TERMS OF TRADE SHOCKS AND STRUCTURAL ADJUSTMENTS IN KAZAKHSTAN[1]

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Abstract

Kazakhstan is a natural resources abundant country with the large amount of stocks of crude petroleum and natural gas. Favourable conditions at the world hydrocarbon markets, building of the oil pipelines led to the increase of the export of crude petroleum and natural gas abroad. This constituted the main factor of the positive and sustained growth in Kazakhstan during the last eight years with 9.8% of economic growth per annum on average. The paper constitutes an attempt to quantitatively evaluate the effects of the two simulated oil price shocks on the structural adjustments in the economy using a multisectoral static CGE model. The paper delivers two main results. First, the economy responds asymmetrically to the oil price shocks, although the magnitude of the oil price changes is the same, but different in signs. Second, paper represents a clear indication of the vulnerability of the Kazakhstani economy to the world oil price changes and thus represents a clear evidence of the possible Dutch disease consequences for the Kazakhstani economy.

Keywords: oil price shock, computable general equilibrium (CGE) model, social accounting matrix, Dutch disease.

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1. Introduction

After the break up of the Soviet Union in 1991, Kazakhstan embarked on the transition process towards building of an open market-based economy. Great number of adjustment reforms has been implemented since then, among which the most important were the creation and privatization of institutions for the market-based system. During the first years after the break-up of the Soviet Union the economy faced a deep recession, which was accompanied by the high inflation. GDP growth dropped by -9.3% interannually (i.a.) in 1993, the tendency continued in the following years (-12.6% in 1994 and -8.2% in 1995). In 1996 the situation changed (+0.5%) and with the exception of the slowdown in 1998 (-1.9% i.a.) the subsequent years have shown positive rates of growth (above 9% i.a.) since 2000 /National Accounts, 2003/. Given that 2003 was characterized with a stable economic situation, 2003 year is chosen as a benchmark year for construction of the SAM for Kazakhstan.

(Insert Figure 1 here)

As it is known, Kazakhstan is a natural resources abundant country with large amount of stocks of crude petroleum and natural gas. Favourable conditions at the world hydrocarbon markets, building of the oil pipelines led to the increase of the export of crude petroleum and natural gas abroad. This constituted the main factor of the positive and sustained growth in Kazakhstan during the last eight years with 9.8% of economic growth per annum on average. However as both empirical and theoretical research examining the economy of the resource abundant countries suggests that the abundance of the natural resources turns out be the resource curse for the countries themselves in most of the cases. The effects of the resource boom in the resource abundant countries have been investigated to a large extent in the economic literature. There is an ongoing debate on the advantages and disadvantages for the country being a resource rich country. Ploeg (2006) in his paper analyzes the experience of the resource rich countries and states that there are some countries that benefited from their natural wealth and there are some that are in terrible state. Among the successful ones he distinguishes Botswana, Canada, Australia and Norway. Among the least successful ones is Nigeria, which enters the group of the 15 poorest countries in the world, despite its immense natural wealth. Other oil exporters such as Iran, Venezuela, Libya, Iraq and Kuwait and Qatar experienced negative growth rates during the last few decades. The OPEC as a whole experienced a decline in GNP per capita while other comparable countries in terms of GNP per capita enjoyed economic growth. As it was emphasized by Ploeg (2006) one of the main reasons that some countries experienced a positive impact from exploring and exporting natural resources abroad and some did not was a political side of the problem, namely low quality of the institutions and the legal system. In order to improve the situation the author suggests to improve the quality of institutions and the legal

system and to insist on accountability and transparency of the resource revenues.

Another line of the research represents an attempt to simulate the oil price shocks and oil boom in the particular economy and examine the possible consequences. For instance, Benjamin, Devarajan and Weiner (1987) simulated with computable general equilibrium model the oil boom in Cameroon and evaluated its impact on Cameroon's economy. They have found that when imperfect substitutability between domestic and imported goods is incorporated, one of the standard Dutch disease results can be reversed: not all the traded sectors will contract.

Another research by Olomola, Adejumo (2006) examined the effect of the oil price shock on output, inflation, the real exchange rate and the money supply in Nigeria using quarterly data from 1970 to 2003. Their findings were contrary to the previous empirical findings in other countries; oil price shock does not affect output and inflation in Nigeria. However, oil price shocks do significantly influence the real exchange rate. The implication is that a high oil price may give a rise to the wealth effect that appreciates the real exchange rate. This in turn may squeeze the tradable sector, giving rise to the "Dutch Disease".

Fardmanesh (1996), in his 3 factor and 3 sector general equilibrium model of "Dutch Disease" provides another explanation for the expansion of the manufacturing sector in most of the oil exporting countries and the concurrent decline in their agricultural sectors in the 1970s. Inclusion of the "world price effect" into the analysis and the positive impact of it in the manufacturing sector may dominate the negative impact on this sector of the spending effect thus expanding the manufacturing sector.

