UKRAINE'S WTO ACCESSION: IMPACT ON UKRAINIAN SUNFLOWER OIL SECTOR

by

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Abstract

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In the paper Ukraine's World Trade Organisation (WTO) accession impact on Ukrainian sunflower oil industry is analysed through the mechanism of sunflower seed export duty decrease as a precondition of the country WTO membership. The expected relationship is as follows: due to lower sunflower seed export duty export and production of sunflower oil should decrease. The thesis gives us qualitative and quantitative confirmation of the prediction. Data used in the research cover the period from October, 1998 to September, 2004. Because of endogenous variables in the right-hand side of equations appearance estimations are done using Simultaneous-Equation Model. The results indicate on not too harmful influence of the sunflower seed export duty decrease on domestic sunflower oil producers and exporters. Furthermore, such measure is needed not only as WTO accession precondition, but also as competition and higher efficiency stimuli for sunflower oil market.

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GLOSSARY

CGE Computable General Equilibrium

GATT General Agreement on Tariffs and Trade

GE General Equilibrium

ILS Indirect Least Squares

MMT Million Metric Tons

MT Metric Ton

MY Marketing year

OLS Ordinary Least Squares

SEM Simultaneous-Equation model

WTO World Trade Organisation

2SLS Two-Stage Least Squares

3SLS Tree-Stage Least Squares

Chapter 1

INTRODUCTION

The main principle of WTO is fair competition in both domestic and foreign markets. Developing countries' WTO accession is usually accompanied by its foreign trade liberalization. Results of these changes are hardly predictable because of the ambiguous impact on different countries dependent on time horizon. Gains of WTO membership for international trade have already been widely discussed (Rose, 2002; Subramanian, Wei, 2003; Ivus, 2004), hence, it becomes more important to evaluate possible implication for a specific country or even for a particular sector or a sub sector of a certain country economy. Ukraine's WTO accession and its possible implications on foreign trade, industrial and other key sectors have been analysed in several studies, but an analysis of its influence on certain products markets in agricultural sector has not been done yet.

Since Ukraine has a fairy high agricultural potential and a high intensity of production (in the 90s Ukraine produced just as much food per capita as each of the most advanced countries of the world) and 13-14% of Ukrainian exports is agricultural output which is quite high compared to WTO members (Luzan, 2003), a focus of this paper is the impact on agricultural performance of Ukraine's WTO accession. Historically, Ukraine is a net exporter of agro-food products. The structure and quantities of the agro-food export have been changed significantly since 1991. One of the dominant Ukrainian exported agro-food products is sunflower oil. It was the third-large component of the agro-food exports in 2001 (12%), after cereals (27%) and milk products (15%) (OECD, 2004). Relatively high weight in the export structure and vulnerability to changes in the economic policy in agriculture, as a precondition for the WTO membership, make it important to estimate its possible implications for the sunflower oil industry. In general, due to the main WTO principle government support of agricultural sector in a sense of protectionism and production stimulation and also measures of domestic agricultural sector defence should be gradually reduced. In particular, WTO accession will mean almost absence of producers and consumers supports and diminishing of import tariffs on sunflower oil and export duties on oil seeds. Logically, these measures should lead to decrease of sunflower oil exports and, consequently, production. In this paper I will try to estimate empirically whether the outcome will be as predicted. Results of the study will qualitative and quantitative answer the question.

Such analysis might be helpful for policy-makers when they analyze conditions and terms of the WTO accession for agriculture sector of Ukrainian economy and negotiate on the scales and time horizons of changes introduction.

The structure of the research is as follows. After the introduction related literature is described and analysed in Chapter 2. Description of Ukrainian sunflower oil industry is depicted in Chapter 3. Methodology is provided in Chapter 4. Data description follows the methodology in Chapter 5. Empirical results are given in Chapter 6 and conclusions follow in Chapter 7.

Chapter 2

LITERATURE REVIEW

In general, WTO promotes trade-compatible policy. Several authors have investigated whether the WTO really increases trade. Estimating the impact of the membership in the GAAT/WTO on the international trade Rose (2002) used "standard gravity" model of bilateral merchandise trade and a large panel data set covering over fifty years and 175 countries. The author concluded that membership in the GATT/WTO on average have not promoted foreign trade. This result was criticized based on two, economic and econometric, grounds (Subramanian, Wei, 2003). Economic incompleteness appeared because of need to include asymmetries of WTO impact on developed versus developing countries, new versus old developing countries members and protected versus liberalized sectors in developed countries. Econometric incorrectness appeared because of non-including country fixed effects in a gravity equation (Anderson, Wincoop, 2003). Taking into account these modifications Subramanian and Wei (2003) have used "updated" gravity model to estimate the WTO impact on trade. Their conclusion was the opposite of Rose's: WTO has positively, strongly but unevenly influenced trade. Mainly, the impact is different, but positive, between industrial and developing countries and between sectors.

Among other approaches of modeling an impact of WTO negotiations on trade flows quantitative models (multi-regional general equilibrium (GE) model, GE model for individual countries, partial equilibrium and microsimulation model) are often used (Klepper et al., 2003). Depending on the object of an analysis, an appropriate modification is chosen. For example, multi-regional models might simulate the interaction between national economies; partial equilibrium models are useful for analysis of the impact of trade policy on individual sectors or markets.

While assessing possible implications of China's WTO accession computable GE (CGE) models were widely applied both at the national level (Gilbert and Wahl, 2002) and at the regional level (Diao et al., 2003). The latter researchers concentrated on asymmetric influence of China's WTO accession on rural and urban incomes and whether its will result in contraction or widening of regional income gap. Nevertheless an overall impact is positive, the authors estimated, using CGE model, that less developed Chinese regions will be hurt, while most developed will benefit from WTO membership.

Nowadays Ukraine's accession to the WTO is a very popular topic in Ukrainian newspapers, economic journals, publication. But modeling in this sphere seems to be a rare thing. Nevertheless, gravity model with some deviations have been used while analyzing losses from trade barriers and potential level of Ukrainian export, using data on 85 trade partners of Ukraine for the period 2000-2001 (Dean et al., 2003). The result indicates on more than double level of Ukrainian export compared to predicted by gravity model one and non-expected positive effect of trade barriers on Ukrainian foreign trade. The particularity of Ukrainian trade partners is assumed by the authors to be an explanation of this mystery.

Using gravity model for evaluating the impact of the previous EU enlargements on the import flows from the excluded developing countries and the impact of EU Eastern expansion on Ukrainian patterns of trade, results indicate positive effect on trade patterns on an average developing country for the period of 1958-2000 (Ivus, 2004). The conclusion acknowledges truthfulness of widespread idea that integration (like WTO membership) promotes foreign trade even for developing countries and non-members of unions or organizations.

CGE model has been used to evaluate reduction of import tariffs in Ukraine at aggregate level (Kosse, 2002). Results were similar to the Chinese case. Considering that import tariff reduction is one of the most important conditions of Ukraine's WTO membership, the author estimated that meeting the requirement of a decrease in tariff to the average level of no more than 14% will be beneficial for Ukraine at the national level. Furthermore, bigger import tariff reduction results in lower marginal excess burden of import tariffs and, hence, causes an increase in welfare.

