TRADE IN BEEF AND MILK IN THE UKRAINE: THE IMPACT OF LONG TERM TRADE CONDITIONS, TRADE SHOCKS AND GOVERNMENT INTERVENTION

by

Ostashko Hanna

A thesis submitted in partial fulfillment of
the requirements for the degree of

Master of Arts in Economics

National University of "Kyiv-Mohyla Academy"
Economics Educational and Research Consortium
Master's Program in economics

2007

Approved by ____
Ms. Svitlana Budagovska (Head of State Examination Committee)

____

____

Program Authorized
to Offer Degree Master's Program in Economics, NAUKMA

Date ____

National University of "Kyiv-Mohyla Academy"

Abstract

TRADE IN BEEF AND MILK IN THE UKRAINE: THE IMPACT OF LONG TERM TRADE CONDITIONS, TRADE SHOCKS AND GOVERNMENT INTERVENTION

by Ostashko Hanna

Head of State Examination Committee: Ms. Svitlana Budagovska
Economist, The World Bank, Ukraine

This thesis applies the partial equilibrium simulation model to the livestock sector of Ukraine. The applied model was used for analysis of government intervention impact, consequences of trade conditions and trade shock influence on the beef and milk sectors of Ukraine. Model was estimated by 2SLS procedure. Livestock sector performance and welfare effect was analyzed

TABLE OF CONTENTS

LIST OF FIGURES

GLOSSARY

2SLS. Two stage least squares

3SLS Three stage least squres

AoA Agreement on Agriculture

CAP Common Agriculture Policy

CPI Consumer Price index

CS Consumer surplus

FAO Food Agricultural Organization of United Nations

GR Government Revenue

EU European Union

GMM Generalized Model of Moments

OECD Organization of Economic Cooperation and Development

OLS Ordinary Least Squares

SEM Simultaneous Equation Modeling

SUR Seemingly Unrelated Regression

TW Total Welfare

WTO World trade organization

Chapter 1.

INTRODUCTION

Agriculture in the Ukraine is one of the most vulnerable sectors from the point of view of government intervention and trade conditions. Furthermore, agriculture is a basis for food security and social welfare of the major part of rural population. Processes of economic integration significantly impact agricultural market and policy.

As Ostashko T (2004), underlined, any economic integration for current situation in the agriculture of the Ukraine will be Pareto inefficient, because it is impossible to find the instruments how to improve performance of one market agents without weakening the performance of at least one other market agents. Furthermore, Seperovich and Shevtsov in their survey of consistency of Ukrainian agriculture policy in 2004 made a conclusion, that none of government efforts to regulate agriculture and improve agricultural market performance was consistent enough to have a positive influence on the agricultural market.

Therefore, questions about the effect of the government intervention and trade conditions on the Ukraine's agricultural market provide a wide field for research.

In this thesis I will make an attempt to contribute in the analyzing and predicting the effects of policy instruments and trade conditions in the livestock sector of agricultural market.

I would address the following questions:

- What will be the effect of the decrease of government support of agriculture due to requirements of international organizations for the livestock sector performance?

- Whether the trade shocks have a consistent negative effect on livestock sector performance or in contradiction they improve the performance?

This analysis will be conducted on the base of partial equilibrium simulation model of the Ukrainian livestock sector. These models are widely used by researchers, both for one country and regional or international analysis. However, these models do not provide accurate estimate of the level of changes and are more useful to estimate long-term trends and directions of impact of policy instruments and other market interventions on the market parameters .

Therefore, understanding these restrictions, in my analysis I will operate rather with trends, relationship and comparison of impact, than with numerical estimation of welfare results.

The model includes 3 inter-related markets: beef market, raw milk market and dairy market. I estimated and analyzed the domestic demand functions, production functions and net trade.

Coefficients for the simulation model are estimated using econometric technique, in particular 2SLS methodology for estimating the simultaneous regression. 3SLS estimation procedure would provide with more accurate results, however, in this survey I stop on 2SLS procedure, providing some considerations about possible robustness of estimation.

In order to make my dynamic analysis more precise, I used the partial adjustment function methodology in the model specification. That means I assumed that market agents real reaction to the market conditions changes does not equal the desired level of their reaction. In model specification it is represented by including the lagged value of dependent variable in vector predictors.

In the empirical part I made an attempt to apply the model to simulate the scenarios of government intervention, trade conditions changes and trade shocks. Simulation allowed to conclude that import tariff reduction for both beef and dairy commodities will result in decline in total social welfare, while import tariff for beef reduction contributes to the development of livestock sector (livestock number increases in the long run) and import tariff for dairy reduction influence sector performance negatively.

The most surprising finding of the empirical applications of developed model is that trade shock in milk and dairy sector has a significantly negative impact on the livestock sector performance. In contradiction trade shock in beef market improves the sector performance significantly than any instruments of government intervention.

This thesis proceeds as follows:

Chapter 2 provides literature review and is mainly devoted to review of models used for policy instruments analysis in agriculture. Basic types of models as well as their empirical applications are discussed, also similar models developed for Ukrainian agriculture are mentioned and described. Chapter is finished by description of the basic pillars for my model development.

Chapter 3 provides basic information about the livestock sector in Ukraine, and the level of protection of the livestock sector and discusses main conclusions of Ukrainian experts on the possible consequences of joining the WTO.

In Chapter 4 I develop a theoretical framework for further analysis. Chapter starts with adoption of the partial equilibrium model for the purposes of my analysis, then I proceed with welfare effect estimation and finish with introducing the partial adjustment coefficient.

In Chapter 5 model specification is described, expectations about coefficients signs, significance and level are stated an analyzed.

Chapter 6 provides the empirical estimation of the model and detailed explanations of coefficients. The Chapter starts with arguing for choice of methodology for estimation, and analysis of possible restrictions in the model application caused by the methodology chosen. At the end of the Chapter I analyze the effect of implemented assumption of the model and made an attempt to predict how releasing of these assumptions could influence the model, its empirical applications and the results of analysis.

Chapter 7 presents examples of empirical application of the model. Six scenarios are simulated. The Chapter provides trends analysis and some calculations.

Chapter 8 Summarizes main findings of the thesis and discuss possibilities for further research.

Chapter 2

LITERATURE REVIEW

In this chapter we want to address the existing literature in sphere of theoretical approaches to agricultural policy analysis, methodology and techniques of models construction and estimation and empirical implication of the models. Then we will proceed with special features of model specifications in surveys of beef and milk sector and the results obtained in research conducted in livestock sectors of other countries. Special attention will be paid for the model used as the pillars for the development of the model of this research.

In the beginning let us revise the classification of the models used for policy analysis in agriculture. Garforth and Rehman (2006) in their review of approaches and models used purposes of Common agriculture Policy analysis in Great Britain and other countries of European Union defines 4 main types of models: econometric models, mathematical programming models, simulation models and partial equilibrium models. This range of models represents all main approaches; therefore let us underline main features of these models, as well as core advantages and drawbacks.

Econometrics models imply statistical methods and economic theory to express the relationship between economic variables in algebraic computable form. Mathematical programming implies optimization methods to describe behavior of market agents. Simulation models answer the questions about more probable results of scenario, given the initial conditions. These models are very different by structure and level of aggregation and complexity, furthermore, simulation models usually aggregate the achievements of all other types of models in order to construct the most accurate simulation.

And the last type of models discussed - partial and general equilibrium models – reflects rather methodology of analysis that the type of model technique. Partial equilibrium model analyses a restricted object – the sector of economy, or several sectors in one country, while general equilibrium analyses mainly the economy as a whole. Obviously, the general equilibrium models provide with more accurate analysis, however the partial equilibrium models are much easier both to estimate and to implement for empirical analysis. The common feature of the models is closure conditions - conditions of market equilibrium. This type of model is the most useful to estimate welfare effects of policy changes. As Meilke (1999) stresses in his methodology overview, partial equilibrium model, if properly applied, provides an effective instrument for WTO access consequences for developing countries analysis.

Garforth and Rehman (2006 underline that choice of methodology depends upon the purposes of research. Ex-post analysis could be effectively conducted on the base of econometric model, ex-ante analysis requires partial equilibrium or general equilibrium models for accurate forecasting.

Static comparative analysis can be conducted by simple computable model, while dynamic models requires capture of evolution factors such as technological changes, capital accumulation etc.

However, it is more useful to combine all methods in order to obtain accurate model for policy instruments estimation. More et al (2002), Kuhn (2004) and Bienfield P et al (2003) use partial equilibrium models for their analysis, however, they used the econometric approach to estimate the elasticity for the model, and in order to implement dynamic analysis, the simulation model on base of partial equilibrium framework was constructed. This scheme of procedure appears to be the most suitable for the targets of our analysis.

Number of surveys on the base of listed above model types were conducted for Ukraine. Below I would like to discuss the last contributions in this sphere.

General equilibrium model, developed by Burakovsky et al in 2006 includes all aggregated sectors of Ukrainian economy, and among them agriculture was analyzed. The main findings of this survey was the fact, that trade protection of Ukrainian agriculture market brings significant distortion in the trade and is inefficient, furthermore agricultural market was estimated as overprotected.

Partial equilibrium model for sunflower seeds market was developed by O. Nivjevskiy in 2006, who also argued to inefficiency of the market caused by the high level of trade protection. However, sunflower seeds are considered to be a special product in Ukrainian trade as well as raw sugar, and therefore, the results obtained in this research could not be overstretched to the whole agricultural market of Ukraine.

In general, simulation models are usually applied in Ukraine for the purposes of aggregated sector analysis or analysis of special goods – either export oriented goods, such as sunflower seeds, or domestic goods with comparatively high production costs, as raw sugar from sugar beets, or suffer for significant institutional inefficiency as grain trade market.

Further I will proceed with a brief description of the models which I particular use for the purposes of theoretical framework development, model and particular equation specification, choice of the methodology of model estimation and procedure of empirical implication of the model developed.

One of the basic pillar for framework development was International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT model), constructed by Rosegrand and Meijer in 2002.The model describes the framework for analyzing the competitive agricultural market and modeling the scenarios of policy instruments consequences, and is widely used for the purposes of FAO analysis.

Another model, that contributes to the model specification of this research is ERS/PENN trade model developed by Stout and Able in 2003. The model is a simulation partial equilibrium model and aggregates markets of 32 goods in 16 regions. The authors obtained the elasticity coefficients of the models from previous research, therefore, no estimation methodology is presented in the model as well as impact of model specification on the results of estimation is not discussed.

Similar to the previous survey approach to model development was adopted to Ukrainian agriculture by Kuhn in 2004. Regional agricultural sector model of Ukraine (RAMSU) presents the simulation agricultural production an trade in 4 regions of Ukraine. International trade was not included in this model, but is reported to be in the process of development.

A main pillar for the model specification in my research and adoption to the livestock sector is a partial equilibrium model of beef and milk sector in Italy under imperfect competition, developed by More et al in 2002. In the model discussion authors underlined a number of useful hints for specification on the model especially for analysis of the livestock sector.

Furthermore, analyzing the findings and policy implications of the model listed below, it can be concluded, that the results obtained in simulation analysis must be treated very carefully. This means that the targets of such models are mainly analyzing trends and direction of changes, not the exact value of changes. For example, authors did not attempt to determine the optimal level of tariff rate or government support using the simulation model, while they provided analysis and discussion on how significantly and in what direction particular policy instruments influence market and welfare parameters. This contributes to the development of the scheme of empirical applications of the model developed in this research.

Chapter 3

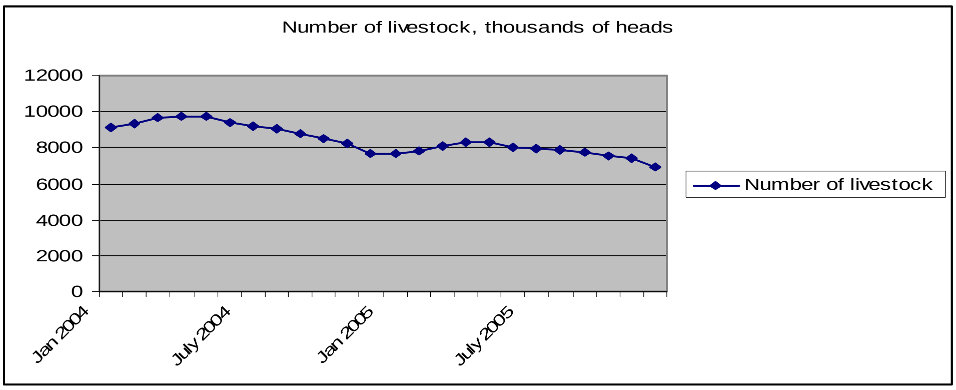
LIVESTOCK MARKET AND TRADE IN LIVESTOCK GOODS IN UKRAINE

3.1. Overview of Ukrainian livestock sector

In this Chapter I will describe the situation in beef and milk sector and present some conclusions of Ukrainian experts about the possible consequences of Ukrainian accession to the WTO and implementing the principles of Common Agriculture Policy (CAP).

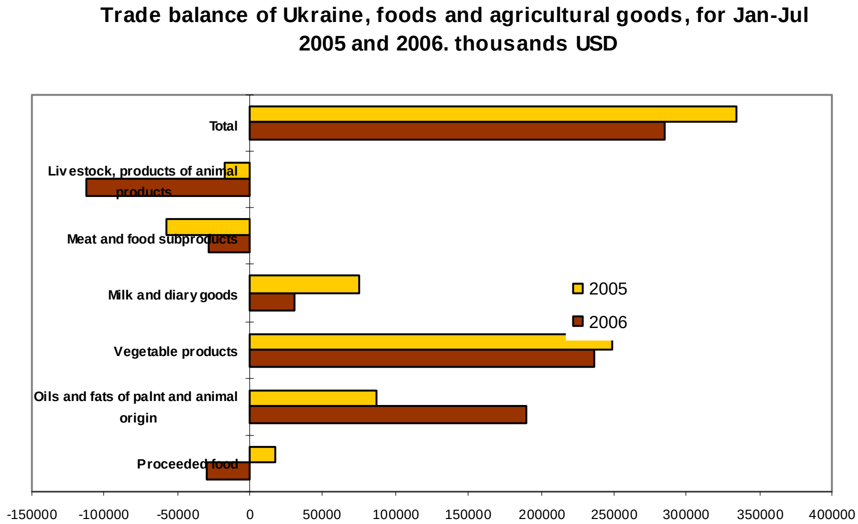
Livestock market in Ukraine was suffering problems until the end of 2005. Continuing decline in the livestock number creates a threat for beef and milk production, as well as to the level of rural employment. Beef market is the only sector of meat and poultry market in Ukraine that demonstrates positive value of the net trade. As can be seen on the diagram below, total trade balance in meat and poultry sector is negative.

Graph 3.1. Dynamics of Number of Livestock in Ukraine



Furthermore, the problem with declining number of livestock is aggravated by the fact that household producers keep more than 60% of livestock number and are responsible for more that 55% of total beef and raw milk production. Taking into account that SME and household producers are the most vulnerable for policy and market conditions changes, livestock is highly subjected to the risks is the WTO accession process and CAP implementing steps.

Graph 3.2. Trade Balance of Agricultural Commodities in Ukraine



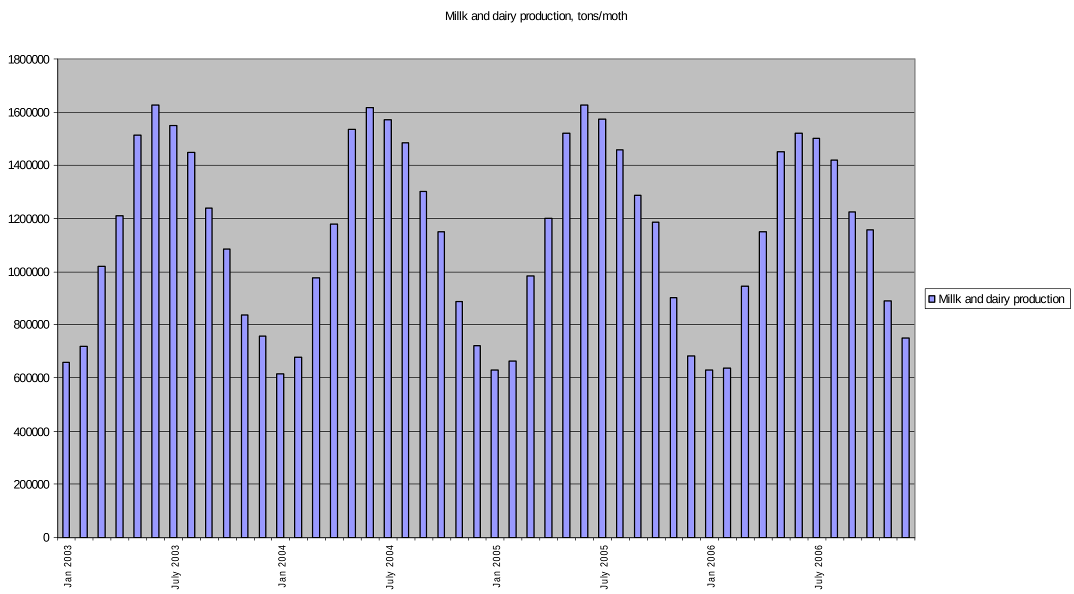
Source: Ostashko T, Ostashko H., Ukraine in the Process of WTO and EU accession, Insitute for Rural development, 2006.

