



Implementation of Equilibrium-Price Model to the Estimation of Import Inflation

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ABSTRACT

This study aims at investigating the the import inflationary processes as a result of feedbacks of mutual economic relations of World countries. It is used Equilibrium Price Model to estimate the import inflationary processes in CIS countries. The study investigates the further results regarding the import inflationary processes in the CIS countries on the scenario of increasing the Value Added norm in Russia. As well as by standpoint of economic growth and price stability, the recent revaluation of US dollar in the World and its impacts to total output of other countries have been investigated in details. In other words due to revaluation of the US dollar, if the final product decreases in USA, this decreasing impact how to be transmitted to the world countries have been estimated by the Input-Output Table in this study as well. The work is fulfilled on the Input-Output data for the year 2011. This study assumes theoretical and practical importance in defining the monetary policy.

Keywords: Equilibrium-price model, gross output, gross value added, input-output table.

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1.0 INTRODUCTION

The recent oil price shocks and revaluation of US dollar causes the inflationary processes in the CIS countries as a result of mutual relations among the countries. So, it makes the problem to be topic at present time. It is interesting to know the import inflation sensitivity of the CIS countries against the change in macroeconomic indicator in Russia. In the same time by standpoint of economical effects, the recent revaluation of US dollar may cause the decrease in final product of USA. And additionally it is also interesting to know how the decrease in final product of USA will impact the other world countries including the CIS countries. Of course, the estimation of this impact and to know how much it will result in losses of total output of other countries is very interesting for all by standpoint of price stability and economic sustainability.

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World economy is running in systematic form in the framework of mutual economic relations of world countries at present. Certainly, each national economy wants to derive its benefits from these relations. So, it isn't merely relations, it should be considered like the countries' behavior in relation to others ones too. System elements are being changed under recurrent economic processes and taking a new shape. Surely, these relations can be modelled through matrix. Economic crisis occurred recent decades could be considered as the result of qualitative and quantitative changes in the world economy. All these changes is an appearance of mutual economic relations of the world countries.

In this study, we try to estimate the import inflationary processes of the CIS countries by Equilibrium-Price model. This model is an adjoint of Input-Output model and one of the important economic-mathematics methods applied in investigating the interindustry relations of the economic sectors. The study involves the 70 world countries, including Azerbaijan. In order to maintain the equilibrium among the world countries the remaining countries of the world were given under the title of the rest world.

In the study we used some macroeconomic and National Accounts data such as intermediate consumption, intermediate products, gross domestic products, gross output, gross value added, final demand. This study is fulfilled on the data for the year 2011. In accordance with international manuals Input-Output model are compiled after each five years. The statistic data for compiling the Input-Output Table were obtained from the official internet site of the United Nations Organizations(UNO).

Note that, Input-Output model is widely recommended and useful methods in studying the World and national economies. The methodical essentials for implementing to the world countries relations have been prepared and introduced in the project titled as "The World Input-Output Database (WIOD): Contents, Sources and Methods" which financed by European Commission. (Commission, 2012).

The main objective of this study is to define an import inflation emerged from mutual relations among the countries, especially CIS countries by Equilibrium-Price model. Additionally, in this study we have investigated reciprocally influence of changes in economic indicators of any world countries to the others one by Input-Output model.

2.0 THEORETICAL DESIGN

2.01 THEORETICAL BASIS OF INPUT-OUTPUT(I-O) MODEL

Input-Output model was compiled first of all under the title of interindustry balance by Central Statistics Committee of USSR in 1926. Compilation of I-O was based on "Economic table" of Fransua Kene and "Broad reproduction scheme". Note that first interindustry balance analysis was established by Wassili Leontiev. Due to this scientific work he was awarded with Nobel Prize in 1973. (Hasanli and Moghsoudi, 2011)

The general shape of interindustry balance table is depicted as follows.