Estimation of an impact of tariffs and non-tariff barriers on Ukrainian import using panel data for the period from 1996 to 2000 showed that for almost all industries, except for leather footwear, and paper and paper products, diminishing of tariffs and non-tariff barriers will not result in increase of import. Therefore, the WTO membership should not lead to considerable import enlargement and, consequently, displacement of domestic products (Movchan, 2004).

Analysis of losses due to protection of Ukrainian sunflower industry has been made using a partial equilibrium approach (Shulha, 2003). The author employed a simultaneous equation model for the estimation of the internal demand and supply, import demand and export supply elasticities. The sum of production distortions, consumption distortions less the terms-of-trade effect equal the loss of economic efficiency associated with the export tax. Received estimations show that in case of Ukrainian sunflower seed industry the country's welfare might be increase if seasonal optimal taxes were implemented instead of existed ones.

Chapter 3

DESCRIPTION OF UKRAINIAN SUNFLOWER OIL INDUSTRY

Production

Sunflower oil production has been fluctuating much since 1990. Its decrease in middle 90s (from 0.92 million ton [MMT] in 1992/93 marketing year [MY][1] to 0.45 MMT in 1996/97 MY) might be explained by low processing efficiency, producers' difficulties in receiving credits to pay for sunflower seeds and high attractiveness of sunflower seed export. After introduction of 23% export duty on sunflower seed in October, 1999 sunflower oil producers' activity recovered. But possibility of sunflower seed export as an intermediate raw material has dampened the recovery. Lowering the export duty to 17%[2] and abandoning of sunflower seed processing abroad as intermediate raw material have become more effective measure for decrease of sunflower seed export and, as result, domestic sunflower oil producers started intensively develop capacities.

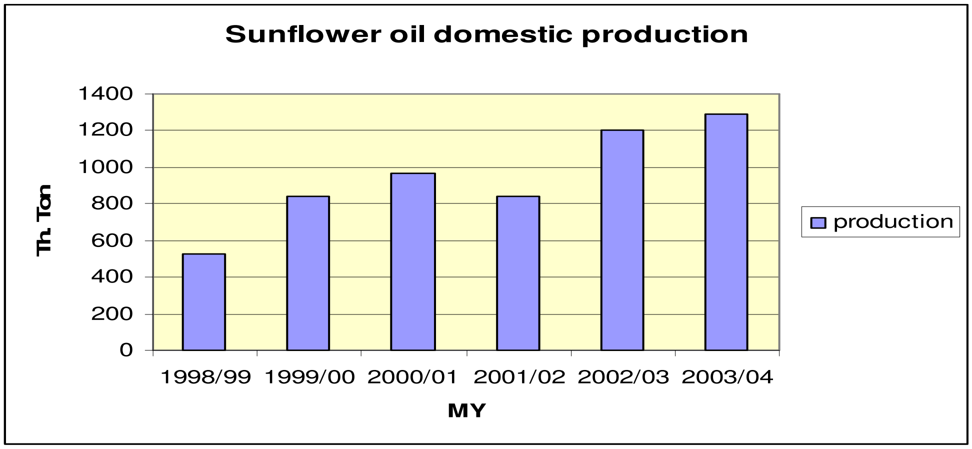
The volume of sunflower oil produced in 2003/2004 reached it maximum level for the last decade at about 1.3 MMT. Ukraine is the 3rd largest world sunflower oil producer after Argentina and Russia (Plastun, Osypenko, 2004).

Sunflower oil production dynamic for the last six marketing years is shown on the Figure 3.1. Production of sunflower oil gradually increased from 1998/99 MY to 2003/04 MY. 2001/02 MY production reduction is explained by bad sunflower seed harvest in 2001 (FAO/EBRD, 2002).

1 Marketing year, in this case, starts in October and ends in September.

2 For comparison: sunflower seed export duty in Argentina is 23.5%, in Russia – 20% (Zorka, 2003).

Figure 1: Ukrainian Sunflower Oil Production 1998/99 – 2003/04 MY



Data source: www.fas.usda.gov/psd/psdreport.asp

Seasonality is the main feature of Ukrainian sunflower oil production. There are usually production peaks in latter autumn and winter, while to the end of marketing year production level often decreases dramatically (Appendix A, Figure A.1).

Capacity of oilseed crushing industry in Ukraine now is estimated at 3.9 MMT per year level. There are about 200 refinery enterprises in Ukraine, 19 largest of them are members of the Association of Ukrainian Sunflower Seed Crushers UkrOliyaProm, producing about 85% of total vegetable oil production. The rest is produced by small enterprises.

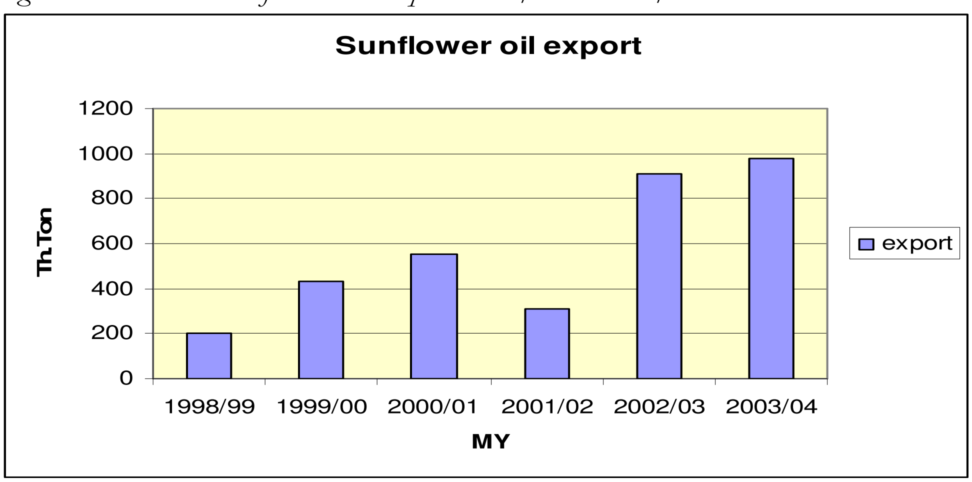
Average crushing costs in Ukraine has fallen since 1990s, reaching 20-40 USD/Ton in 2001/02, which is near Western European efficiency levels (FAO/EBRD, 2002). In general, current situation in sunflower oil refinery industry is characterized by huge achievements in efficiency, quantity and quality levels compared with 1990s. This raises a question about rationality of sunflower seed export duty, which nowadays became not a measure of domestic sunflower oil producers' defence, but a gift for efficient domestic crushers in a form of excess profits (Kuhn, Nivyevs'kiy, 2005).

Export

About 50% of Ukrainian sunflower oil production is exported to about 40 countries nowadays. Russia (about 25% of export), EU, Southern Europe, North Africa are among its main export markets. (FAO/EBRD, 2002). Crude sunflower seed oil is the basic exported product.

Sunflower seed export was crowded out by sunflower oil export during last several years. This has happened mainly because of sunflower export duty introduction. The agricultural export structure has been substantially changed: sunflower seed part of overall agricultural export was 10.5% and sunflower oil share was 1.8% in 1999, while in 2003 their portions became 9.6 and 20.5% respectively (Plastun, Osypenko, 2004). The dynamic of Ukrainian sunflower oil export for 1998/99 – 2003/04 MY is shown at the Figure 2.

