and call for further elaboration of my thesis.

An author, who undertakes effort to identify all significant sources of growth, is Sala-I-Martin (1997). He proposes for discussion his results gotten from running more than 30,000 regressions. The test is designed to answer the question: which of 60 examined variables are strongly related to growth. As contrary to the claim "Nothing is Robust", Sala-I-Martin finds 21 variables to be strongly related to growth, when extreme bound analysis is avoided. The variable "Number of years open economy" (NYOE) is among the variables with the best explanatory power, while other trade-openness variables seem to be insignificant.

The above investigation is elaborated in Doppelhofer, Miller, and Sala-I-Martin (2000). Because of stricter requirements to data they test only 32 variables on their correlation with growth. A novel technique, namely Bayesian Averaging of Classical Estimates, is employed to assess the robustness of the variables, 11 of which prove to be robustly related to growth. Regional, religious, and human capital variables as well as log of GDP per capita are among survivors. Along with NYOE, "Fraction of Primary Exports in Total Export" appears to be significant, though with negative sign. However, the authors admit that their model allows only for a linear relationship. Notably, the data do not include any of the former Central Planning Economies (CPEs).

Baldwin and Forslid (1998) explain that insignificance of trade liberalization and growth link in results of other authors is due to non-linearity of this relationship. The authors bring forward an argument of Rivera-Batiz and Romer (1991), which suggest that gradual liberalization from autarky to free trade first decreases and then raises growth. Baldwin and Forslid develop a simple innovation based growth model and estimate impact on growth of different (*ad valorem* and specific) tariff and non-tariff barriers. Their model is consistent with U-shape relationship between *ad valorem* tariffs and growth; they find it to be bell-shaped for specific tariffs and insignificant for technical barriers in case of small import of inputs to R&D sector.

Hertel *et al* (1997) use perfect competition and constant returns to scale (CRTS) in all industries, although the model allows for alteration in those two assumptions. Rutherford and Tarr (1998) propose a model with large group monopolistic competition and increasing returns to scale (IRTS) in industries producing intermediate commodities. They construct 2 goods sector economy where goods interact through Dixit-Stiglitz function. The advantage of this paper is that it allows to *ex ante* estimate dynamic gains from liberalization. The authors apply their model to five small countries and

emphasize the finding that the resulting from liberalization growth crucially depends on free movement of capital.

Literature on Ukraine, its growth and possible integration in the EU is not very abundant. This is, e.g., represented by Kaufmann (1997) and Hoffmann and Moellers, ed. (2001). Kaufmann discusses obstacles to growth in Ukraine, while the book of Hoffmann and Moellers concerns the place of Ukraine in contemporary Europe, discusses the role of Partnership and Co-operation Agreement (1994) for Ukraine, and also projects influence of eastern enlargement of the EU on Ukraine.

Chapter 3

DESCRIPTION OF UKRAINE'S CONTEMPORARY SITUATION

In this chapter I first describe the documents, which address the question of European Eastern enlargement. In this part, the three requirements to EU candidates are summarized and clarified. The discussion is based on three original sources: The Presidency Conclusions of Copenhagen and Helsinki European Councils and the Composite Paper of the European Commission. Second, a general picture is given on how Ukraine's Western neighbors meet the Copenhagen criteria, their policies pursued and documents applied. Again, the use is made of the Composite Paper of European Commission. Third, the state of play in Ukraine is elucidated and relevant summaries of three basic documents in this field are being made, i.e. Partnership and Co-operation Agreement, European Council Common Strategy on Ukraine, and Program of Integration into the EU.

Copenhagen criteria

In response to a large number of countries applying for accession to the European Union, the European Council adopted the Copenhagen criteria in June 1993. These are explicit requirements that the candidate countries should meet in order to become full members of the EU. The criteria can be split in three areas: political, economic and *acquis*-related⁵. They are described as follows:

“Membership requires that the candidate country has achieved stability of institutions guaranteeing democracy, the rule of law, human rights and respect

⁵ *Acquis* is about 80,000 pages of directives and regulations adopted in the European Union since Treaty of Rome (1957) (Price and Landau, 2000).

for and protection of minorities [political criteria], the existence of a functioning market economy as well as the capacity to cope with competitive pressure and market forces within the Union [economic criteria]. Membership presupposes the candidate's ability to take on the obligations of membership including adherence to the aims of political, economic and monetary union [*acquis*-related criteria]" (7.A).

The political criteria are consistent with Article 6 of the Amsterdam Treaty: "The Union is founded on the principles of liberty, democracy, respect for human rights and fundamental freedoms and the rule of law". Furthermore, the Helsinki European Council stresses that meeting these criteria "is a prerequisite for the opening of accession negotiation" (I.4).

The Commission has construed the economic criteria in Agenda 2000 as "the existence of a functioning market economy" and "the capacity to cope with competitive pressure" (Article T). The existence of a functioning market economy in Composite Paper (June 1999)⁶ is judged by the following:

- Equilibrium between demand and supply is influenced only by market forces
- Trade and prices are liberalized
- Barriers to market entry and exit are not significant (transparent legislation on business establishment and bankruptcy)
- Effective enforcement of legislation on property rights
- Macroeconomic stability (low inflation, public debt, and budget deficit)
- Developed financial sector

The capacity to withstand the competitive pressure within the Union in the same paper is subdivided as follows:

- Economic agents are able to make macroeconomic decisions in stable and predictable environment

⁶ Reports on progress towards accession by each of the candidate countries.

- Developed infrastructure (transport, energy sector, telecommunication) in place
- Properly trained and educated labor force
- Ample spending on research and development by country
- Weighted government role in trade and competition policy, state aid, support for SMEs
- Significant trade volume of appropriate nature with the Union
- Large proportion of small firms, which are flexible enough to withstand competition

The Helsinki European Council (1999) states that "[p]rogress in negotiations must go hand in hand with progress in incorporating the *acquis* into legislation and actually implementing and enforcing it." *Acquis* is divided in 31 chapters for candidate countries:

November 1998⁷(7 chapters): science & research, education & training, small & medium-sized enterprises, culture & audio-visual policy, telecommunications, industrial policy, common foreign & security policy;

First semester of 1999 (8 chapters): company law, statistics, consumer & health protection, fisheries, competition policy, free movement of goods, customs union and external relations;

By the end of 1999⁸ (8 chapters): social policy, EMU, free movement of capital, energy, transport, taxation, freedom to provide services and environment;

By the end of June 2000 (7 chapters): agriculture, regional policy, free movement of persons, justice & home affairs, financial control, financial & budgetary provisions and institutions.

⁷ The date, when respective chapters were opened

⁸ The date, when appropriate chapters were intended to be opened

Progress made by candidate countries

13 countries applied for EU membership and became candidates in the 1990s: Poland, Hungary, the Czech Republic, Estonia, Slovenia, Cyprus, Slovakia, Latvia, Lithuania, Malta, Bulgaria, Romania, and Turkey (European Commission, 1998). If Ukraine applies it will have to pass the same procedure as described below.

The relations of the EU with each of the candidate countries are based on the Accession Partnerships and Europe Agreements. The Accession Partnerships set out the short and medium term priorities for preparation to EU accession. They also allocate financial assistance from the EU (3 billion euro a year from 2000). The Europe Agreements establish and guide functioning of Association Councils, Committees and sub-committees, which oversee the pre-accession process in the candidate countries. Each of the candidate countries has also approved its national program for the adoption of the *acquis*.

All candidate countries from Central and Eastern Europe participate in the programs of the Union on education, training, youth, culture, environment, energy, research, and SMEs.

The financial support of the EU is split in three programs from the year 2000: PHARE, ISPA, and SAPARD. PHARE⁹ (1.5 billion euro yearly) is aimed at financing institution building and investments in *acquis* in the candidate countries. An example of the latter is financing computerization of the eastern border of Poland or equipment of testing laboratories in the Czech Republic¹⁰. Two other programs are structural funds, of which ISPA (1 billion

⁹ Poland and Hungary: aid and economic reconstruction.

¹⁰ Composite Paper.

euro) allocates funds to transport and environmental protection and SAPARD¹¹ (500 million euro) – to agriculture and rural development.

The European Commission prepared questionnaires in April 1996¹², which became the basis for opening negotiations with the first-wave five countries (Poland, Hungary, the Czech Republic, Estonia, Slovenia). Slovakia failed to meet political criteria. Cyprus was added to the negotiation list shortly thereafter. Official date of opening negotiations is March 1998. The negotiations pass in the form of bilateral accession conferences, during which progress on conforming to open chapters (see the previous page) is discussed. Simultaneously in April 1998, the Commission started the process of screening for candidate countries, i.e. explaining legislation of the EU. In 1999, some officials of the Commission forecasted Accession Treaties to be signed for the most advanced candidates in the year 2000 (Franco, 2000, p.75), but as for now the date is postponed till 2002. On the one side, the Commission doesn't want to bring the loss of momentum. On the other, it wants the newcomers to become full Members, so it faces a trade-off.

What are the main obstacles in accession for the candidates? First, this is a poor political environment in the candidate countries. Slovakia was close to meeting the Copenhagen criteria in 1996 if not for "Prime Minister Meciar's antics and undemocratic methods" (Price and Landau, 2000, p.17). In November 2000, EU Enlargement Commission Guenter Verheugen declared that two of the second-wave candidates caught up with the first wave candidates. So, the division in waves is no longer meaningful. Though the two successful countries were not announced, EU representatives singled out Slovakia and Malta in the past (Eubusiness, 2000a). Other political criteria to be overcome are the mistreatment of minorities in Latvia

¹¹ The program is foreseen for years 2000-2006, in November 2000 EUR 520 are available (Composite Paper, 1999).

¹² The questionnaires comprised 150 pages of questions, which the applying countries had to answer in three months. Some answers amounted to 1,500 pages.

as well as unsatisfactory childcare and Roma treatment in Romania (Composite Paper, 1999).

Second, most of the candidates face financial difficulties. For instance, different experts mention sum of 30 to 40 billion of ECU for application of environmental regulations of *acquis* in Poland and ECU 120 billion for the first-wave candidate countries, except Cyprus, together (Cosgrove-Sacks, 2000, p. 61).

Further, the question of nuclear power safety is of great concern for the EU. For the moment, three of the candidate countries have non-upgradeable reactors, namely Lithuania, Slovakia and Bulgaria. Slovakia already committed itself to close its units in 2006 and 2008; Lithuania will close one unit in 2005 and decide on the second in 2004. Only Bulgaria is still not prepared to decide anything on this matter (Composite Paper, 1999).

Finally, economic development statistics in candidates show greater variability in 1998-1999 because of Asian and Russian crisis. The countries that still have substantial ties with Russia were affected considerably by Russian financial crisis. As reforms in Romania were sluggish, its economic growth dropped to -7.3% in 1998 and -5% in 1999. Poland and Hungary endured the crisis most easily - 5.1% and 4.8% growth in 1998 respectively and about 4% in 1999 (Composite Paper, 1999). This is a crucial question as the candidate countries had GDP per capita 18% (Latvia) to 62% (Cyprus) of the EU average in 1996 (*The Economist*, 1997) and can only catch up through growing more quickly.

Rapprochement of Ukraine to the EU

“Any European state may apply to become a Member of the Union. It shall address its application to the Council, which shall act

unanimously after consulting the Commission and after receiving the assent of the European Parliament, which shall act by an absolute majority of its component members.”

Article O of the Treaty of Rome (now article 49 of the Amsterdam Treaty)

The basis for EU-Ukraine relations was laid down in the Partnership and Co-operation Agreement (PCA) on 14 June 1994. Ukraine was the first of the Newly Independent States (NIS) to sign this kind of document with the EU to replace former Agreement on Trade and Commercial and Economic Co-operation with the USSR. The aim of the Parties to the document is to establish a free trade area between them starting from year 1998 if appropriate (Article 4 of PCA). According to the Agreement, the Parties grant to each other most-favored-nation (MFN) treatment and the products of the other party should not be subject to discriminatory direct or indirect taxation, i.e. higher taxed than domestic products (A10 and 15 respectively). However, textile and steel products are exempted from the latter clause. Further, the Agreement encourages “the approximation of Ukraine’s existing and future legislation to that of the Community” (A51). The areas, the co-operation will concentrate, are close to the 31 chapters for negotiation with the candidate countries (see end of part I of this chapter):

“industrial cooperation, investment promotion and protection, public procurement, standards and conformity assessments, mining and raw materials, science and technology, education and training, agriculture and agro-industrial sector, energy, civil nuclear sector, environment, transport, space, telecommunications, financial services, money laundering, monetary policy, regional development, social co-operation, tourism, small and medium-sized enterprises, information and communication, consumer protection, customs, statistical co-operation, economics and drugs”¹³ (Article 52 of PCA).