However, Ukraine was and remains the net exporter in milk and dairy products and in beef products (see Graphs below). This sector currently is one of the export-stable sectors of Ukraine.

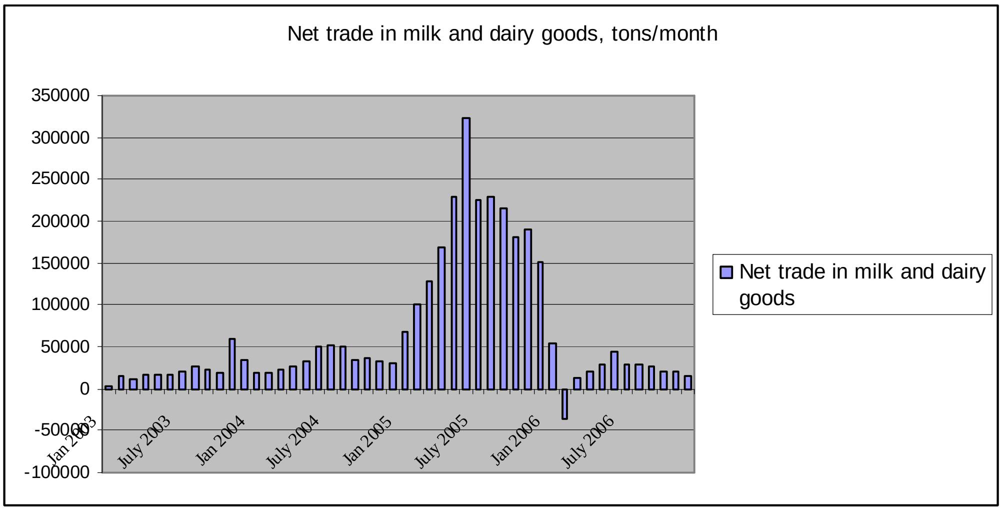
State support of agriculture provides production subsidies for both milk and dairy production, as well as special subsidies are paid by the number of livestock.

Milk and dairy production shows the seasonality trends, which also are partially observed in net trade.

Graph 3.3 Milk and dairy production in Ukraine



Graph 4.3 Net trade in milk and dairy goods



3.2. Protection and Domestic support of the livestock sector.

As the main agricultural commodities, beef and milk sector in Ukraine is protected by the import tariff rate. Tariff rate for beef is 10%, but not less than 10 EUR/tone, tariff rate for raw milk is 10%, but not less then 10 EUR/tone, for dairy products the tariff rate varies from 10% to 40%. For the purposes of analysis I calculated weighted average on the trade data of 2006 – 27%.

3.3 The WTO agricultural conditions, predicted risks and benefits for Ukraine

In the process of discussion of WTO accession of Ukraine, experts (here I refer to Ostashko T (2002), (2004), (2006), Nivjevsky (2004) and Kobuta (2005)) underline the benefits from market liberalization as well as risks for domestic producers. Among the main question of concern is domestic market liberalization, which is expected to weaken the positions of domestic producers. Furthermore, this weakening is expected to be catalyzed by implementing of new sanitary and phyto-sanitary standards defined in the Agreement on Agriculture, and as a result by increasing production costs of domestic producers. State support reduction consider to be efficient, as well as free trade will benefit market efficiency and budget burden will switch to the rural development and improvement of quality of goods produced. Market institutions development is expected to be reinforced; structure of agricultural producers will change towards decline of small and medium enterprise production share in total production. Trade shocks will also become less possible after WTO accession.

It can be forecasted on the base of transition economies experience, that state support of agriculture will restricted mainly by the budget constraints, not be the WTO requirements.

Without any doubts, rural development will benefit from WTO accession, as well as quality of goods produced and consumed, however, influence of implementing WTO requirements and restrictions on the each goods should be analyzed separately.

While analyzing the level of import tariffs for particular goods, the results of survey appears to be controversial. Thus, Nivjevskiy in his survey of ability of domestic goods to compete on the domestic and world market conducted in 2004 argues, that almost all goods will remain in their initial positions after reduction of import tariff. From the other hand, Ostashko T (2006) argues, that Ukraine shows tendency of agricultural and food import growth after changes to the Custom tariff in July 2006 (during first half of 2006 import of these items increased by 26,6% in comparison with the same period of 2005).

By this thesis I want to some extent contribute to the forecasting and estimation of tariff reduction consequences for the case of milk and beef.

Chapter 4

THEORETICAL CONSIDERATIONS: PARTIAL EQUILIBRIUM MODEL AND WELFARE ANALYSIS

4.1 Theoretical framework developing

According the discussion of Chapter 2, it can be concluded that partial equilibrium model is the most feasible tool for our analysis. The model will provide us with the framework for equation specification and static relationship analysis that will further be included into simulation model.

The following assumptions are to be implied before describing the framework:

- Ukraine is a small country, and the level of its export and import of the goods analyzed does not affect the world price

- Goods are homogenous, therefore import and domestic goods compete only by price, not by the means of consumer preferences

- Producers and consumers behavior rationally – producers maximize their profitability, consumers maximize their utility with budged constraints.

- Transportation costs and transactions costs assumed to be equal for imported and domestic goods.

These assumptions, extent of their impact on the model results and forecast of the consequences of realizing these assumptions are presented at the end of this Chapter.

Therefore, the market equilibrium model is described as follows:

For each good i, included in the model,

Domestic Demand:

$$Q^{d}_{d,i} = F(P_{d,i}, P_{d(other)}, I_d, u_d)$$ **Equation 4.1.**

Domestic Production:

$$Q^{d}_{pr,i} = F(P_{pr,i}\ , P_{pr_{(other)}}, I_{pr}, u_{pr})$$ **Equation 4.2.**

with

$\boldsymbol{Q^{d}_{d}}$ stays for level of domestic demand of good i
$\boldsymbol{Q^{d}_{pr}}$ stays for domestic production level of good i
$\boldsymbol{P_{d,i}}$ – market price of the good i
$\boldsymbol{P_{pr,i}}$ – producers price of the good produced (price at which producers supply goods to the market)
$\boldsymbol{I_{d}}$ – vector of exogenous variables that influence demand, for example, income per capita etc
$\boldsymbol{I_{pr}}$ – vector of production factors prices
$\boldsymbol{U_{d}}$ and $\boldsymbol{U_{pr}}$ – disturbances.

The difference in production vector of primary goods produce and proceeding goods will be discussed in model specification in Chapter 5.

The closure of our partial equilibrium model includes price equilibrium conditions and net trade equations. As statistical data on the net trade is collected together for both raw milk and dairy products, and no separate data is available, only two net trade equations will be included into our model as a closure.

That is, for every good i :

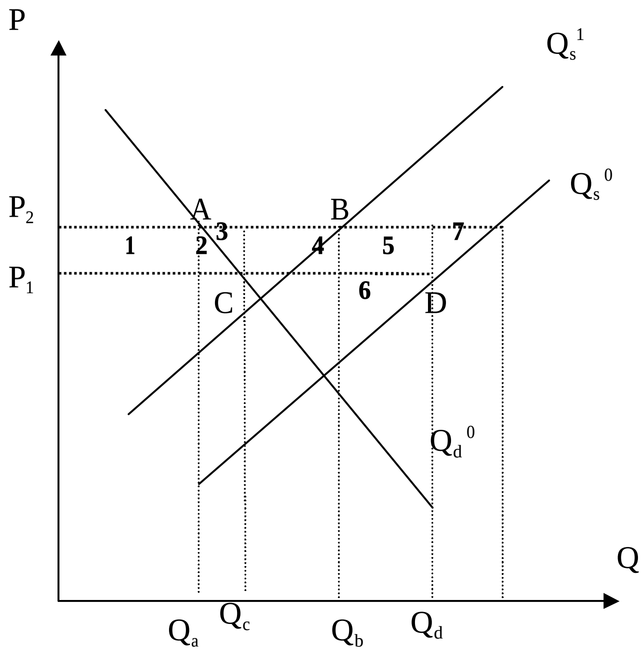
$$P_{d,I} = P_{pr,I}$$
$$Q^{d}_{pr} - Q^{d}_{d} = NT_i$$ **Equation 4.3.**

With NT_i describing the net trade level in good I

4.2. Analysis of reduction in production subsidies

In this Section we will briefly address static graphic analysis of welfare effects of government intervention, terms of trade and trade shocks.

Figure 4.1. Welfare analysis under production subsidies reduction



Source: Perali (2002)

The consequences of reduction of production subsidies for the case when initial and resulting equilibrium prices are above the level of equality of domestic supply and demand, are presented on the Figure 1. With reduction of subsidy, the production curve shifts up, therefore, equilibrium price increases, while market clearing level of net trade decreased. For the purposes of our analysis, we assume that net trade and domestic demand reacts by the same extent to changes in prices. This assumption is true for Ukraine as the small country, and the fact that

Ukraine exports not at the level of the world prices (See Section 4.1. for reasoning).Therefore, the domestic demand declines from the level of Q_c to the level Q_a, the net trade level declines from (Q_d-Q_c) to (Q_b-Q_a). Level of production changes from Q_d to Q_b.

The table below presents the welfare consequences of subsidy reduction:

Table 4. 1. Welfare analysis under reduction production subsidies

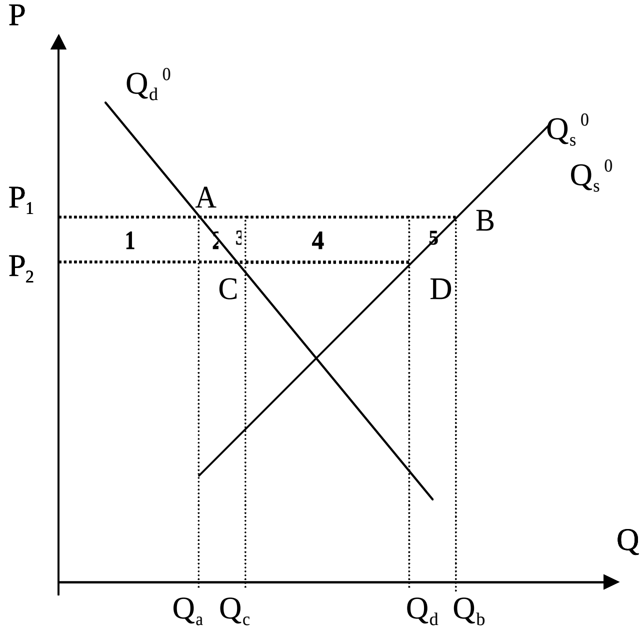
Welfare estimator	*Direction of Change*	*Value of change*
Change in consumer surplus	Decline	1+2
Change in producer surplus	Increase	1+2+3-5-6-7
Change in government costs/revenue	Decline in costs	5
Total welfare effect		(-1)+(-2)+1+2+3-5-6-7 +5 =3-6-7

Note: Figures, which squares reflects the change in welfare presented on Figure 1.

For this and others graphical analysis of this chapter, algebraic calculations of welfare changes are presented in Appendix 1B.

4.3. Import tariff reduction and welfare effects

Figure 4.2. Welfare effect under import tariff reduction



Source: Perali (2002)

The consequences of reduction of import tariff rate for the case when initial and resulting equilibrium prices are above the level of equality of domestic supply and demand, are presented on the Figre 2. As we can see, with reduction of tariff (for a small country), domestic prices increases, quantity supplied declines and demand increases. As a result, net trade increases. Let us revise, that domestic price in Ukraine is less than the world price, which allow as to conclude, that net trade completely fills the increased difference between demand and supply due to tariff reduction.

Therefore, the domestic demand grows from the level of Q_a to the level Q_c, the net trade level increases from (Q_d-Q_c) to (Q_b-Q_a). Level of production changes from Q_d to Q_b.

The table below presents the welfare consequences of subsidy reduction:

Table 4.2. Welfare effect under import tariff reduction

Welfare estimator	*Direction of Change*	*Value of change*
Change in consumer surplus	Increase	1+2
Change in producer surplus	Decline	1+2+3+4+5
Change in government costs/revenue	Decline in revenue	4
Total welfare effect		1+2-1-2-3-4-5+4=-(3+5)

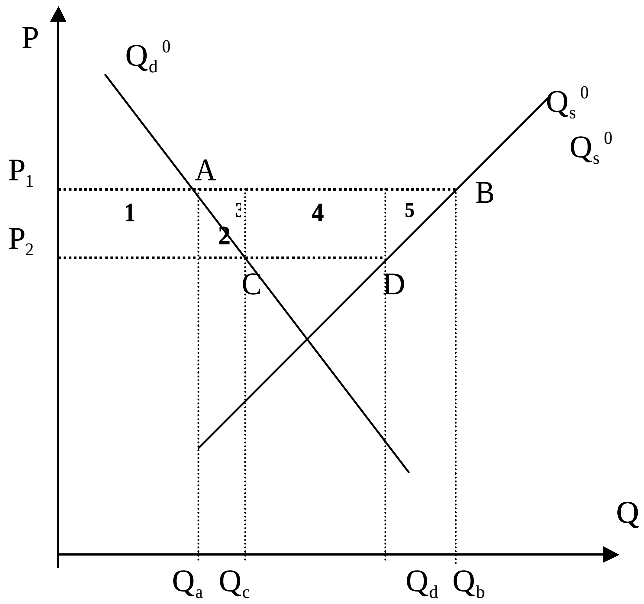
Note: Figures, which squares reflect the change in welfare presented on Figure 2.

Algebraic calculations of welfare changes are presented in Appendix 1.

4.4. Trade shock effect and welfare effects

Trade shock in this analysis is defined as immediate decrease in the net trade level, with the response of production starting from the next period. Graphically the consequences of trade shock are presented in Figure 4.3.

Figure 4. 3. Welfare effects in the case of trade shock



Source: Perali (2002)

The market consequences of trade shock – sharp reduction in export, keeping import and production function constant, which leads to reduction in net trade. Impact on the welfare indicators are very similar to tariff reduction consequences, excluding the decline in government revenue – government revenue is not influenced by trade shocks. However the level of initial price difference (P_2-P_1) will be decreasing in the dynamic analysis, because level of production will adjust to new market conditions, and there is a possibility of the export reorientation.

Therefore, the net trade level increases from (Q_d-Q_c) to (Q_b-Q_a), as a result production declines from the Q_b to Q_d, supply on domestic market increase (form Qa minus the level of import to Qc minus the level of import), the domestic demand grows from the level of Qa to the level Qc,.

The table below presents the welfare consequences of the trade shock:

Table 4. 3. Welfare effects in the case of trade shock 20

Welfare estimator	*Direction of Change*	*Value of change*
Change in consumer surplus	Increase	1+2
Change in producer surplus	Decline	1+2+3+4+5
Change in government costs/revenue	Decline in revenue	
Total welfare effect		1+2-1-2-3-4+4 = -(3)

Note: Figures, which squares reflect the change in welfare presented on graph.

Algebraic calculations of welfare changes are presented in Appendix 1.

4.5. Nerlovian coefficients

In this section I will discuss the Nerlove theory of partial adjustment for production, demand and number of livestock functions.

Gaisford and Kerr (2001), Askari and Cummings (1976), More et al (2002) mentioned that such functions accurately reflects the trends of agriculture production and primary food demand.

