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How Oil Price Drops are reflected by Imported Inflation in Azerbaijan?

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ABSTRACT

Oil price shocks are generally seen as a major factor affecting the macroeconomic situation of the country, especially oil exporting countries such as Azerbaijan. While some authors have stated the direct channels of transmission of energy price shocks, other authors have considered the more of an indirect transmission of oil prices effects to the major macroeconomic variables. In this paper a cointegrated vector autoregressive model, vector error correction model model has been considered for Azerbaijan in order to study the response of inflation to oil price shocks. Empirical analysis shows that, for Azerbaijan there seems to be a statistical significant short-run relationship of unexpected oil price shocks on inflation rate that supported to reveal the imported inflation in Azerbaijan. Besides, there have been found a long run relationship running from exports, exchange rate, money supply, imports to the inflation in Azerbaijan as well. In conclusion, decreases in oil prices are transmitted to high imported inflation by lowering the value of domestic exchange rate and increasing the value of imports.

Keywords: Imported Inflation, Oil Price Shocks, Exchange Rate, Vector Error Correction Model, Money Supply, Exports
JEL Classifications: C58, E31, E43, E51, F31, O24

1. INTRODUCTION

Sharp decreases in the oil prices are seen reflected in different ways in different countries. There have been considerable number of studies conducted in this body of economic research where the transmission channels of oil price shocks to major macroeconomic variables of the country are analyzed and defined. In theoretical framework, there are a number of explanations given to the trends of economic activity as a result of oil price shocks. One of the well-known approaches is the supply shocks which is about production weight (in other words, supply) of the oil production. In this case, the oil prices are fluctuated based on the oil supply (Kilian, 2008). If there is an energy scarcity or the agreement on lowering production or something else that lead to the lower oil production, then oil prices increases, given that demand for oil hasn't fluctuated much unlikely to its supply (Barsky and Kilian, 2004). Besides, expectation of the consumers also plays an important role when the short-run effects are more significant than the long-run effects. Expecting increase in oil prices in near future, consumers would save less and demand more of oil products which will increase demand for the production at the similar level of supply. That will also lead to increased price levels (Baumeister and Kilian, 2016).

Another approach to the effect of oil price shocks to the economy is related with the income of the country. Depending on whether the country oil importing or exporting country, its income links with the oil prices also differ. Oil price fluctuations leads to major changes in most of the countries, plays a very important role in global economy.

The common problems occur in the oil exporting countries when oil prices decrease are mainly due to the strong dependence on oil and gas exports (Mantai and Alom, 2016). It is called the Dutch disease in which the country is experiencing a negative impact of large foreign income derived from abundance of the specific natural resource. Oil price drops directly lowers the income in oil exporting countries experiencing dependence on the oil and gas sector that lead to the robust decrease of the domestic exchange rate and imports being much expensive in domestic currency, imported inflation in the country (Ciccarelli and Mojon, 2010). Oil exporting countries with the high dependence of imports such as Saudi Arabia experience high inflation due to oil price increases as well, since higher oil prices is the higher production costs of the imported products in exporting countries. (Al-Qenaie, 2016)

The paper aims to define the reflection of the oil price drops in imported inflation. Cointegrated vector autoregressive (VAR) model, specifically vector error correction model (VECM) has been utilized for the analysis. This methodology have been broadly applied in empirical investigation recently, especially in order to study the effects of oil price fluctuations (Eltony and Al-Awadi, 2001), the monetary policy and inflation (Waal and Eyden, 2014), to reveal the causes of long-run economic activities (Gambacorta, 2011) and in similar empirical analysis that are reviewed and compared in detail in literature review part of the paper. Briefly, the methodology is chosen to assess the reflection of oil price drops in imported inflation, since it allows to reveal not only long-run via cointegration tool, but also short-run relationship between the variables. Throughout the analysis, impulse responses within the VECM framework have been applied along with the long-run analysis (Carlucci and Montaruli, 2014).

The paper consists of existing literature on the relationship between the oil price shocks on inflation and other major macroeconomic variables; the data and methodology for econometric framework used in the paper; cointegrated VAR, VECM and the impulse response functions (IRF) to estimate the relationship between oil price drops and imported inflation; and interpretation of the major results.

2. LITERATURE REVIEW

The relationship between oil prices and major macroeconomic indicators, especially inflation has an important role in the economies of oil exporting countries. It has been the argument of many studies conducted for different countries. Within the literature review, to the best knowledge of the author, the recent and considerably vital studies have been reviewed and linked with each other to analyze the relationship between oil prices and inflation in general.