¹³ Article 52.

The newly created Co-operation Council is entrusted with the supervision duty on the Agreement (A85). Other established institutions are the Co-operation Committee and the Parliamentary Co-operation Committee. The Agreement is concluded for ten years to be renewable on a year-by-year basis (A101). Except for Articles 30 (on companies) and 59 (on education) this document seems to be very equitable¹⁴.

The next step in the EU-Ukraine relations was the adopted by European Council Common Strategy on Ukraine (December 1999). In this document, “[t]he EU acknowledges Ukraine’s European aspirations and welcomes Ukraine’s pro-European choice” (A6). Likewise, “[t]he European Council recognizes that a successful, stable and secure Ukraine is in the best of interests of the EU” (A7). Further, the European Council reminds Ukraine of all the Conventions it has signed and all the commitments it has made, especially those with the Council of Europe in 1995¹⁵ (A12). Finally, the EU promises to foster development of infrastructure networks in Ukraine through its TACIS programs (INOGATE and TRACECA¹⁶) and to assist in the transmission of *Euronews* on Ukrainian television by June 2000 (A37, 50 and 65).

Ukraine started to actively strive for the EU membership at about that time (1999), providing its foreign policy accordingly (James, 1999a, 1999b; Partridge, 1999). In September 2000 Program on Ukraine’s Integration into the European Union was signed. The program prescribes Ukraine’s strategy in the following important areas: democracy and rule of law, court system, human rights and protection of minorities’ rights, economic development of

¹⁴ So, Ukraine should provide to EU enterprises environment comparable to its own businesses (not worse), while the EU agrees to provide best environment given to other non-EU countries (maybe, worth than its own EU businesses). Also, cooperation on studying Ukrainian culture and language as well as training interpreters in the EU is not foreseen.

¹⁵ Ukraine attained membership in the Council of Europe on 9 November 1995

¹⁶ Interstate Oil and Gas Transport to Europe
and Transport Corridor Europe Caucasus Central Asia

the country, internal market without borders, economic and fiscal questions, sector policy, social harmonization, regional policy and co-operation, living standards and environmental protection, innovations, information policy, education and youth, justice and domestic affairs, foreign-economic activity, foreign and security policy, administration opportunities, and financial questions. In the document Ukraine affirms its commitments to the Council of Europe; *inter alia*, it reminds of canceling death penalty (A4.1.2). Further, it emphasizes its economic stabilization – industrial growth of 4.3%, inflation rate 19.2%, budget deficit 1.5%, and positive trade balance in 1999 - and highlights its objective to gradually increase investments to 27% of GDP in 2010(A5.1). It also announces its intention to encourage trade “far abroad”, up to 60% of total trade in foodstuffs in 2005 (A8.2.5).

Ukraine’s relations with the World Trade Organization (WTO) and Central European Free Trade Association (CEFTA) deserve a separate paragraph because Ukraine holds them as crucial in its pre-accession strategy (A16.1.1, 16.1.2). Currently, Ukraine holds the status of an observer with the prospect of becoming full member in 2001 in case it brings all the necessary harmonization to its legislation¹⁷. For the moment, Ukraine stands in bilateral negotiations on market access with almost 30 countries. The negotiation partners include EU, US, Japan, Canada, Australia, CEFTA Members, etc.

CEFTA was established in March 1993 by Visegrad Three (Hungary, Czechoslovakia, and Poland) (Program on Ukraine’s Integration, 2000). The Visegrad Three became the Visegrad Four after Czechoslovakia’s breakup; and three more countries joined CEFTA from 1996 to 1998 (Slovenia, Romania, and Bulgaria). The criteria for joining the group are as follows:

- Associated membership in the EU
- Membership in the WTO

¹⁷ The Deputy Economy Minister’s words as in *Postup’s* Infobank, 11 October 2000

- Agreements on free trade being signed with every Member Country

CEFTA members trade 90% of their mutual trade volumes duty-free (Program on Ukraine's Integration, 2000) and are looking forward to new members accession. Ukraine, eager to escape a fall in its trade with those countries after their accession to the EU, strives for CEFTA accession as soon as possible. It has already signed program documents on trade liberalization with five of the countries, memorandums being also handed over to Slovenia and Romania.

Conclusion

Ukraine has made some progress in the process of rapprochement to the EU. The European Council gave Ukraine the status of a country with market economy in October 2000 (*Postup*, 2000a). In November 2000, Ukrainian lawmakers approved a program to harmonize Ukrainian legislation with Europe's. A Commission for European Integration will be established to verify the conformity of Ukrainian laws with European laws (*Postup*, 2000c). The advances were positively evaluated by Mr. Romano Prodi (2000), President of the European Commission, during his visit to Ukraine:

“Ukraine has stated clearly that its goal is closer integration with the European Union. The EU, in the Common Strategy, has acknowledged Ukraine's European aspirations and welcomed Ukraine's pro-European choice.”

The legislative improvements are being supported by progress in development of industrial co-operation between Ukraine and the EU, which evidences increased competitive strength of Ukrainian goods (*Postup*, 2000b, 2000d).

UNDERLYING THEORY AND METHODOLOGY

In my work, I am going to answer the following question: how will Ukraine benefit from joining the EU. As Rutherford and Tarr (1998) suggest, static gains often underestimate real benefit from liberalization and, thus, dynamic estimates would be more precise. Further, Hertel (2001) argues that general equilibrium (GE) analysis allows for controlling effects of liberalization in one market on the rest of the markets and, in this way, GE analysis has its advantages over partial equilibrium (PE). Applied general equilibrium (AGE) models also take account of resource constraints for economy.

The best model to suit for calculations would be dynamic version of Global Trade Analysis Project (Dyn-GTAP). That model of Purdue University Center for Global Trade Analysis takes time as continuous variable in capital accumulation equation, permits capital mobility among regions to adjust for difference in risk-free interest rates, hence approximating long-run equilibrium. The user can perform a series of simulations with controlled path of tariff reductions for a desirable number of years. Unfortunately, the model is not available publicly for the moment.

Consequently, I will have to restrain myself to estimation of static result from tariff reduction, i.e. short-run equilibrium result. Ordinary GTAP model can serve this purpose, version 4. The main difference from Dyn-GTAP is absence of time variable. This version includes 45 regions and 50 sectors, which result in more than 20 000 variables in more than 15 000 equations. The data in the model is updated for year 1995.

TABLO file in GTAP model

All the theory GTAP builds on is contained in the TABLO file. The underlying theory in the model is as follows. First, perfect competition is assumed in all sectors. Some authors (Rutherford and Tarr, 1998) prefer large group monopolistic competition (MC) in the intermediate sector. Basic argument for this could be high fixed costs for starting business in this sector. High fixed costs call for mark-up in the industry, which is not possible in competitive industry but is consistent with monopolistic competition. Second, Hertel and Tsigas (1997) employ constant returns to scale (CRTS) for all sectors, while increasing returns to scale (IRTS) are imposed upon intermediate sector by Rutherford and Tarr (1998) for the same line of reasoning as MC. Large fixed costs result in ever decreasing average costs and economy of scale. Both suggestions of Rutherford and Tarr seem to be reasonable, but those required changes to GTAP demand more time/expertise than is available for this work.

Further, Hertel and Tsigas (1997) employ Armington style product differentiation. This means, consumers differentiate among products of different origins and the country imports according to formula (Geraci and Prewo, 1982):

$$m'_r = \left[\sum_{i \neq r} a_{ir} x_{ir}^{(s_r - 1)/s_r} \right]^{s_r / (s_r - 1)} \quad \text{for } r, i = 1, 2, \dots, n$$

where

m'_r = quantity index of total imports into r (prime indicates CES functional form);

x_{ir} = quantity of imports into country r from country i;

a_{ir} = weight multipliers;

σ = elasticity of substitution between any two imported products of different origins ($\sigma > 0$);

n = total number of countries.

Finally, the GTAP model has a nested structure. Both production and consumption are nested. Production process in GTAP can be depicted by scheme that follows.

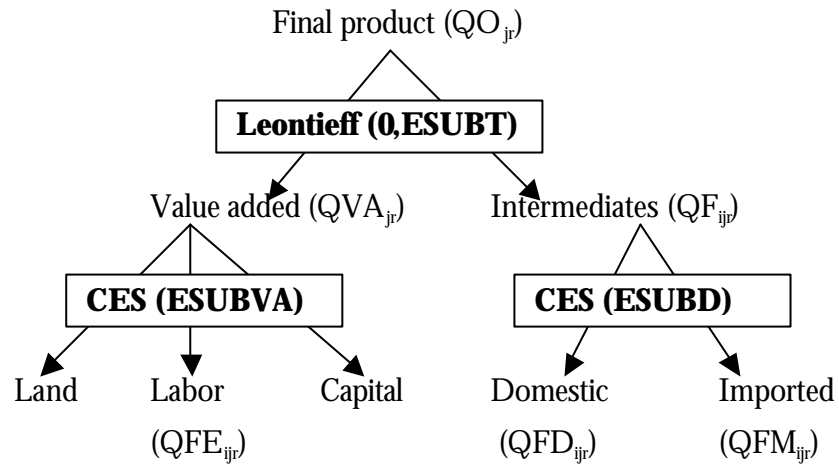


Figure 1. The production tree. Presented by Tom Hertel (2001). Adapted from a presentation of Christian Friis Bach.

In this scheme, production of good j in region r (QO_{jr}) is performed using Leontieff production function, which implies 0 substitutability between value added composite (QVA_{jr}) and intermediate composite (QF_{jr}). There are I =(quantity of traded commodities) intermediate composites, which can be safely chosen for production of final good with elasticity of substitution $ESUBT_j$ among them.

Production of value added composite (QVA_{jr}) is carried out with constant elasticity of substitution (CES) function, where $ESUBVA_j$ – elasticity of substitution among primary factors of production (QFE_{ijr}).

Finally, the intermediate composite is produced from domestic good (QFD_{ijr}) and import composite (QFM_{ijr} or m') with CES production function (elasticity of substitution $ESUBD_{ij}$).

The production process is performed under assumption of separability, which means that optimal mix of land, labor, and capital (QFE_{ijr}) doesn't depend on prices of intermediates. Thus, solution procedure has two steps: firstly, we choose optimal mix of primary factors of production and optimal mix of domestic and foreign goods and, secondly, we choose optimal intermediate composite for production of final good.

Nested structure of demand takes the following form:

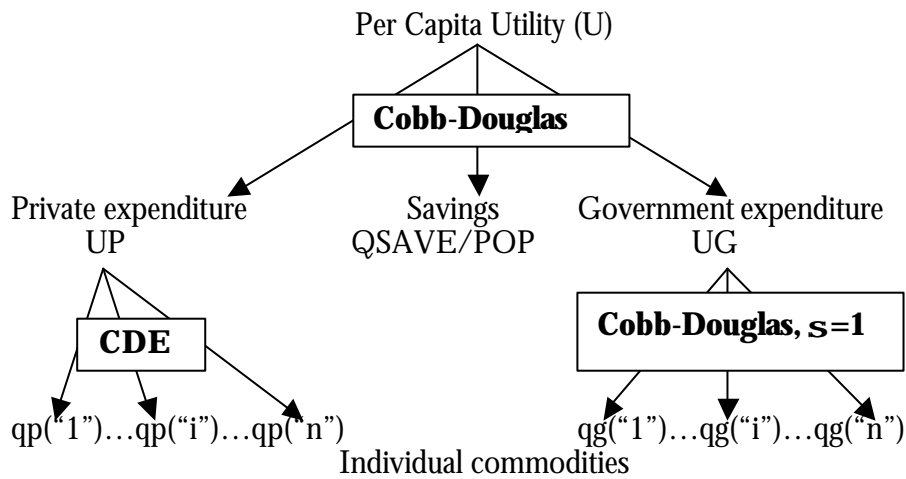


Figure 2. Tree structure of final demand. Presented by Tom Hertel (2001).

Consumer derives utility from private expenditure (UP), savings (QSAVE/POP), and government expenditure (UG) according to Cobb-Douglas utility function. Inclusion of savings in static model bases on the work of Howe (1975) as in Hertel and Tsigas (1997, p.46), who has shown that intertemporal expenditure system can be derived from static maximization problem with savings. Government Cobb-Douglas expenditure (UG) are executed with constant share of outlays for each good ($\sigma=1$, i.e. in

$s = (Q_1/Q_2)/(P_2/P_1)$ 1% increase in ratio of prices is compensated by 1% decrease in ratio of quantities). Inclusion of UG into households' utility is motivated by the work of Keller (1980) as in Hertel and Tsigas (1997, p.47). Finally, private expenditure function has constant difference of elasticities (CDE) form, originally suggested by Hanoch (1975).