The Nerlove theory is based on the postulate, that producers make their decision about the desired level of production changes on the base of market conditions. However, they are not always able to react at the desired level in practice, therefore, the real level of changes is a part of the desired level. In the case of livestock sector, we can provide an example, that in the case of price for milk increase, a farmer desires to enlarge its production by 40%, however, by means of decrease in slaughtering for beef he can increase raw milk production only by 20%. Further increase is possible only by enlargement of production capacities – buying of new cows, natural number livestock growth, or technology/feeding improvement. All these measures requires time and capital inputs, therefore they could not be implemented in the short-run period. In this case, the Nerlovian coefficient of partial adjustment will be 0,5.

In the consumers behavior analysis, such partial adjustment can be explained by the psychological factors, such as subjective consumer preferences and low level of short-run response to change in market conditions. Furthermore, in our analysis we consider primary consumption goods, which for some consumers could not be substituted by other goods, at least in short-run. This statement is also supported by Seperovich and Shevtsov (2004), in their theoretical considerations about low elasticity of demand response for change in market conditions.

Providing the reasons for including the Nerloviann coefficient into modeling framework, I further proceed with algebraic derivation of the coefficient.

For the purposes of our analysis, I will use the ratio, or percentage, adjustment coefficient. Derivation of coefficient is described below:

Equation 4.3.

$$\frac{Q_t}{Q_{t-1}} = \left(\frac{Q_t^d}{Q_{t-}} \right)^g ,$$

with Q_t and Q_{t-1} – real value of function in period *t* and *t-1* correspondingly,
Q_t^d – the desired level of function Q.

Then, g reflects the level of adjustment.

Equation 4.4.

$$Q_t = \left(\frac{Q_t^d}{Q_{t-1}} \right)^g * Q_{t-1} = (Q_t^d) * (Q_{t-1})^{1-g}$$

As far as function specification in Partial Equilibrium model are developed on the postulates of producers and consumers rational behavior, these specifications represents the desired level of function. Implementing Nerlove coefficients methodology via including the lagged value into functions estimated will provide us with accurate estimation of real value of function.

Chapter 5

MODEL SPECIFICATION

5.1. Production function specification

Following the discussions of the previous two chapters, I proceed with identification of factors that are expected to influence milk and beef producers in their decision to supply goods to the market.

Here I want to clarify the issue of difference in the terms of production and supply . Even if supply is calculated as a sum of supplied in domestic market and exported, nevertheless for case of beef and especially for case of milk not all goods produced will be supplied. This is mainly caused by the large share of household production, which have a choice between own consumption and supply to the market. However, in further specifications we assume that all production is supplied.

Key determinants of the level of market supply and theoretically expected relationship with production are presented in Table 5.1.

Table 5.1. determinant of production functions

No	Factor	Expected relationship with level of supply
1	Price of the good supplied	Positive
2	Price vector of production factors	Negative
3	Price vector of other agricultural and food goods indexes	Negative
4	Number of livestock at the beginning of the period	Uncertain
5	Level of supply in past period	Positive

6	Dummy for seasonality (base period – Mar-Oct)	Negative

Coefficients of Price for good supplied and prices of production factors and their expected relationship with dependant variable are defined by the theory and need no further discussion. Here I just want to mention that the vector of production factors includes price for feed and price for labor. Price for labor is calculated as a wage level index in agriculture and is the part of my database, described in the beginning Chapter 6. Price for feed is a price index of animal feeding, collected by the State Statistics Committed. Intuitively, here could be included three more production factors – land, capital and energy sources. However, as the majority of agricultural producers obtained the land and capital buildings as a share after reforming the collective farms, or the land with buildings in the long-term rent, and, furthermore, agriculture land could not legally be an object of trade, I did not include this factor into my analysis. Energy sources price are among the most significant for agriculture production, however its impact expected to be much lower for livestock than for crop production. Therefore, price for energy impacts the level of production via price for feed, and don't need to be included into the model as a separate factor.

Prices vector of other agricultural and food goods is defined as following:

- price index of other (not beef and milk) primary livestock products,
- price index of crop production for primary consumption,
- price index of basic processed agricultural goods
- cross-good prices, therefore price for milk for beef production equation and vice verse.

Number of livestock at the beginning of the period is included with purpose to reflect the relationship between beef and milk production. This will benefit for simplification of estimation process. However, the direction of this variable's impact on production is currently uncertain, and it will be discussed below.

Level of supply in previous period reflects the partial response of supply to market structure changes (I refer here to Nerlovian coefficients discussion in Chapter 4).

Dummy variables is included to capture the effect of seasonality of production which is explained by specifics of agriculture (see Chapter 3). Base period for dummy is March-October.

The specification of the production of the second level of vertical aggregation – dairy production function, is a little different from specification of the function of primary agriculture goods production. Again, referring ERS_PENN model described by Abler and Stout (2004) and other sources, the following factors are expected to influence the level of production:

Table 5.2. Determinants of Dairy production function

No	Factor	Expected relationship with level of supply
1	Price ratio (price of dairy/price of raw milk)	Positive
2	Price vector of production factors	Negative
3	Level of production in past period	Positive
4	Dummy for seasonality (base period – Mar-Oct)	Negative

Firstly I would like to note, that level of production is assumed to depend upon level of profitability (expressed as the price ratio variable). In order to avoid multicolinearity, dairy price is not included in the model.

Price vector of production factors consists of price for labor (average wage in industry index) and energy price index.

In this case, the relationship of dependant variable with the level of production in past period expected to be significant and the coefficient is expected to be higher that 0,5, because the technology and capital equipment of dairy production could not be shifted to other goods production in short-term.

5.2. Specification of demand equations

Following the discussions of the previous two chapters, I proceed with identification of factors that are expected to influence raw milk final demand, dairy demand, and beef demand. The demand for milk for processing requires separate discussion, and will be discussed later un this Chapter.

According to theory and surveys of agriculture demand determinants conducted by Seperovich and Shevtsov in 2004 and More et al in 2002, the key determinants of the level of demand are the following: price of good, price for substitutes and supplements (if appropriate for the good analyzed), level of income per capita (expected level, sign and significance depends upon the nature of good, in our case, for beef and dairy income elasticity is expected to be positive and significant, for milk insignificant or very low) and other reasons such as consumer preferences, share of rural/urban population, cultural reasons, etc. The last reasons listed will not be estimated separately in our analysis, because they are outside of targets of this research, their impact in our case will be represented by Nerlovian coefficient (see discussion in Chapter 4). The own price elasticity is expected to be in the interval (0,2-0,4); expected level, sign and significance of income elasticity depends upon the nature of good. Income elasticity for beef and dairy is expected to be positive and significant, for raw milk it is expected to be insignificant or very low)

The discussed factors that influence raw milk final demand level, beef demand level and dairy demand level together their expected relationship with demand functions are listed in Table 5.3

Table 5.3. Determinants of demand functions

No	Factor	Expected relationship with level of demand
1	Price of the good	Negative, in interval (-0,2) – (-0,40
2	Price vector of goods-substitutes	Positive
3	Income per capita	Positive (insignificant for raw milk final demand)
4	Level of demand in past period	Positive in interval (0,5)-(0,7)

In the process of model estimation I will check the hypotheses stated in the above table.

Further in this section I will proceed with specification of demand of raw milk for the purposes of processing. As stated in Stout and Abler (2004), industrial demand for raw milk depends upon the expected level of dairy production, this dependence is linear until the technology is not changed. Therefore, on the base of the statistics of milk demand for dairy production presented by the Association of Dairy Producers of Ukraine, I finish up with the following specification of demand for milk for processing:

Dprocmilk = 1,27 PrDairy, **Equation 5.1**

With Dprocmilk - industrial demand of raw milk, and PrDairy – level of dairy production.

The estimation of the specified equations is presented in Chapter 6.

5.3 Number of livestock equation specification In this section I will address the specification of the number of livestock equation. This equation estimates a base and restrictions for production of beef and raw milk, as well as the performance of livestock sector in general (further discussion of number of livestock as an indicator of agriculture sector performance will be discussed in Chapter 7). In our analysis we use the term *livestock* only for livestock used for milk and beef production.

The decision of producers about the number of livestock depends upon the price of goods produced from livestock and production factors prices . Also we include Nerlovian coefficient in the model. The hypotheses of this coefficient are the following:

- it is statistically significant (nature of livestock keeping supports this, and furthermore, livestock increases by reproducing itself)
- it is possible that Nerlovian coefficient here is higher that 1,00. If it is higher, this means that market conditions do not prevent natural increasing of the livestock.

Factors that influence the number of livestock and the expected relationship of these factors with the number of livestock are presented in the Table below

No	*Factor*	*Expected relationship with level of demand*
1	Price of milk	Positive
2	Price of dairy	Positive
3	Price of beef	Both sided, therefore can't be expected without estimation

4	Level of livestock by the end of the last period	Positive and could be higher than 1
5	Price for production factors	Negative

Some factors and the relationship between factors and dependant variable are not obvious from the theoretical point of view, therfore I will proceed with providing some reasoning for them. Price for dairy is included in the model as a factor of goods produced due to existence of farms aggregated with the processing facilities. They do not supply raw milk in the market, however they produce and supply dairy, and their decision on the number of livestock keeping depends upon the price for dairy.

Price of beef influence the number of livestock in both sides – a farmer can decide to produce more in this period, while the price is high, an therefore the number of livestock will decline. From the other point of view, farmer can decide to accumulate livestock according to rational expectations of further price growth. Therefore, currently the expected relationship is uncertain.

Chapter 6

MODEL ESTIMATION

6.1. Data description.

Data was collected by State Statistics Committee of Ukraine and the United Nations Development Project (Agricultural Database) and processed by the author.

The data describes the livestock market of Ukraine, therefore it was analyzed in the market analysis in Chapter 2.

The data which I use to construct the database for this research was monthly for the period of January 2000 till March 2007.

The processing of data includes the following: adjustment of the level of income by CPI, constructing price indexes and labor price indexes.

Section The 2SLS models estimation procedure, chosen with the purpose to solve the problem of endogeneity in the model, reported statistically significant results for all equations. Furthermore, initial OLS estimation (estimation output presented in Appendixes 3-10), while having a difference from 2SLS results in the value of coefficients, is consistent with 2SLS in the direction of relationship.

Here we don't use 3SLS or GMM for estimating the model, as it is not necessary for the purposes of our analysis, however it must be done, if more detailed or wide research is conducted. Brief analysis of the possible robustness of estimation by 2SLS comparatively to 3SLS is presented at the end of this chapter.

Below I will proceed with the results of 2SLS estimation of the functions.

The results of 2SLS estimation of production of beef, milk and dairy equations are presented below in Table 6.1, Table 6.2, Table 6.3. Tables includes only statistically significant variables, while for the results of regression on all variables listed as the predictors in Chapter 5 I refer to Appendix 3-10. Some discussions and reasoning on both significant and insignificant variables and comparison of their signs and values with expected are provided later in this section.

6.2. Livestock equation estimation results

In this section I will present results of number of livestock equation estimation and some discussion behind these results

The table below includes only statistically significant coefficients, for detailed estimation output I refer to Appendix 8.

Table 6. 1. Livestock number equation estimation results.

No	Predictor	Coefficient and significance level
1	Price for beef	-,208 (,016)
2	Price for raw milk	,039 (,101)
3	Number of livestock in the beginning of the period	1,152 (,000)
5	Constant	Exp(,153) (,626)
	R^2 = 0,982	F=766,619

Firstly, I want to mention, that Price for Dairy appears to be insignificant, that means that either share of joint farms and proceeding plants is low, or they also make the decisions about level of production on the base of raw milk prices, for example if processing production facilities productivity if higher, than farm milk productivity, and producers have to buy additional raw milk for the purposes of production process.

Price for beef is negatively related to the number of livestock, therefore, we conclude, that maximization of profit in current period are more important for farmers than expected profitability level (they decide to slaughter for beef, instead of accumulation of livestock in order to increase the future production level).

Raw milk price elasticity sign is expected, while level if rather low. Again, this supports the idea that future profitability level is not so important in farmers decision-making. As increasing of milk production could not be done immediately due to restrictions of available livestock, farmers do not increase the livestock for possible future proficts.

Nerlovian coefficient of the equation is higher than 1,00. That means, that keeping all other market parameters constant, number of livestock will increase. This allows us to conclude, that applying protection instruments to the livestock sector will gives it possibility to develop, and therefore be efficient

6.3. Production functions estimation results

Table 6.2. Raw milk production Function estimation results.

No	Predictor	Coefficient and significance level
1	Price for raw milk	,512 (,001)
2	Production of milk lagged	-
3	Price for feed	-,905 (,000)
4	Dummy for seasonality	-,354 (,000)

	Number of livestock at the beginning of the period	-,348 (,007)
5	Price index (all agricultural goods)	1,583 (,000)
5	Constant	Exp(11,425) (,000)
	R^2 = 0,865	F=23,278

Note: level of significance is in parenthesis

Level of raw milk production is insignificant in the reports of all methodologies I used to estimate the functions. This result is surprising, because it shows that Nerlovian coefficient of raw milk production equals 1 and production is absolutely elastic to market changes. However, this statement is partially controversial, because the coefficient of the number of livestock in the beginning of the period is significant. Furthermore, logically milk production depends upon the number of livestock. As we saw in the previous section of this Chapter, the Nerlovian coefficient of the number of livestock is significant and even higher than 1, therefore, the elasticity of raw milk production is restricted by the low level of respond of the number of livestock. Furthermore, coefficient of the number of livestock variable is negative, which can be explained by the fact, that while farmers are increasing the livestock, they use raw milk for the purposes of feeding, and therefore, number of supplied production decreases

Elasticity coefficient of price for raw milk and dummy variable coefficient obtained support the hypothesis about sign and value.

Cross-price elacticity (here presented by the coefficient of price index for all other agricultural goods) shows surprising results in sign and level. A possible explanation of this could be the decision-making process about enlargement of agricultural enterprises and increasing/decreasing number of these enterprises. For example, if agricultural price index is growing, producers are more stimulated to attracting more capital (crediting is included) and labor into the enlargement of their production level on the base of expectations of increasing profitability. The same logic lies behind the creating of new farms. As the processes of production of agricultural goods are interrelated, usually the production of goods increased simultaneously.

When analyzing the impact of production factors prices, we could see that the theoretical expectations are not satisfied – price for feed is more significant than price for labor. However, production of milk is rather labor-intensive than feed-intensive. A possible explanation of this is as following: due to high level of rural unemployment and lack of other employment possibilities for farm-workers, the influence of average wage proposed on the decision of whether to supply labor force in labor market or not is not so significant as supposed by the theory. Feed is competitively traded in the market, therefore its price and number supplied is influenced by market forces, therefore it more likely influences the level of production as a production factor price.

Table 6.3. Beef production function estimation results

No	Predictor	Coefficient and significance level
1	Price for beef	,695 (,142)
2	Number of livestock at the beginning of the period	-1,448 (,006)
3	Price for raw milk	-,827 (,000)
4	Price for labor	,814 (,000)
5	Dummy for seasonality	-
6	Constant	Exp (19,793) (,000)
	R^2 = 0,570	F=14,243

Note: level of significance is in parenthesis

All coefficients obtained (except price of labor coefficient) support signs and values expected on the base of theory and methodology. Insignificance of dummy variable is compensated by the significance of prices for beef (however, the level of its significance is surprisingly low), because price for beef is more periodically fluctuated than the price for milk (I refer to Chapter 3 for reasoning).

A possible explanation of higher significance of cross-price elasticity coefficient the own-price elasticity (raw milk and beef correspondingly) could be explained by perfect substitution of milk and beef (but not vise versa) in production process. If a producer decides to decrease the production of milk, he has to decrease the number of milk livestock, which results if increase in beef production. Note that vice versa dependence is not so direct, therefore the production of raw milk is not significantly influenced by prices for beef.

Explanation for number of livestock coefficient is obvious: beef is produced via slaughtering the livestock, consequently the lower is the number of livestock, the less beef could be produced.

Positive significant coefficient of price for labor contradicts theoretical expectations about the sign. However, if we consider that increase in production of beef leads to decrease in number of livestock, and therefore, to decline in the labor necessary for livestock keeping, we can conclude, that expectations of increase in labor price will positively effect the level of beef production. Furthermore, based on the theory of rational expectations, the increase in current price for labor will develop of expectations its of further growth. According to this explanations, positive sign of the coefficient could not be treated as biased statistical estimation.