Figure 2: Ukrainian Sunflower Oil Export 1998/99 – 2003/04 MY



Data source: www.fas.usda.gov/psd/psdreport.asp

Ukrainian sunflower oil export prices are approximately by 10% lower than European ones. That is the main reason of Ukrainian part in the world export market significant increase during last several years (Vlasenko, 2003). Ukraine is a main sunflower oil exporter now, having pushed off Argentina from the leader position. Ukrainian sunflower oil is characterized by the highest comparative advantage after sunflower seed and, therefore, is one of the most competitive products on the world market. The weight of Ukrainian sunflower oil export in a world volume is more than 40% now (Plastun, 2003).

Seasonal particularity of Ukrainian sunflower oil export is not as legible as in production case, but could be observed (Appendix A, Figure A.2).

Import

Sunflower oil import levels are almost equal to zero, because of more than enough domestic production and high import duty (in average EUR 800/ton [www.ukroliya.kiev.ua]) (Table 3.1). Furthermore, the whole Ukrainian agricultural market is import soundproof because of the next factors: high transportation costs of imported products; receiving and distribution of huge consignments of imported agricultural goods structure absence in regions; relatively low consumers' purchasing power; traditional Ukrainian tastes.

Consumption

Sunflower oil consumption in Ukraine has increased gradually during last several years because of higher vegetable oil consumption tendency both by households and by oil processing enterprises. Household sunflower oil consumption is relatively smoothed, because of particularity of the product. Slight domestic demand decline during last two years (Table 3.1, Figure 3.3) might be explained by increasing popularity of corn, olive and other oils-substitutes. While, in general, sunflower oil consumption is traditionally constant.

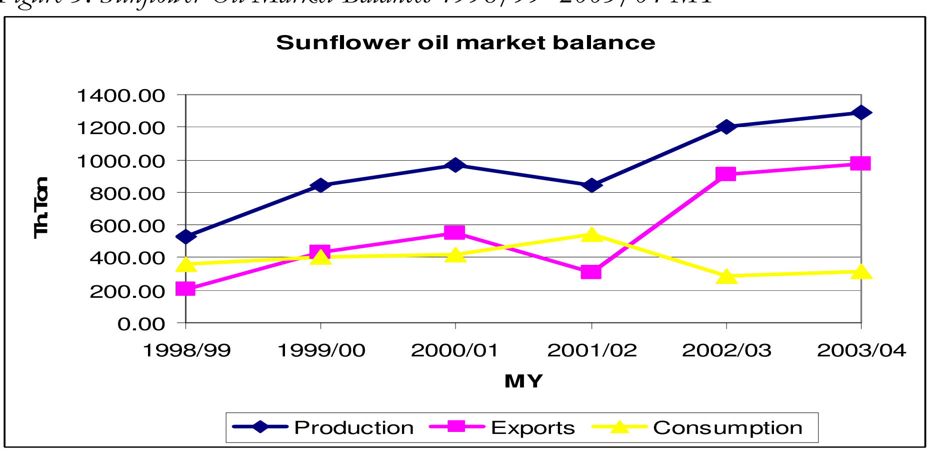
Average annual sunflower oil consumption per person in Ukraine was 12.3 kg in 2003, while in the world – 14.3 kg. (Zorka, 2003). Recommended consumption level for one person is equal 13 kg per year. About ¾ of domestically consumed vegetable oil is sunflower oil. Domestic market capacity is estimated at 500-550 Th.Ton per year.

Table 3.1: Sunflower Oil Balances in Ukraine 1998/99 – 2003/04 MY

Th. Ton	**1998/ 1999**	**1999/ 2000**	**2000/ 2001**	**2001/ 2002**	**2002/ 2003**	**2003/ 2004**	**2004/ 2005**
Crush	1,300	2,100	2,330	2,057	2,800	3,150	2,870
Beginning Stocks	9	7	12	15	10	19	20
Production	**530**	**840**	**970**	**842**	**1,200**	**1,290**	**1,168**
Imports	30	0	0	0	6	4	0
TOTAL SUPPLY	569	847	982	857	1,216	1,313	1,188
Exports	**205**	**430**	**550**	**308**	**911**	**978**	**785**
Industrial Dom. Consum	10	10	10	10	10	10	10
Food Use Dom. Consump.	345	380	400	524	276	305	373
Other uses	2	15	7	5	0	0	0
TOTAL Dom. Consump.	**357**	**405**	**417**	**539**	**286**	**315**	**383**
Ending Stocks	7	12	15	10	19	20	20

Source: www.fas.usda.gov/psd/psdreport.asp

Figure 3: Sunflower Oil Market Balances 1998/99–2003/04 MY



Data source: www.fas.usda.gov/psd/psdreport.asp

Chapter 4

METHODOLOGY

If there is only one-sided relation between endogenous (Y) and exogenous (X) variables, or the assumption about absence of correlation between right-hand side variables and error terms holds, then the Ordinary Least Squares (OLS) method is used to estimate regression parameters. But, if the condition is not satisfied, then one assumption of classical regression analysis does not hold ($COV(X,\varepsilon) \neq 0$). Therefore, OLS method gives biased and inconsistent estimators. The problem might be solved by transfer from one equation to the system of equations which describes the whole structure of interdependence between the variables. Such system is called Simultaneous-Equation model (SEM). It contains endogenous variable on the left-hand side and contains endogenous as well as predetermined variables on the right-hand side. The most popular methods of SEM estimation are:

1. Indirect Least Squares Method (ILS).

2. Two-Stage Least Squares Method (2SLS).

3. Three-Stage Least Squares Method (3SLS).

First two methods are from the category of one equation method, as they might be used for every separate equation; while the third one is called system method, as it is used to all equations of the system simultaneously.

As a rule, SEM identification gives us an answer to the question which estimation method to choose. If just one equation of the system is underidentified, then the whole system is underidentified and does not have solution. Identified model might be exactly identified, if all equations in the system are exactly identified, or overidentified, if at least one equation in the system is overidentified. Special rules for SEM identification will be given in more details latter.

The easiest method for exactly identified SEM estimation is ILS, while all other methods can also be used. The most popular methods of overidentified SEM estimation are 2SLS and 3SLS (Lukyanenko, Gorodnichenko, 2002).

SEM was chosen for the analysis of interdependence between Ukrainian sunflower seed export duty and sunflower oil production and export because of endogenous variables appearance in the right-hand side of equations. Consequently, simple OLS method gives in this case inconsistent and biased estimates.