Table 1.1: Interindustry balance table

Key industry	Intermediate consumption				Total intermediate Product (IP)	Final demand (d)	Components of final demand	Gross output (X)
	1	...	j	...				
1	X_{11}	...	X_{1j}	...	X_{1n}	d_1		X_1
...
I	X_{i1}	...	X_{ij}	...	X_{in}	d_i		X_i
...
N	X_{n1}	...	X_{nj}	...	X_{nn}	d_n		X_n

Total intermediate consumption (GIC)	AI₁	...	AI_j	...	AI_n	d	X
Gross Value Added (GVA)	VA₁	...	VA_j	...	VA_n	VA	
Net taxes (NT)	NT₁	...	NT_j	...	NT_n	NT	
Gross Domestic Product (GDP)	GDP₁	...	GDP_j	...	GDP_n	GDP	
Gross Output (X)	X₁	...	X_j	...	X_n	X	

In order to elucidate the I-O model it is important to point some required equations by standpoint of methodical aspects. All equations pointed below are involving main elements of National Accounts and hence in generally these equations are carrying the table elements into the equilibrium condition (Hasanli and Abbasov, 2014).

First section of I-O model refers to intermediate consumption movements, second section to the components of final demand and third section to the component of Value Added (Yadulla Hasanli, 2011). The following equations are valid for each row of the table (Brown and Giarratani, 1979).

$$X_i = (x_{i1} + x_{i2} + \dots + x_{in}) + d_i \tag{2.1}$$

The following equations are valid for each column of the table,

$$X_j = (x_{1j} + x_{2j} + \dots + x_{nj}) + V_j \tag{2.2}$$

If we sum equation (1.1) for j and equation (2.2) for i , then we can get the below mentioned:

$$\sum_{i=1}^n X_i = \sum_{j=1}^n \sum_{i=1}^n x_{ij} + \sum_{i=1}^n d_i \tag{2.3}$$

$$\sum_{j=1}^n X_j = \sum_{i=1}^n \sum_{j=1}^n x_{ij} + \sum_{j=1}^n V_j \tag{2.4}$$

From the latter expressions, since

$$\sum_{i=1}^n X_i = \sum_{j=1}^n X_j$$

Then we can get the following equation

$$\sum_{i=1}^n d_i = \sum_{j=1}^n V_j$$

Gross value added and total final demand arising from mutual relations of world countries equals each others. If consider the equation $a_{ij} = \frac{x_{ij}}{X_j}$ in equation (1.1) then we get

$$X_i = \sum_{i=1}^n a_{ij}x_i + d_i \tag{2.5}$$

It is known that this is simultaneous equations and these equations systems could be written as matrix form. So, equation (2.5) could be expressed as follows.

$$\begin{pmatrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{pmatrix} = \begin{pmatrix} a_{11}, a_{12}, \dots, a_{1n} \\ a_{21}, a_{22}, \dots, a_{2n} \\ \dots \dots \\ a_{n1}, a_{n2}, \dots, a_{nn} \end{pmatrix} \begin{pmatrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{pmatrix} + \begin{pmatrix} d_1 \\ d_2 \\ \vdots \\ d_n \end{pmatrix} \tag{2.6}$$

Or

$$X = AX + D$$

The above mentioned equations conveys the same meaning. Having made some conversion we can modify this equation to the following one (Leontief, 1979).

$$X = (I - A)^{-1}D \tag{2.7}$$

Let's state National Accounts indicators in equations forms which used in this model. Gross output is the value of goods and services produced by entities within one point of time (Gorkhmaz Imanov, 2001)

I. Production account equilibrium equation (Gorkhmaz Imanov, 2001)

$$GO = IC + GVA \tag{2.8}$$

Here, GO-gross output, IC- intermediate consumption, GVA- means gross value added.

II. Goods and services account equilibrium equation (Gorkhmaz Imanov, 2001)

$$GDP = GO - IC + T - S = C(C + G) + S(I) + NEX \tag{2.9}$$

Here, GO-gross output, IC- intermediate consumption, GDP-gross domestic product, T-taxes, S-subsidy, C-consumption, S-saving, NEX-net export.