Nerlovian coefficient appears to be insignificant (see Appendix 4), that can be explained as for the milk production – its effect is captured by the livestock number variable coefficient.

Table 6.4. Dairy production function estimation results

No	Predictor	Coefficient and significance level
1	Price ratio	2,162 (,000)
2	Production of dairy lagged	,164 (,224)
3	Price for labor (industrial)	-,045 (,064)
4	Constant	Exp (7,573) (,000)
	R^2 = 0,745	F=40,281

Notes: price ratio stays for ratio of prices of raw milk to dairy products prices
level of significance is in parenthesis

As it was expected, the coefficient of price ratio variable that reflects the profitability of production is significant and its value is high. This supports the theoretical background after the behavior of agriculture processing industry producers.

Also the significance of Nerlovian coefficient (which is low, but still allows rejecting the hypothesis, that coefficient is statistically zero) provides as with conclusions, that dairy production function *is* a partially responding function. Furthermore, the level of Nerlovian coefficient is 0,164, therefore, real response of dairy production to the market changes is equal 1 – 0,164 = 0,836, i.e. 83%. This level is rather high, and the possible explanation for this is that producers can decrease their production, however, they are not able to re-orient production facilities to other goods production. From the other point, producers are able to increase production level, because their production facilities are not used at all capacity (as noted by the Head of Dairy Producers Association of Ukraine, see Kobuta (2006), however increase of production capacity will require capital inflow and/or technological changes. These reasons explain why the dairy production is partially responding, but the level of immediate response is rather high.

Price for labor coefficient supports theoretical hypothesis about sign and significance. The Seasonal dummy variable was not included into analysis, because the production process of dairy do not depends on the seasonality, as agricultural production do (producers has stocks of dry milk produced from raw milk and ensures the stable level of production through the year).

In this section we discussed results of production functions estimation by the 2SLS procedure. In the next section we will proceed with presentation and discussion of demand functions estimation, and further the whole obtained model including the partial equilibrium closure conditions will be presented.

Section 6.4. Demand functions estimation

In this section I will present results of demand equations estimation and some discussion behind these results

As for the production function estimation, the tables below include statistically significant coefficients, and, some of statistically insignificant but important for our discussion. For detailed estimation output I refer to Appendixes 7,6,9.

Table 6.5. Demand for beef Function estimation results.

No	Predictor	Coefficient and significance level
1	Price for beef	-,549 (,007)
2	Income per capita	,480

		(,000)
3	Price index (all agricultural goods)	,476 (,099)
4	Price for raw milk	-,610 (,000)
5	Constant	Exp (13,934) (,000)
	R^2 = 0,653	F=19,267

Own price elasticity supports the expectations in a sign, however, it does not support the consideration presented in Seperovich and Shevstov (2004) about the expected value interval. The explanation is that these considerations were developed for Ukraine as for typical industrialized country, which may be not exactly true. Also, the demand for meat, including beef, must react to change in price more elastically than in developed countries, because of the difference in its consumption in different groups of population. Consumption of beef in average-income and high-income groups of population are not expected to raise their consumption significantly with the price decline, while low-income part of population is expected to react to the price changes significantly. Furthermore, here we don't analyze separately industrial demand for beef (because we do not analyze proceeding meat products), while industrial demand theoretically is more elastic to price changes due to the substitution effect.

Consequently, the obtained results are reasonable for Ukraine, even if they contradict expected results for industrialized countries.

Income per capita and cross-price elasticities show the expected signs, while elasticity of demand for beef on the price for raw milk is surprising. However, econometrics completely supports the sign and significance level of this coefficient.

Table 6.6. Final raw milk estimation results

No	Predictor	Coefficient and significance level
1	Price for raw milk	-,516 (,005)
2	Price index 2 (livestock goods)	,326 (,000)
3	Income	,207 (,000)
4	Constant	Exp (6,580) (,000)
	R^2 = 0,526	F=16,248

Note: level of significance is in parenthesis

All coefficients have the expected signs, however the own price elasticity is higher than expected, as well as for analyzed above demand for beef equation, and the reasoning for this is very similar. Income elasticity is lower than income elasticity of demand for beef. The reason is that milk is less expensive, and almost all group of population consumes it at sufficient level. Therefore, increase in consumers income effect the demand for milk to the lower extent, than it affects the demand for beef. Cross price elasticity is positive, as expected, however, price index of livestock goods appears to be more significant than overall agricultural prices index, and therefore I included it in the model

Raw milk demand for proceeding will not be discussed in this section, because its is specified proportionally to dairy production function (see Chapter 5) and was not estimated statistically.

Table 6.7. Demand for dairy function estimation results

No	Predictor	Coefficient and significance level
1	Price for dairy	-.847 (,000)
2	Price for raw milk	,428 (,224)
3	Constant	Exp (17,25) (,000)

R^2 = 0,590	F=31,463

Notes: level of significance is in parenthesis

The dairy demand function estimated results appears to be the simplest one, and they completely support theoretical considerations. Own price elasticity value is rather high, because dairy is a processed good with almost perfect substitution effect of the unprocessed input – raw milk. That is why, consumers in case of price increase substitute dairy products with raw milk, especially in rural areas. This substitution effect could also be a reasoning for rather high level of cross-price elasticity. As milk and dairy are first-necessity goods, income elasticity coefficient appears to be insignificant. Therefore, it could be concluded, that in case of income per capita reduction, consumers shift from milk consumption to dairy consumption, and the income elasticity effect is statistically represented in own-price and cross price elasticity.

Furthermore, these estimation results remind us about the problem of endogeneity between demand for milk and demand for dairy. In the case of 3SLS estimation procedure, we could obtain different and more accurate results, including the significance of coefficients. However, it is a proposition for a further research.

Summarizing this section I would like to underline, that none of the Nerlovian coefficients in final demand functions appear to be significant. That means, that for the case of beef, milk and dairy the demand is completely adjusted to market changes.

6.5. Assumptions analysis.

In this section we will discuss the role of assumptions in our model and the approaches to estimate the bias caused by them. In the Chapter 2 we mentioned that econometrically estimated models are usually the most vulnerable to the assumptions defined. In our case assumptions are questioned by including non-homogenous producers into our model: we discussed large farms, small farms and households producers in one equation estimated.

The first assumption of our model states that all producers' behavior is determined by the profit-maximization principle. The literature supports this assumption for developing of econometric models. However, in our estimation this assumption is suspected to bring a significant bias due to large share of household producers, which at the same are factor suppliers for production. Hence supply function estimation may face a problem of non-homogenous of supplier's behavior.

For example, household production, and furthermore the decision to supply production to the market, is influenced by variety of other factors, such as: level of employment, wage in agriculture, income per capita, level of uncertainty, rural development and infrastructure. There appears a possible bias in the production function estimation. The most efficient way to release this assumption is to develop 2 separate production equation and, possibly, livestock number equation – for farms-producers and households producers. However, we will not construct these 2 equations in order to keep our model estimable, nut instead we will try to analyze the possible bias in the process of production equation estimation.

One of the most significant assumption of econometric models estimation is constant relationship, i.e. coefficients of production function are constant through period of data used for estimation. This does not capture the possibility of technological changes. However, based on the agriculture enterprises survey in 2005 in Ukraine, conducted by Ostashko (2004) the producers mentioned, that there were no significant improvement in technologies during 2000-2005.

Therefore, this assumption is realistic and econometric approach to policy analysis suits the case of Ukrainian livestock sector.

Other assumption concerning the producers is their equal access to exporting possibilities. This is definitely not real, but taking into account well grounded assumption of goods homogeneity in domestic market (realistic for the case of Ukraine) we will just assume that goods produced by households that are desired to exported are substituted with the goods produced by farms, while domestic market is a little shift to the higher share of household producers.

In a difference from our case, European studies Bienfield (2003) and Meinke (1999 pay more attention to bias caused by assumptions of consumer side. A lot of discussions of are around of assumption of import-domestic goods level of substitutability. It means, that the competition of these goods is not determined only by price, but also by some transparent or hidden factors of consumer preferences. In some models, for example in IMPACT and ERS-PENN models (see Chapter 2) special coefficient of substitution is included. However, we consider, that beef and milk (especially the last one) market is sufficiently homogenous for our analysis. One of the features of milk and dairy sector in Ukraine is high share of goods produced by joint or multinational companies. These companies usually have their departments in Ukraine and in main trade partners of Ukraine. Therefore, historically Ukrainian milk and dairy market is not distorted by subjective preferences between domestic and imported goods.

6.6. Considerations on 3SLS estimation procedure

By means of conduction 2SLS procedure we obtain more accurate estimation of coefficients, than would obtain is using OLS. We use and assumption of endogeneity between production and prices, demand and prices, production and number of livestock, demand and number of livestock.

In the begging Chapter 5 I presented how the possibility of endogeneity between left-side variables (production and demand variables) of different equations is addressed in the model specification.

However, in this Section I want to come back to this problem again and discuss it from the point of view of statistical criteria. Therefore, this paragraph is devoted to the question if 2SLS estimation was significantly less accurate than estimation of 3SLS.

I used test for endogeneity, developed on the base of Hausman test. The procedure was as follows: I conducted the OLS estimation of endogenous left-side variables on the base of all exogenous variables in the model (one by one). Obtained predicted values and residuals were included in the set of predictors of other endogeneity variables. The results presented in Appendix 3. As they show, we can consider non-significant problem of endogenously between Production and Demand for Milk - the *t*-test shows the significance of coefficient of residuals.

This problem should be addressed separately, however, as these variables do not appear in our model in one equation, and there is no endogeneity between others left-side variables, we will not use the 3SLS procedure for estimation in order not to make our analysis too overloaded by statistical estimation.

However, when using model to analysis of scenarios of raw milk market interventions, this problem and bias that might be caused by it must be taken into account.

C h a p t e r 7

EMPIRICAL IMPLICATIONS OF THE MODEL TO ANALYZE THE EFFECT OF POLICY INSTRUMENTS AND TRADE CONDITIONS

In this Chapter we will provide the examples of empirical implications of the model developed in previous Chapter. We will analyze the following scenarios – reduction in production subsidies, reduction of import tariff and trade shocks. The analysis will be conducted for separate scenarios of beef and milk markets, while the welfare analysis will include changes on both markets (as prices of beef influence the milk market and vice verse).

Special attention will be paid to the trends in number of livestock, as one of the factors of livestock sector potential. As argue Ostashko T. (2003), decreasing tendencies in the number of livestock before entering trade organization eliminated the possibility to develop an export-oriented livestock sector and to ensure the position of the country as a net importer of livestock goods.

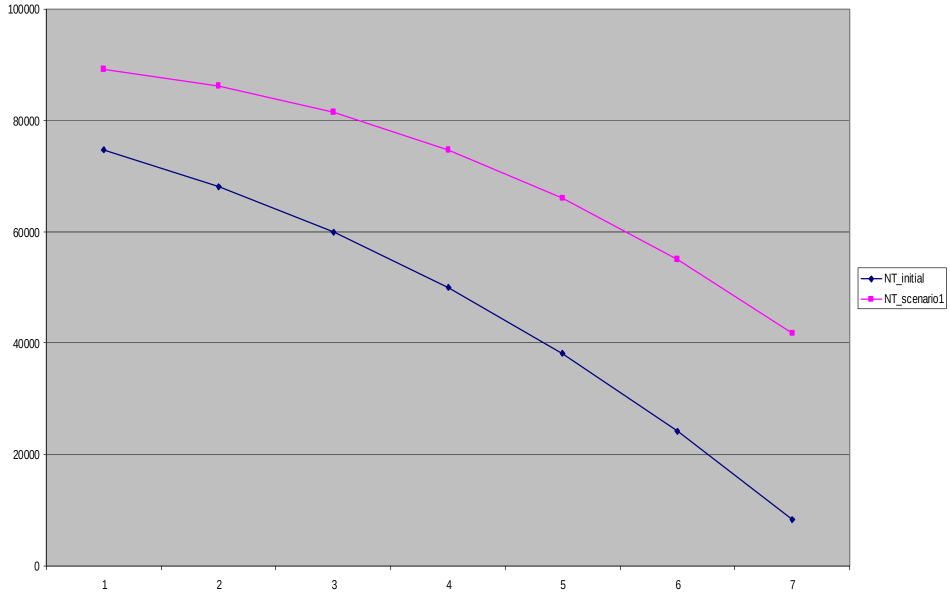
7.1. Reduction in beef production subsidy.

The scenario parameters suppose that the level of production subsidies is decreased by 20%.

For this condition we estimate – the level of net trade in beef, change in the market agents' welfare, and trends of livestock growth.

Net trade trends for initial and analyzed scenarios are presented in Graph 7.1. As it can be seen, net trade in the case of subsidy reduction increases. Explanation is, that due to price increase, domestic demand declines, and therefore more goods are exported.

Graph 7.1. Net trade changes under the case of beef production subsidy eliminating



Changes in welfare (monitored at the 4th month after subsidy reduction are presented in Table7.1.

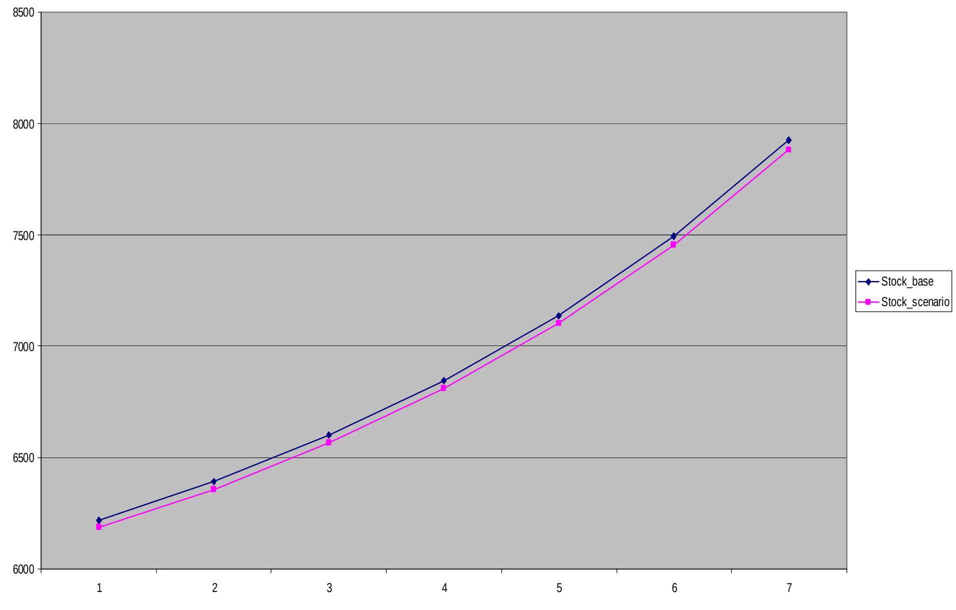
Table 7.1. Welfare changes under the case of beef production subsidy eliminating

	Direction of	Value of change,

	change	mln. UAH
Consumer loss change	Increase in loss	- 480
Producers surplus change	Increase	145
Government revenue/cost change	Decrease in costs	3
Total welfare change	Negative	- 337

Number of livestock is lower than under the basic scenario; however it shows the growing tendency, as presented n Graph 7.2.

Graph 7.2 Number of livestock changes under the case of beef production subsidy eliminating



Therefore, on the base of this analysis we can conclude that, reduction of the production subsidy for beef will not contribute to the process of Ukraine becoming a net importer of beef, while it subsidy reduction will not also prevent this. The overall tendency estimated in the models shows, that Ukraine in time will become a net importer, however, level of net trade is higher than in the base scenario.

From the other hand, consumer loss increases, and the total social welfare changes is negative.

Number of livestock is lower than under the basic scenario, therefore, in general, it negatively influences the livestock sector development potential.

7.2. Import tax reduction.

As it was argued in Chapter 3, current level of ad valorem import tariff for beef is 10%, and it does not exceed the marginal level allowed according to the negotiations between Ukraine and WTO. However, in order to make our analysis consistent and estimate all scenarios of level of protection change, we will here analyze the possible decline in import tariff by 5%.

The results obtained are discussed and presented in Table 7.2 and Diagrams 7.3 ,7.4 below.

Net trade in beef is lower than under base scenario, the trend remains the same as under the base scenario. Therefore, tariff reduction could possibly contribute to loosing by Ukraine it position of net exporter in beef.