Why CDE? Cobb-Douglas and CES are inconsistent with real data because they are homothetic, i.e. expenditure shares spent for particular goods are independent on level of income. Thus, there would be no possibility for luxury goods, which is unrealistic. The function that allows for change not only in expenditure shares but in marginal expenditure shares (observed in real life) is CDE (Huff *et al*, 1997). CDE lies halfway from CES to fully flexible form function (i.e. one defined in point by fixing second derivative in that point).

Expected static gains from tariff reduction: Theory

Why should tariff reduction bring welfare gain to a country? International trade studies answer this question in two categories: trade diversion and trade creation. Trade creation unambiguously produces welfare gain, while trade diversion is vague in sign of welfare change. Let's look at them closer.

Trade creation arises under customs union (CU) formation if a country engages in trade in a good it didn't trade in before.

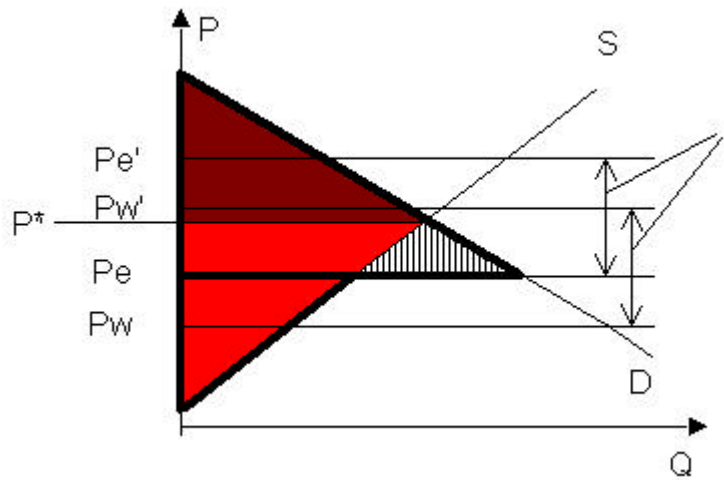


Figure 3. Trade creation.

On the graph above, the country has prohibitive tariff t on the good, which causes Rest of the World (P_w') and EU (P_e') supply prices to be higher than domestic equilibrium price (P^*). That's why the country doesn't trade that good. After it forms customs union with the EU, it eliminates tariff t on EU's goods and the price lowers below domestic price (P^*) to P_e . Consumer surplus in the country increases from vinous triangle to a bigger upper triangle bordered with a bold line. The difference between those two triangles (change in consumer surplus) is equal to equivalent variation under quasilinear utility function. Initial producer surplus of the country, marked red, decreases to the lower bordered with bold line triangle. Net gain for the country is the hatched triangle. Note that it is not the most efficient outcome as the country uses less efficient supplier (with higher costs) but it is better in terms of efficiency than initial equilibrium. Thus, we would expect allocation of resources in the country to improve. Together with better terms of trade (TOT) it would source increase in welfare.

Trade diversion is switching from cost-effective partner to ineffective one, i.e. the country trades in the same good but with a different partner.

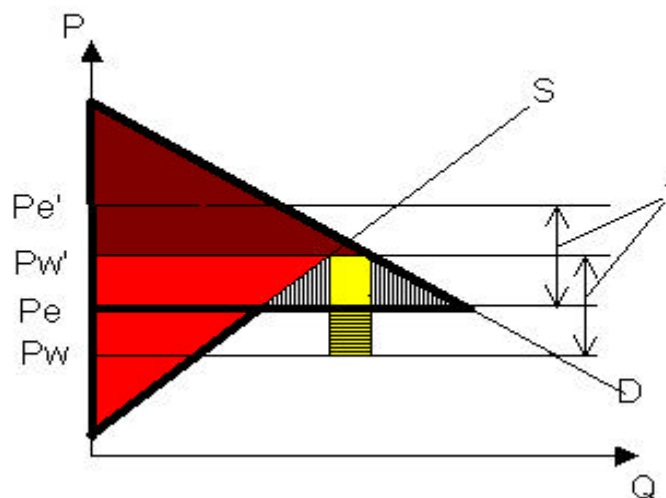


Figure 4. Trade diversion.

On the graph above, the country maintained tariff rate t , which was prohibitive for the EU but not for Rest of the World. Thus, the country imported some of the good from the Rest of the World (ROW) at price P_w' and gathered import duty equivalent to the area of yellow rectangular. There was no trade with the EU. Consumer surplus (CS) was equal to the area of vinous triangle and producer surplus (PS) corresponded to the red triangle. Now, that the country forms a customs union with the EU, it eliminates import tariff t for the EU. The equilibrium price falls to P_e . At once, there is no import of the commodity from ROW but only from the EU. Consumer and producer surpluses change to the areas bounded with bold line; tax revenues for the country disappear. On the net, the country gains two hatched triangles and loses hatched part of the yellow rectangular. As the things are, gains prevail, but if P_e rises or P_w decreases the hatched rectangular becomes larger and two triangles can decrease so that losses come to overweigh gains. Hence, change in consumer surplus (under quasilinear utility – EV) is positive and overall effect is ambiguous. Note partial equilibrium

(PE) nature of analysis in this section. See Suranovic (1999) for detailed (PE) treatment of the topic.

In GTAP, all the income, including taxes, accrues to consumers. That's why EV encompasses change in both CS and PS as well as government revenue and equals total effect of trade creation or trade diversion. Its sign is ambiguous. The formula for EV in the model is (Hertel and Tsigas, 1997, p.61):

$$EV(r) = u(r) * INC(r) / 100,$$

where $u(r)$ = percent change in per capita utility (see Figure 2);
 $INC(r)$ = income of region r before simulation.

As population shocks are possible in GTAP, the final equation takes more sophisticated form. I won't present it here because in my simulations population is held constant.

Tariff reduction: How does it work in GTAP?

When Ukraine enters into a customs union with the EU, both eliminate bilateral tariffs on all goods (eventually). Let's consider in details how elimination of tariff on import of good i from the EU to Ukraine influences general equilibrium (Hertel and Tsigas, 1997, p.45-46). A remark should be made that uppercase letters define absolute changes (X), while lowercase letters label mostly relative changes ($x = \Delta X / X$) in GTAP. Concerning import tariffs, uppercase letters mark power of the tax (T) – ratio of domestic (market) price to world price. $T > 1$ in case of import tax and $T < 1$ in case of import subsidy. Again, lowercase letters mark change in the power of the tax. I will adhere to GTAP designation.

Elimination of bilateral import tariff on good i will decrease the tariff to 0 (decrease the power of import tax to 1). It will lower price of good i in Ukraine according to equation:

$$\mathbf{pms(i,EU,Ukr)} = tm(i,Ukr) + \mathbf{tms(i,EU,Ukr)} + pcif(i,EU,Ukr), \quad \mathbf{(1)}$$

where $pms(i,EU,Ukr)$ = change in domestic (market) price in Ukraine of commodity i imported from the EU

$tm(i,Ukr)$ = change in power of the source-generic import tax on imports of commodity i in Ukraine

$tms(i,EU,Ukr)$ = change in power of the tax on imports of commodity i from the EU to Ukraine

$pcif(i,EU,Ukr)$ = change in world price of commodity i imported from the EU to Ukraine

In the equation, $tm(i,Ukr)=0$ (this tax doesn't change), $tms(i,EU,Ukr)<0$ (this tax is eliminated), and $pcif(i,EU,Ukr)=0$ (world CIF price doesn't change too). Thus, change in domestic price of commodity i is negative, i.e. this good becomes cheaper in Ukraine.

Further, lower prices for commodity i from the EU induce consumers in Ukraine to substitute it for commodity i from other countries. Consequently, quantity of imports of commodity i from the EU (export for the EU) increases:

$$\mathbf{qxs(i,EU,Ukr)} = qim(i,Ukr) - E_{SUBM(i)} * [\mathbf{pms(i,EU,Ukr)} - pim(i,Ukr)], \quad \mathbf{(2)}$$

where $qxs(i,EU,Ukr)$ = change in quantity of exports of commodity i from the EU to Ukraine

$qim(i,Ukr)$ = change in quantity of aggregate imports ($m_{f=Ukk}$ in Armington formula) of commodity i demanded by Ukraine

$ESUBM(i)$ = elasticity of substitution among imports from different countries of commodity i (σ in Armington formula)

$pim(i,Ukr)$ = change in market price of aggregate imports of commodity i in Ukraine

In this equation, $pms(i,EU,Ukr)<0$ from equation (1), $ESUBM>0$, and other variables are equal zero (PIM and QIM don't change). Therefore, $qxs(i,EU,Ukr)>0$.

Immediately, price of composite imports (m_i) of commodity i decreases, because the share of cheaper imports from the EU increases:

$$\mathbf{pim(i,Ukr)} = \sum_{k \in REG} \mathbf{MSHRS(i,k,Ukr)} * \mathbf{pms(i,k,Ukr)}, \quad (3)$$

where $MSHRS(i,k,Ukr)$ = market share of country k (k runs through all regions) in aggregate imports to Ukraine assessed at market prices

Market share of the EU increases $MSHRS(i,EU,Ukr)$ and $pms(i,EU,Ukr)<0$ from equation (1). As prices of imported commodity i from other countries don't change, i.e. $pms(i,k \neq EU,Ukr)=0$, price of import composite of commodity i decreases ($pim(i,Ukr)<0$).

Decrease in price of import composite causes decrease in price that other industries j in Ukraine pay for this input:

$$\mathbf{pfi(i,j,Ukr)} = \mathbf{tfm(i,j,Ukr)} + \mathbf{pim(i,Ukr)}, \quad (4)$$

where $pfm(i,j,Ukr) =$ demand price of imported commodity i for firms in industry j in Ukraine

$tfm(i,j,Ukr) =$ change in the power of the tax on imported commodity i for usage in industry j in Ukraine

Tax on intermediate usage of commodity i doesn't change, i.e. $tfm(i,j,Ukr)=0$, and $pim(i,Ukr)<0$ from equation (3). Hence, demand price on imported composite i for production of intermediate composite j decreases too ($pfm(i,j,Ukr)<0$).

Lower price of commodity i for intermediate usage induces expansion in demand on that composite from industries j that use commodity i as input:

$$\mathbf{qfm(i,j,Ukr)} = qf(i,j,Ukr) - ESUBD(i) * [\mathbf{pfm(i,j,Ukr)} - pf(i,j,Ukr)], \quad (5)$$

where $qfm(i,j,Ukr) =$ change in quantity of imported composite i demanded by firms in industry j in Ukraine

$qf(i,j,Ukr) =$ change in quantity of intermediate composite i (see figure 1) demanded by firms in industry j in Ukraine

$ESUBD(i) =$ elasticity of substitution between domestic commodity i and import composite i for production of intermediate composite i

$pf(i,j,Ukr) =$ change in price of intermediate composite i demanded by firms in industry j in Ukraine

As $pfm(i,j,Ukr)<0$ from equation (4) and $ESUBD(i)>0$, the other two right-hand side (RHS) variables being equal zero, $qfm(i,j,Ukr)>0$, i.e. demand for imported composite increases.

Cheaper aggregate imports also trigger decrease in price of intermediate composite:

$$\mathbf{pf(i,j,Ukr)} = \text{FMSHR}(i,j,\text{Ukr}) * \mathbf{pfm(i,j,Ukr)} + [1 - \text{FMSHR}(i,j,\text{Ukr})] * \text{pfd}(i,j,\text{Ukr}), \quad (6)$$

where $\text{FMSHR}(i,j,\text{Ukr})$ = share of import i in the intermediate composite j in Ukraine calculated at agent prices

$\text{pfd}(i,j,\text{Ukr})$ = change in demand price of domestic commodity i by firms in industry j in Ukraine for production of intermediate composite

In this equation, $\text{pfm}(i,j,\text{Ukr}) < 0$ from equation (4) and $\text{FMSHR}(i,j,\text{Ukr}) > 0$. As the third RHS variable equals zero, $\text{pf}(i,j,\text{Ukr}) < 0$, which means price of intermediate composite declined.