Parvar (2006) studies potential loss of competitiveness in a group of oil producing countries due to the oil price shock. Empirical results of the study support the hypothesis that oil price shocks may indeed cause loss of competitiveness in lower income products. On the other hand, high income producers seem to be able to neutralize adverse effects of oil price shocks and avoid loss of competitiveness.

The possibility of the Dutch disease for Kazakhstani economy should be investigated given the fact that Kazakhstan, being a country with extensive reserves of crude oil and natural gas of 3 billion tons, with projected reserves about 7 billion tons (*Statisticheskoe obozrenie Kazakhstan*, 1999) has undiversified structure of the exports with a highest share of 49% attributed to the exports of crude petroleum and natural gas. Any shocks on the world oil prices would have certain effects on the domestic economy. Turning to the imports structure, it is obvious that it is more diversified, with most of the imports attributed to the construction and services (54%). Possible depreciation of the domestic currency, as a result of the oil price shock would make imported goods more expensive, and would negatively affect the welfare

of the households. In order to evaluate the impact of the oil price increase on the domestic economy further research is needed.

Recent contribution to this field was done by Kuralbayeva et al. (2001) and Egert et al. (2007). Both studies identify the evidence of the vulnerability of the Kazakhstani economy to the Dutch disease. Thus it is critical that policymakers design appropriate macroeconomic polices to successfully deal with such issues (Kuralbayeva, et al. 2001).

In order to identify the effect of the oil price shocks on the economy as a whole the paper uses the static multisectoral CGE model, developed by Lofgren et al. (2002) and simulate the economy by imposing different types of oil price shocks.

The paper is organized as follows. Second part of the paper outlines the benchmark data used in the analysis. Third part of the paper deals with the description of the CGE model. The fourth part considers the results and simulations from the model. The paper finishes with the conclusions.

2. Benchmark SAM for Kazakhstan

This part of the paper documents constructed Social accounting matrix (SAM) for Kazakhstan for 2003 and gives an overview of the economic situation in the corresponding year. The 2003 SAM is aimed to provide a benchmark data for the applied general equilibrium analysis that can be used to analyze an array of issues related to the economic growth, income distribution and the structural adjustments in the economy.

Formed as a square table with rows indicating incomings and columns expenditures, a SAM gives a general overview of the nominal transactions and flows of goods and services among representative agents, usually represented by industries, households, enterprises, government and rest of the world. The design of the SAM depends on the aim of the study and characteristics of the economy. Therefore, it does not have permanent structure but, instead, it might vary from case to case. Independent of the topic under consideration the SAM should reflect market clearance and income balance conditions captured by the equality of the totals of each column and corresponding row in the SAM. This feature makes the SAM a suitable database for applied general equilibrium analysis. (Pyatt and Round, 1985; Reinert and Roland-Holst, 1997).

The structure of the SAM presented in this paper is shown in Table 1. Initially the SAM was constructed for 55 sectors but for the analysis in the paper I use eight sectors, described in the Table 2. The SAM makes a differentiation between the commodities and the activities accounts, the separation of the taxes account from the government account, and it breaks down the households account.

(Insert Table 1 here)

Data on output, intermediate demand, private final demand, public and investment demand, exports, imports, components of value added, plus taxes on products and imports, and margins which drive a wedge between purchaser price and basic price were extracted from the input-output table supplemented by the data from households survey to facilitate the disaggregation of the household account. Private final demand is recorded in the input-output table as a demand of the only one aggregated household. Disaggregation of this account into two sub accounts urban and rural households is accomplished by using relevant shares of expenditures and incomes by urban and rural households, which were obtained from the households' survey.

The remaining information on the distribution of factor incomes across institutions, net factor incomes to the rest of the world, income taxes, interinstitutional transfers, savings and net current transfers abroad is taken from the National Accounts and the above mentioned sources. The approach to the construction of the SAM taken in this paper is different from the previous approaches (e.g. Hauser, 1999), where the sequence of steps is done in the following order. As a first step the macro SAM is compiled, as the second step micro SAM is generated and as the third step the micro SAM is balanced to the entries in the macro SAM. The choice of the approaches to the construction of the SAM depends on which data are assumed to be the true ones. This is important at the balancing stage. Usually a macro SAM is compiled on the basis of the national accounts, whereas most entries in the micro SAM stem from the input-output table.

The data available from the input-output table for Kazakhstan differ from the data provided in the national accounts. Since most entries in the national accounts, according to the national accounting stem from the input-output table, I assume that the data from the input-output table are more reliable, and therefore proceed in the following order. As a first step micro SAM is generated, as a second step micro SAM is balanced using a RAS procedure, and as a third step macro SAM is generated upon the micro SAM. Macro SAM generated upon the micro SAM is given in the Table 3.