Graph 7.3 Net trade changes under import tariff reduction

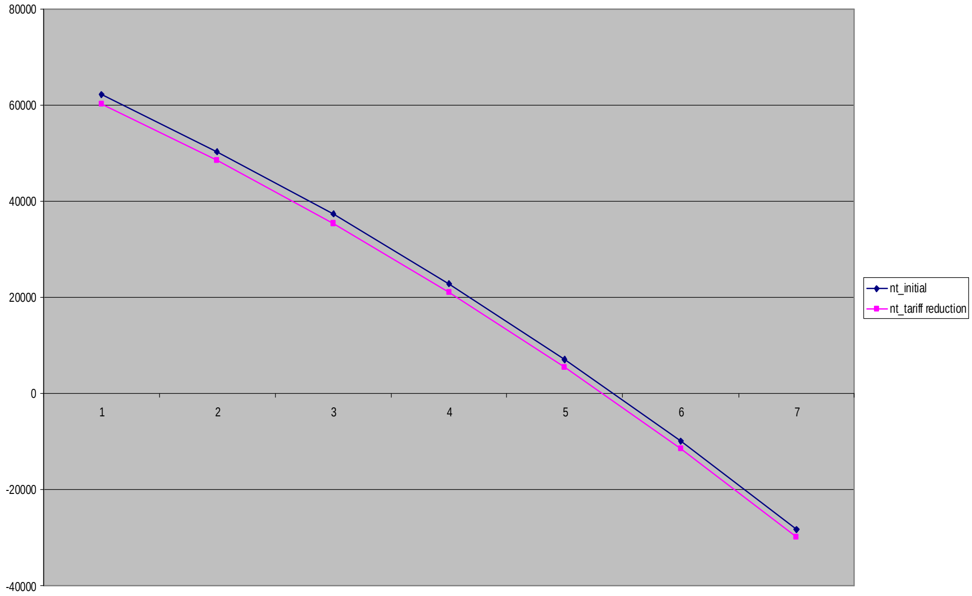
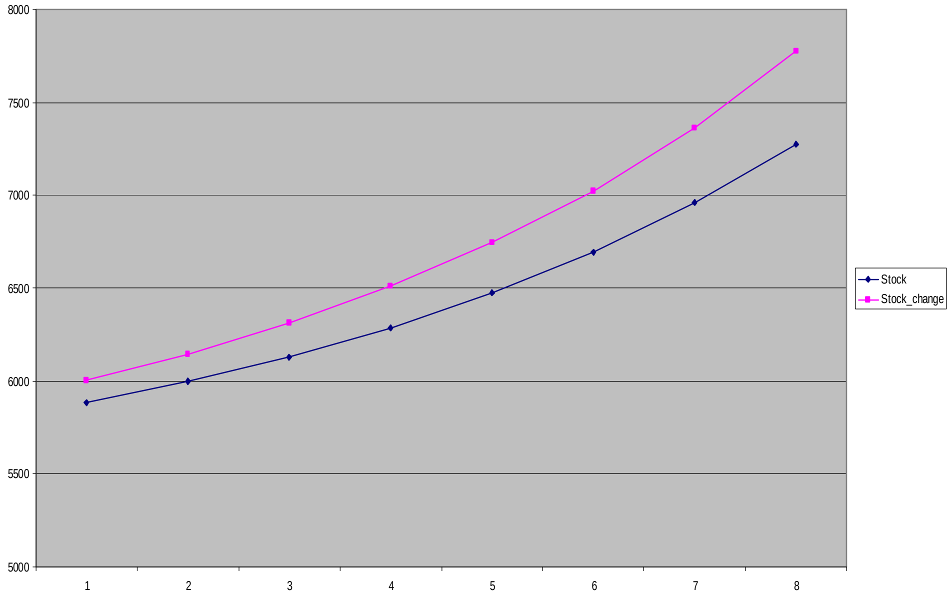


Table 7.2 Wellfare effects under import tariff reduction

	Direction of change	Value of change, mln. UAH
Consumer loss change	Decrease	27
Producers surplus change	Decrease	-167
Government revenue/cost change	Decrease in revenue collected	-0,2
Total welfare change	Negative	- 140

As can be seen from the above Table, decrease in consumer loss is lower than production surplus decrease, therefore the total welfare effect of tariff reduction is negative.

Graph 7.4 Livestock number changes under import tariff reduction



Effect of tariff reduction has a positive effect on the number of livestock, therefore, tariff reduction can be considered as a measure, that improves the potential of livestock sector.

7.3. Trade shock analysis

This scenario supposes, that net trade sharply declines and, as result level of supply in domestic market increases and domestic price goes down.

The output of scenario simulation is presented below. As the Net trade change is in the defining conditions of scenario, there is no need to analyze it further.

However, the results of livestock are reasonable but surprising. The trend of the number of livestock shows much higher speed of growth, than under the basic scenario, that means that trade shock in beef market improves the potential of the livestock sector.

Graph 7.5 Number of livestock changes under the trade shock

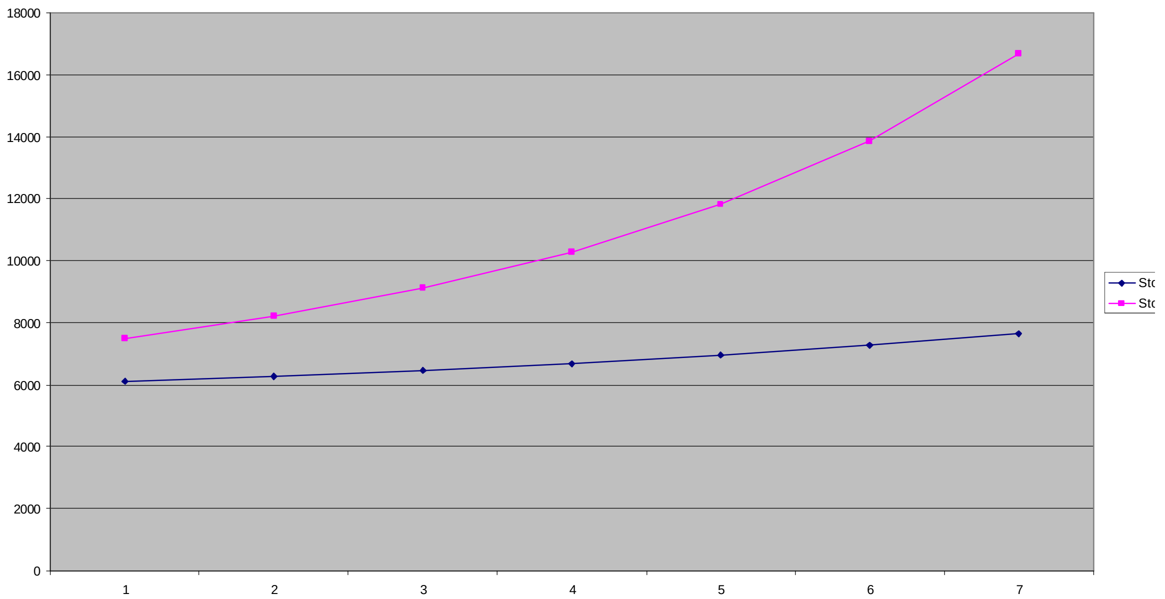


Table 7.3 Wellfare effect under the trade shock

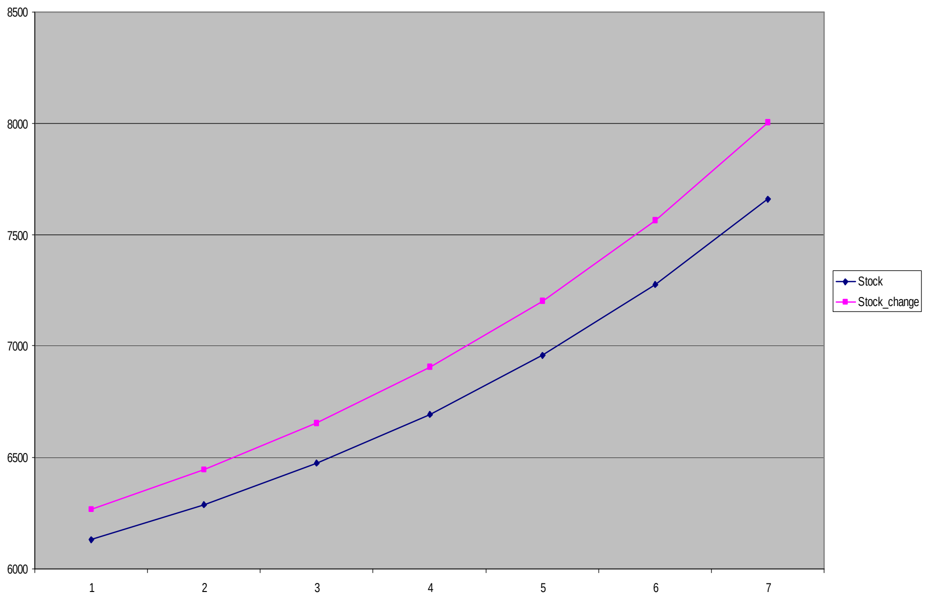
	Direction of change	Value of change, mln. UAH
Consumer loss change	Decrease	856
Producers surplus change	Decrease	-258
Government revenue/cost change		0
Total welfare change	Positive	140

As can be seen from the table above, trade shock yields in positive effect on the total welfare, because the decrease in consumer loss is higher than decrease in producer surplus.

7.4. Eliminating of the production subsidy for milk analysis

Eliminating of production subsidy for milk, as expected, will result in price increase and production decline. Analyzing the trends of the livestock number, we can conclude, that livestock number for the analyzed scenario in each period is higher than for the basic scenario.

Graph 7.6. Number of livestock changes under subsidy elimination



Net trade under the analyzed scenario remains in each period lower, than in basic scenario(see Graph 7.7)., however id does not go below zero.

Graph 7.7.Net trade changes under subsidy elimination

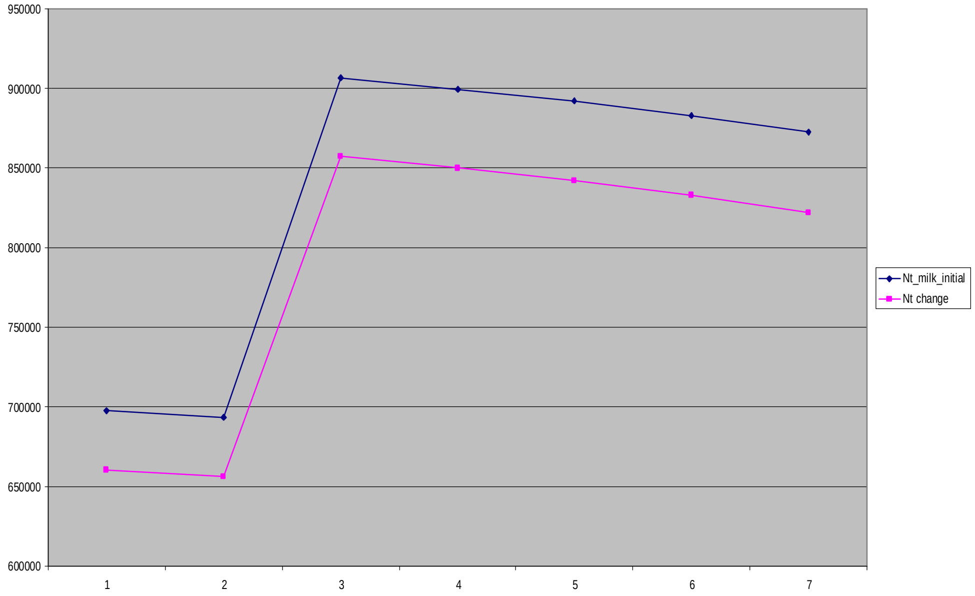


Table 7.4.Welfare analysis under subsidy elimination

	Direction of change	Value of change, mln. UAH
Consumer loss change	Increase	- 0,017
Producers surplus change	Increase	13,5
Government revenue/cost change	Cost decrease	0,8
Total welfare change	Positive	14,3

Consequently, on the base of discussion of this section we can conclude, that eliminating of the milk production subsidy leads to decline in the level of net yrade, however it does not become negative, total welfare increases, mainly due to producers surplus increase as a result of price changes, and livestock number increases. These trends yield into improvement of livestock sector potential.

7.5. Import tariff for milk and dairy products reduction.

As it was mentioned in Chapter 3 of this research, average level of import tax on raw milk and dairy products is 27%, allowed marginal level of tariff is

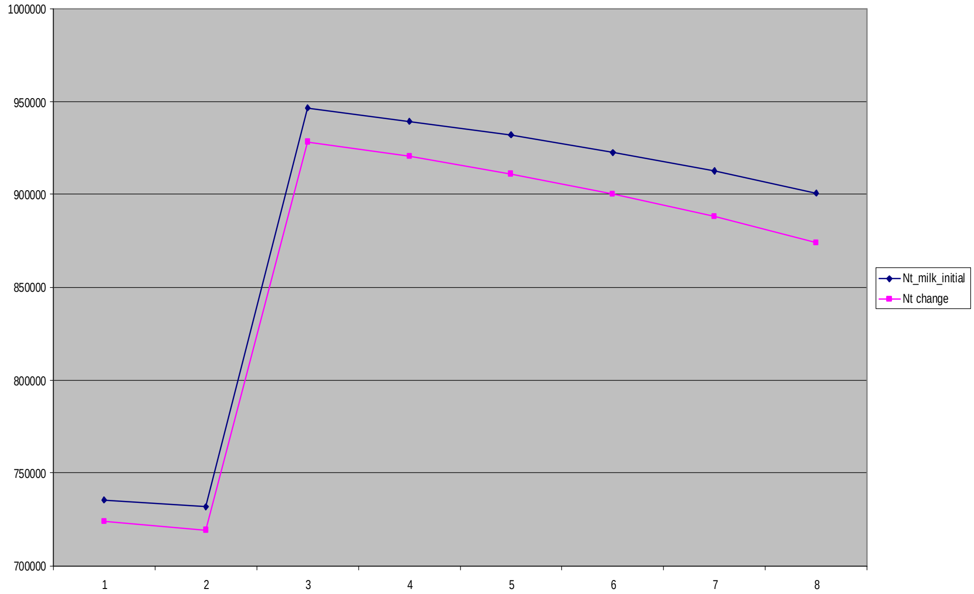
13,5%. Hence, it is useful to simulate and analyze how tariff rate reduction influences the milk and dairy market

Table 7.5 welfare analysis under import tariff reduction

	Direction of change	Value of change, mln. UAH
Consumer loss change	Decrease	+0,013
Producers surplus change	Decrease	-13,5
Government revenue/cost change	Revenue decline	-0,2
Total welfare change	Negative	-13,7

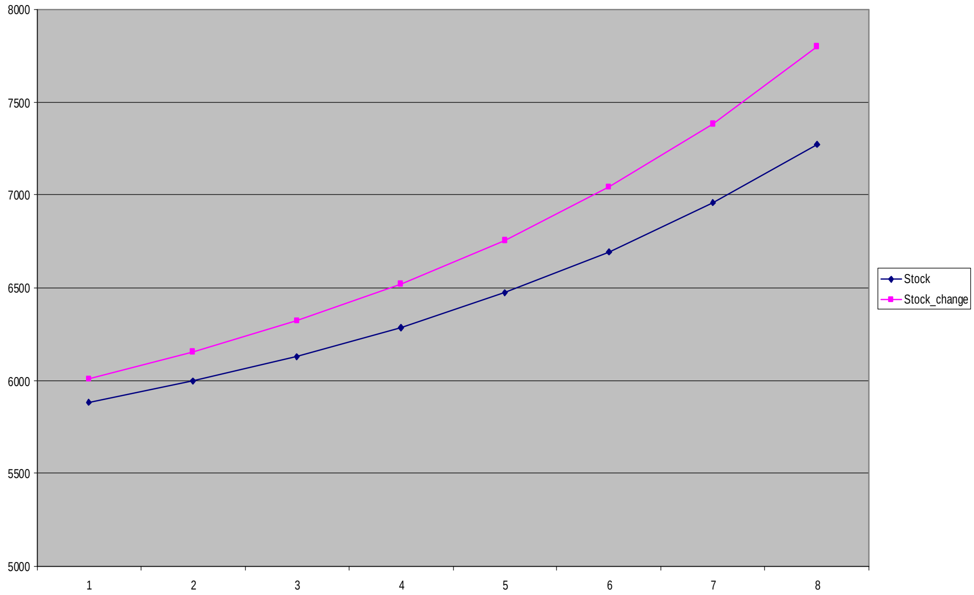
Net trade is lower than the initial level, that is logical due to liberalization of market access for foreign producers. Sharp increase is partially caused by seasonality.