Model specification

DD = DD (WAGE(+) ,DOM_PRICE (-), DD(-1) (+)) (1)

DS = DS (PROD_SEED(+), DOM_PRICE (+), WORLD_PRICE(-), X(-1) (+), SEED_X_DUTY(+), DUMMY_UP(+), DUMMY_DOWN(-)) (2)

X = X (WORLD_PRICE(+), DOM_PRICE (-), SEED_X_DUTY(+), SEED_DAV_ALLOW(-), DD(-1) (-), X(-1) (+), DUM_X_UP(+), DUM_X_DOWN(-)) (3)

DD = DS – X + A Identity (4)

Where:

Signs in parentheses (+/-) indicate expected sign of relation between variables (positive/negative),

DD = domestic demand (consumption) of sunflower oil (Thd. Ton),

WAGE = domestic average wage (UAH per month),

DOM_PRICE = domestic price of sunflower oil (UAH/Ton),

DD(-1) = domestic demand (consumption) of sunflower oil in previous period (Thd. Ton),

DS = domestic supply (production) of sunflower oil (Thd. Ton),

PROD_SEED = domestic supply (production) of sunflower seeds (Thd. Ton),

WORLD_PRICE = world sunflower oil price (USD/Ton),

X(-1) = sunflower oil export in previous period (Thd. Ton),

SEED_X_DUTY = sunflower seed export duty (%),

DUMMY_UP = dummy for seasonal production increase,

DUMMY_DOWN = dummy for seasonal production decrease,

X = sunflower oil export (Thd. Ton),

SEED_DAV_ALLOW = dummy for allowing of operations of goods made on commission (tolling scheme allowance),

DUM_X_UP = dummy for seasonal export increase,

DUM_X_DOWN = dummy for seasonal export decrease,

A = discrepancy = (Import (≈0) + Beginning Stocks - Ending Stocks) is used as an auxiliary variable.

Endogenous variables are: DD, DS, X, A.

Exogenous variables are: WAGE, DOM_PRICE, WORLD_PRICE, PROD_SEED, SEED_X_DUTY, SEED_DAV_ALLOW, DUMMY_UP, DUMMY_DOWN, DUM_X_UP, DUM_X_DOWN.

Lagged variables are: DD(-1), X(-1).

Our model has 4 endogenous variables and 12 predetermined (exogenous plus lagged) variables.

Model identification

The next step of our analysis is the identification of the model according to the rank condition and the order condition to determine the method of estimation.

At the beginning we check **the rank condition** which is necessary and sufficient condition of the model identification. In the model containing M equations and M endogenous variables, an equation is identified if and only if at least one nonzero determinant of order (M-1)*(M-1) can be constructed from the coefficients of the variables (both exogenous and endogenous) excluded from the particular equation, but included in the other equation of the model (Lukyanenko, Gorodnichenko, 2002). Let us make the table for all regression equations of the model and all its variables. Identities equations do not need the identification.

Table 4.1: Variables Entry to the Model's Regression Equations

№	DD	WAGE	DOM_PRICE	DD(-1)	DS	PROD_SEED	WORLD_PRICE	X(-1)	SEED_X_DUTY	DUMMY_UP	DUMMY_DOWN	X	SEED_DAV_ALLOW	DUM_X_UP	DUM_X_DOWN
1	**X**	**X**	**X**	**X**	0	0	0	0	0	0	0	0	0	0	0
2	0	0	**X**	0	**X**	**X**	**X**	**X**	**X**	**X**	**X**	0	0	0	0
3	0	0	**X**	**X**	0	0	**X**	**X**	**X**	0	0	**X**	**X**	**X**	**X**

Rank condition (1):

№	DS	X
2	***X***	0
3	0	***X***

Rank condition (2):

№	DD	X
1	***X***	0
3	0	***X***

Rank condition (3):

№	DD	DS
1	***X***	0
2	0	***X***

Each equation of the system satisfies the rank condition. But the rank condition does not give us the answer to the question about over- or underidentification. The answer can be provided by the **order condition**: in the model of M simultaneous equations in order for an equation to be identified, the number of predetermined variables excluded from the equation must not be less than the number of endogenous variables included in that equation less one, K-k >= m-1. If K-k = m-1, the equation is exactly identified, if K-k > m-1 the equation is overidentified (Lukyanenko, Gorodnichenko, 2002).

Equation (1)

$$LOG(DD) = \beta_0 + \beta_1 * D(LOG(WAGE))^{3} + \beta_2 * LOG(DOM\_PRICE) + \beta_3 * LOG(DD(-1))$$

K = 12, k = 3 , m = 1;

12 - 3 > 1 - 1, equation (1) is overidentified.

Equation (2)

$$LOG(DS) = \beta_0 + \beta_1 * D(LOG(PROD\_SEED)) + \beta_2 * LOG(DOM\_PRICE) + \beta_3 * D(LOG(WORLD\_PRICE)) + \beta_4 * LOG(X(-1)) + \beta_5 * SEED\_X\_DUTY + \beta_6 * DUMMY\_UP + \beta_7 * DUMMY\_DOWN$$

K = 12, k = 7 , m = 1;

12 - 7 > 1 – 1, equation (2) is overidentified.

Equation (3)

$$LOG(X) = \beta_0 + \beta_1 * D(LOG(WORLD\_PRICE)) + \beta_2 * LOG(DOM\_PRICE) + \beta_3 * SEED\_X\_DUTY + \beta_4 * SEED\_DAV\_ALLOW + \beta_5 * LOG(DD(-1)) + \beta_6 * LOG(X(-1)) + + \beta_7 * DUM\_X\_UP + \beta_8 * DUM\_X\_DOWN$$

K = 12, k = 8 , m = 1;

12 - 8 > 1 – 1, equation (3) is overidentified.

Structural forms of equation (1)-(3) were chosen basing on predicted economic interdependences between variables. More details on this are given in the Chapter 6. Stationarity of time series are checked using Unit Root Test (Appendix B).

[3] D is an indicator for difference, i.e. D(LOG(WAGE)) = LOG(WAGE) - LOG(WAGE(-1)).

Non-stationarity of some time series is the reason for including in equations their first differences, which are stationary and could be interpreted as rates of growth.

As we can see, every equation is overidentified, hence, the system is overidentified. So in the process of estimation we will use 2SLS or 3SLS.

Chapter 5

DATA DESCRIPTION

The research covers the period from October, 1998 (1998/1999 marketing year start) to September, 2004. Consequently, there are 72 observations. The data come from UkrAgroConsult, Derzhkomstat, National Bank of Ukraine (NBU) and Food and Agricultural Organization of the United Nations (FAO) database (www.ukrstat.gov.ua, www.bank.gov.ua, www.fao.org). Table 5.1 provides descriptive statistics of main variables.

Table 5.1: Descriptive Statistics of Main Variables

Variable	**Mean**	**Max**	**Min**	**Std.dev.**
DD, Th. Ton	31.11	40.00	21.00	4.73
DS, Th. Ton	77.94	134.00	9.10	35.86
X, Th. Ton	49.02	106.30	1.00	28.62
DOM_PRICE, UAH/Ton	2682.64	4005.53	1309.92	668.53
WORLD_PRICE, USD/Ton	534.96	731.00	340.00	96.33

Data on sunflower seed export duty for the sample are as follows:

- 0% October,1998 – September, 1999
- 23% October, 1999 – June, 2001
- 17% July, 2001 – September, 2004 (and until now)

There is no sunflower oil export duty in Ukraine.

Production and export seasonal particularities are the reason of including seasonal dummies into regression equations. This helps us to follows seasonal peaks and slowdowns of export and production levels during the considered period.

Chapter 6

EMPIRICAL RESULTS

Estimation of the equations

Let us use the **OLS** method for initial estimating every equation. Such way we will check the possibility of regression to describe the variation of real data and necessary information for estimation the system of regression equations. We will not estimate identity equations.

Equation (1): DD

Logically, sunflower oil demand positively depends on consumer income level increase and negatively depends on domestic sunflower oil price. We can also predict relatively smoothed consumption level during a year, because of particularity of the product.