(Insert Table 3 here)

Analysis with respect to the structure of production and demand, margins, institutional incomes and allocation of factor incomes across households, provides with some facts, which are briefly summarized as follows:

1) Concentration of the economic activities around the crude petroleum and natural gas sector is evident (see Table 4). The transport and communications sector, basic metals and fabricated metal industry and real estate operations and other business services sectors are capable for generating forward linkages. Investment into these sectors will expand the production of crude

petroleum and natural gas and of course the sectors themselves, thus concentrating most activities around the crude petroleum and natural gas sector.

(Insert Table 4 here)

2) Exports are characterized by a low degree of diversification across products, and are represented mostly by natural resources. Any shocks to the prices of natural resources, or to the exchange rate would affect the domestic economy (see Table 4).

3) Liberalization of trade, in particular liberalization of flow of goods into production process from developed countries might have a positive impact on the economic growth. Given that it would promote increase in the flows of new technology, liberalization of trade would have a positive impact on productivity and economic growth.

4) High transport margins in intermediate production might be due to poor transportation infrastructure, which render high transportation costs. To decrease transportation costs there is a need in policies which would improve transportation infrastructure.

5) There are factor income differences between rural and urban households. Labor income per capita is on average 1.2 times higher in urban areas than in rural areas and net capital income received by urban households per capita is 1.3 times larger than that received by rural households. Further widening of this gap might be a possible source for labor migration and reallocation of most activities in the urban area. To control over the spatial allocation of activities the policies which would favour production in the rural area should be implemented, e.g. increase in the level of subsidies to the rural households.

6) Despite that Kazakhstan experiences positive rate of economic growth during the last years, which are mostly due to the favourable conditions at the world markets for raw materials, it is necessary to increase the rate of the fixed capital formation or at least to maintain it at the existing level in the long run.

3. Model

The paper employs the IFPRI model of Loefgren et al. (2002) with some minor adjustments relevant for the constructed benchmark SAM for Kazakhstan.

Domestic Production Structure

We assume that each industry produces under constant returns to scale and operates in the perfect competition environment. Production of each industry is characterized by the behavior of a single representative producer which

minimizes its production costs subject to his production technology. Production technology is summarized in Figure 2.

(Insert Figure 2 here)

Domestic goods are combined with imported goods via CES function under Armington assumption, emphasizing the fact that the domestic and imported goods are imperfect substitutes. This composite good is used later for intermediate uses by the industries and final uses by households and government. The model employs two factors of production: labor and capital which are combined via CES function into the composite value added. At the next stage value added combined with intermediate goods via Leontief function form composite industrial outputs. The composites of industrial outputs in their turn represent the CET composite of the domestically produced and exported goods.

Assuming profit-maximizing behavior of the producers, each representative producer uses a capital and labor to the level where the marginal revenue product of each factor is equal to its factor price. Profit maximizing equations for the producers are derived using a duality approach. Under constant returns to scale and perfect competition assumptions profit maximizing is equivalent to the cost minimizing, the equality of the marginal costs of the production with its price. In the paper I use the default closure for the factor markets (Lofgren, et.al, 2002). The quantity supplied of each factor is fixed at the observed level. An economywide wage variable is free to vary to assure that the sum of demands from all activities equals the quantity supplied. Each activity pays an activity specific wage that is the product of the economywide wage and an activity-specific wage (distortion term). For this type of closure the latter terms are fixed.

Institutional side

This part of the model incorporates different categories of the representative institutions. Depending on the data available the model distinguishes between two types of households, urban and rural households; two types of enterprises - financial and nonfinancial enterprises, and considers government and the rest of the world.

The households receive their income from the factors of production, transfers from government and financial and nonfinancial enterprises. On the expenditure side households pay income taxes, spend income on buying commodities, make transfers to the rest of the world and save residual part of their income. In this part of the model direct taxes and transfers to other domestic institutions are defined as fixed shares of the household's income, whereas the savings share is flexible for selected households.

Enterprises receive their income from the factors of production and transfers from other enterprises. In their turn they spend their income on paying income

taxes, transfers to the households, enterprises, government and rest of the world and additionally saving the residual part of the income.

The third institution - government receives capital income, taxes on products and imports, corporate taxes, individual income taxes, net transfers from enterprises and net transfers from the rest of the world. On the expenditure side the government account comprises final public demand and net transfers to households. The rest of the government income is saved.

There are 4 groups of taxes: other taxes on production, taxes on products and imports, corporate taxes and individual income taxes. This separate account is needed to differentiate government income on taxes and the rest of the income that government receives.

The final institution – the rest of the world receives income from the consumed imported goods, factor incomes, transfers from households and enterprises. Expenditures of the rest of the world comprise consumption of the goods exported by the domestic economy, transfers to government and savings.