Graph 7.8. Net trade changes under import tariff reduction



Livestock under the scenario analyzed is higher than in the initial scenario, therefore, reduction in tariff rate improves the potential of livestock sector.

Graph 7.9. Number of livestock changes under import tariff reduction



7.6. Trade shock in milk and dairy trade analysis

The results of the scenario simulation shows that in months after trade shock the number of livestock becomes lower under analyzed scenario, than under base scenario, and this difference increases in time.

Furthermore, this analysis provides us with a transparent example of usability of simulation model – static analysis of the first month shows that livestock number is higher that under the base scenario and trade shock even improve the performance of the sector. However, further simulation analysis contradicts this statement.

Graph 7.10. Number of livestock changes under trade shock

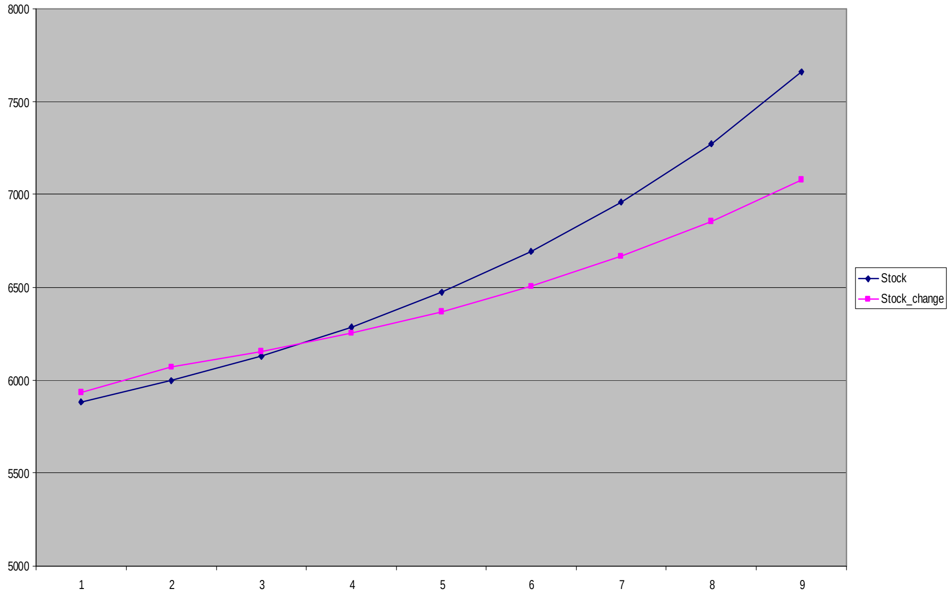


Table 7.6. The impact of trade shock on the total welfare

	Direction of change	Value of change, mln. UAH
Consumer loss change	Decrease	+0,18
Producers surplus change	Decrease	-127
Government revenue/cost change		0
Total welfare change	Negative	-127

The impact of trade shock on the total welfare is negative and significant.

Concluding that Chapter I would like to underline that reduction or eliminating production subsidies on both beef and milk and dairy market leads to improve in potential of livestock sector, however, influence of these policy measures of total welfare are different: while reduction of beef production subsidy benefits total welfare, eliminating of milk production subsidy leads to decline in total welfare.

Import tariff reduction in both cases reduces the social welfare, however, it improves the potential of livestock sector by means of livestock accumulation trend.

Trade shocks simulation shows the most interesting results. Its appears, that trade shock simulation analysis contradicts the static analysis results that could be obtained in the first period.

Main changed in livestock number, for example, started in the third month after the trade shock.

As the results show, the beef trade shock benefits the sector potential, while milk and dairy trade shock is harmful to it.

Chapter 8.

CONCLUSIONS AND PROPOSITIONS FOR FURTHER RESEARCH

In my thesis I estimated and analyzed the simulation model of the livestock sector of the Ukraine and applied it for the empirical scenario analysis.

Results obtained supported the theoretical expectations and previous literature in this sphere results. However, the analysis shows that trade shock can leas to an improvement in the livestock sector performance.

Also I concluded that no government intervention at this point is Pareto efficient.

In this thesis we constructed the model using the limited number of factors. Obviously, the model developed on the base on wider of range of factors, including some variables from other sectors of economy will estimate the policy scenarios more correctly.

From the other hand, the model developed does not address the impact of trade shocks and policy instruments on the social and economic parameters of rural sector. For example any reduction in number of livestock will lead either to increase in rural unemployment (or switch to non-farm rural employment) or to decline in number of household livestock producers. As far as rural development is one of the important questions in process of economic integration, the relationship between trade policy instruments and rural development indictors could be interesting to analyze.

Methodology of model estimation that we used in this thesis could also be improved. In the procedure we omitted the dependence between production and demand levels of different goods. Here we compensated it by including cross-price coefficients and the livestock equation into the model. However the econometric theory supports using 3SLS method in such situation.

BIBLIOGRAPHY

Bienfield P, et al *Reforming the CAP: A Partial Equilibrium Analysis of the MTR Propsals,* International conference of Agricultural economists, 2003

Bienfield P, et al *The econometric Accounting for Trade,* The World Bank working paper, 1995

Confornoti P, *Partial equilibrium Analysis of policy Impacts Part II FAO Training materials* , NAPC, 2002

Evenson R, et al *Methods for Agricultural policy Analysis* Journal of Philippine development, Volume XIII 1986

Gaisford J.D. and Kerr W.A. *Economic Analysis for International Trade Negotiations: The WTO and Agricultural Trade*, Edward Elgar Publishing, Ltd.

Garaulet, J. *Glossary of the Common Agricultural Policy and the Agenda 200 Reform*, European Parliament, Luxembourg, 2000

Garforth C, Rehman T, *Review o models for Agricultural Policy Analysis.*, Project report, 2006

Kobuta I, *WTO Accession And Agriculture's State Support* WTO accession new possibilities for Ukraine (brochure), 2006

Kuhn A, *RAMSU: Regional Agricultural Sector Model for Ukraine* , Working paper#27 Institute for economic Reaserch and Policy Consulting, 2004

Meilke K, *A Proposed framework for an International Multicommodity framework,* University of Guleph Press, 1999

Meyer, F.H, *Theoretical Foundation of Partial Equlilibrium Modelling,* University of Pretoria Press, 2003

More, D, Sckokai, P and Soregapoli C. *A partial equilibrium model or the beef and milk sector in Italy under Imperfect Competition*, EAAE Congress, Contributed Paper Proposal, 2002.

Nivjevskiy O, *Analysis of Compatibility of Agricultural Goods* WTO accession new possibilities for Ukraine (brochure), 2004

Ostashko T, *Ukraine's Agriculture in WTO Conditions: Producerss' Expectations and Analytical Forecasting,* Economy of Ukraine, Vol 6, 2002

Ostashko T, , *Ukraine's Agriculture Perspectives After Joining the WTO* WTO accession new possibilities for Ukraine (brochure), 2005

Ostashko T, Ostashko H. ,*Ukraine in the Process of WTO and EU accession*, Insitute for Rural development, 2006

Pavel, F, Burakovsky I, and others. *Economic Impact of Ukrainian WTO accession. First Results From a Computed General Equlilibrium Model* , Institue for Economic Reasearch and Policy consulting, Kiev, 2004.

Perali F, *Partial equilibrium Analysis of policy Impacts Part I FAO Training materials* , NAPC, 2002

Seperovich N, Shevtsov O, *Determinants of agricultural* WTO accession new possibilities for Ukraine (brochure), 2006

Zorya, S. *Improving agricultural Fiscal Policy In Ukraine* , The World Bank working paper, 2006

Zhao X, et al, *The competitive structure of Australian Beef Industry: Accounting for Trade*, The World Bank working paper, 1995

Appendix 1. Algebraic calculation of welfare effects

1. Welfare effect calculations for the subsidy reduction case.

$$\Delta S = \int_{p_2}^{p_i} Q^d(P)$$

$$\Delta CS = \int_{p_1}^{p_2} Q_2^{pr}(P) - \int_{p_1}^{p_2} Q_1^{pr}(P)$$

$$\Delta GR = (P_2 - P_1) * (Q_a - Q_c)$$

2. Welfare effect calculation for the tariff rate reduction case

$$\Delta CS = \int_{p_2}^{p_i} Q^d(P)$$

$$\Delta PS = \int_{p_1}^{p_2} Q^{pr}(P)$$

$$\Delta GR = (P_2 - P_1) * (Q_d - Q_c)$$

3 Welfare effect calculation for the trade shock case

$$\Delta CS = \int_{p_2}^{p_i} Q^d(P)$$

$$\Delta PS = \int_{p_1}^{p_2} Q^{pr}(P)$$

$$\Delta GR = 0$$

Appendix 2. Results of Hausman test for simultaneity between production variables and price variables, demand variables and price variables, livestock_number variable and price variables

Pr Milk

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	pRE_p_mILK, rES_p_MILk(a)	.	Enter

a All requested variables entered.
b Dependent Variable: LnPrMilk

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	1,000(a)	1,000	1,000	,000000000

a Predictors: (Constant), pRE_p_mILK, rES_p_MILk
b Dependent Variable: LnPrMilk

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6,908	,000		.	.
	Res_p_MILk	1,000	,000	,788	.	.
	Pre_p_mILK	1,000	,000	,616	.	.

a Dependent Variable: LnPrMilk

Hausman_1 DMilk

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	9,180	,601		15,276	,000
	rES_p_MILk	-,328	,067	-,524	-4,889	,000
	pRE_p_mILK	-,367	,086	-,457	-4,265	,000

a Dependent Variable: LNDMILK

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,695(a)	,483	,460	,118178919

a Predictors: (Constant), pRE_p_mILK, rES_p_MILk
b Dependent Variable: LNDMILK

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	pRE_p_mILK, rES_p_MILk (a)	.	Enter

a All requested variables entered.
b Dependent Variable: LNDMILK

HAusman 1 – Pr Beef

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	rES_p_bEEF, pRE_p_bEEF(a)	.	Enter

a All requested variables entered.
b Dependent Variable: LnPrBEEF

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,293(a)	,086	,045	,2496367

a Predictors: (Constant), rES_p_bEEF, pRE_p_bEEF
b Dependent Variable: LnPrBEEF

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	13,679	1,634		8,374	,000
	pRE_p_bEEF	-,176	,196	-,128	-,899	,373
	rES_p_bEEF	-1,167	,632	-,263	-1,845	,072

a Dependent Variable: LnPrBEEF

Hausman_1 DBeef

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	res_p_beef pre_p_beef	.	Enter

a All requested variables entered.
b Dependent Variable: LnDBEFF

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,211(a)	,044	,002	,2764922

a Predictors: (Constant), rES_p_bEEF, pRE_p_bEEF
b Dependent Variable: LnDBEFF

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	12,540	1,809		6,931	,000
	Pre_p_beef	-,041	,217	-,028	-,189	,851
	Res_p_beef	-1,004	,700	-,209	-1,433	,159

a Dependent Variable: LnDBEFF

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	Res_p_milk, Pre_p_milk, Res_p_beef, Pre_p_beefF(a)	.	Enter

a All requested variables entered.
b Dependent Variable: LNSTOCK

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,900(a)	,809	,792	,135662617

a Predictors: (Constant), rES_p_MILk, pRE_p_mILK, rES_p_bEEF, pRE_p_bEEF
b Dependent Variable: LNSTOCK

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-3,437	1,037		-3,313	,002
	Pre_p_bEEF	1,413	,108	,885	13,069	,000
	Res_p_bEEF	,291	,347	,056	,839	,406
	Pre_p_mILK	,023	,100	,016	,232	,818
	Res_p_MILk	-,165	,078	-,142	-2,116	,040

a Dependent Variable: LNSTOCK

Hausman_1 Ddairy

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	res_dairy, pre_dairy(a)	.	Enter

a All requested variables entered.
b Dependent Variable: lnD_dairy

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,228(a)	,052	,009	,12335013

a Predictors: (Constant), res_dairy, pre_dairy
b Dependent Variable: lnD_dairy

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	16,000	2,747		5,825	,000
	pre_dairy	-,421	,275	-,224	-1,529	,133
	res_dairy	,208	,844	,036	,246	,807

a Dependent Variable: lnD_dairy

Hausman 1 – Pr DAiry

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	res_dairy, pre_dairy(a)	.	Enter

a All requested variables entered.
b Dependent Variable: LnDprocmilk

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,238(a)	,056	,015	,125146608

a Predictors: (Constant), res_dairy, pre_dairy
b Dependent Variable: LnDprocmilk

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	16,423	2,777		5,914	,000
	pre_dairy	-,457	,278	-,238	-1,640	,108
	res_dairy	,027	,848	,005	,032	,975

a Dependent Variable: LnDprocmilk

Appendix 3. Output of Hausman test for simultaneity between Production variables and demand variables

LnDProcMilk **Coefficients(a)**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	16,677	3,042		5,482	,000
	Pre_dairy	-,603	,697	-,314	-,865	,392
	Res_dairy	,960	,366	,164	2,622	,013
	Pre_d_Milk	-,323	,439	-,311	-,736	,466
	Res_d_Milk	-,258	,127	-,216	-2,037	,049
	Pre_Pr_MILK	,274	,185	,435	1,482	,147
	Res_Pr_MILK	,118	,052	,241	2,260	,030
	Pre_PR_BEEF	-,441	,202	-,598	-2,185	,035
	Pr_dBeef	,404	,154	,555	2,621	,013
	Res_D_BEEF	-,094	,056	-,161	-1,694	,098

a Dependent Variable:

ANOVA(b)

Model		Sum of SquaRes	df	Mean Square	F	Sig.
1	RegRession	,649	9	,072	28,110	,000(a)
	Residual	,098	38	,003		
	Total	,747	47			

a Predictors: (Constant), Res_D_BEEF, Pr_dBeef, Pre_dairy, Res_dairy, Pre_Pr_MILK, Res_d_Milk, Res_Pr_MILK, Pre_PR_BEEF, Pre_d_Milk
b Dependent Variable: LnDProcMilk

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,932(a)	,869	,838	,050664529

a Predictors: (Constant), Res_D_BEEF, Pr_dBeef, Pre_dairy, Res_dairy, Pre_Pr_MILK, Res_d_Milk, Res_Pr_MILK, Pre_PR_BEEF, Pre_d_Milk
b Dependent Variable: LnDProcMilk

Variables Entered/Removed(b)

Model	Variables Entered	Variables Re	Method

		mov ed	
1	Res_D_BEEF, Pr_dBeef, Pre_dairy, Res_dairy, Pre_Pr_MILK, Res_d_Milk, Res_Pr_MILK, Pre_PR_BEEF, Pre_d_Milk(a)	.	Enter

a All requested variables entered.
b Dependent Variable: LnDProcMilk

LNSTOCK **Coefficients(a)**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	196,102	24,189		8,107	,000
	Pre_d_Milk	-8,052	1,170	-3,191	-6,881	,000
	Res_d_Milk	,241	,209	,086	1,153	,256
	Res_Pr_MILK	-,089	,095	-,077	-,945	,351
	Pre_Pr_MILK	2,797	,219	1,785	12,758	,000
	Pre_d_dAIRY	-14,960	1,676	-4,581	-8,928	,000
	Res_D_dAIRY	-,331	,237	-,092	-1,396	,171
	Pre_PR_BEEF	-6,000	,580	-3,459	-10,349	,000
	Res_Pr_Beef	-,225	,246	-,143	-,915	,366
	Pr_dBeef	6,278	,626	3,669	10,030	,000
	Res_D_BEEF	,026	,230	,019	,113	,910

a Dependent Variable:

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,974(a)	,948	,934	,076834813

a Predictors: (Constant), Res_D_BEEF, Pre_PR_BEEF, Pre_d_Milk, Res_D_dAIRY, Pre_Pr_MILK, Res_Pr_MILK, Res_d_Milk, Pr_dBeef, Res_Pr_Beef, Pre_d_dAIRY
b Dependent Variable: LNSTOCK