At this moment, producers catch a rise in their profits:

$$\text{VOA}(j,\text{Ukr}) * \text{ps}(j,\text{Ukr}) = \sum_{i=\text{ENDW}} \text{VFA}(i,j,\text{Ukr}) * \text{pfe}(i,j,\text{Ukr}) + \sum_{i \in \text{TRAD}} \text{VFA}(i,j,\text{Ukr}) * \mathbf{pf(i,j,Ukr)} + \text{VOA}(j,\text{Ukr}) * \mathbf{profitslack(j,Ukr)}, \quad (7)$$

where $\text{VOA}(j,\text{Ukr})$ = value of non-savings¹⁸ commodity j produced or imported to Ukraine and calculated at agent prices

$\text{ps}(j,\text{Ukr})$ = change in supply price of non-savings commodity j in Ukraine (think of it as the price producers and owners get for goods and factors of production)

¹⁸ Non-savings commodities include: land, labor, capital, natural resources (endowments), tradable goods, and capital goods

$VFA(i,j,Ukr)$ = value of purchases of demanded commodity i by firms in industry j in Ukraine (note that the first RHS item is summation over endowments and the second is summation over tradables)

$pfe(i,j,Ukr)$ = change in demand price of endowment i by firms in industry j in Ukraine

$profitslack(j,Ukr)$ = slack variable that incorporates profit in industry j in Ukraine; under zero profit condition applied to this perfect competition model should be equal zero in equilibrium

As endowment and supply prices still didn't change ($pfe(i,j,Ukr)=ps(j,Ukr)=0$) and value variables are positive by nature, negative shock to demand price of intermediate composite i ($pf(i,j,Ukr)<0$) translates in non-zero profit in industry j ($profitslack(j,Ukr)>0$) in the short run.

Positive profit of producers of final goods causes upsurge in their production. This results in expansion effect for manufacturing value added and intermediate composites:

$$\mathbf{qva(j,Ukr)} + \mathbf{ava(j,Ukr)} = \mathbf{qo(j,Ukr)} + \mathbf{ao(j,Ukr)} \quad (8)$$

$$\mathbf{qf(i,j,Ukr)} + \mathbf{af(i,j,Ukr)} = \mathbf{qo(j,Ukr)} + \mathbf{ao(j,Ukr)} \quad (9)$$

where $qva(j,Ukr)$ = change in quantity of value added composite j in Ukraine

$ava(j,Ukr)$, $af(i,j,Ukr)$, and $ao(j,Ukr)$ = technology changes in production of value added composite, intermediate composite, and final good, respectively

$qo(j,Ukr)$ = change in quantity of final good j produced in Ukraine

As technologies are held constant (respective variables equal zero), positive $q_0(j, \text{Ukr})$ transforms into positive $q_{va}(j, \text{Ukr})$ and $q_f(i, j, \text{Ukr})$. In partial equilibrium analysis for some industry expansion effect in other industries would be neglected.

Proliferation in production of value added composite intensifies demand for primary factors of production:

$$\mathbf{qfe(i,j,Ukr)} + afe(i,j,Ukr) = \mathbf{qva(j,Ukr)} - \text{ESUBVA}(j) * [pfe(i,j,Ukr) - afe(i,j,Ukr) - pva(j,Ukr)], \quad (10)$$

Technologies and prices being constant at this stage, positive $q_{va}(j, \text{Ukr})$ means positive $q_{fe}(i, j, \text{Ukr})$ in equilibrium.

Expansion effect in primary factors market generates extra demand on mobile endowments, raises their price and spreads the tariff reduction shock to all industries in Ukraine. This is the chain, through which per capita utility and EV in Ukraine are affected.

Description of simulations performed

Unfortunately, the available GTAP model, version 4, besides its static nature, has still another deficiency: it does not contain Ukraine as a separate region. Ukraine is aggregated in the Former Soviet Union (FSU) region. Disaggregating a country from a region is quite a cumbersome procedure in GTAP that should be subject of a separate research. Therefore, my strategy is to run simulations for FSU and then disaggregate Ukraine's part of the static gains in welfare according to its share in FSU trade on an industry basis.

First of all, I perform aggregation to reduce the number of regions from 45 to 8: Asia, USA, the EU, European Free Trade Association (EFTA), Central

European Associates (CEA)¹⁹, FSU, Turkey, and the Rest of the World (ROW); and to cut number of sectors from 50 to 10: agriculture, forest, coal, oil & gas, other minerals & chemicals, textiles & other clothes, ferrous & other metals, machinery, electricity, and services. Asia is singled out not on geographic basis but is a generic abbreviation for Asian quickly growing countries (including China) and Japan here. For detailed mapping of regions and sectors see Appendices A and B.

Next, two simulations are performed. As positive consideration of Ukrainian application to the EU is virtually made conditional on CEA's full membership in the EU (TSN, 2001) the first simulation is run in order to model CEA joining the EU and Turkey forming CU with the EU. The Turkish agricultural sector is exempted from CU regulations in this simulation (Harrison *et al*, 1996). The economy is put out of equilibrium by a series of shocks that eliminate bilateral import and export tariffs among the EU, CEA, and Turkey and adjust tariffs with third countries to EU level (See Appendix C).

The second simulation is run to answer the question posed in my thesis. It models FSU forming CU with the EU. The simulation constitutes a series of shocks performed to eliminate bilateral tariffs between FSU, on the one hand, and the EU, CEECs, and Turkey, on the other hand. It also adjusts bilateral tariffs of FSU with third countries to EU level and eliminates tariffs in FSU itself. Again, because of high concern of the EU with its agricultural sector and undesirability of increasing tariffs with third countries for Ukraine/FSU, FSU's agricultural sector is exempted from CU in this base scenario.

Alternative scenario includes agricultural sector for Turkey, in the first simulation, and for Ukraine, in the second simulation, into CU. There is

¹⁹ CEA includes 7 countries: Poland, Hungary, Czech Republic, Slovakia, Slovenia, Romania, and Bulgaria

mostly base scenario considered in the next chapter. Alternative scenario is used for comparison and policy implications.

DISCUSSION OF RESULTS

Analyzing results of simulations

The results of both simulations are put together into Table 1 as follows. We can see that the world as a whole gains from both liberalizations, but there is some redistribution of wealth. CEA and Turkey gain in both simulations, while USA and ROW lose. Asia and the EU are losers firstly and gain later, but the EU almost restores its losses while Asia doesn't. Changes for EFTA are marginal.

Table 1. Equivalent variation, in millions of US\$

Region	Simulation 1	Simulation 2	Total change
Asia	-1281	58	-1223
USA	-528	-42	-570
EU	-583	561	-22
EFTA	50	-99	-50
CEA	2915	251	3166
FSU	-127	195	67
Turkey	1441	165	1606
ROW	-859	-430	-1289
World total	1028	658	1687

FSU loses somewhat (-\$127mn) when CEA and Turkey tighten their trade relations with the EU, but recovers after forming CU with enlarged EU

(+\$195mn). This latter figure is disaggregated with the purpose of singling out Ukraine's EV in the next section of this chapter.

We can decompose welfare changes for second simulation (those \$658mn) by component (see Table 2).

Table 2. Decomposition of EV, in millions of US\$

Region	Allocation	TOT	Capital goods	Total
Asia	-44	123	-20	58
USA	6	10	-58	-42
EU	59	527	-26	561
EFTA	-20	-83	4	-99
CEA	17	220	13	251
FSU	589	-498	105	195
Turkey	23	138	4	165
ROW	29	-438	-22	-430
World total	659	-1	0	658

In this table, “allocation” is EV due to changes in tax revenues, “TOT” is EV due to changes in terms of trade, and “capital goods” is EV due to change in price of investment goods. We can see that positive figure for FSU comes mainly from increase in taxes gathered. TOT are affected negatively (they deteriorate) and investment goods appreciate slightly.

Further investigation reveals that TOT of FSU worsen for exports and improve for imports in general (see Table 3). This means that both prices of exports and prices of imports more often than not decrease, but deterioration in value of exports overweighs gain from cheaper imports. Changes in world prices also contribute to negative number for FSU's EV due to TOT. Note

significant negative numbers for exports in forestry and oil & gas sectors. This table is used further for singling out Ukraine's EV – the first constituent of it – on an industry basis.

Table 3. Decomposition of TOT component for FSU, in millions of US\$

Sector	World price	Price of export	Price of import	Total
1 Agriculture	-2	19	-7	10
2 Forestry	0	-116	6	-110
3 Coal	0	-8	4	-4
4 Oil & gas	-39	-360	19	-380
5 Minerals	0	-43	36	-7
6 Textiles	-1	-44	-55	-100
7 Metals	-2	-70	8	-64
8 Machinery	-4	-29	-10	-42
9 Electricity	0	3	-2	2
10 Services	-1	33	165	197
Total	-49	-615	166	-498

Also, GTAP allows for decomposition of allocation effect (\$589mn) from Table 2 by tax type. Table 4 presents the result. The first column of the table shows the type of tax and the second column displays how changes in proceeds from various taxes influence EV. The results suggest that revenues from almost all taxes rise; only proceeds from consumption tax decline.

This table is applied further for calculating the second and third constituents of Ukraine's EV. The second constituent is singled out from EV due to trade tariffs on an industry basis (see Table 5 for decomposing trade tariffs effects

by industry). The last (third) constituent incorporates components that are proportional to GDP rather than trade – capital goods effect from Table 2 as well as production, input, and consumption tax effects from Table 4.

Table 4. Decomposing allocation effect for FSU, in millions of US\$

Type of tax	Contribution to EV
1. Tax on production	36
2. Tax on inputs	38
3. Consumption tax	-33
4. Export tariff	32
5. Import tariff	516
Total	589

Table 5. Decomposing trade tariff effects for FSU, in millions of US\$

Sector	EV due to export tariff	EV due to import tariff
1 Agriculture	-2	5
2 Forestry	4	40
3 Coal	0	2
4 Oil & gas	19	5
5 Minerals	4	78
6 Textiles	3	80
7 Metals	0	55
8 Machinery	3	241
9 Electricity	0	0
10 Services	1	9
Total	32	516

Weights applied for calculating the first two trade-related constituents of EV for Ukraine are displayed in Table 6.

Table 6. Share of Ukraine's trade in FSU's trade

Sector	Export and import	Export	Import
1 Agriculture	0.12	0.25	0.06
2 Forestry	0.06	0.02	0.11
3 Coal	0.35	0.05	1.00
4 Oil & gas	0.07	0.01	1.00
5 Minerals	0.13	0.11	0.16
6 Textiles	0.07	0.09	0.06
7 Metals	0.14	0.13	0.23
8 Machinery	0.16	0.39	0.12
9 Electricity	0.15	0.21	0.00
10 Services	0.07	0.11	0.04

Ukraine's small share in negatively affected export industries – 2% in forestry and 1% in oil & gas – is noteworthy. See Appendix E for description of data underlying the calculations.

Data from IMF (1998) is used for assessing share of Ukraine's GDP in FSU's GDP (see Appendix F). The number comprises roughly 10%. This figure is employed for receiving the third constituent of EV for Ukraine.

Disaggregating Ukraine's EV

Ukraine's EV is separated in three steps: 1) EV_1 due to change of terms of trade, 2) EV_2 due to change in revenues from export and import tariffs, and 3) EV_3 due to production, input, and consumption taxes as well as change in price of capital goods.

EV_1 for each sector in Ukraine is received after multiplying respective columns of Tables 3 and 6 and summing up. For example, to get EV_1 for agriculture, one finds EV due to change in the world price, price of exports and imports first. In part, EV due to change in price of exports is received from multiplying "19" from Table 3 by "0.25" from Table 6. The result – "4.7" - is put down in Table 7. Then, values in the row are summed up to receive "4.0" for agriculture.

Table 7. Ukraine's EV due to TOT, millions of US\$

Sector	World price	Export price	Import price	Total
1 Agriculture	-0.3	4.7	-0.4	4.0
2 Forestry	0.0	-2.3	0.7	-1.6
3 Coal	0.0	-0.4	4.2	3.8
4 Oil & gas	-2.9	-2.5	19.3	14.0
5 Minerals	0.0	-4.7	5.7	0.9
6 Textiles	-0.1	-4.2	-3.5	-7.7
7 Metals	-0.2	-9.0	1.9	-7.3
8 Machinery	-0.6	-11.4	-1.1	-13.2
9 Electricity	0.0	0.7	0.0	0.8
10 Services	-0.1	3.6	7.3	10.8
Total	-4.1	-25.5	34.1	4.4

EV due to change in TOT comprises \$4.4mn for Ukraine. We can see that despite negative figure for FSU (-\$498mn) the number for Ukraine is positive. This result is, mainly, due to small exports by Ukraine of forestry and oil & gas.

EV₂ for Ukraine is calculated analogously to EV₁ using Tables 5 and 6. The results are gathered in Table 8. We can see that Ukraine receives proportionally more from FSU's EV due to trade tariffs effect – 13% [=72.4/(32+516)*100%] as compared to the share of its economy in FSU's GDP (10%).

Table 8. EV for Ukraine due to trade tariffs effect, in millions of US\$

Sector	Export tax	Import tax	Total
1 Agriculture	-0.4	0.3	-0.1
2 Forestry	0.1	4.3	4.4
3 Coal	0.0	1.5	1.5
4 Oil & gas	0.1	5.1	5.3
5 Minerals	0.4	12.4	12.8
6 Textiles	0.2	5.1	5.3
7 Metals	0.0	12.6	12.6
8 Machinery	1.2	28.9	30.1
9 Electricity	0.0	0.0	0.0
10 Services	0.1	0.4	0.5
Total	1.8	70.6	72.4

The third constituent, EV₃, is computed according to methodology, mentioned above (see Table 9 for results). 10.22% is share of Ukraine's GDP in FSU's GDP.