Macro Closures

Given that the model includes three macroeconomic balances: the current government balance, the external balance and the savings-investment balance the macro closures are specified. The choice of a particular closure is done on the basis of the subject under investigation. Considering the oil price shock and its possible impact on the whole economy the following closures are considered. For the government balance the default closure that government savings is a flexible residual while all tax rates are fixed is selected. For the external balance, the closure where real exchange rate is flexible, whereas foreign savings is fixed is selected. The trade balance is also fixed. The Savings-Investment closure is investment driven. In this respect real investment quantities are fixed, whereas the base-year savings rates of selected nongovernmental institutions are adjusted by the same number of percentage points.

4. Model Simulations and Results

The choice of the free parameters is an important element in CGE analysis. These parameters critically determine the magnitude of the response to different exogenous shocks. However, in most of the cases due to the unavailability of the data the estimates of the elasticities remain to be an educated guess work. Given that the values of the elasticities and some other parameters are not entirely based on the direct estimation from Kazakhstani data, the model results may not be precise estimates of the particular outcomes and thus should be interpreted with caution. Nevertheless the results give a general overview of the likely responses of the economy to a given set of

macroeconomic conditions which could be of great assistance in making economic policy decisions.

Most of the parameters chosen for the model are borrowed from the paper by Jensen and Tarr (2006) and the rest remain to be the subject of the guess work. The parameters are shown in Tables 6 and 7.

(Insert Table 6 and 7 here)

Consider the oil price shock of the 30% decline in the world oil prices. The Table 8 shows the percentage deviation from the base level.

(Insert Table 8 here)

As a result of the decline of the world oil prices there is 1% decline in the domestic producer prices index (DPI) in the whole economy, depreciation of the nominal exchange rate by 3.5%, decline in the total absorption by 3.8%, decline in the investment by 8.5%. However, it is necessary to note that the prices across sectors react differently to the simulated shock. As it can be seen from the Table 8 demand prices for commodities produced and sold domestically show decline for almost all sectors, except the prices of crude petroleum and gas (increase of 31%), coke and refined petroleum (increase of 4%) and electrical energy sectors (increase of 1%). The price of exports on crude petroleum and gas declines by 28% as a result of the nominal exchange depreciation, whereas the export prices for other commodities exhibit large changes.

(Insert Table 9 here)

As it can be seen from the Table 9, as a result of the simulated oil price shock, there is an increase in the quantity of domestic sales in agriculture (increase of 6%), coal and other fuel (increase of 53%), food and textile (increase of 6%), coke and refined petroleum (increase of 4%) and chemicals and machinery (increase of 17%). However there is a strong decline in the quantity of domestic sales of the crude petroleum (-91%), followed by decline in the construction and services sector (-3.5%).

As the result of the decline in oil export prices, the exports of the crude oil squeeze largely. Additionally given that the domestic prices on crude oil and gas rise, demand on the crude oil and gas drops significantly.

Because of the tumble in the oil prices at the world markets the exporters try to supply crude oil and gas domestically. Due to its large supply and limited domestic demand, domestic oil prices will decline initially, which will lead to a decline in supply of the crude oil. Given that the most of the aggregate demand on crude oil and gas is composed of intermediate demand by crude and oil gas sector itself, decline in the production will lead to a less intermediate demand of crude oil and gas by the sector itself, which will cause

the decline in the demand for crude oil and gas in the aggregate level in the new equilibrium and as result the contraction of the supply of crude oil and gas and consequent rise in the their domestic prices.

Additionally to the change in the production structure and prices, oil price shock leads to a reallocation of the factors across sectors. Due to the shrink in the crude petroleum and gas sector both labor and capital moves out of this sector to other sectors as it is shown in the Table 10. The overall wage income in the economy rises by 2.3%, however capital income declines by 0.5%.

(Insert Table 10 around here)

Now consider the positive oil price shock of 30% increase in the world oil prices.

As a result of the 30% increase in the world oil prices exchange rates appreciates by 21%, domestic price index rises by 8%, total absorption rises by 18%, investment rises by 43%. As it can be seen, the economy responds asymmetrically to the oil price changes at the world markets. This is in line with the empirical stylized facts about the oil prices, when the economy reacts differently to the oil price changes of the same magnitude, but different signs (Hooker, 1999).

As a result of the appreciation of the exchange rate export price on crude petroleum and gas rises by 3% while domestic oil prices decline by 1.4%. Domestic prices on other commodities ascend. Average import prices across all commodities show a decline of 21% (see Table 11).

(Insert Table 11 here)

(Insert Table 12 here)

As it can be seen from the Table 12, production and exports of the crude petroleum and gas increase by more than 1.5 times. Production and exports of other tradables goods decline. High decline in production and exports of more than 20% is observed in the agriculture, coal and other fuel, food textile and wood, coke and refined petroleum, chemicals and machinery. Production of construction and services sector also declines, but not to a large extent, only by 5%. The production of electrical energy, which can be treated as nontradable sector, given that its export share in total exports is negligible (around 2%) increases by 6%.