2.02 THEORETICAL ESSENTIALS OF EQUILIBRIUM-PRICE MODEL

Equilibrium-Price model is adjoint of Input-Output model. One of the main directions of interindustry analysis is to establish the equilibrium-price model. This model determines the relations among the total output of the industries, intermediate consumption and gross value added on the columns of input-output table. So, in mathematical form total output of each industry on respective industry column of the table is equal to the sum of intermediate consumption and value added amount. Mathematical expression of this equation is as follows:

$$X_j = (x_{1j} + x_{2j} + \dots + x_{nj}) + V_j \tag{2.10}$$

In accordance with I-O table the goods produced in any X_j industry are sold at certain P_j price and hence cause the formation of total output of the same industry. Note that, in order to produce for unit product in each industry it is required to spend money for obtaining the proper intermediate goods from other industries ($a_{1j}p_1 + a_{2j}p_2 + \dots + a_{nj}p_n$) and reimbursing the value added (V_j), such as wages, social pension fees, profit etc. So, with reference to above mentioned we can write the mathematical shape of the equilibrium model as below mentioned. (Hasanli and Moghsoudi, 2011)

$$X_j p_j = X_j (a_{1j} p_1 + a_{2j} p_2 + \dots + a_{nj} p_n) + V_j \tag{2.11}$$

If the both sides of equations (2.11) are divided by X_j , then we shall get the following equation

$$p_j = a_{1j} p_1 + a_{2j} p_2 + \dots + a_{nj} p_n + v_j \quad v_j = \frac{V_j}{X_j} \tag{2.12}$$

It is obvious that, an equation (2.12) is simultaneous equations. These equations could be written in the form of matrix.

$$\begin{pmatrix} p_1 \\ p_2 \\ \cdot \\ \cdot \\ p_n \end{pmatrix} = \begin{pmatrix} a_{11}, a_{21}, \dots, a_{n1} \\ a_{12}, a_{22}, \dots, a_{n2} \\ \dots \dots \\ \dots \dots \\ a_{1n}, a_{2n}, \dots, a_{nn} \end{pmatrix} \begin{pmatrix} p_1 \\ p_2 \\ \cdot \\ \cdot \\ p_n \end{pmatrix} + \begin{pmatrix} v_1 \\ v_2 \\ \cdot \\ \cdot \\ v_n \end{pmatrix} \quad \text{or} \tag{2.13}$$

$$P = A^T P + V$$

Here, A^T - transpose matrix

If we some conversion to the equation (2.13) we can get the following equations.

$$P = (I - A^T)^{-1}V \quad (2.14)$$

The above mentioned equation is the mathematical expression of Equilibrium-Price Model.

3.0 IMPLEMENTATION AND ESTIMATES OF EQUILIBRIUM-PRICE MODEL

In order to compile the 3rd part of the I-O Table, the intermediate product and intermediate consumption statistic data were obtained from the official site of UNO (“UNcomtrade”)⁴. We obtained the data related to GVA and GDP⁵ too.

There are some estimates on the countries were given in the Table 3.1. Although the final product and Gross Value Added consists of more than 50% of gross output in the countries such as USA, Great Britain, France, Japan, Mexico, Argentine, Canada, Cyprus, Georgia, Greece, India, Kazakhstan, Azerbaijan, Egypt, Norway, Philippines, Swiss, Tunis, UAE and Venezuela, but this point was fixed 50% and less for the remaining countries (see. Table 3.1).