Table 9. Decomposition for Ukraine of EV due to capital goods as well as production, input and consumption tax, in millions of US\$

Type of tax	FSU	Weighing, %	Ukraine
Capital goods	104.6	10.22	10.7
Input tax	36.3	10.22	3.7
Production tax	38.0	10.22	3.9
Consumption tax	-33.2	10.22	-3.4
Total	145.6		14.9

The final step is gathering all the figures together (Table 10). We see that Ukraine gets about 47% of FSU's EV (=91.7/195).

Table 10. Summing up EV for Ukraine, in millions of US\$

TOT	4.4
Allocation, trade tariffs	72.4
The rest, proportional to GDP	14.9
Total	<u>91.7</u>

Comparing base and alternative scenarios

Calculations for alternative scenario are performed under the same methodology as for base scenario. EV for Ukraine under alternative scenario constitutes -\$52.5 millions and for FSU the number is -\$1182 millions. The received numbers suggest that Ukraine would appropriate 4.44% [= (-52.5)/(-1182)*100%] of FSU's loss from joining CU with the EU if agricultural sector were liberalized too. Negative figure for FSU comes from deterioration

in TOT for imported agricultural products. As Ukraine comprises 6% of total FSU's agricultural imports, it is hurt less. But still, it also faces deterioration in export prices, which results in negative figure for Ukraine in general.

Proposals for future research

This research has a few weaknesses that free space for future research. The first weakness is inconsistency of data on FSU in GTAP. Data on FSU's trade (IMF, 1998) used for disaggregation is higher than this in GTAP. As GTAP data on FSU resembles the data provided by the WTO (2000), I can question the quality of FSU trade data in GTAP. The reason for this is that WTO also uses COMTRADE (COMmodity TRADE) data of the UN as GTAP does, but there is a remark in WTO (2000) that the data for FSU includes intra-region trade only starting from the year 1996. Version 4 of GTAP is composed for the year 1995 and total FSU's trade is argued to include intra-region trade. Such explanation clarifies also inconsistency faced during disaggregation, when Ukraine's adjusted imports of oil & gas as well as coal exceeded the respective figure for FSU (part of which Ukraine is). As Ukrainian imports of fuel mostly come from Russia (intra-region trade), this number is not included in inter-region trade (reported by WTO and supposedly used in GTAP). Refining data on FSU or, due to the problem of lack of data for 1995, using the next version of GTAP (forthcoming version 5 is composed for year 1997) should make estimates more precise. Using version 5 would also eliminate the shortcomings from Baltic States being part of FSU. They are represented separately in version 5.

The second problem is availability of data on other states of FSU region. GTAP allows disaggregating non-trade allocation effects (Table 9) on industry basis. As input-output tables for other countries of FSU are not accumulated in Derzhkomstat and it is rather specific information to be gathered by international organizations, I made disaggregation proportionally to share of

Ukraine's GDP in FSU's GDP. This introduces inaccuracy into calculations and can be treated by applying for data to State Statistical Committees of respective states.

The next suggestion for research comes from absence of Ukraine as a separate region in GTAP. Singling out Ukraine in the model and performing a standard for GTAP procedure of data correction would refine the evaluation considerably. This procedure would also allow simulating joining of Ukraine alone to the EU, and not in the family of all FSU countries.

Further, the model assumes perfect competition and constant returns to scale, while some authors (Rutherford and Tarr, 1998) contend that large group monopolistic competition and IRTS should be used. Those claims could be investigated and implemented in future research too.

Finally, static models underestimate consequences from trade liberalization (Rutherford and Tarr, 1998). Thus, when dynamic model is publicly available, it could be used for refining results received with this static model.

Chapter 6

CONCLUSION

As the model predicts, Ukraine stands to gain from joining customs union with the European Union if agricultural sector is excluded from agreement. The respective gain – \$91.7 millions – is to accrue yearly in terms of better terms of trade (TOT), higher budget revenue from taxes gathered, and appreciation in the value of investment goods. Ukraine's gain constitutes 47% of FSU's equivalent variation, while its GDP comprises 10% and volume of trade – 13% of respective indicators of FSU. This means Ukraine would gain disproportionately more than on average other FSU countries under base scenario.

The alternative scenario suggests that imitating EU's highly protected agricultural sector would be undesirable for Ukraine. It would worsen TOT in import as well as export of agricultural products for Ukraine (EV makes up -\$101 and -\$88 millions, respectively). Import prices would increase because of elimination of 20% subsidy on export of agricultural products from EU (on average) and higher common external tariffs (CET) in the EU on imports from third countries. Export prices would decrease due to higher import taxes of third countries on agricultural products from the EU (and its CU partners) as response to EU's protectionism.

Therefore, the final result is sensitive to shocks performed on tariffs to agricultural products. The EU is considering slashing its export subsidies to avoid difficulties with common agricultural policy after enlargement. Such step will be followed by bilateral reducing tariffs with third countries in this sector. Such modifications are expected to make Ukraine's gain higher,

because it would benefit from expanding its exports to the EU and not lose on the markets of third countries.

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APPENDIX A: AGGREGATION OF REGIONS

Definition of new (aggregated) regions

ase	Quickly growing Asian economies (including China) and Japan
usa	USA
eun	European Union
eft	EFTA
cea	Central European Associates
fsu	Former Soviet Union
tur	Turkey
row	Rest of the world

Regions mapping

Previous	Previous region definition	New
AUS	Australia	row
NZL	New Zealand	row
JPN	Japan	ase
KOR	Republic of Korea	ase
IDN	Indonesia	ase
MYS	Malaysia	ase
PHL	Philippines	ase
SGP	Singapore	ase
THA	Thailand	ase
VNM	Viet Nam	row
CHN	China	ase
HKG	Hong Kong	ase
TWN	Taiwan	ase
IND	India	row
LKA	Sri Lanka	row

RAS	Rest of South Asia	row
CAN	Canada	row
USA	United States of America	usa
MEX	Mexico	row
CAM	Central America and Caribbean	row
VEN	Venezuela	row
COL	Colombia	row
RAP	Rest of Andean Pact	row
ARG	Argentina	row
BRA	Brazil	row
CHL	Chile	row
URY	Uruguay	row
RSM	Rest of South America	row
GBR	United Kingdom	eun
DEU	Germany	eun
DNK	Denmark	eun
SWE	Sweden	eun
FIN	Finland	eun
REU	Rest of European Union	eun
EFT	European Free Trade Area	eft
CEA	Central European Associates	cea
FSU	Former Soviet Union	fsu
TUR	Turkey	tur
RME	Rest of Middle East	row
MAR	Morocco	row
RNF	Rest of North Africa	row
SAF	South African Customs Union	row
RSA	Rest of Southern Africa	row
RSS	Rest of Sub Saharan Africa	row
ROW	Rest of World	row

APPENDIX B: AGGREGATION OF INDUSTRIES

Definition of new (aggregated) sectors

1. agr	Food products, plant-based fibers, fishery, beverages and tobacco
2. for	Forestry, wood and paper products
3. col	Coal
4. o_g	Oil, gas, petroleum and coal products
5. min	Minerals and chemicals
6. tex	Textiles, wearing apparels, and leather products
7. fer	Metals and metal products
8. mac	Motor vehicles, transport and electronic equipment, machinery
9. ele	Electricity
10. ser	Utilities, trade, transport, construction, financial services

Industries mapping

Previous	Previous industry definition	New
1. pdr	Paddy rice	agr
2. wht	Wheat	agr
3. gro	Other cereal grains	agr
4. v_f	Vegetables, fruit, nuts	agr
5. osd	Oil seeds	agr
6. c_b	Sugar cane, sugar beet	agr
7. pfb	Plant-based fibers	agr
8. ocr	Other crops	agr
9. ctl	Bovine cattle, sheep and goats, horses	agr
10. oap	Other animal products	agr

11. rmk	Raw milk	agr
12. wol	Wool silk-worm cocoons	agr
13. for	Forestry	for
14. fsh	Fishing	agr
15. col	Coal	col
16. oil	Oil	o_g
17. gas	Gas	o_g
18. omn	Other minerals	min
19. cmt	Bovine cattle, sheep and goat, horse meat prods	agr
20. omt	Other meat products	agr
21. vol	Vegetable oils and fats	agr
22. mil	Dairy products	agr
23. pcr	Processed rice	agr
24. sgr	Sugar	agr
25. ofd	Other food products	agr
26. b_t	Beverages and tobacco products	agr
27. tex	Textiles	tex
28. wap	Wearing apparel	tex
29. lea	Leather products	tex
30. lum	Wood products	for
31. ppp	Paper products, publishing	for
32. p_c	Petroleum, coal products	o_g
33. crp	Chemical, rubber, plastic products	min
34. nmm	Other mineral products	min
35. i_s	Ferrous metals	fer
36. nfm	Other metals	fer
37. fmp	Metal products	fer
38. mvh	Motor vehicles and parts	mac
39. otn	Other transport equipment	mac
40. ele	Electronic equipment	mac

41. ome	Other machinery and equipment	mac
42. omf	Other manufactures	mac
43. ely	Electricity	ele
44. gdt	Gas manufacture, distribution	ser
45. wtr	Water	ser
46. cns	Construction	ser
47. t_t	Trade, transport	ser
48. osp	Financial, business, recreational services	ser
49. osg	Public admin and defense, education, health	ser
50. dwe	Dwellings	ser

APPENDIX C: SHOCKS PERFORMED UNDER THE FIRST SIMULATION (BASE SCENARIO)

Shock tms("for", "eun", "tur") = -4.74 - change in power of import tariff on forestry delivered from the EU to Turkey, levied in Turkey

Shock txs("ele", "cea", "eun") = -0.76 - change in the power of export tariff on electricity delivered from CEA to the EU, levied in CEA

! Sim 1d: CEEC&Turkey(-agr) join the EU/
form CU with it + adj!

!CEEC eliminate tariffs in itself!

Shock tms("agr", "cea", "cea") = -10.79;
Shock tms("for", "cea", "cea") = -3.97;
Shock tms("col", "cea", "cea") = -2.89;
Shock tms("o_g", "cea", "cea") = -4.66;
Shock tms("min", "cea", "cea") = -6.09;
Shock tms("tex", "cea", "cea") = -9.60;
Shock tms("fer", "cea", "cea") = -4.43;
Shock tms("mac", "cea", "cea") = -7.46;
Shock txs("agr", "cea", "cea") = -2.35;
Shock txs("mac", "cea", "cea") = -0.05;
Shock txs("ele", "cea", "cea") = -0.76;

! The EU eliminates bilateral tariffs with
CEEC!

Shock tms("agr", "cea", "eun") = -22.32;
Shock tms("for", "cea", "eun") = -2.59;
Shock tms("o_g", "cea", "eun") = -1.69;
Shock tms("min", "cea", "eun") = -3.06;
Shock tms("tex", "cea", "eun") = -6.23;
Shock tms("fer", "cea", "eun") = -3.40;
Shock tms("mac", "cea", "eun") = -3.86;
Shock tms("ser", "cea", "eun") = -0.02;
Shock txs("agr", "eun", "cea") = -11.16;
Shock txs("for", "eun", "cea") = 0.34;
Shock txs("col", "eun", "cea") = 0.53;
Shock txs("o_g", "eun", "cea") = 0.59;
Shock txs("min", "eun", "cea") = 0.49;
Shock txs("tex", "eun", "cea") = 0.46;
Shock txs("fer", "eun", "cea") = 0.39;
Shock txs("mac", "eun", "cea") = 0.38;
Shock txs("ele", "eun", "cea") = 0.65;
Shock txs("ser", "eun", "cea") = 0.81;

!CEEC eliminates bilateral tariffs with the EU!

Shock tms("agr", "eun", "cea") = -14.06;
Shock tms("for", "eun", "cea") = -5.92;
Shock tms("col", "eun", "cea") = -4.74;
Shock tms("o_g", "eun", "cea") = -6.34;
Shock tms("min", "eun", "cea") = -7.68;
Shock tms("tex", "eun", "cea") = -8.39;
Shock tms("fer", "eun", "cea") = -5.97;
Shock tms("mac", "eun", "cea") = -7.21;
Shock txs("agr", "cea", "eun") = -8.54;
Shock txs("tex", "cea", "eun") = 0.01;
Shock txs("mac", "cea", "eun") = -0.06;
Shock txs("ele", "cea", "eun") = -0.76;

!Turkey eliminates bilateral tariffs with the EU!