As it can be seen from this comparative static experiment, increase in the world oil price shock distorts the trade position, affects competitiveness and the structure of production. In a nutshell, it is possible to conclude that Kazakhstan might experience the evidence of the Dutch disease, given that the most of the strategic sectors contract and non-traded sectors grow.

Turning to the reallocation of labor and capital across sectors as a result of the increase in the world oil prices we can observe the following tendency.

(Insert Table 13 here)

It is clearly seen, that there is a reallocation of labor and capital towards crude petroleum and gas and electrical energy sectors. There is a decline in the labor and capital demand by the construction and services sector, but in comparison to other sectors the decline in demand is not that large. Turning to the other tradable sectors, it is clearly seen that the labor and capital are leaving these sectors and moving to the crude oil and gas and electrical energy sectors. This effect occurs because of the stiff competition at the markets caused by the exchange rate appreciation, which in turn leads to a decline in their production and thus drop in the demand for factors employed. These sectors become less competitive in comparison to the foreign imports. Additionally, nominal wages in the whole economy increase by 6.7% and capital returns increase by 18%.

5. Conclusion

This paper represents an attempt to quantify the possible effects of the possible oil price changes at the world markets on the structural adjustments in the Kazakhstani economy. The paper presents the results from the two simulated oil price shocks, 30% increase and decrease in the world oil price level from its benchmark situation.

It is necessary to note that the economy responds asymmetrically to the oil price changes, although the magnitude of the change is the same. This is in line with empirical stylized results found in the literature. As a result of the 30% decline in the world oil prices economy faces 1% decline in the domestic producer prices index (DPI), depreciation of the nominal exchange rate by 3.5%, decline in the total absorption by 3.8% and decline in the investment by 8.5%. The exports and domestic demand of the crude oil and gas drop significantly. Additionally there is a reallocation of labor and capital from crude oil and gas sector towards other sectors in the long run.

As a result of the 30% world oil price shock exchange rate appreciates by 21%, the domestic price index rises by 8%, total absorption rises by 18%, investment rises by 43%. Export prices on crude oil and gas rise by 3%, domestic oil prices decline by 1.4%. Domestic prices on the other commodities increase. Average import prices across all commodities show a decline of 21%. Production and exports of the crude petroleum and gas increase by more than 1.5 times. Production and exports of other traded goods tumble.

The simulations described above point towards the vulnerability of the Kazakhstani economy to the oil prices changes at the world markets. Although, due to the assumed and not estimated elasticities, the results should

be interpreted with caution, the possible evidence of the Dutch disease should not be ignored. Thus taking into account this fact the government should undertake the required reforms in order to eliminate possible negative consequences of the oil price shocks in the future.

One of the measures against Dutch disease undertaken by the government was an establishment of the Oil fund in Kazakhstan. The aim of its establishment is in keeping the oil revenues and their use in cases of emergency. Establishment of the Oil Fund was accomplished in order to prevent the overheating of the economy. To evaluate its work, further research will be needing, which will consider the transfer of the oil revenues to the Oil Fund directly and the evaluation of it on the economy as a whole.

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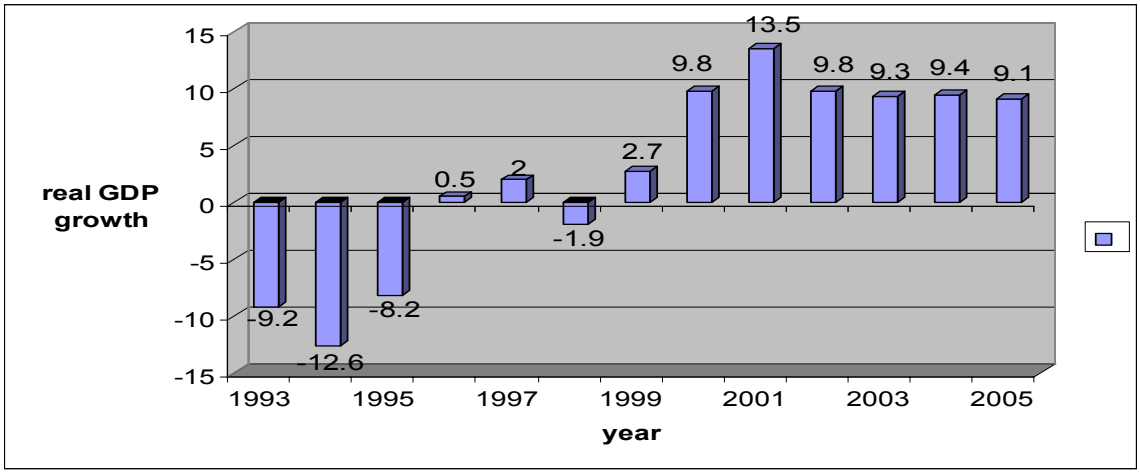