Table 3.1: Model estimates

Countries	Portion of final product in the total output % D/GO	VA norm coefficient with basis price GVA/GO	Countries	Portion of final product in the total output % D/GO	VA norm coefficient with basis price GVA/GO
Albania	0.492836	0.485600	Latvia	0.458115	0.452700
Argentine	0.552726	0.551971	Lithuania	0.509222	0.521700
Armenia	0.642447	0.645237	Luxembourg	0.363481	0.360700
Australia	0.477081	0.476000	Malaysia	0.491904	0.490000
Austria	0.481981	0.484000	Malta	0.440671	0.435826
Azerbaijan	0.683336	0.680887	Mexico	0.582434	0.582700
Belarus	0.354918	0.379982	Netherlands	0.467411	0.470378
Belgium	0.423016	0.424400	New Zealand	0.468848	0.468994
Brazil	0.494926	0.493000	Norway	0.521764	0.519872
Bolqaristan	0.402440	0.401540	Pakistan	0.490536	0.490000
Canada	0.516583	0.517000	Peru	0.492475	0.490000
Chili	0.500113	0.503600	Philippines	0.589674	0.585954
China	0.339607	0.341000	Poland	0.447351	0.447496
Colombia	0.533290	0.531800	Portugal	0.461680	0.462257
Cyprus	0.570072	0.560000	Rep. of Korea	0.403119	0.402299
Czech Rep.	0.340875	0.340000	Rep. of Moldova	0.398173	0.399815
Denmark	0.465040	0.465000	Romania	0.459883	0.460192
Egypt	0.621465	0.625000	Russian Federation	0.490702	0.492340
Estonia	0.420101	0.409875	Serbia	0.433185	0.432253
Finland	0.457871	0.428200	Singapore	0.490687	0.490000
France	0.501290	0.504100	Slovakia	0.384374	0.383806
Georgia	0.584850	0.585555	Slovenia	0.444389	0.441687
Germany	0.497030	0.496950	South Africa	0.452204	0.452078
Greece	0.583085	0.581500	Spain	0.467844	0.467989
Hungary	0.396255	0.396011	Sri Lanka	0.615019	0.611587
Iceland	0.454084	0.450000	Sweden	0.472545	0.471316
India	0.516164	0.514300	Switzerland	0.514127	0.512854
Indonesia	0.492009	0.490806	Thailand	0.411083	0.410141
Iran	0.657679	0.658200	Tunisia	0.565807	0.572077
Ireland	0.432719	0.432131	Turkey	0.470515	0.469692
Israel	0.497869	0.501600	USA	0.523487	0.522713
Italy	0.456280	0.458667	Ukraine	0.392260	0.393590
Japan	0.553609	0.552600	United Arab Emirates	0.600339	0.597475

⁴ <http://comtrade.un.org/>

⁵ <http://unstats.un.org/unsd/snaama/resQuery.asp>

Kazakhstan	0.589493	0.587500	United Kingdom	0.501893	0.501433
Kyrgyzstan	0.436167	0.418700	Venezuela	0.639597	0.637657

Now, let`s look at the implementation of the equilibrium-price model and review the our research results. Assume that, the value added norm goes up 10%. In that case, the obtained results are given as follows: (see: Table 3.2). Equilibrium Price Model shows that in the scenario of 10% increase in value added norm in Russia, it may cause an inflation go up by 20.2% in Russia. This impact may spread to the partner countries gradually by means of trade and non-trade transmission channels. Consequently it may generate the import inflation in Azerbaijan about 0.02%, in Georgia 0.04%, in Kirgizistan 0.18%, in Moldova 0.15%, in Ukraine 0.08%. Model estimates show that the smaller import inflation sensitivity among the CIS countries against the change in macroeconomic indicator in Russia seems to be in Azerbaijan and Kazakistan.

Table 3.2: The results of 10% increase in value added norm in Russia.

Countries	Change in general price level (%-percentage)
Russia Federation	120,240
Azerbaijan	100,023
Georgia	100,040
Armenia	100,057
Kazakhstan	100,00006
Kirghizistan	100,181
Moldova	100,154
Ukraine	100,082

The model indicates that there is higher sensitivity in Kirgizistan than the others one. So, it points that the countries having the rich natural resources have more tolerance in this cases against the import inflation. But the countries having rich natural resources should diversify the output of the industries (fields) of the national economy. So it is very important point in strengthening the sustainability of the country. Because if country is depended on exporting the natural resources, in that case while decreasing the price of natural resources it will cause non-diversified economy to be suffered from the lack of foreign currency reserves and consequently devaluation of national currencies.