Shock tms("for", "eun", "tur") = -4.74;
Shock tms("col", "eun", "tur") = -1.22;
Shock tms("o_g", "eun", "tur") = -12.94;
Shock tms("min", "eun", "tur") = -4.56;
Shock tms("tex", "eun", "tur") = -6.37;
Shock tms("fer", "eun", "tur") = -4.15;
Shock tms("mac", "eun", "tur") = -4.36;
Shock txs("for", "tur", "eun") = -0.10;
Shock txs("col", "tur", "eun") = -27.42;
Shock txs("o_g", "tur", "eun") = -7.29;
Shock txs("min", "tur", "eun") = -3.72;
Shock txs("tex", "tur", "eun") = 0.03;
Shock txs("mac", "tur", "eun") = -0.08;
!The EU eliminates bilateral tariffs with
Turkey!

Shock tms("for", "tur", "eun") = -2.61;
Shock tms("col", "tur", "eun") = -0.60;
Shock tms("o_g", "tur", "eun") = -1.40;
Shock tms("min", "tur", "eun") = -3.61;
Shock tms("tex", "tur", "eun") = -8.30;
Shock tms("fer", "tur", "eun") = -3.44;
Shock tms("mac", "tur", "eun") = -4.47;
Shock tms("ser", "tur", "eun") = -0.01;
Shock txs("for", "eun", "tur") = 0.42;
Shock txs("col", "eun", "tur") = 0.82;
Shock txs("o_g", "eun", "tur") = 1.04;
Shock txs("min", "eun", "tur") = 0.58;
Shock txs("tex", "eun", "tur") = 0.58;
Shock txs("fer", "eun", "tur") = 0.61;
Shock txs("mac", "eun", "tur") = 0.40;
Shock txs("ser", "eun", "tur") = 0.75;

!Turkey eliminates bilateral tariffs with CEEC!

Shock tms("agr", "cea", "tur") = 18.04;
Shock tms("for", "cea", "tur") = -7.12;
Shock tms("col", "cea", "tur") = -1.35;
Shock tms("o_g", "cea", "tur") = -17.53;
Shock tms("min", "cea", "tur") = -8.42;
Shock tms("tex", "cea", "tur") = -8.89;
Shock tms("fer", "cea", "tur") = -4.66;
Shock tms("mac", "cea", "tur") = -9.10;
Shock txs("agr", "tur", "cea") = 2.19;
Shock txs("for", "tur", "cea") = -0.11;
Shock txs("col", "tur", "cea") = -27.42;
Shock txs("o_g", "tur", "cea") = -37.64;
Shock txs("min", "tur", "cea") = -2.24;
Shock txs("mac", "tur", "cea") = -0.08;

!CEEC eliminate bilateral tariffs with Turkey!

Shock tms("agr", "tur", "cea") = -8.33;

Shock tms("for", "tur", "cea") = -9.65;
 Shock tms("col", "tur", "cea") = -1.38;
 Shock tms("o_g", "tur", "cea") = -2.12;
 Shock tms("min", "tur", "cea") = -8.35;
 Shock tms("tex", "tur", "cea") = -7.03;
 Shock tms("fer", "tur", "cea") = -7.63;
 Shock tms("mac", "tur", "cea") = -12.43;
 Shock txs("agr", "cea", "tur") = 47.08;
 Shock txs("mac", "cea", "tur") = -0.06;
 !CEEC adjust import tax rates to the third countries to the EU level!

Shock tms("agr", "ase", "cea") = 1.38;
 Shock tms("for", "ase", "cea") = -3.31;
 Shock tms("col", "ase", "cea") = -1.87;
 Shock tms("o_g", "ase", "cea") = -5.44;
 Shock tms("min", "ase", "cea") = -3.04;
 Shock tms("tex", "ase", "cea") = 2.39;
 Shock tms("fer", "ase", "cea") = -3.08;
 Shock tms("mac", "ase", "cea") = -6.75;
 Shock tms("agr", "usa", "cea") = 3.94;
 Shock tms("for", "usa", "cea") = -4.90;
 Shock tms("o_g", "usa", "cea") = -9.38;
 Shock tms("min", "usa", "cea") = -5.06;
 Shock tms("tex", "usa", "cea") = 0.89;
 Shock tms("fer", "usa", "cea") = -3.96;
 Shock tms("mac", "usa", "cea") = -5.99;
 Shock tms("agr", "eft", "cea") = -3.45;
 Shock tms("for", "eft", "cea") = -4.45;
 Shock tms("col", "eft", "cea") = -0.77;
 Shock tms("o_g", "eft", "cea") = -3.22;
 Shock tms("min", "eft", "cea") = -5.75;
 Shock tms("tex", "eft", "cea") = -7.98;
 Shock tms("fer", "eft", "cea") = -6.21;
 Shock tms("mac", "eft", "cea") = -6.17;
 Shock tms("agr", "fsu", "cea") = 14.52;
 Shock tms("for", "fsu", "cea") = -5.79;
 Shock tms("col", "fsu", "cea") = -0.66;
 Shock tms("o_g", "fsu", "cea") = -1.33;
 Shock tms("min", "fsu", "cea") = -1.52;
 Shock tms("tex", "fsu", "cea") = -1.12;
 Shock tms("fer", "fsu", "cea") = -3.29;
 Shock tms("mac", "fsu", "cea") = -5.89;
 Shock tms("agr", "row", "cea") = 6.79;
 Shock tms("for", "row", "cea") = -4.35;
 Shock tms("col", "row", "cea") = 0.95;
 Shock tms("o_g", "row", "cea") = -2.00;
 Shock tms("min", "row", "cea") = -2.71;
 Shock tms("fer", "row", "cea") = -3.00;
 Shock tms("mac", "row", "cea") = -6.98;

!CEEC adjust export tax rates to the third countries to the EU level!

Shock txs("agr", "cea", "ase") = 6.62;
 Shock txs("agr", "cea", "usa") = -0.35;
 Shock txs("agr", "cea", "eft") = 3.76;
 Shock txs("agr", "cea", "fsu") = 17.21;
 Shock txs("agr", "cea", "row") = 28.04;
 Shock txs("col", "cea", "ase") = -1.00;
 Shock txs("col", "cea", "usa") = -1.00;
 Shock txs("col", "cea", "fsu") = -1.00;
 Shock txs("col", "cea", "row") = -1.00;
 Shock txs("o_g", "cea", "ase") = -1.00;

Shock txs("o_g", "cea", "fsu") = -1.00;
 Shock txs("o_g", "cea", "row") = -1.00;
 Shock txs("min", "cea", "ase") = -1.00;
 Shock txs("min", "cea", "usa") = -1.00;
 Shock txs("min", "cea", "fsu") = -1.00;
 Shock txs("min", "cea", "row") = -1.00;
 Shock txs("tex", "cea", "ase") = -1.00;
 Shock txs("tex", "cea", "usa") = -0.95;
 Shock txs("tex", "cea", "eft") = 0.01;
 Shock txs("tex", "cea", "fsu") = -1.00;
 Shock txs("tex", "cea", "row") = -1.00;
 Shock txs("fer", "cea", "row") = -1.00;
 Shock txs("mac", "cea", "ase") = -0.06;
 Shock txs("mac", "cea", "usa") = -0.06;
 Shock txs("mac", "cea", "eft") = -0.05;
 Shock txs("mac", "cea", "fsu") = -0.04;
 Shock txs("mac", "cea", "row") = -1.05;
 Shock txs("ele", "cea", "eft") = -0.76;
 Shock txs("ele", "cea", "row") = -1.75;
 Shock txs("ser", "cea", "ase") = -1.00;
 Shock txs("ser", "cea", "usa") = -1.00;
 Shock txs("ser", "cea", "fsu") = -1.00;
 Shock txs("ser", "cea", "row") = -1.00;

!Turkey adjusts its bilateral tariffs with third countries to the EU level!

Shock tms("for", "ase", "tur") = -6.55;
 Shock tms("col", "ase", "tur") = -0.76;
 Shock tms("o_g", "ase", "tur") = -3.07;
 Shock tms("min", "ase", "tur") = -3.35;
 Shock tms("tex", "ase", "tur") = -1.14;
 Shock tms("fer", "ase", "tur") = -7.31;
 Shock tms("mac", "ase", "tur") = -4.44;
 Shock tms("for", "usa", "tur") = -1.92;
 Shock tms("col", "usa", "tur") = -2.91;
 Shock tms("o_g", "usa", "tur") = -1.82;
 Shock tms("min", "usa", "tur") = -3.39;
 Shock tms("tex", "usa", "tur") = 1.21;
 Shock tms("fer", "usa", "tur") = 0.92;
 Shock tms("mac", "usa", "tur") = -1.79;
 Shock tms("for", "eft", "tur") = -8.35;
 Shock tms("col", "eft", "tur") = -2.75;
 Shock tms("o_g", "eft", "tur") = -11.41;
 Shock tms("min", "eft", "tur") = -6.89;
 Shock tms("tex", "eft", "tur") = -7.05;
 Shock tms("fer", "eft", "tur") = -6.82;
 Shock tms("mac", "eft", "tur") = -5.41;
 Shock tms("for", "fsu", "tur") = -4.51;
 Shock tms("col", "fsu", "tur") = -1.92;
 Shock tms("o_g", "fsu", "tur") = -2.98;
 Shock tms("min", "fsu", "tur") = -2.05;
 Shock tms("tex", "fsu", "tur") = 3.25;
 Shock tms("fer", "fsu", "tur") = -2.47;
 Shock tms("mac", "fsu", "tur") = -2.45;
 Shock tms("for", "row", "tur") = -2.60;
 Shock tms("col", "row", "tur") = -1.91;
 Shock tms("o_g", "row", "tur") = -8.18;
 Shock tms("min", "row", "tur") = -3.46;
 Shock tms("tex", "row", "tur") = 1.36;
 Shock tms("fer", "row", "tur") = -1.91;
 Shock tms("mac", "row", "tur") = -4.71;
 Shock txs("for", "tur", "ase") = -0.04;

Shock txs("col", "tur", "ase") = -1.00;
Shock txs("o_g", "tur", "ase") = -1.00;
Shock txs("min", "tur", "ase") = -10.60;
Shock txs("tex", "tur", "ase") = -1.00;
Shock txs("mac", "tur", "ase") = -0.13;
Shock txs("ser", "tur", "ase") = -1.00;
Shock txs("for", "tur", "usa") = -6.69;
Shock txs("col", "tur", "usa") = -1.00;
Shock txs("min", "tur", "usa") = -8.03;
Shock txs("tex", "tur", "usa") = -0.96;
Shock txs("mac", "tur", "usa") = -0.10;
Shock txs("ser", "tur", "usa") = -1.00;
Shock txs("min", "tur", "eft") = -5.57;
Shock txs("tex", "tur", "eft") = 0.02;
Shock txs("mac", "tur", "eft") = -0.09;
Shock txs("for", "tur", "fsu") = -0.08;
Shock txs("col", "tur", "fsu") = -1.00;
Shock txs("o_g", "tur", "fsu") = -1.34;
Shock txs("min", "tur", "fsu") = -2.02;
Shock txs("tex", "tur", "fsu") = -1.00;
Shock txs("mac", "tur", "fsu") = -0.10;
Shock txs("ser", "tur", "fsu") = -1.00;
Shock txs("for", "tur", "row") = -2.25;
Shock txs("col", "tur", "row") = -28.15;
Shock txs("o_g", "tur", "row") = -1.00;
Shock txs("min", "tur", "row") = -2.36;
Shock txs("tex", "tur", "row") = -0.99;
Shock txs("fer", "tur", "row") = -1.00;
Shock txs("mac", "tur", "row") = -1.10;
Shock txs("ele", "tur", "row") = -1.00;
Shock txs("ser", "tur", "row") = -1.00;
!The third countries adjust their tariffs for CEEC to the EU level!
Shock tms("agr", "cea", "ase") = -5.63;
Shock tms("agr", "cea", "usa") = -2.88;
Shock tms("agr", "cea", "eft") = -29.49;
Shock tms("agr", "cea", "fsu") = -1.55;
Shock tms("agr", "cea", "row") = -4.21;
Shock tms("for", "cea", "ase") = 1.93;
Shock tms("for", "cea", "usa") = 1.85;
Shock tms("for", "cea", "eft") = -4.95;
Shock tms("for", "cea", "fsu") = -5.25;
Shock tms("for", "cea", "row") = -7.74;
Shock tms("col", "cea", "ase") = 1.99;
Shock tms("col", "cea", "row") = 0.57;
Shock tms("o_g", "cea", "ase") = 13.71;
Shock tms("o_g", "cea", "usa") = 0.97;
Shock tms("o_g", "cea", "eft") = -28.49;
Shock tms("o_g", "cea", "fsu") = -0.45;
Shock tms("o_g", "cea", "row") = 1.89;
Shock tms("min", "cea", "usa") = 0.99;
Shock tms("min", "cea", "eft") = -3.21;
Shock tms("min", "cea", "fsu") = -0.66;
Shock tms("min", "cea", "row") = -5.13;
Shock tms("tex", "cea", "ase") = -1.73;
Shock tms("tex", "cea", "usa") = -1.92;
Shock tms("tex", "cea", "eft") = -12.03;
Shock tms("tex", "cea", "fsu") = -2.76;
Shock tms("tex", "cea", "row") = -16.73;
Shock tms("fer", "cea", "ase") = 1.40;
Shock tms("fer", "cea", "usa") = 1.32;