Figure 1: Real GDP Growth

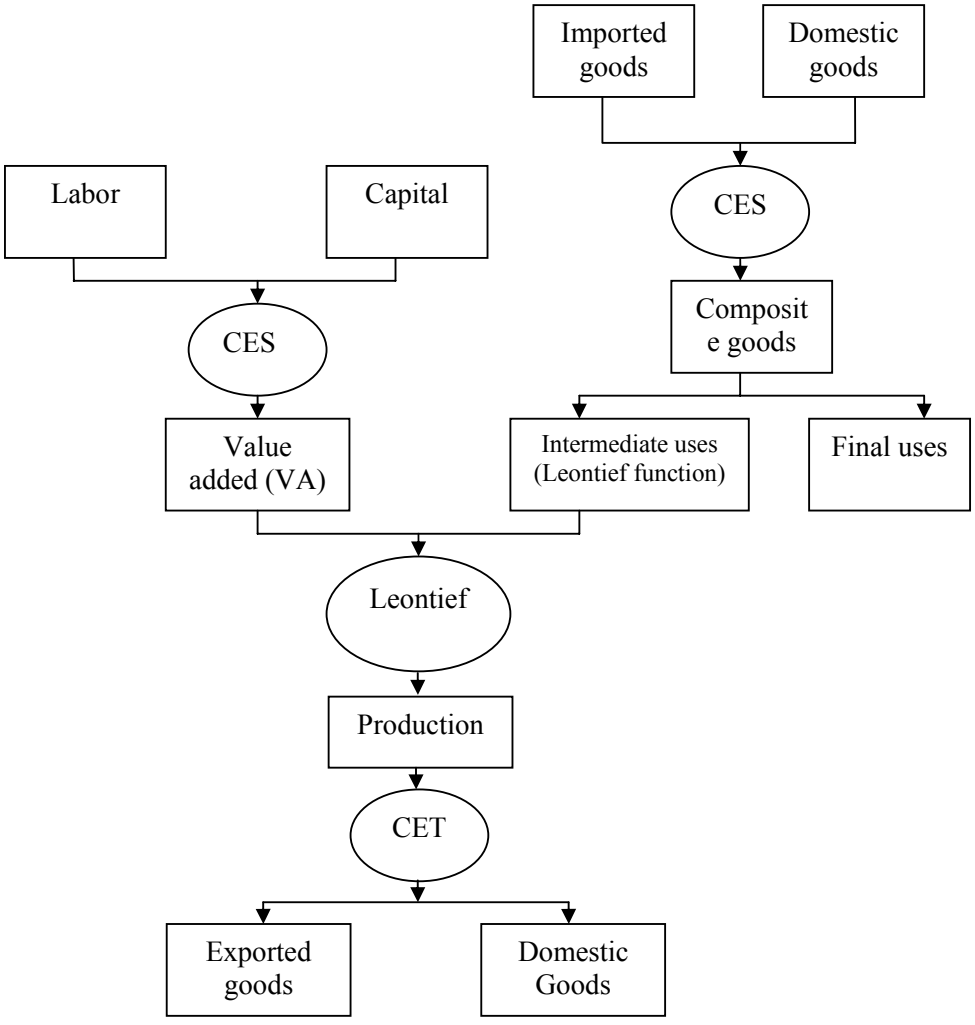

Figure 2: Production Structure

Table 1: Structure of the SAM

	Activities	**Commodities**	**Margins**	**Factors**	**Taxes**	**Households**	**Enterprises**	**Government**	**Saving-Inv**	**ROW**	**TOTAL**
Activities		Gross output									**Total production**
Commodities	Intermediate consumption		Margins			Household final consumption		Government final consumption	Investment demand	Exports of goods and services	**Total uses of goods and services**
Margins		Margins									**Total margins**
Factors	Net VA (net of taxes on prod and cons of fixed capital)										**Net VA**
Taxes	Taxes less subsidies on production	Net taxes on products and import				Income tax	Income tax				**Total taxes less subsidies**
Households				Households factor income			Net transfers	Net transfers			**Household Income**
Enterprises				Enterprises factor income			Transfers				**Enterprises Income**
Government				Government factor income	Taxes less subsidies		Net transfers			Net transfers from abroad	**Government Income**
Savings - Inv	Consumption of fixed capital					Net saving	Net saving	Net saving		Foreign saving	**Total Savings**
ROW		Import of goods and services		Net factor income to ROW		Net transfers to ROW	Net transfers to ROW		Net capital transfers to ROW		**Foreign receipts**
TOTAL	**Total costs of production**	**Total supply of goods and services**	**Total margins**	**Net factor outlays**	**Total taxes less subsidies**	**Household outlays**	**Enterprises outlays**	**Government outlays**	**Investment**	**Foreign outlays**	