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	Res_D_BEEF, Pre_PR_BEEF, Pre_d_Milk, Res_D_dAIRY, Pre_Pr_MILK, Res_Pr_MILK, Res_d_Milk, Pr_dBeef, Res_Pr_Beef, Pre_d_dAIRY(a)	.	Enter

a All requested variables entered.
b Dependent Variable: LNSTOCK

ANOVA(b)

Model		Sum of SquaRes	df	Mean Square	F	Sig.
1	RegRession	3,908	10	,391	66,196	,000(a)
	Residual	,213	36	,006		

Total	4,120	46			

a Predictors: (Constant), Res_D_BEEF, Pre_PR_BEEF, Pre_d_Milk, Res_D_dAIRY, Pre_Pr_MILK, Res_Pr_MILK, Res_d_Milk, Pr_dBeef, Res_Pr_Beef, Pre_d_dAIRY
b Dependent Variable: LNSTOCK

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	32,968	29,484		1,118	,271
	pre_dairy	-,572	1,835	-,235	-,312	,757
	res_dairy	,509	,477	,068	1,067	,293
	pRE_pr_MILK	,422	,658	,503	,642	,525
	rES_pr_MILK	-,076	,070	-,123	-1,085	,286
	pRE_PR_BBEF	-,914	,861	-,983	-1,062	,296
	pR_dbEEF	,870	,717	,948	1,214	,233
	rES_D_BEEF	,210	,076	,284	2,762	,009
	res_D_dAIRY	-,155	,209	-,081	-,744	,462
	pRE_d_dAIRY	-2,161	1,587	-1,233	-1,361	,182
	PRE_STOCK	-,056	,091	-,102	-,612	,544
	rES_STOCK	,477	,258	,173	1,850	,073

a. Dependent Variable: LNDMILK

ANOVA(b)

Model		Sum of SquaRes	df	Mean Square	F	Sig.
1	RegRession	1,064	11	,097	27,951	,000(a)
	Residual	,121	35	,003		
	Total	1,186	46			

a Predictors: (Constant), Res_STOCK, Pre_PR_BEEF, PRE_STOCK, Res_dairy, Res_D_BEEF, Pre_Pr_MILK, Res_D_dAIRY, Res_Pr_MILK, Pre_d_dAIRY, Pre_dairy, Pr_dBeef
b Dependent Variable: LNDMILK

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,948(a)	,898	,866	,058838066

a Predictors: (Constant), Res_STOCK, Pre_PR_BEEF, PRE_STOCK, Res_dairy, Res_D_BEEF, Pre_Pr_MILK, Res_D_dAIRY, Res_Pr_MILK, Pre_d_dAIRY, Pre_dairy, Pr_dBeef
b Dependent Variable: LNDMILK

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method

1	Res_STOCK, Pre_PR_BEEF, PRE_STOCK, Res_dairy, Res_D_BEEF, Pre_Pr_MILK, Res_D_dAIRY, Res_Pr_MILK, Pre_d_dAIRY, Pre_dairy, Pr_dBeef(a)	.	Enter

a All requested variables entered.
b Dependent Variable: LNDMILK

LnPrMilk **Variables Entered/Removed(b)**

Model	Variables Entered	Variables Removed	Method
1	Res_d_Milk, Pre_PR_BEEF, PRE_STOCK, Res_dairy, Res_STOCK, Pre_d_dAIRY, Res_D_BEEF, Res_D_dAIRY, Pre_dairy, Pr_dBeef, Pre_d_Milk(a)	.	Enter

a All requested variables entered.
b Dependent Variable:

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,925(a)	,856	,810	,138971279

a Predictors: (Constant), Res_d_Milk, Pre_PR_BEEF, PRE_STOCK, Res_dairy, Res_STOCK, Pre_d_dAIRY, Res_D_BEEF, Res_D_dAIRY, Pre_dairy, Pr_dBeef, Pre_d_Milk
b Dependent Variable: LnPrMilk

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-56,648	28,002		-2,023	,051
	Pre_dairy	1,816	1,802	,376	1,008	,321
	Res_dairy	-1,013	1,132	-,068	-,895	,377
	Pre_PR_BEEF	1,590	,826	,860	1,924	,063
	Pr_dBeef	-1,507	,956	-,826	-1,576	,124
	Res_D_BEEF	-,484	,181	-,329	-2,672	,011
	Res_D_dAIRY	,273	,495	,071	,552	,584
	Pre_d_dAIRY	3,614	2,293	1,038	1,576	,124
	PRE_STOCK	,077	,261	,071	,297	,768
	Res_STOCK	-1,592	,579	-,291	-2,752	,009
	Pre_d_Milk	1,222	2,183	,454	,560	,579
	Res_d_Milk	-,426	,393	-,142	-1,085	,286

a Dependent Variable: LnPrMilk

ANOVA(b)

Model		Sum of SquaRes	df	Mean Square	F	Sig.
1	RegRession	4,008	11	,364	18,866	,000(a)
	Residual	,676	35	,019		
	Total	4,684	46			

a Predictors: (Constant), Res_d_Milk, Pre_PR_BEEF, PRE_STOCK, Res_dairy, Res_STOCK, Pre_d_dAIRY, Res_D_BEEF, Res_D_dAIRY, Pre_dairy, Pr_dBeef, Pre_d_Milk
b Dependent Variable: LnPrMilk

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	Pre_Pr_MILK, Res_D_dAIRY, Res_dairy, PRE_STOCK, Res_STOCK, Res_D_BEEF, Res_d_Milk, Res_Pr_MILK, Pre_d_Milk, Pre_d_dAIRY, Pre_dairy(a)	.	Enter

a All requested variables entered.
b Dependent Variable: LnPrBEEF

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,954(a)	,910	,881	,0885888

a Predictors: (Constant), Pre_Pr_MILK, Res_D_dAIRY, Res_dairy, PRE_STOCK, Res_STOCK, Res_D_BEEF, Res_d_Milk, Res_Pr_MILK, Pre_d_Milk, Pre_d_dAIRY, Pre_dairy
b Dependent Variable: LnPrBEEF

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	35,788	10,505		3,407	,002
	Pre_dairy	-7,329	,951	-1,883	-7,707	,000
	Res_dairy	-,672	,730	-,056	-,920	,364
	Res_D_BEEF	,777	,127	,655	6,138	,000
	Res_D_dAIRY	-,281	,317	-,091	-,888	,381
	Pre_d_dAIRY	,135	,666	,048	,202	,841
	PRE_STOCK	,387	,127	,441	3,040	,004
	Res_STOCK	-,403	,407	-,091	-,991	,329
	Pre_d_Milk	3,805	,615	1,755	6,182	,000
	Res_d_Milk	,367	,254	,152	1,442	,158
	Res_Pr_MILK	,120	,108	,121	1,115	,273
	Pre_Pr_MILK	1,403	,280	1,042	5,016	,000

a Dependent Variable: LnPrBEEF

ANOVA(b)

Model		Sum of SquaRes	df	Mean Square	F	Sig.
1	RegRession	2,766	11	,251	32,040	,000(a)
	Residual	,275	35	,008		
	Total	3,041	46			

a Predictors: (Constant), Pre_Pr_MILK, Res_D_dAIRY, Res_dairy, PRE_STOCK, Res_STOCK, Res_D_BEEF, Res_d_Milk, Res_Pr_MILK, Pre_d_Milk, Pre_d_dAIRY, Pre_dairy
b Dependent Variable: LnPrBEEF

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,146	16,609		-,009	,993
	Pre_dairy	-6,878	1,500	-1,632	-4,587	,000
	Res_dairy	,372	1,151	,029	,323	,749
	Res_D_dAIRY	-1,102	,449	-,330	-2,452	,019
	Pre_d_dAIRY	2,598	1,053	,855	2,467	,019
	PRE_STOCK	,467	,201	,492	2,321	,026
	Res_STOCK	-1,818	,530	-,381	-3,431	,002
	Pre_d_Milk	5,043	,971	2,149	5,196	,000
	Res_d_Milk	,854	,365	,326	2,343	,025
	Res_Pr_MILK	-,349	,155	-,325	-2,249	,031
	Pre_Pr_MILK	,933	,441	,640	2,118	,041

a Dependent Variable: LnDBEFF

ANOVA(b)

Model		Sum of SquaRes	df	Mean Square	F	Sig.
1	RegRession	2,859	10	,286	14,572	,000(a)
	Residual	,706	36	,020		
	Total	3,565	46			

a Predictors: (Constant), Pre_Pr_MILK, Res_D_dAIRY, Res_dairy, PRE_STOCK, Res_STOCK, Res_d_Milk, Res_Pr_MILK, Pre_d_Milk, Pre_d_dAIRY, Pre_dairy
b Dependent Variable: LnDBEFF

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,895(a)	,802	,747	,1400603

a Predictors: (Constant), Pre_Pr_MILK, Res_D_dAIRY, Res_dairy, PRE_STOCK, Res_STOCK, Res_d_Milk, Res_Pr_MILK, Pre_d_Milk, Pre_d_dAIRY, Pre_dairy
b Dependent Variable: LnDBEFF

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	Pre_Pr_MILK, Res_D_dAIRY, Res_dairy, PRE_STOCK, Res_STOCK, Res_d_Milk, Res_Pr_MILK, Pre_d_Milk, Pre_d_dAIRY, Pre_dairy(a)	.	Enter

a All requested variables entered.
b Dependent Variable: LnDBEFF

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	13,985	2,835		4,934	,000
	Pre_dairy	,074	,585	,040	,127	,900
	Res_dairy	1,184	,401	,206	2,955	,005
	PRE_STOCK	,019	,078	,046	,248	,806
	Res_STOCK	-,313	,200	-,147	-1,564	,126
	Pre_d_Milk	-,674	,288	-,645	-2,339	,025
	Res_d_Milk	-,315	,132	-,271	-2,395	,022
	Res_Pr_MILK	,114	,057	,238	1,991	,054
	Pre_Pr_MILK	,098	,161	,152	,613	,544

a Dependent Variable: lnD_dairy

ANOVA(b)

Model		Sum of SquaRes	df	Mean Square	F	Sig.
1	RegRession	,592	8	,074	24,659	,000(a)
	Residual	,114	38	,003		
	Total	,706	46			

a Predictors: (Constant), Pre_Pr_MILK, Res_Pr_MILK, PRE_STOCK, Res_dairy, Res_STOCK, Res_d_Milk, Pre_d_Milk, Pre_dairy
b Dependent Variable: lnD_dairy

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,916(a)	,838	,804	,05478403

a Predictors: (Constant), Pre_Pr_MILK, Res_Pr_MILK, PRE_STOCK, Res_dairy, Res_STOCK, Res_d_Milk, Pre_d_Milk, Pre_dairy
b Dependent Variable: lnD_dairy

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	Pre_Pr_MILK, Res_Pr_MILK, PRE_STOCK, Res_dairy, Res_STOCK, Res_d_Milk, Pre_d_Milk, Pre_dairy(a)	.	Enter

a All requested variables entered.
b Dependent Variable: lnD_dairy

Appendix 4. A. Estimation output of beef production function: regression on significant variables

Model Description

		Type of Variable
Equation 1	LnPrBEEF	dependent
	LnStock_lag_1	predictor
	LNPBEEF	predictor
	LNPMILK	predictor
	LNPLABOR	predictor
	LnInc	instrumental
	LnPother_all	instrumental
	LnPother_crop	instrumental
	LnPOther_animal	instrumental
	LnDMilk_lag_1	instrumental
	ln_Price_ratio	instrumental
	LnPdairy	instrumental
	LnStock_lag_2	instrumental
	LnPbeef_lag_1	instrumental
	LnPMilk_lag_1	instrumental
	LnPFeed_lag_1	instrumental
	LnPLabor_lag_1	instrumental
	LnPBeef_lag_2	instrumental
	LnPFeed_lag_2	instrumental
	LnPMilk_lag_2	instrumental

	LnPLabor_lag_2	instrumental

MOD_37

Model Summary

Equation 1	Multiple R	,755
	R Square	,570
	Adjusted R Square	,530
	Std. Error of the Estimate	,186

Coefficients

		Unstandardized Coefficients		
		B	Std. Error	Beta
Equation 1				
	(Constant)	19,793	1,470	
	LnStock_lag_1	-1,448	,498	-1,640
	LNPBEEF	,695	,464	,530
	LNPMILK	-,827	,127	-1,053
LNPLABOR	,814	,209	1,301	3,889

F=14,243

Appendix 4B **Estimation output of beef production function: 2SLS estimation on all variables listed in specification**

Model Description

		Type of Variable
Equation 1	LnPrBEEF	dependent
	LnStock_lag_1	predictor
	LNPBEEF	predictor
	LNPMILK	predictor
	LNPLABOR	predictor
	lnPrBeef_lag	predictor
	Lnpfeed	predictor
	DUMMY	predictor
	LnInc	instrumental
	LnPother_all	instrumental
	LnPother_crop	instrumental
	LnPOther_animal	instrumental
	LnDMilk_lag_1	instrumental
	ln_Price_ratio	instrumental
	LnPdairy	instrumental
	LnStock_lag_2	instrumental
	LnPbeef_lag_1	instrumental
	LnPMilk_lag_1	instrumental
	LnPFeed_lag_1	instrumental
	LnPLabor_lag_1	instrumental
		instrumental

	LnPBeef_lag_2	
	LnPFeed_lag_2	instrumental
	LnPMilk_lag_2	instrumental
	LnPLabor_lag_2	instrumental

MOD_40

Model Summary

Equation 1	Multiple R	,744
	R Square	,554
	Adjusted R Square	,474
	Std. Error of the Estimate	,199

Coefficients

		Unstandardized Coefficients		
		B	Std. Error	Beta
Equation 1				
	(Constant)	20,436	6,185	
	LnStock_lag_1	-1,561	,689	-1,727
	LNPBEEF	,774	,620	,574
	LNPMILK	-,804	,288	-1,007
	LNPLABOR	,847	,271	1,311
	lnPrBeef_lag	-,037	,329	-,035
	Lnpfeed	-,042	,200	-,038
DUMMY	,047	,157	,087	,302

F=6,927

Appendix 4C **Estimation output of beef production function: OLS method**

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients
		B	Std. Error	Beta
1				
	(Constant)	23,207	5,168	
	lnPrBeef_lag	-,113	,184	-,108
	LNPBEEF	-1,108	,490	-,823
	LNPMILK	-,668	,200	-,837
	Lnpfeed	-,374	,332	-,343
	LNPLABOR	,668	,323	1,034
	LnStock_lag_1	-,460	,561	-,509
	LnPother_all	,170	1,206	,067
	LnPother_crop	,303	,591	,224
	LnPOther_animal	,931	,583	,671
DUMMY	-,041	,105	-,076	-,392

a Dependent Variable: LnPrBEEF

F=6,929

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,811(a)	,658	,563	,1691924

a Predictors: (Constant), DUMMY, LnStock_lag_1, LnPother_all, lnPrBeef_lag, LnPother_crop, LNPMILK, Lnpfeed, LNPBEEF, LnPOther_animal, LNPLABOR

b Dependent Variable: LnPrBEEF

Appendix 5C Estimation output of dairy production function: OLS method
Dairy production variable: OLS maethod

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	LNPLABOR, ln_Price_ratio, LnPOther_animal, LnPother_crop, LNPMILK, LnPdairy, LNPBEEF, LnPother_all (a)	.	Enter

a All requested variables entered.
b Dependent Variable: LnDprocmilk

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2,349	3,199		,734	,467
	LNPMILK	,161	,048	,416	3,331	,002
	LnPdairy	,968	,356	,530	2,721	,010
	LnPother_all	-,038	,285	-,031	-,132	,896
	LnPother_crop	,088	,147	,131	,598	,553
	LnPOther_animal	-,172	,183	-,256	-,943	,351
	ln_Price_ratio	1,417	,381	,470	3,724	,001
	LNPBEEF	-,216	,132	-,334	-1,638	,109

LNPLABOR	-,100	,059	-,324	-1,689	,099

a Dependent Variable: LnDprocmilk

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,926(a)	,858	,829	,052198339

a Predictors: (Constant), LNPLABOR, ln_Price_ratio, LnPOther_animal, LnPother_crop, LNPMILK, LnPdairy, LNPBEEF, LnPother_all