Shock tms("fer", "cea", "eft") = -1.48;
Shock tms("fer", "cea", "fsu") = -2.67;
Shock tms("fer", "cea", "row") = -0.96;
Shock tms("mac", "cea", "ase") = -5.52;
Shock tms("mac", "cea", "usa") = 2.61;
Shock tms("mac", "cea", "eft") = -2.92;
Shock tms("mac", "cea", "fsu") = -1.77;
Shock tms("mac", "cea", "row") = -6.54;
Shock tms("ele", "cea", "fsu") = 4.00;
Shock tms("ser", "cea", "ase") = -0.70;
Shock tms("ser", "cea", "eft") = -0.03;
Shock tms("ser", "cea", "fsu") = 1.01;
Shock txs("agr", "ase", "cea") = -3.86;
Shock txs("for", "ase", "cea") = -0.38;
Shock txs("col", "ase", "cea") = 0.83;
Shock txs("o_g", "ase", "cea") = -0.26;
Shock txs("min", "ase", "cea") = -0.90;
Shock txs("tex", "ase", "cea") = -3.29;
Shock txs("fer", "ase", "cea") = -0.70;
Shock txs("agr", "usa", "cea") = -0.32;
Shock txs("min", "usa", "cea") = -0.05;
Shock txs("mac", "usa", "cea") = 0.01;
Shock txs("ele", "usa", "cea") = -6.00;
Shock txs("ser", "usa", "cea") = 3.25;
Shock txs("agr", "eft", "cea") = 12.59;
Shock txs("for", "eft", "cea") = -0.15;
Shock txs("o_g", "eft", "cea") = 0.06;
Shock txs("min", "eft", "cea") = -0.03;
Shock txs("tex", "eft", "cea") = -0.02;
Shock txs("fer", "eft", "cea") = -0.04;
Shock txs("mac", "eft", "cea") = -0.04;
Shock txs("ele", "eft", "cea") = -0.04;
Shock txs("ser", "eft", "cea") = -0.04;
Shock txs("agr", "fsu", "cea") = -0.90;
Shock txs("for", "fsu", "cea") = -1.27;
Shock txs("o_g", "fsu", "cea") = -0.87;
Shock txs("agr", "row", "cea") = 3.52;
Shock txs("for", "row", "cea") = -1.25;
Shock txs("col", "row", "cea") = 1.40;
Shock txs("min", "row", "cea") = 0.07;
Shock txs("tex", "row", "cea") = -2.23;
Shock txs("fer", "row", "cea") = 0.61;
!The third countries adjust their tariffs for Turkey to the EU level!
Shock tms("for", "tur", "ase") = -1.60;
Shock tms("col", "tur", "ase") = 2.00;
Shock tms("o_g", "tur", "ase") = 11.58;
Shock tms("min", "tur", "ase") = -0.94;
Shock tms("fer", "tur", "ase") = 2.89;
Shock tms("mac", "tur", "ase") = 1.26;
Shock tms("ser", "tur", "ase") = -0.85;
Shock tms("for", "tur", "usa") = 1.74;
Shock tms("o_g", "tur", "usa") = 1.96;
Shock tms("min", "tur", "usa") = 2.35;
Shock tms("tex", "tur", "usa") = -3.08;
Shock tms("fer", "tur", "usa") = 1.98;
Shock tms("mac", "tur", "usa") = 2.76;
Shock tms("for", "tur", "eft") = -3.46;
Shock tms("o_g", "tur", "eft") = -2.90;
Shock tms("min", "tur", "eft") = -2.18;
Shock tms("tex", "tur", "eft") = -9.97;

Shock tms("fer", "tur", "eft") = -2.02;
 Shock tms("mac", "tur", "eft") = -1.93;
 Shock tms("ser", "tur", "eft") = -0.03;
 Shock tms("for", "tur", "fsu") = -5.83;
 Shock tms("col", "tur", "fsu") = 5.00;
 Shock tms("o_g", "tur", "fsu") = -7.15;
 Shock tms("min", "tur", "fsu") = -4.74;
 Shock tms("tex", "tur", "fsu") = -3.72;
 Shock tms("fer", "tur", "fsu") = -3.70;
 Shock tms("mac", "tur", "fsu") = -6.24;
 Shock tms("ele", "tur", "fsu") = 4.00;
 Shock tms("for", "tur", "row") = -4.98;
 Shock tms("col", "tur", "row") = -7.88;
 Shock tms("o_g", "tur", "row") = -2.66;
 Shock tms("min", "tur", "row") = -3.39;
 Shock tms("tex", "tur", "row") = 3.22;
 Shock tms("fer", "tur", "row") = 2.86;
 Shock tms("mac", "tur", "row") = -7.87;
 Shock tms("ele", "tur", "row") = 0.82;
 Shock txs("for", "ase", "tur") = 0.18;
 Shock txs("col", "ase", "tur") = -1.14;
 Shock txs("o_g", "ase", "tur") = -2.54;
 Shock txs("min", "ase", "tur") = -0.31;
 Shock txs("tex", "ase", "tur") = -4.96;
 Shock txs("fer", "ase", "tur") = 0.53;

Shock txs("mac", "ase", "tur") = -1.45;
 Shock txs("ser", "ase", "tur") = 0.29;
 Shock txs("o_g", "usa", "tur") = 0.01;
 Shock txs("min", "usa", "tur") = -0.06;
 Shock txs("fer", "usa", "tur") = 0.41;
 Shock txs("ele", "usa", "tur") = -6.00;
 Shock txs("ser", "usa", "tur") = 3.46;
 Shock txs("for", "eft", "tur") = -0.15;
 Shock txs("o_g", "eft", "tur") = 0.36;
 Shock txs("min", "eft", "tur") = -0.03;
 Shock txs("tex", "eft", "tur") = -0.02;
 Shock txs("fer", "eft", "tur") = -0.06;
 Shock txs("mac", "eft", "tur") = -0.04;
 Shock txs("ser", "eft", "tur") = -0.04;
 Shock txs("for", "fsu", "tur") = -1.41;
 Shock txs("o_g", "fsu", "tur") = -1.03;
 Shock txs("ele", "fsu", "tur") = 1.00;
 Shock txs("ser", "fsu", "tur") = -0.80;
 Shock txs("for", "row", "tur") = 0.69;
 Shock txs("o_g", "row", "tur") = -1.33;
 Shock txs("min", "row", "tur") = 0.22;
 Shock txs("tex", "row", "tur") = -1.94;
 Shock txs("fer", "row", "tur") = 0.25;
 Shock txs("ser", "row", "tur") = 0.18;

APPENDIX D: SHOCKS PERFORMED UNDER THE SECOND SIMULATION (BASE SCENARIO)

Shock tms("for", "eun", "fsu") = -9.91 - change in power of import tariff on forestry delivered from the EU to FSU, levied in FSU

Shock txs("agr", "fsu", "eun") = 1.83 - change in the power of export tariff on electricity delivered from FSU to the EU, levied in FSU

!Sim2d: FSU joins the EU (AA, -agr)!

!FSU eliminates tariffs in itself!

Shock tms("for", "fsu", "fsu") = -12.05;

Shock tms("col", "fsu", "fsu") = -4.76;

Shock tms("o_g", "fsu", "fsu") = -4.79;

Shock tms("min", "fsu", "fsu") = -9.80;

Shock tms("tex", "fsu", "fsu") = -12.90;

Shock tms("fer", "fsu", "fsu") = -11.42;

Shock tms("mac", "fsu", "fsu") = -8.98;

Shock tms("ele", "fsu", "fsu") = -3.66;

Shock tms("ser", "fsu", "fsu") = -1.75;

Shock txs("for", "fsu", "fsu") = 0.58;

Shock txs("col", "fsu", "fsu") = 1.05;

Shock txs("o_g", "fsu", "fsu") = 3.18;

Shock txs("min", "fsu", "fsu") = 0.32;

Shock txs("tex", "fsu", "fsu") = 0.18;

Shock txs("fer", "fsu", "fsu") = 0.19;

Shock txs("mac", "fsu", "fsu") = 0.25;

Shock txs("ele", "fsu", "fsu") = -0.72;

Shock txs("ser", "fsu", "fsu") = 1.05;

!The EU eliminates bilateral tariffs with FSU!

Shock tms("for", "fsu", "eun") = -1.25;

Shock tms("col", "fsu", "eun") = -0.50;

Shock tms("o_g", "fsu", "eun") = -0.20;

Shock tms("min", "fsu", "eun") = -3.85;

Shock tms("tex", "fsu", "eun") = -7.37;

Shock tms("fer", "fsu", "eun") = -2.12;

Shock tms("mac", "fsu", "eun") = -4.42;

Shock tms("ele", "fsu", "eun") = -0.10;

Shock tms("ser", "fsu", "eun") = -0.03;

Shock txs("for", "eun", "fsu") = 0.38;

Shock txs("col", "eun", "fsu") = 1.04;

Shock txs("o_g", "eun", "fsu") = 0.53;

Shock txs("min", "eun", "fsu") = 0.45;

Shock txs("tex", "eun", "fsu") = 0.52;

Shock txs("fer", "eun", "fsu") = 0.37;

Shock txs("mac", "eun", "fsu") = 0.31;

Shock txs("ser", "eun", "fsu") = 0.78;

!FSU eliminates bilateral tariffs with the EU!

Shock tms("for", "eun", "fsu") = -9.91;

Shock tms("col", "eun", "fsu") = -4.61;

Shock tms("o_g", "eun", "fsu") = -4.77;

Shock tms("min", "eun", "fsu") = -9.49;

Shock tms("tex", "eun", "fsu") = -12.47;

Shock tms("fer", "eun", "fsu") = -10.86;

Shock tms("mac", "eun", "fsu") = -7.79;

Shock tms("ele", "eun", "fsu") = -3.66;

Shock tms("ser", "eun", "fsu") = -1.74;

Shock txs("for", "fsu", "eun") = 1.54;

Shock txs("col", "fsu", "eun") = 1.05;

Shock txs("o_g", "fsu", "eun") = 2.85;

Shock txs("min", "fsu", "eun") = 0.37;

Shock txs("tex", "fsu", "eun") = 0.15;

Shock txs("fer", "fsu", "eun") = 0.25;

Shock txs("mac", "fsu", "eun") = 0.27;

Shock txs("ele", "fsu", "eun") = -0.72;

Shock txs("ser", "fsu", "eun") = 0.61;

!FSU eliminates bilateral tariffs with CEEC!

Shock tms("for", "cea", "fsu") = -9.91;

Shock tms("col", "cea", "fsu") = -4.76;

Shock tms("o_g", "cea", "fsu") = -4.77;

Shock tms("min", "cea", "fsu") = -9.91;

Shock tms("tex", "cea", "fsu") = -12.28;

Shock tms("fer", "cea", "fsu") = -10.71;

Shock tms("mac", "cea", "fsu") = -8.25;

Shock tms("ser", "cea", "fsu") = -1.96;

Shock txs("for", "fsu", "cea") = 2.04;

Shock txs("col", "fsu", "cea") = 1.05;

Shock txs("o_g", "fsu", "cea") = 3.09;

Shock txs("min", "fsu", "cea") = 0.41;

Shock txs("tex", "fsu", "cea") = 0.19;

Shock txs("fer", "fsu", "cea") = 0.23;

Shock txs("mac", "fsu", "cea") = 0.31;

Shock txs("ele", "fsu", "cea") = -0.72;

Shock txs("ser", "fsu", "cea") = 0.75;

!CEEC eliminate bilateral tariffs with FSU!

Shock tms("for", "fsu", "cea") = -0.99;

Shock tms("col", "fsu", "cea") = -0.99;

Shock tms("min", "fsu", "cea") = -3.85;

Shock tms("tex", "fsu", "cea") = -7.41;

Shock tms("fer", "fsu", "cea") = -1.96;

Shock tms("mac", "fsu", "cea") = -4.77;

Shock txs("col", "cea", "fsu") = 1.01;

Shock txs("o_g", "cea", "fsu") = 1.01;

Shock txs("min", "cea", "fsu") = 1.01;

Shock txs("tex", "cea", "fsu") = 1.01;

Shock txs("ser", "cea", "fsu") = 1.01;

!FSU eliminates bilateral tariffs with Turkey!