Table 2: List of the Sectors

1.	Agriculture
2.	Crude Petroleum and Gas
3.	Coal and Other Fuel
4.	Food, Textile and Wood Products Sector
5	Coke, Refined Petroleum
6.	Chemicals, Machinery
7.	Electrial Energy
8.	Construction and Services

Table 3: Macro SAM for 2003 (the source: micro SAM) (mln. tenge)

	Activities	**Commodities**	**Margins**	**Factors**	**Taxes**	**Households**	**Enterprises**	**Government**	**Saving-Investment**	**ROW**	**TOTAL**
Activities		8924010									**8924010**
Commodities	4619643		969662			2520153		525068	1331568	2214702	**12180796**
Margins		969662									**969662**
Factors	3495816										**3495816**
Taxes	136529	313010				101147	272661				**823347**
Households				2489117			65968	169212			**2724298**
Enterprises				968615			96682				**1065297**
Government				5407	823347		62923			25608	**917284**
Savings - Inv	672022					50519	349733	223004		36290	**1331568**
ROW		1974115		32676		52479	217330				**2276600**
TOTAL	**8924010**	**12180796**	**969662**	**3495816**	**823347**	**2724298**	**1065297**	**917284**	**1331568**	**2276600**	

Table 4: Demand and Production Structure

Commodity/Activity	$\frac{Y_i}{\sum_i Y_i}$	$\frac{\sum_j Int_{ij}}{\sum_j \sum_i Int_{ij}}$	$\frac{X_i}{\sum_i X_i}$	$\frac{M_i}{\sum_i M_i}$	$\frac{C_i^u}{\sum_i C_i^u}$	$\frac{C_i^r}{\sum_i C_i^r}$	$\frac{Inv_i}{\sum_i Inv_i}$	$\frac{Gov_i}{\sum_i Gov_i}$	$\frac{X_i}{Y_i}$
Agriculture	0.072	0.061	0.059	0.010	0.076	0.073	0.021	0.043	0.204
Crude petroleum and gas	0.137	0.088	0.493	0.041	0.030	0.032	0.000	0.000	0.894
Coal and other fuel	0.035	0.062	0.043	0.006	0.000	0.000	0.000	0.002	0.306
Food, textile and wood	0.050	0.076	0.025	0.091	0.120	0.196	0.001	0.000	0.126
Coke,ref petroleum	0.028	0.073	0.023	0.040	0.016	0.030	0.000	0.000	0.209
Chemicals, machinery	0.108	0.264	0.231	0.554	0.091	0.110	0.377	0.000	0.533
Electrical energy	0.032	0.054	0.003	0.003	0.038	0.045	0.000	0.000	0.020
Construction and services	0.538	0.322	0.122	0.256	0.628	0.514	0.601	0.955	0.057
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	

where,
$\mathbf{Y_i}$ – output of commodity i;
$\mathbf{Int_{ij}}$ – intermediate of commodity i by sector j;
$\mathbf{X_i}$ – exports of commodity i;
$\mathbf{M_i}$ – imports of commodity i;
$\mathbf{C_i^u}$ – consumption of commodity i by urban households;
$\mathbf{C_i^r}$ – consumption of commodity i by rural households;
$\mathbf{Inv_i}$ – investment of commodity i;
$\mathbf{Gov_i}$ – government consumption of commodity i;

Table 5: Structure of the Value Added Across Sectors

	Activity	Share of labor inputs in sector i	Share of capital inputs in sector i	Total
1.	Agriculture	0.20	0.80	1.00
2.	Crude Petroleum and Gas	0.26	0.74	1.00
3.	Coal and Other Fuel	0.57	0.43	1.00
4.	Food, Textile and Wood Products Sector	0.27	0.73	1.00
5	Coke, Refined Petroleum	0.29	0.71	1.00
6.	Chemicals, Machinery	0.39	0.61	1.00
7.	Electrial Energy	0.47	0.53	1.00
8.	Construction and Services	0.39	0.61	1.00

Table 6: Parameters used in Calibration

Parameter	Description	Parameter value
Sigmaq	"Armington" elasticity of substitution between imports and domestic goods	3.0
Sigmat	Elasticity of transformation (domestic output versus exports)	5.0
PRODELAS(A)	Elasticity of substitution between factors - bottom of technology nest	0.7
PRODELAS2(A)	Elasticity of substitution between aggregate factors and intermediate goods	0.3
ELASAC(C)	Output aggregation elasticity for commodity C	0.0
FRISCH(H)	Frisch parameter for household LES demand	-4.0