<u>Estimation Equation</u>:
LOG(DD) = C(1)*D(LOG(WAGE)) + C(2)*LOG(DOM_PRICE) + C(3)*LOG(DD(-1)) + C(4)

<u>Substituted Coefficients</u>:
LOG(DD) = 0.122*D(LOG(WAGE)) - 0.053*LOG(DOM_PRICE) + 0.823*LOG(DD(-1)) + 1.026

There is suspicious about domestic price is an endogenous variable. The result given by Granger Causality Test tells us that we can not reject the hypothesis that DD does not Granger cause DOM_PRICE but we do reject the hypothesis that

DOM_PRICE does not Granger cause DD (Appendix C). This is the reason for including DOM_PRICE as an exogenous variable and DD as an endogenous variable in the equation (1).

Estimation output summary for equation (1) is shown in Table 6.1.

Table 6.1: OLS Estimation of Equation (1)

Variable	**Coefficient**[4]	**t-Statistic**
D(LOG(WAGE))	*0.122495*	0.799172
LOG(DOM_PRICE)	*-0.053279*	-1.272774
LOG(DD(-1))	**0.822680**	12.32453
C	**1.025766**	2.331968
R^2 = 0.72	F-statistic: 56.11	Prob(F-stat.): 0
Ramsey RESET Test:	F-statistic: 0.84	Probability: 0.35
White Heteroskedasticity Test:	F-statistic: 0.44	Probability: 0.91
LM Test	F-statistic: 0.61	Probability: 0.55

The overall quality of the regression is quite high (R^2 = 72%). F-statistic shows that the regression is adequate, also the RESET and White heteroscedasticity tests show no specification errors. There is no autocorrelation because p(Breusch-Godfrey)>10%. So this specified equation is very good for our model.

Equation (2): DS

Sunflower oil production level presumably should increase when level of sunflower seed production, domestic and world prices, previous period export level or export duty on sunflower seed increases. The equation also includes

[4] **Bold** coefficients are statistically significant, while *italic* coefficients are statistically insignificant ones.

dummies for seasonal peaks to reproduce seasonal particularities of Ukrainian sunflower oil production.

Estimation Equation:

LOG(DS) = C(1)*D(LOG(PROD_SEED)) + C(2)*LOG(DOM_PRICE) + C(3)*D(LOG(WORLD_PRICE)) + C(4)*LOG(X(-1)) + C(5)*SEED_X_DUTY + C(6)*DUMMY_UP + C(7)*DUMMY_DOWN + C(8)

Substituted Coefficients:

LOG(DS) = -0.156*D(LOG(PROD_SEED)) + 0.492*LOG(DOM_PRICE) + 0.592*D(LOG(WORLD_PRICE)) + 0.260*LOG(X(-1)) + 0.017*SEED_X_DUTY + 0.454*DUMMY_UP - 1.228*DUMMY_DOWN - 0.875

Summary of equation (2) estimation output is shown in Table 6.2.

Here there is also suspicious that domestic price is an endogenous variable. The result given by Granger Causality Test tells us that we can not reject the hypothesis that DS does not Granger cause DOM_PRICE but we do reject the hypothesis that DOM_PRICE does not Granger cause DS (Appendix C). This is the reason for including DOM_PRICE as an exogenous variable and DS as an endogenous variable in the equation (2).

Explicative variables explain 81% of dependent variable's variation which is observed from high value of R^2. High quality of the equation is confirmed by the high value of F-statistic and zero p-value. Existence of autocorrelation and heteroscedasticity might be explained by simultaneity. This problem will be solved after using 2SLS or 3SLS for estimation of the system.

Table 6.2: OLS Estimation of Equation (2)

Variable	Coefficient	t-Statistic
D(LOG(PROD_SEED))	*-0.156450*	-0.349699
LOG(DOM_PRICE)	**0.492344**	2.987772
D(LOG(WORLD_PRICE))	*0.592159*	0.923527
LOG(X(-1))	**0.260012**	5.541553
SEED_X_DUTY	**0.017098**	2.973493
DUMMY_UP	**0.454195**	4.818620
DUMMY_DOWN	**-1.228070**	-9.610196
C	-0.875492	-0.712698
R^2 = 0.81	F-statistic: 37.74	Prob(F-stat.): 0
Ramsey RESET Test:	F-statistic: 0.21	Probability: 0.64
White Heteroskedasticity Test:	F-statistic: 2.32	Probability: 0.01
LM Test	F-statistic: 3.44	Probability: 0.04

Equation (3): X

Ukrainian sunflower oil export, logically, positively depends on world price, sunflower seed export duty increase and previous period export; negatively depends on domestic price, tolling scheme for sunflower seed allowance and previous domestic consumption level. The equation also includes dummies for seasonal peaks to reproduce seasonal particularities of Ukrainian sunflower oil export.

Estimation Equation:

LOG(X) = C(1)*D(LOG(WORLD_PRICE)) + C(2)*LOG(DOM_PRICE) + C(3)*SEED_X_DUTY + C(4)*SEED_DAV_ALLOW + C(5)*LOG(DD(-1)) + C(6)*LOG(X(-1)) + C(7)*DUM_X_UP + C(8)*DUM_X_DOWN + C(9)

Substituted Coefficients:

LOG(X) = -0.610*D(LOG(WORLD_PRICE)) - 0.197*LOG(DOM_PRICE) + 0.056*SEED_X_DUTY - 0.344*SEED_DAV_ALLOW - 0.685*LOG(DD(-1)) + 0.581*LOG(X(-1)) + 0.51*DUM_X_UP - 0.438*DUM_X_DOWN + 4.582

Estimation output summary for equation (3) is shown in Table 6.3.

The overall quality of regression is quite high: R^2 = 88%, F-statistic = 55.13. Ramsey test result confirms right specification form choosing. But, again, we face the problem of 2nd order autocorrelation and heteroscedasticity. Its explanation and solution are the same as in the previous equation.

Table 6.3: OLS Estimation of Equation (3)

Variable	**Coefficient**	**t-Statistic**
D(LOG(WORLD_PRICE))	*-0.610359*	-0.832068
LOG(DOM_PRICE)	*-0.196686*	-0.837981
SEED_X_DUTY	**0.056290**	4.746717
SEED_DAV_ALLOW	**-0.343771**	-2.279900
LOG(DD(-1))	**-0.684824**	-2.243152
LOG(X(-1))	**0.580656**	9.249162
DUM_X_UP	**0.509708**	4.966770
DUM_X_DOWN	**-0.437977**	-3.979639
C	**4.581990**	1.981028
R^2 = 0.88	F-statistic: 55.13	Prob(F-stat.): 0
Ramsey RESET Test:	F-statistic: 1.99	Probability: 0.12
White Heteroskedasticity Test:	F-statistic: 1.88	Probability: 0.06
LM Test	F-statistic: 5.02	Probability: 0.01

Estimation of the system

We have the system, which consists of three regressing equations. As our system is overidentified (the order and rank conditions showed) and also we have the problem of endogenous variables in the right-hand side of equation, we have to make us sure about what method of estimating we have to use 2SLS or 3SLS. Let's make these two systems and compare their results (Table 6.4).