Appendix 5. A. Estimation output of dairy production function: regression on significant variables

Model Description

Model Description

		Type of Variable
Equation 1	LnDprocmilk	dependent
	LnDprocmilk_lag	predictor
	ln_Price_ratio	predictor
	LNPLABOR	predictor & instrumental
	Lnpfeed	instrumental
	LnInc	instrumental
	LnPother_all	instrumental
	LnPother_crop	instrumental
	LnPOther_animal	instrumental
	LnPrMilk_lag	instrumental
	lnDdairy_lag	instrumental

MOD_1

Model Summary

Equation 1	Multiple R	,863
	R Square	,745
	Adjusted R Square	,726
	Std. Error of the Estimate	,063

Coefficients

		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Beta	t	Sig.
Equation 1	(Constant)	7,573	1,216		6,229	,000
	LnDprocmilk_lag	,164	,133	,164	1,235	,224
	ln_Price_ratio	2,162	,422	,727	5,119	,000
LNPLABOR	-,045	,024	-,144	-1,902	,064	

F=40,281

Appendix 5B Estimation output of dairy production function: 2SLS estimation on all variables listed in specification

Model Description

		Type of Variable
Equation 1	LnDprocmilk	dependent
	ln_Price_ratio	predictor
	lnDdairy_lag	predictor
	LNPLABOR	predictor & instrumental
	LnPother_all	predictor & instrumental
	LnPother_crop	predictor & instrumental
	LnPOther_animal	predictor & instrumental
	Lnpfeed	instrumental
	LnInc	instrumental
	LnPrBEEF	instrumental

MOD_22

Model Summary

Equation 1	Multiple R	,807
	R Square	,652
	Adjusted R Square	,598
	Std. Error of the Estimate	,088

Coefficients

	Unstandardized Coefficients		
	B	Std. Error	Beta
Equation 1			

	(Constant)	1,566	5,521	
	ln_Price_ratio	1,160	1,150	,390
	lnDdairy_lag	,903	,624	,901
	LNPLABOR	-,070	,040	-,225
	LnPother_all	,752	,795	,615
	LnPother_crop	-,526	,475	-,782
LnPOther_animal	-,512	,420	-,755	-1,218

F=12,73

Appendix 6. A. Estimation output of final demand for raw milk function: regression on significant variables

Coefficients

		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Beta	t	Sig.
Equation 1	(Constant)	6,580	1,110		5,930	,000
	LNPMILK	-,516	,176	-1,044	-2,938	,005
	LnPOther_animal	,326	,068	,380	4,821	,000
	LnInc	,207	,039	,480	5,307	,000

Model Summary

Equation 1	Multiple R	,725
	R Square	,526
	Adjusted R Square	,493
	Std. Error of the Estimate	,087

Model Description

		Type of Variable
Equation 1	LNDMILK	dependent
	LNPMILK	predictor
	LnPOther_animal	predictor & instrumental
	LnInc	predictor & instrumental
	LnPother_all	instrumental
	LnPother_crop	instrumental

MOD_3

F=16,248

Appendix 6C **Estimation output of final demand for raw milk function: OLS method**

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	LnPdairy, LnPother_all, LNPMILK, LnInc, LnPother_crop, LNPBEEF, LnPOther_animal(a)	.	Enter

a All requested variables entered.
b Dependent Variable: LNDMILK

ANOVA(b)

Model		Sum of Squares	F	Sig.
1	Regression	1,027	30,913	,000(a)
	Residual	,190		
	Total	1,216		

a Predictors: (Constant), LnPdairy, LnPother_all, LNPMILK, LnInc, LnPother_crop, LNPBEEF, LnPOther_animal
b Dependent Variable: LNDMILK

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,919(a)	,844	,817	,068878111

a Predictors: (Constant), LnPdairy, LnPother_all, LNPMILK, LnInc, LnPother_crop, LNPBEEF, LnPOther_animal

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	9,022	3,326		2,712	,010
	LnInc	,259	,060	,602	4,305	,000
	LnPother_all	-,022	,381	-,014	-,058	,954
		-,219	,200	-,256	-1,095	,280

	LnPother_crop					
	LnPOther_animal	,459	,211	,534	2,174	,036
	LNPBEEF	-,273	,161	-,331	-1,702	,096
	LNPMILK	-,349	,033	-,706	-10,509	,000
	LnPdairy	-,137	,395	-,059	-,346	,731

a Dependent Variable: LNDMILK

Appendix 6B Estimation output of final demand for raw milk function: 2SLS estimation on all variables listed in specification

Coefficients

		Unstandardized Coefficients				
		B	Std. Error	Beta	t	Sig.
Equation 1	(Constant)	6,740	3,384		1,992	,053
	LNPMILK	-,176	,355	-,356	-,496	,623
	LnPOther_animal	,393	,159	,458	2,473	,018
	LnInc	,280	,122	,649	2,299	,027
	VAR00025	,220	,265	,653	,833	,410
	LnPdairy	-,411	,717	-,176	-,574	,569
	LnDMilk_lag_1	,066	,167	,064	,397	,693

Model Summary

Equation 1	Multiple R	,895
	R Square	,802
	Adjusted R Square	,773
	Std. Error of the Estimate	,085

F=27,619

Appendix 7. A. Estimation output of demand for dairy function: regression on significant variables

Model Summary

Equation 1	Multiple R	,768
	R Square	,590
	Adjusted R Square	,571
	Std. Error of the Estimate	,091

Model Description

		Type of Variable
Equation 1	lnD_dairy	dependent
	LnPdairy	predictor
	LNPMILK	predictor
	Lnpfeed	instrumental
	LNPLABOR	instrumental
	LnInc	instrumental
	LnPother_all	instrumental
	LnPother_crop	instrumental
	LnPOther_animal	instrumental
	LnPrBEEF	instrumental

MOD_10

Coefficients

		Unstandardized Coefficients				
		B	Std. Error	Beta	t	Sig.
Equation 1	(Constant)	17,257	2,030		8,499	,000
	LnPdairy	-,847	,211	-,473	-4,022	,000

LNPMILK	,428	,056	1,102	7,698	,000

F=31,643

Appendix 7B Estimation output of dairy demand function: 2SLS estimation on all variables listed in specification

Model Description

		Type of Variable
Equation 1	lnD_dairy	dependent
	LnPdairy	predictor
	LNPMILK	predictor
	LNPBEEF	predictor
	LnPother_all	predictor & instrumental
	LnPother_crop	predictor & instrumental
	LnPOther_animal	predictor & instrumental
	LnInc	predictor & instrumental
	Lnpfeed	instrumental
	LNPLABOR	instrumental
	LnPrBEEF	instrumental

MOD_11

Model Summary

Equation 1	Multiple R	,852
	R Square	,726
	Adjusted R Square	,677
	Std. Error of the Estimate	,073

Coefficients

	Unstandardized Coefficients				
	B	Std. Error	Beta	t	Sig.
Equation					

1	(Constant)	5,957	8,139		,732	,469
	LnPdairy	,748	,969	,418	,772	,445
	LNPMILK	,413	,075	1,063	5,492	,000
	LNPBEEF	-,385	,369	-,610	-1,043	,303
	LnPother_all	,364	,528	,306	,688	,495
	LnPother_crop	-,158	,355	-,237	-,446	,658
	LnPOther_animal	-,313	,248	-,473	-1,261	,215
LnInc	-,077	,138	-,233	-,555	,582	

F=14.473

Appendix 6C Estimation output of dairy demand function: OLS method

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	LNPMILK, LnPother_all, LnPdairy, LnInc, lnDdairy_lag, LnPOther_animal, LNPBEEF, LnPother_crop(a)	.	Enter

a All requested variables entered.
b Dependent Variable: lnD_dairy

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,912(a)	,832	,795	,05559341

a Predictors: (Constant), LNPMILK, LnPother_all, LnPdairy, LnInc, lnDdairy_lag, LnPOther_animal, LNPBEEF, LnPother_crop

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1						
	(Constant)	-2,731	2,925		-,934	,357
	lnDdairy_lag	,293	,126	,299	2,320	,026
	LnPdairy	1,423	,327	,783	4,352	,000
	LnInc	-,234	,053	-,704	-4,419	,000
	LnPother_all	,233	,362	,196	,643	,524
	LnPother_crop	-,026	,198	-,038	-,130	,897
	LnPOther_animal	-,513	,192	-,771	-2,669	,011
	LNPBEEF	-,076	,132	-,119	-,579	,566
	,192	,047	,482	4,088	,000	

LNPMIL K					

a Dependent Variable: lnD_dairy

F=22,279

Appendix 8. A. Estimation output of livestock number function: regression on significant variables

Model Description

		Type of Variable
Equation 1	LNSTOCK	dependent
	LNPMILK	predictor
	LNPBEEF	predictor
	LnStock_lag_1	predictor
	LnInc	instrumental
	LnPother_all	instrumental
	LnPother_crop	instrumental
	LnPOther_animal	instrumental
	LnDMilk_lag_1	instrumental
	ln_Price_ratio	instrumental
	LnPdairy	instrumental

MOD_16

Coefficients

		Unstandardized Coefficients				
		B	Std. Error	Beta	t	Sig.
Equation 1	(Constant)	,153(,626)	,311		,492	
	LNPMILK	,039(,101)	,023	,042	1,676	
	LNPBEEF	-,208(,016)	,083	-,136	-2,498	
LnStock _lag_1	1,152(,000)	,053	1,121	21,613		

Model Summary

Equation 1	Multiple R	,991
	R Square	,982
	Adjusted R Square	,981
	Std. Error of the Estimate	,041

F=766,619

Appendix 8B Estimation output of livestock number function: 2SLS estimation on all variables listed in specification

Model Description

		Type of Variable
Equation 1	LNSTOCK	dependent
	LNPBEEF	predictor
	LNPMILK	predictor
	LnStock_lag_1	predictor
	LNPLABOR	predictor & instrumental
	Lnpfeed	predictor & instrumental
	LnPOther_animal	predictor & instrumental
	LnInc	instrumental
	LnPother_all	instrumental
	LnPother_crop	instrumental
	LnPrMilk_lag	instrumental
	lnDdairy_lag	instrumental

MOD_17

Model Summary

Equation 1	Multiple R	,990
	R Square	,980
	Adjusted R Square	,977
	Std. Error of the Estimate	,045

Coefficients

	Unstandardized Coefficients				
		Std. Error	Beta	t	Sig.

		B				
Equation 1						
	(Constant)	-1,654	1,446		-1,144	,260
	LNPBEEF	,442	,497	,287	,890	,379
	LNPMILK	-,003	,046	-,003	-,068	,946
	LnStock_lag_1	,988	,200	,958	4,948	,000
	LNPLABOR	-,090	,081	-,123	-1,113	,272
	Lnpfeed	,042	,060	,034	,695	,491
LnPOther_animal	-,349	,266	-,220	-1,314	,196	

F=319, 793

Appendix 8C **Estimation output of livestock number function: OLS method**

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	Lnpfeed, VAR00001, LNPBEEF, LNPMILK, LNPLABOR, LnStock_lag_1(a)	.	Enter

a All requested variables entered.
b Dependent Variable: LNSTOCK

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,995(a)	,990	,988	,031962898

a Predictors: (Constant), Lnpfeed, VAR00001, LNPBEEF, LNPMILK, LNPLABOR, LnStock_lag_1

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,531	,329		1,614	,114
	LNPMILK	,007	,019	,008	,366	,716
	LNPBEEF	,130	,066	,085	1,961	,057
	VAR00001	,051	,014	,081	3,500	,001
	LNPLABOR	,155	,038	,212	4,040	,000
		,733	,080	,713	9,151	,000

LnStock_lag_1					
Lnpfeed	-,053	,028	-,042	-1,876	,068

a Dependent Variable: LNSTOCK

F=670,683

Appendix 10B Estimation output of milk production function: 2SLS estimation on all variables listed in specification

Model Description

		Type of Variable
Equation 1	LnPrMilk_lag	dependent
	LNPMILK	predictor
	LnStock_lag_1	predictor
	LnPdairy	predictor & instrumental
	LNPBEEF	predictor
	LNPLABOR	predictor
	LnPother_all	predictor & instrumental
	LnPother_crop	predictor & instrumental
	LnPOther_animal	predictor & instrumental
	Lnpfeed	predictor
	DUMMY	predictor
	LnInc	instrumental
	LnDMilk_lag_1	instrumental
	ln_Price_ratio	instrumental
	LnStock_lag_2	instrumental
	LnPbeef_lag_1	instrumental
	LnPMilk_lag_1	instrumental
	LnPFeed_lag_1	instrumental
	LnPLabor_lag_1	instrumental
	LnPBeef_lag_2	instrumental
		instrumental

	LnPFeed_lag_2	
	LnPMilk_lag_2	instrumental
	LnPLabor_lag_2	instrumental

MOD_1

Coefficients

		Unstandardized Coefficients				
		B	Std. Error	Beta	t	Sig.
Equation 1	(Constant)	22,460	8,112		2,769	,009
	LNPMILK	,430	,192	,425	2,242	,031
	LnStock_lag_1	-1,431	,539	-1,249	-2,655	,012
	LnPdairy	-1,164	,878	-,242	-1,326	,193
	LNPBEEF	,632	,657	,370	,963	,342
	LNPLABOR	,795	,288	,971	2,764	,009
	LnPother_all	,951	,912	,297	1,043	,304
	LnPother_crop	-,064	,405	-,037	-,157	,876
	LnPOther_animal	,377	,411	,214	,917	,365
	Lnpfeed	-,590	,380	-,427	-1,550	,130
	DUMMY	-,199	,091	-,289	-2,189	,035
VAR00010	1,001	,488	1,044	2,052	,047	

Model Summary

Equation 1	Multiple R	,953
	R Square	,908
	Adjusted R Square	,883
		,111

	Std. Error of the Estimate	

F=35,624

Appendix 10.A. Estimation output of mil production function: regression on significant variables

Model Description

		Type of Variable
Equation 1	LnPrMilk_lag	dependent
	LNPMILK	predictor
	LnStock_lag_1	predictor
	Lnpfeed	predictor
	DUMMY	predictor
	LnPother_all	predictor & instrumental
	LnInc	instrumental
	LnPother_crop	instrumental
	LnPOther_animal	instrumental
	LnDMilk_lag_1	instrumental
	ln_Price_ratio	instrumental
	LnPdairy	instrumental
	LnStock_lag_2	instrumental
	LnPbeef_lag_1	instrumental
	LnPMilk_lag_1	instrumental
	LnPFeed_lag_1	instrumental
	LnPLabor_lag_1	instrumental
	LnPBeef_lag_2	instrumental
	LnPFeed_lag_2	instrumental
	LnPMilk_lag_2	instrumental
		instrumental

	LnPLabor_lag_2	

MOD_27

Model Summary

Equation 1	Multiple R	,930
	R Square	,865
	Adjusted R Square	,848
	Std. Error of the Estimate	,125

Coefficients

		Unstandardized Coefficients				
		B	Std. Error	Beta	t	Sig.
Equation 1	(Constant)	11,425	1,543		7,404	,000
	LNPMILK	,512	,136	,506	3,766	,001
	LnStock_lag_1	-,348	,124	-,304	-2,815	,007
	Lnpfeed	-,905	,239	-,656	-3,790	,000
	DUMMY	-,354	,091	-,514	-3,908	,000
	LnPother_all	1,583	,402	,494	3,934	,000

F=33,278

Appendix 10C **Estimation output of milk production function: OLS method**

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1						
	(Constant)	-27,422	8,193		-3,347	,002
	LNPBEEF	,262	,413	,155	,634	,530
	VAR00001	,146	,097	,214	1,510	,139
	LNPLABOR	-,717	,294	-,886	-2,441	,019
	LnStock_lag_1	,553	,485	,488	1,140	,262
	Lnpfeed	,326	,167	,239	1,951	,058
	LnPrMilk_lag	1,189	,142	1,203	8,389	,000
	LnPOther_animal	-1,138	,370	-,655	-3,072	,004
LnPdairy	2,551	,981	,538	2,601	,013	

a Dependent Variable: LnPrMilk

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,904(a)	,817	,779	,150818454

a Predictors: (Constant), LnPdairy, LnPrMilk_lag, Lnpfeed, LnPOther_animal, VAR00001, LNPLABOR, LNPBEEF, LnStock_lag_1

F=21,238