It is known that, nowadays the world crises cycle becomes shorter than the previous century. The latest world financial crisis just initially appeared in USA. Consequently, since the countries having the mutual economic relations with one another, it was exposed them to the certain losses too. Since US dollar revaluates against the other currencies, it will impact the local production adversely. Because in that case exporting goods of USA isn`t expedient than importing ones. Assume that, the final product of USA decreases by 5(five)%. In that case the results of some countries are given in the table as below mentioned. (see:Table 3.3).

Table 3.3: Results of 5% decrease in final product of USA.

Countries	Losses in the volume of Total Output (US dollar)	Relative to the world, percentage
USA	-1,445,705,221,556.80	0,9969129
Azerbaijan	-3,330.50	0,00000229
Georgia	-549,324.70	0,0000378
Armenia	-210,559.20	0,000014
Russia Federation	-98,847,467.50	0,0068
Canada	-676,672,999.50	0,046
China	-1,098,831,167.60	0,075

Great Britain	-205,107,045.70	0,014
Netherland	-121,347,514.80	0,008
Mexico	-286,689,608.10	0,019
France	-325,160,503.30	0,02
Total World	-1,450,181,992,935.60	100,00

Input-Output model analysis shows that scenario of decrease in final product in USA by 5%, will influence the total output of the world countries differently. While reviewing the effect on the mentioned scenario the most decrease in output seems to be in China. Note that, it is shown from the model that the smallest losses among the 70 countries seems to be in Azerbaijan. Studing the decrease in final product of USA is important for determining the indirect inflationary effect due to losses in the volume of the output of the countries. Additionally, the inflationary processes arising from the output decreasing effect in domestic commodity market could be estimated through econometric methods and models on each countries.

4.0 CONCLUSION

Hence, we have obtained some useful and interesting results on the scenario of increasing the Value Added norm in Russia. Consequently in that case CIS countries are to be exposed to the import inflationary processes differently. The estimated Equilibrium Price Model model shows that in case of 10% increase in value added norm in Russia, it may cause inflation go up by 20.2% in Russia. This impact may spread to the partner countries too. So, by means of the trade and non-trade transmission channels, it may generate the import inflation in Kazakistan by 0.00006%, in Azerbaijan 0.02%, in Georgia 0.04%, in Kirgizistan 0.18%, in Moldova 0.15%, in Ukraine 0.08%. Model results indicate that the economy of Azerbaijan and Kazakistan have smaller import inflation sensitivity against the change in price level in Russia. However, model shows that there is higher sensitivity in the economy of Kirgizistan in relation to the economy of Russia.

As well as by standpoint of economic growth and price stability, it was defined that due to revaluation of the US dollar, if the final product decreases in USA, this decreasing impact may be transmitted to the world countries and consequently other countries will be suffered from it. So, it was found that in the scenario of 5% decrease in final product of USA, the smallest losses in the volume of the output appears to be in Azerbaijan, but the biggest losses in China.

In order to diminish the impacts of import inflation and avoid the above mentioned cases each country should consider the following suggestions:

The first, to stimulate the consumption of domestic product rather than imported ready-made goods. The second, the country should diminish the intermediate goods from the countries impacting the prices level adversely. Because the inflation can be imported through the intermediate goods and it will cause cost(supply) inflationary processes in the country. The third, in the purpose of strengthening the foreign currency position and getting rid of any adverse devaluation of national currency it should be expedient to export the final consumption goods to the other countries than the raw materials. It concerns the countries which have rich natural resources. The fourth, each country should stimulate the increase in portion of intermediate consumption in total output in order to mitigate inflation pressure inside the country. So, it will cause diversification of the industries of the countries and will increase sustainability of the economy and maintain the price stability in the country.

Note that, modelling the import inflation arising from mutual relations among the world countries by using the equilibrium price model has a great importance in making decisions on the way of establishing trade relations and providing the welfare of the people in the country.

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