Results provided in the Table 6.4 are almost the same. In addition, determinant residual covariance for 3SLS (6.25E-05) is only slightly lower than for 2SLS (6.80E-05) estimation method. This means that residuals do not correlate across equations much. The matrix of residuals' correlations confirms the statement (Table 6.5). But 3SLS provides more precise estimates. Hence, for results interpretation 3SLS estimates will be used.

After estimation of the system (1)-(3) using 3SLS method, the problem of endogenous variables in the right-hand side of equations is solved. Coefficients received are not biased and consistent. Their interpretation is as follows:

- Coefficient of <u>income elasticity</u> of sunflower oil consumption is statistically insignificant, which indicates absence of relationship between income level and level of sunflower oil consumption. In other words, from the result we can say that sunflower oil is a necessity (like bread or milk) in average Ukrainian's basket of goods.

- Coefficient of <u>price elasticity</u> of sunflower oil consumption is also statistically insignificant. Equivalently, sunflower oil domestic demand is price inelastic. But, compared with OLS estimates, here we obtained higher absolute value of t-statistics and the same, negative as predicted, sign.

Table 6.4: 2SLS and 3SLS Estimation Outputs for Equations (1)-(3)

	2SLS		3SLS	
Variable	**Coeff.**	**t-Stat.**	**Coeff.**	**t-Stat.**
LOG(DD)				
D(LOG(WAGE))	0.251372	0.874229	*0.273744*	0.983442
LOG(DOM_PRICE)	-0.056894	-1.343694	*-0.057634*	-1.401375
LOG(DD(-1))	0.816812	12.11526	**0.811712**	12.42209
C	1.071941	2.407931	**1.094820**	2.534353
LOG(DS)				
D(LOG(PROD_SEED))	0.379727	0.279047	*0.186512*	0.153234
LOG(DOM_PRICE)	0.446337	2.038272	**0.453376**	2.221097
D(LOG(WORLD_PRICE))	2.716659	1.579935	**2.767987**	1.722029
LOG(X(-1))	0.330173	4.551751	**0.317242**	4.695770
SEED_X_DUTY	0.011918	1.777590	**0.013703**	2.180430
DUMMY_UP	0.436457	3.589541	**0.361484**	3.394128
DUMMY_DOWN	-1.204020	-8.293429	**-1.135649**	-9.369275
C	-0.687494	-0.436508	*-0.714927*	-0.486224
LOG(X)				
D(LOG(WORLD_PRICE))	2.557623	1.144918	*2.334858*	1.141786
LOG(DOM_PRICE)	0.086627	0.283271	*0.069188*	0.253521
SEED_X_DUTY	0.044918	2.891317	**0.045354**	3.417692
SEED_DAV_ALLOW	-0.189716	-0.965850	*-0.202947*	-1.222224
LOG(DD(-1))	-0.748273	-1.996150	**-0.631096**	-1.946209
LOG(X(-1))	0.557125	6.016573	**0.566762**	6.809620
DUM_X_UP	0.497804	4.240519	**0.472884**	4.720484
DUM_X_DOWN	-0.424905	-3.360987	**-0.372779**	-3.567161
C	2.795189	0.997074	*2.488876*	1.025134

Table 6.5: Residual Correlation Matrix

	LOG(DD1)	LOG(DS)	LOG(X)
LOG(DD1)	1.000000	-0.110954	-0.096858
LOG(DS)	-0.110954	1.000000	0.471038
LOG(X)	-0.096858	0.471038	1.000000

- 1% increase of previous period's consumption level leads to 0.81% increase of consumption in current period. This result and constant coefficient significance depict the fact of relatively smoothing and constancy of sunflower oil consumption in Ukraine.

- Change in growth rate of sunflower seed production does not influence Ukrainian sunflower oil production significantly, as it coefficient is statistically insignificant. This might be explained by low interdependence between domestic sunflower seed and oil production. For example, when domestic sunflower seed harvest is enough to satisfy domestic and foreign consumers demand imported sunflower seed is usually used in the crushing process.

- Coefficient of domestic supply price elasticity is equal 0.45, meaning 1% domestic price increase results in by 0.45% higher production level.

- If world sunflower oil price growth rate increases by 1%, then its production increases by 2.76%. When we estimated equation (2) using OLS method the result received was an insignificant coefficient of the variable D(LOG(WORLD_PRICE)). The whole system 3SLS estimation method eliminates the problem of endogenous variables in the right-hand side. Hence, in reality the coefficient is significant as was predicted.

- If previous period export level increases by 1%, production level in current period also increases by 0.32%. The dependence is as predicted.

- **1% increase of sunflower seed export duty results in 0.014% increase of domestic sunflower oil production.** Really, it becomes more attractive to produce and export sunflower oil than to export seeds.

- Seasonal dummies also affect sunflower oil production statistically significantly in predicted directions.

- Growth rate change of sunflower oil world price does not lead to Ukrainian sunflower oil export change. It also does not depend on domestic prices. Such results are unexpected. Possible explanation of the situation is as follows: export agreements are usually signed beforehand; hence, current price changes do not significantly influence current export levels. Current domestic price does not influence current export level due to the same reason.

- Higher restriction level on sunflower seed export results in higher sunflower oil export level from Ukraine. **By 1% increase of sunflower seed export duty causes 0.045% export level increase.** Allowance or abandon of operations of goods made on commission have not significant impact on sunflower export level change.

- Previous period export level increase by 1% results in by 0.57% higher export in current period, while higher previous period domestic demand leads to current period export decline by 0.63%. These results follow the logic and do not contradict predictions.

- Seasonal dummies also affect sunflower oil export statistically significantly in predicted directions.

Summing up the results, almost all dependences are as expected. The effect of sunflower seed export duty change has not substantial impact on Ukrainian sunflower production and export level movements. Interdependence between these variables is as predicted, but the scale of impact is not dramatic. Therefore, meeting the precondition of WTO accession in issue of lowering sunflower seed export duty will not result in extreme sunflower oil crushers and exporters losses.

Estimation of the model forecasting quality

Let us check the forecasting quality of the model, using formal statistic criteria:

- Root of Medius Square Error (RMSE): $RMSE = \sqrt{\frac{1}{N}\sum_{i=1}^{T}\left(y_i - \hat{y}_i\right)^2}$;
- Medium Error (ME): $ME = \frac{1}{N}\sum_{i=1}^{N}\left(y_i - \hat{y}_i\right)$;
- Medium Percent Error (MPE): $MPE = \frac{1}{N}\sum_{i=1}^{N}\frac{\left(y_i - \hat{y}_i\right)}{y_i}$;
- Medium Absolute Percent Error (MAPE): $MAPE = \frac{1}{N}\sum_{i=1}^{N}\frac{\left|y_i - \hat{y}_i\right|}{\left|y_i\right|}$.

Estimation results are given in the Table 6.6. For visual inspection of correspondence between real and fitted values of variables appropriate figures are given in Appendix D.

Unfortunately, the quality of historical forecasting of the model is not good enough, as MAPE for DD, DS and X is not less than 10%. This means that the forecast or scenario made basing on the model will not be precise. Such result might be explained by relatively low number of observations, omitting of other relevant factors of influence on endogenous variables in the model etc.