Table 7: Expenditure elasticity of market demand for commodity c by household h

	LESELAS1(C,H)	Urban Households	Rural Households
1.	Agriculture	1.2	0.62
2.	Crude Petroleum and Gas	0.95	0.80
3.	Coal and Other Fuel	0.95	0.80
4.	Food, Textile and Wood Products Sector	0.95	0.80
5	Coke, Refined Petroleum	1.2	0.80
6.	Chemicals, Machinery	0.95	0.80
7.	Electrial Energy	1.1	0.9
8.	Construction and Services	0.8	0.76

Table 8: Percentage Change of the Prices from their Benchmark Level as a Result of the Decline in the World Oil Prices by 30%

	pdd	**pds**	**pq**	**pva**	**pa**
Agriculture	-5%	-5%	-4%	-3%	-3%
Crude petroleum and gas	31%	48%	20%	-3%	4%
Coal and other fuel	-2%	-2%	-2%	-1%	0%
Food, textile and wood	-2%	-3%	-1%	-3%	-2%
Coke,ref petroleum	4%	6%	4%	-3%	6%
Chemicals, machinery	-5%	-8%	0%	-2%	-1%
Electrical energy	1%	1%	1%	-1%	1%
Construction and services	-1%	-1%	-1%	-2%	-1%

Table 9: Percentage Change in the Quantity Levels Across Sectors as a Result of 30% Decrease in the World Oil Prices

	Qd(c)	**Qe(c)**	**Qm(c)**	**Qq(c)**	**Qva(a)**	**Qa(c)**
Agriculture	6%	61%	-18%	5%	17%	17%
Crude petroleum and gas	-91%	-100%	-82%	-89%	-99%	-99%
Coal and other fuel	53%	106%	29%	52%	69%	69%
Food, textile and wood	6%	45%	-11%	2%	11%	11%
Coke,ref petroleum	3%	-9%	4%	4%	1%	1%
Chemicals, machinery	17%	109%	-9%	2%	67%	67%
Electrical energy	-2%	9%	-9%	-3%	-2%	-2%
Construction and services	-3%	24%	-17%	-5%	-2%	-2%

where

QD(C) quantity of domestic sales
QE(C) quantity of exports
QM(C) quantity of imports
QQ(C) quantity of composite goods supply
QVA(A) quantity of aggregate value added
QX(C) quantity of aggregate marketed commodity output
QA(A) level of domestic activity
QINV(C) quantity of fixed investment demand

Table 10: Percentage Change in the Allocation of Capital and Labor as a Result of the Decline in the World Oil Prices by 30%

	Agriculture	Crude petroleum and gas	Coal and other fuel	Food, textile and wood	Coke,ref petroleum	Chemicals, machinery	Electrical energy	Construction and services
LAB	13%	-99%	66%	7%	-2%	63%	-5%	-5%
CAP	19%	-98%	74%	12%	2%	71%	0%	0%

Table 11: Percentage Change in Prices from Their Benchmark Level as a Result of the 30% Increase in the World Oil Prices Across Sectors

	pa(a)	pdd(c)	pds(c)	pq(c)	pva(a)
Agriculture	11%	15%	15%	12%	16%
Crude petroleum and gas	2%	-1%	-4%	-9%	15%
Coal and other fuel	5%	9%	11%	7%	11%
Food, textile and wood	7%	7%	9%	-2%	15%
Coke,ref petroleum	0%	3%	3%	-4%	15%
Chemicals, machinery	3%	9%	14%	-11%	13%
Electrical energy	5%	5%	5%	4%	13%
Construction and services	7%	8%	8%	3%	13%

Table 12: Percentage Change in the Production and Demand Across Sectors and Commodities as a Result of the 30% Increase in the World Oil Prices

	qa(a)	qd(c)	qe(c)	qq(c)	qva(c)
Agriculture	-24%	-10%	-86%	-5%	-24%
Crude petroleum and gas	165%	93%	174%	144%	165%
Coal and other fuel	-63%	-53%	-91%	-49%	-63%
Food, textile and wood	-30%	-23%	-84%	-1%	-30%
Coke,ref petroleum	-36%	-25%	-80%	-8%	-36%
Chemicals, machinery	-65%	-40%	-90%	10%	-65%
Electrical energy	6%	7%	-74%	10%	6%
Construction and services	-5%	-1%	-79%	11%	-5%

Table 13: Percentage Change in Allocation of Capital and Labor Across Sectors as a Result of the 30% Increase in the World Oil Prices

	Agricul-ture	Crude petroleum and gas	Coal and other fuel	Food, textile and wood	Coke,ref petroleum	Chemicals, machinery	Electrical energy	Construc tion and services
LAB	-20%	179%	-62%	-26%	-32%	-63%	10%	-1%
CAP	-25%	160%	-65%	-31%	-37%	-66%	2%	-8%