Shock tms("for", "tur", "fsu") = -9.91;

Shock tms("o_g", "tur", "fsu") = -4.77;

Shock tms("min", "tur", "fsu") = -9.91;

Shock tms("tex", "tur", "fsu") = -12.28;

Shock tms("fer", "tur", "fsu") = -10.72;

Shock tms("mac", "tur", "fsu") = -8.26;

Shock tms("ser", "tur", "fsu") = -1.72;

Shock txs("for", "fsu", "tur") = 2.04;

Shock txs("col", "fsu", "tur") = 1.05;
Shock txs("o_g", "fsu", "tur") = 3.10;
Shock txs("min", "fsu", "tur") = 0.34;
Shock txs("tex", "fsu", "tur") = 0.18;
Shock txs("fer", "fsu", "tur") = 0.19;
Shock txs("mac", "fsu", "tur") = 0.49;
Shock txs("ser", "fsu", "tur") = 1.01;
!Turkey eliminates bilateral tariffs with FSU!
Shock tms("for", "fsu", "tur") = -0.99;
Shock tms("col", "fsu", "tur") = -0.99;
Shock tms("min", "fsu", "tur") = -3.85;
Shock tms("tex", "fsu", "tur") = -7.41;
Shock tms("fer", "fsu", "tur") = -1.96;
Shock tms("mac", "fsu", "tur") = -4.76;
Shock txs("o_g", "tur", "fsu") = 1.01;
Shock txs("min", "tur", "fsu") = 1.01;
Shock txs("tex", "tur", "fsu") = 1.01;
Shock txs("ser", "tur", "fsu") = 1.01;
!FSU adjusts its import tax rates to the EU level!
Shock tms("for", "ase", "fsu") = -10.72;
Shock tms("col", "ase", "fsu") = -3.81;
Shock tms("o_g", "ase", "fsu") = -3.82;
Shock tms("min", "ase", "fsu") = -8.12;
Shock tms("tex", "ase", "fsu") = -7.82;
Shock tms("fer", "ase", "fsu") = -10.83;
Shock tms("mac", "ase", "fsu") = -8.67;
Shock tms("ser", "ase", "fsu") = -1.80;
Shock tms("for", "usa", "fsu") = -10.58;
Shock tms("col", "usa", "fsu") = -4.76;
Shock tms("o_g", "usa", "fsu") = -6.57;
Shock tms("min", "usa", "fsu") = -5.66;
Shock tms("tex", "usa", "fsu") = -7.45;
Shock tms("fer", "usa", "fsu") = -16.58;
Shock tms("mac", "usa", "fsu") = -5.96;
Shock tms("ser", "usa", "fsu") = -1.80;
Shock tms("for", "eft", "fsu") = -12.43;
Shock tms("o_g", "eft", "fsu") = -7.24;
Shock tms("min", "eft", "fsu") = -7.36;
Shock tms("tex", "eft", "fsu") = -13.14;
Shock tms("fer", "eft", "fsu") = -13.05;
Shock tms("mac", "eft", "fsu") = -9.46;
Shock tms("ser", "eft", "fsu") = -1.63;
Shock tms("for", "row", "fsu") = -10.47;
Shock tms("col", "row", "fsu") = -3.81;
Shock tms("o_g", "row", "fsu") = -5.23;
Shock tms("min", "row", "fsu") = -9.46;
Shock tms("tex", "row", "fsu") = -7.79;
Shock tms("fer", "row", "fsu") = -11.03;
Shock tms("mac", "row", "fsu") = -5.36;
Shock tms("ser", "row", "fsu") = -1.52;
!FSU adjusts its export tax rates to the EU level!
Shock txs("for", "fsu", "ase") = 3.06;
Shock txs("col", "fsu", "ase") = 0.04;
Shock txs("o_g", "fsu", "ase") = 4.05;
Shock txs("tex", "fsu", "ase") = -0.80;
Shock txs("ele", "fsu", "ase") = -0.72;
Shock txs("col", "fsu", "usa") = -1.00;
Shock txs("o_g", "fsu", "usa") = 3.60;
Shock txs("tex", "fsu", "usa") = -0.88;
Shock txs("for", "fsu", "eft") = 3.04;
Shock txs("col", "fsu", "eft") = 1.05;
Shock txs("o_g", "fsu", "eft") = 2.54;
Shock txs("min", "fsu", "eft") = 0.36;
Shock txs("tex", "fsu", "eft") = 0.13;
Shock txs("fer", "fsu", "eft") = 0.29;
Shock txs("mac", "fsu", "eft") = 0.34;
Shock txs("ele", "fsu", "eft") = -0.72;
Shock txs("ser", "fsu", "eft") = 0.39;
Shock txs("col", "fsu", "row") = 0.04;
Shock txs("o_g", "fsu", "row") = 1.60;
Shock txs("tex", "fsu", "row") = -0.82;
Shock txs("ele", "fsu", "row") = -1.00;
!Third countries adjust bilateral tariffs with FSU to the EU level!
Shock tms("for", "fsu", "ase") = 4.12;
Shock tms("col", "fsu", "ase") = 1.46;
Shock tms("o_g", "fsu", "ase") = 11.84;
Shock tms("min", "fsu", "ase") = 0.96;
Shock tms("tex", "fsu", "ase") = 2.01;
Shock tms("fer", "fsu", "ase") = 1.57;
Shock tms("mac", "fsu", "ase") = -2.23;
Shock tms("ele", "fsu", "ase") = -0.97;
Shock tms("ser", "fsu", "ase") = -1.16;
Shock tms("for", "fsu", "usa") = 1.32;
Shock tms("min", "fsu", "usa") = 3.61;
Shock tms("tex", "fsu", "usa") = -2.38;
Shock tms("fer", "fsu", "usa") = 2.34;
Shock tms("mac", "fsu", "usa") = 2.29;
Shock tms("for", "fsu", "eft") = -1.52;
Shock tms("col", "fsu", "eft") = -0.30;
Shock tms("o_g", "fsu", "eft") = -1.94;
Shock tms("min", "fsu", "eft") = -0.83;
Shock tms("tex", "fsu", "eft") = -9.98;
Shock tms("fer", "fsu", "eft") = -1.80;
Shock tms("mac", "fsu", "eft") = -3.82;
Shock tms("ser", "fsu", "eft") = -0.05;
Shock tms("for", "fsu", "row") = -4.38;
Shock tms("col", "fsu", "row") = -5.82;
Shock tms("o_g", "fsu", "row") = 1.11;
Shock tms("min", "fsu", "row") = -7.80;
Shock tms("tex", "fsu", "row") = -14.04;
Shock tms("fer", "fsu", "row") = -1.04;
Shock tms("mac", "fsu", "row") = -8.68;
Shock tms("ele", "fsu", "row") = 1.00;
Shock txs("for", "ase", "fsu") = -1.24;
Shock txs("col", "ase", "fsu") = -1.38;
Shock txs("o_g", "ase", "fsu") = -1.49;
Shock txs("min", "ase", "fsu") = -0.95;
Shock txs("tex", "ase", "fsu") = -4.75;
Shock txs("fer", "ase", "fsu") = 0.13;
Shock txs("mac", "ase", "fsu") = -1.24;
Shock txs("ser", "ase", "fsu") = -0.66;
Shock txs("fer", "usa", "fsu") = 0.33;
Shock txs("ele", "usa", "fsu") = -6.00;
Shock txs("ser", "usa", "fsu") = 1.97;
Shock txs("for", "eft", "fsu") = -0.10;
Shock txs("o_g", "eft", "fsu") = 0.36;
Shock txs("min", "eft", "fsu") = -0.03;
Shock txs("tex", "eft", "fsu") = -0.02;
Shock txs("fer", "eft", "fsu") = -0.03;

Shock txs("mac", "eft", "fsu") = -0.04;
Shock txs("ser", "eft", "fsu") = -0.03;
Shock txs("for", "row", "fsu") = -1.73;
Shock txs("col", "row", "fsu") = 1.24;
Shock txs("o_g", "row", "fsu") = 1.89;

Shock txs("tex", "row", "fsu") = -1.44;
Shock txs("fer", "row", "fsu") = 0.19;
Shock txs("ser", "row", "fsu") = -0.37;

APPENDIX E: TRADE DATA USED FOR CALCULATIONS

Two sources of trade data used in this work are IMF (1998) and Pakhomov *et al* (1997). IMF data (Table E1) is used to calculate Ukraine's share in FSU's exports and imports.

Table E1. Exports and imports of FSU countries, millions of US\$

Country	Exports, fob	Imports, cif
Armenia	357	696
Azerbaijan	544	666
Belarus	4641	5505
Estonia	1840	2546
Georgia	151	392
Kazakhstan	5250	3807
Kyrgyz Rep.	483	392
Latvia	1284	1646
Lithuania	2706	3649
Moldova	739	841
Russia	81096	60945
Tajikistan	749	810
Turkmenistan	1881	1364
Ukraine	13317	16052
Uzbekistan	2708	3030
FSU	117746	102341
Ukraine, share of FSU	0.11	0.16

Source: IMF (1998) and calculations of the author.

Pakhomov *et al* (1997) data is used to calculate percentage structure of Ukrainian exports and imports. The original data and calculations are presented in Table E2.

Table E2. The structure of Ukrainian exports and imports, millions of US\$

Sector	Export, value	Export, share	Import, value	Import, share
1 Agriculture	2823	0.18	1190	0.07
2 Forestry	150	0.01	490	0.03
3 Coal	72	0.00	560	0.03
4 Oil & gas	176	0.01	6731	0.41
5 Minerals	2125	0.14	1600	0.10
6 Textiles	389	0.03	572	0.03
7 Metals	4620	0.30	777	0.05
8 Machinery	2285	0.15	3394	0.21
9 Electricity	91	0.01	0	0.00
10 Services	2559	0.17	1179	0.07
Total	15289	1	16492	1

The next table shows calculation of adjusted trade flows for Ukraine. It uses only relative relationships among different sectors. The table is composed as follows. Numbers for FSU are taken from GTAP, exports and imports at market prices (MP).

Table E3. Calculating adjusted trade flows for Ukraine, millions of US\$

Sector	GTAP, FSU		Ukraine, GTAP adjusted	
	Export, MP	Import, MP	Export	Import
1 Agriculture	7543	16735	1852	958
2 Forestry	4918	3650	98	394
3 Coal	955	438	47	451
4 Oil & gas	16621	1190	116	5417
5 Minerals	12716	8108	1394	1288
6 Textiles	2688	7290	255	460
7 Metals	23715	2728	3031	625
8 Machinery	3795	22851	1499	2732
9 Electricity	279	130	60	0
10 Services	15451	21507	1679	949
Total	88682	84628	10030	13274

Then the numbers for total adjusted export and import for Ukraine are calculated using shares from Table E1, i.e. $10,030 = 0.11 * 88,682$. Finally, the value of each sector's export and import is computed by applying weights from Table E2 to just calculated total values. For example, adjusted export of agriculture by Ukraine is computed by multiplying weight from Table E2 – 0.18 – by adjusted total exports – 10,030. The result – 1852 – is put down to the forth column of Table E3.

Further, Ukrainian adjusted exports are divided by FSU exports from Table E3 and the same is done for imports. Also, sum of Ukraine's exports and imports is divided by sum of FSU's exports and imports to get weighting coefficient for EV due to change in world prices. Computed weights are put down into Table E4 and resemble Table 6 in the body of the thesis.

Table E4. Share of Ukraine's trade in FSU's trade

Sector	Export and import	Export	Import
1 Agriculture	0.12	0.25	0.06
2 Forestry	0.06	0.02	0.11
3 Coal	0.35	0.05	1.00
4 Oil & gas	0.07	0.01	1.00
5 Minerals	0.13	0.11	0.16
6 Textiles	0.07	0.09	0.06
7 Metals	0.14	0.13	0.23
8 Machinery	0.16	0.39	0.12
9 Electricity	0.15	0.21	0.00
10 Services	0.07	0.11	0.04

APPENDIX F: GDP DATA USED FOR CALCULATIONS

For disaggregating non-trade allocation effects is used the weighting coefficient computed from table below. Input data are from the World Bank (2001).

GDP at market prices (current \$US millions), 1995	
Armenia	2887
Azerbaijan	2894
Belarus	20071
Estonia	4789
Georgia	1900
Kazakhstan	19925
Kyrgyz Rep.	3325
Latvia	4904
Lithuania	6445
Moldova	3093
Russia	337902
Tajikistan	1827
Turkmenistan	4505
Ukraine	49061
Uzbekistan	16294
FSU	479822
Ukraine, share	0.1022

Source: World Bank (2001) and author's calculations.