Table 6.6: Formal Statistic Criteria of the Model Quality

	DD	**DS**	**X**
RMSE	3.82	17.60	17.45
ME	0.68	2.13	2.42
MPE, %	0.3	-2.6	-6.6
MAPE, %	10	18	26

Improvement of the model forecasting quality by, for example, alternative data construction or sample enlargement might be helpful for further research and WTO membership impact on Ukrainian sunflower oil sector forecasting.

C h a p t e r 7

CONCLUSIONS

New Ukrainian government plans to join WTO till the end of 2005. Although such step has many advantages, it also brings risks to separate sectors of Ukrainian economy. One of them is sunflower oil industry. The most evident mechanisms of interconnection between WTO accession and its impact on sunflower oil industry are decrease of sunflower oil import duty and lowering of sunflower seed export duty. Taking into account Ukrainian comparative advantage in sunflower oil production and that Ukrainian agricultural market is import soundproof, lower import duty is almost not dangerous for domestic producers. While, sunflower seed export duty decrease might be harmful for Ukrainian sunflower oil producers and exporters in a sense of sunflower oil export forcing out by sunflower seed export.

Empirical estimations basing on the sample from October, 1998 to September, 2004 gave us the following results: by 1% sunflower seed export duty decrease leads to by about 0.014% and 0.045% decline of sunflower oil production and export respectively. Such figures are not seemed to be dramatic. Furthermore, sunflower seed export duty lowering is a logical step in Ukraine's economic policy required not only by WTO accession conditions.

The reason of the export duty introduction was essentiality of sunflower oil refineries recovery. Due to higher attractiveness of the industry for domestic and foreign investors after sunflower seed export duty introduction Ukrainian sunflower oil production is characterized by substantial growth, development and improvement during last six marketing years. Nowadays Ukrainian sunflower oil producers are surely competitive in the world market. The products are high-quality, as new technologies are used in operation processes, and meet the most exigent consumer needs. Therefore, sunflower seed export duty has been transformed from the measure for sunflower oil capacities recovery to just a burden for sunflower seed producers. For further development sunflower oil market must be competitive. Indirectly this means competitiveness on the sunflower seed market.

Consequently, sunflower seed producers will win from the export duty reduction as their product will become even more competitive abroad. While domestic sunflower oil producers will have to pay more for sunflower seeds, as its price established by domestic producers will move near relatively higher world price.

Impact of WTO accession on Ukrainian consumers is expected to be positive, as competitive equilibrium approach in any market leads to both consumer and producers benefits. Taking into consideration price and income inelastic sunflower oil domestic demand and relatively constancy of the product consumption, Ukrainian consumer will not lose due to WTO accession. Especially if WTO accession will result in higher economic growth rates, foreign direct investment stimulation etc. and, consequently, an increase of Ukrainians purchasing power.

Although the budget revenues from the export duty will decrease in response to its elimination, alternative sources of the budget revenues are expected to appear as a consequence of Ukraine's WTO membership.

Summing up the conclusions, an aggregate impact of Ukraine's WTO accession on Ukrainian sunflower oil sector will be absolutely positive, as it promotes competition development both in the sunflower oil market and in the whole economy. Producers and government potential losses from the accession are surely overwhelmed by its advantages.

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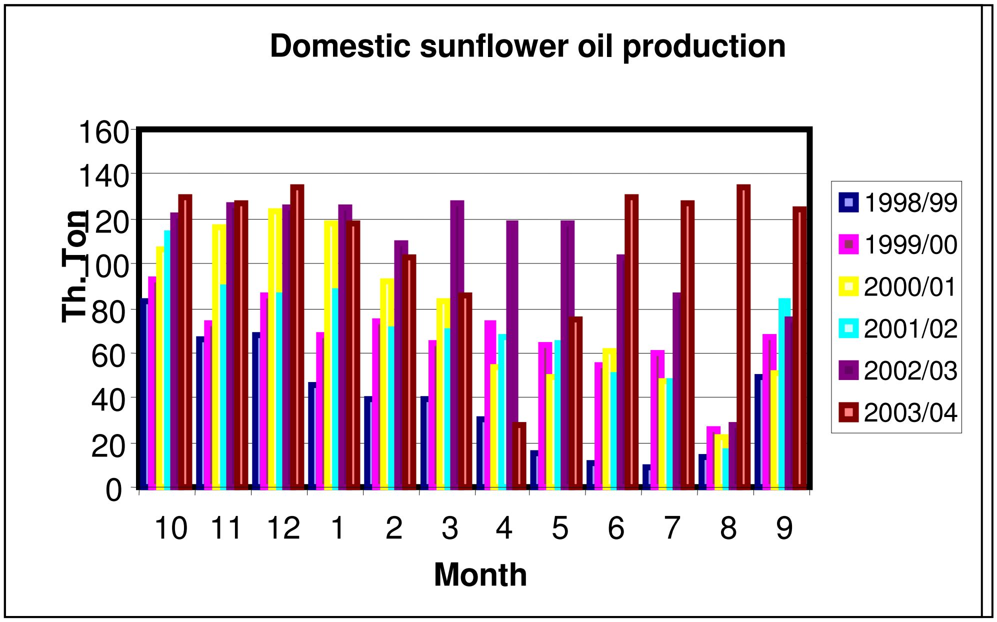
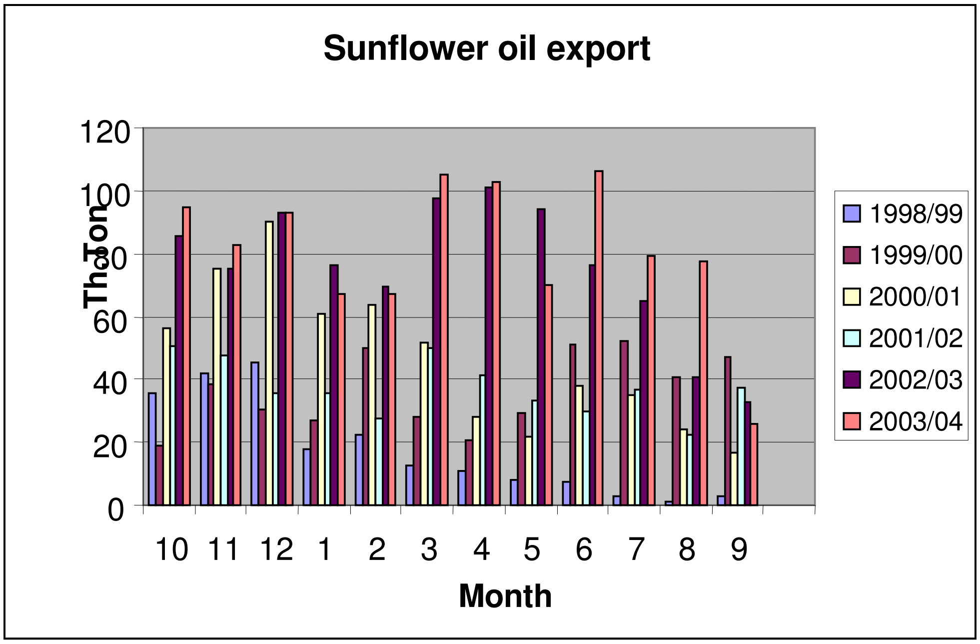
APPENDIX A

Figure A.1: Monthly Domestic Sunflower Oil Production 1998/99-2003/04 MY



Source: UkrAgroConsult.

Figure A.2: Monthly Domestic Sunflower Oil Export 1998/99-2003/04 MY



Source: UkrAgroConsult.

APPENDIX B

Unit root test of time series results

LOG(DD) – stationary

Null Hypothesis: LOG_DD has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.456800	0.1304
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	
*MacKinnon (1996) one-sided p-values.			

D(LOG(WAGE)) – stationary

Null Hypothesis: D(LOG_WAGE) has a unit root			
Exogenous: Constant			
Lag Length: 1 (Automatic based on SIC, MAXLAG=9)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.35264	0.0001
Test critical values:	1% level	-3.528515	
	5% level	-2.904198	
	10% level	-2.589562	
*MacKinnon (1996) one-sided p-values.			

LOG(DOM_PRICE) – stationary

Null Hypothesis: LOG_DOM_PRICE has a unit root			
Exogenous: Constant			
Lag Length: 7 (Fixed)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.567761	0.0092
Test critical values:	1% level	-3.536587	
	5% level	-2.907660	
	10% level	-2.591396	
*MacKinnon (1996) one-sided p-values.			

LOG (DD(-1)) – stationary

Null Hypothesis: LOG_DD_PREV has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.434728	0.1361
Test critical values:	1% level	-3.527045	
	5% level	-2.903566	
	10% level	-2.589227	
*MacKinnon (1996) one-sided p-values.			

LOG(DS) – stationary

Null Hypothesis: LOG_DS has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.435255	0.0129
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	
*MacKinnon (1996) one-sided p-values.			

D(LOG(PROD_SEED)) – stationary

Null Hypothesis: D(LOG_PROD_SEED) has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.344850	0.0000
Test critical values:	1% level	-3.527045	
	5% level	-2.903566	
	10% level	-2.589227	
*MacKinnon (1996) one-sided p-values.			

D(LOG(WORLD_PRICE)) – stationary

Null Hypothesis: D(LOG_WORLD_PRICE) has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.825803	0.0000
Test critical values:	1% level	-3.527045	
	5% level	-2.903566	
	10% level	-2.589227	
*MacKinnon (1996) one-sided p-values.			

LOG(X(-1)) – stationary

Null Hypothesis: LOG_X_PREV has a unit root			
Exogenous: Constant			
Lag Length: 10 (Fixed)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.593314	0.0087
Test critical values:	1% level	-3.544063	
	5% level	-2.910860	
	10% level	-2.593090	
*MacKinnon (1996) one-sided p-values.			

LOG(X) – stationary

Null Hypothesis: LOG_X has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.473339	0.1262
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	
*MacKinnon (1996) one-sided p-values.			

APPENDIX C

Pairwise Granger Causality Tests
Date: 05/21/05 Time: 14:24
Sample: 1998:10 2004:09
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
LOG_DOM_PRICE does not Granger Cause LOG_DD	71	3.28483	0.07434
LOG_DD does not Granger Cause LOG_DOM_PRICE		0.02693	0.87013

Pairwise Granger Causality Tests
Date: 05/21/05 Time: 14:38
Sample: 1998:10 2004:09
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
DD does not Granger Cause DOM_PRICE	71	0.20589	0.65145
DOM_PRICE does not Granger Cause DD		4.20295	0.04421

Pairwise Granger Causality Tests
Date: 05/21/05 Time: 14:45
Sample: 1998:10 2004:09
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
DOM_PRICE does not Granger Cause DS	70	3.51067	0.03566
DS does not Granger Cause DOM_PRICE		0.37787	0.68681

Pairwise Granger Causality Tests
Date: 05/21/05 Time: 14:45
Sample: 1998:10 2004:09
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
LOG_DOM_PRICE does not Granger Cause LOG_DS	70	3.84723	0.02636
LOG_DS does not Granger Cause LOG_DOM_PRICE		0.12718	0.88080

APPENDIX D

Figure D.1: Actual and Fitted (Baseline) Values of Ukrainian Sunflower Oil Production

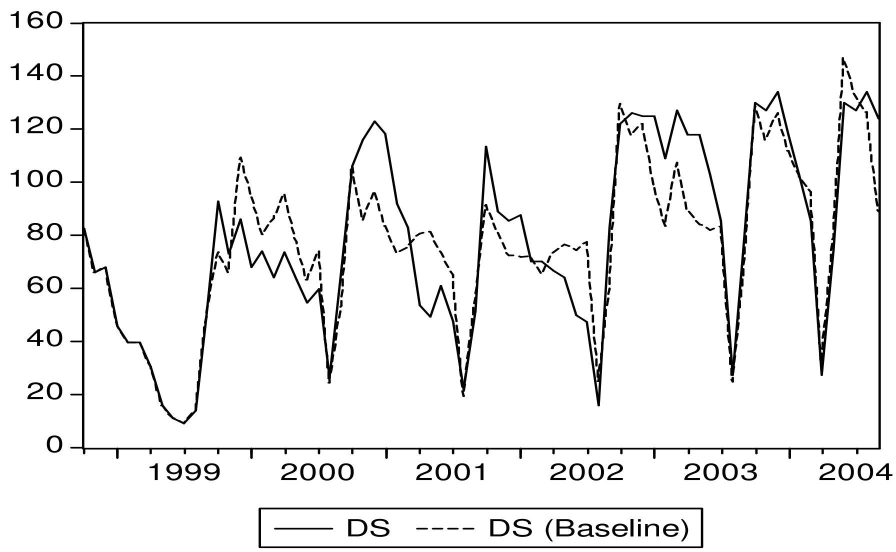


Figure D.2: Actual and Fitted (Baseline) Values of Ukrainian Sunflower Oil Export

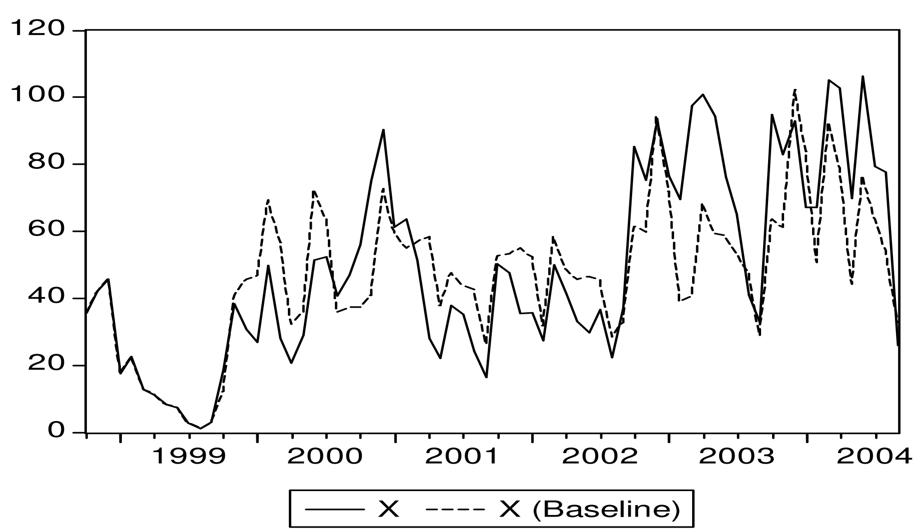


Figure D.3: Actual and Fitted (Baseline) Values of Ukrainian Sunflower Oil Demand