The main goal of the section is to review the available literature and generalize the realtionship between the oil prices and inflation for different countries, then to specify it for the case of Azerbaijan which will be continued to be studied more detailed in the results part.

The main transmission channels of the relationship between oil prices and inflation is also reviewed in this section. When the world oil prices change, it leads to some changes in the country income as well. Due to that effect, there are some changes occur in domestic exchange rates. The prices of imported products converting to the local currency changes along with the value of domestic exchange rate too. Due to the government intervention to the economy, the mentioned effects are to some degrees (Peersman and Van Robays, 2009). In the case of oil price decreases, the income of the country will fall suddenly. According to World Integrated Trade Solution of the World Bank, the exports of goods and services in Azerbaijan consists 46.45% of the country GDP in Azerbaijan (Wits.worldbank.org, 2018). In the mean time, in 2018 oil and gas exports consists of around 91.5% of the overall exports in Azerbaijan (The State Statistical Committee of the Republic of Azerbaijan, 2018). Due to shown dependence on oil exports in the country, the decrease in oil prices significantly affects the GDP. As the income in foreign currency decreases, the country is forced to decrease the value of its currency. The devaluation or depreciation of the exchange rate makes exports much cheaper and imports much expensive relatively. Unlikely to exports, imports are less elastic during the decrease in domestic exchange rate. It is explained with the dependence of production in the country on imported raw materials and the lack of local producers or manufacturers.

Analysis of the countries with the same characteristics (mainly being oil exporting countries) has considerable conclusions for the paper. The research conducted by Brini et al. (2016) is about the impact of oil price shocks on inflation and real exchange rate in six of MENA countries. Structural VAR econometric model has been used for the estimation of the relationship. The study concludes that economies in these countries (Tunisia, Morocco, Algeria, Bahrain, Saudi Arabia and Iran) respond to oil price fluctuations more significantly with real exchange rate than with inflation in the long term period. The less significant effect of oil prices on inflation is explained by the subsidized prices of the products in those economies. Tural Karimli et al. (2016) have also investigated the impact of oil price fluctuations on inflation for the case of 3 oil exporting countries, Azerbaijan, Kazakhstan and Russia. Two main transmission channels of the relationship have been reviewed and quite significant effects of oil price shocks on inflation have been stated based on empirical evidence of the paper. Kpogli (2015) in his research concluded that that oil price increases lead to higher domestic prices in Ghana. Since Ghana is refined oil importing country at the same time crude oil exporting country. The crude oil exports is the 3rd biggest share in total exports with 7.2% after gold and cocoa beans. Inflation in the economy depends on world energy prices, since the country is import dependent as well. The country still depends on refined oil imports in order to satisfy the local needs. The VAR econometric model have been implemented for the period of 1998-2003 using monthly data to research the relationship between the oil price fluctuations and consumer price index changes in Ghana. Both the short and long-run effects have been found out for the case of Ghana. So the higher world energy prices leads to higher inflation in the country. Beside the oil exporting developing countries, there is also a study conducted for oil exporting developed countries such as the United Kingdom and Norway which both are oil producing OECD countries (Hilde Christiane Bjørnland, 1997). The study has used the Structural

VAR econometric model for the analysis of the relationship in the paper. It is found that imported inflation shocks are the important sources of inflation movements in Norway. Another oil exporting country with the well-known economy is Malaysia. The study conducted by Wong and Shamsudin, in 2017 examined the impact of crude oil prices on food price fluctuation in Malaysia, alongside the real GDP and exchange rate as explanatory variables in the models. Unrestricted Non-linear Auto-Regressive Distributed Lag model has been implemented in the study given the possibility of asymmetric relationship between the variables. As a conclusion of the analysis, there is found long-run effects of crude oil prices on food price fluctuations. Another study by Al-Qenaie in 2016 analyzed five main oil exporting countries, Algeria, Iran, Nigeria, Saudi Arabia and Venezuela for the determination of inflation in the economy. The more significant effects have been reflected by Saudi Arabia. Oil prices and government expenditures have been found to be the statistically significant determinants of inflation in the country. Although Saudi Arabia is one of the biggest oil exporting country, the oil price increases lead to higher inflation in the country as well. It is because the country have high rate of imports dependence from the oil importing countries. An increase in oil prices rise production costs in oil importing countries and, in turn, increases the costs of Saudi Arabia imports too (Figure 1).

Throughout the reviewing existing literature and model building, a number of working papers and research works have been found and compared with each other in order to understand the questioned relationship better both theoretically and empirically. References of the reviewed studies along with the mentioned researches are given in detail in the reference list of the paper.

3. DATA AND METHODOLOGY

Quarterly data for the period of 2001-2018 is used in the study. Unlikely to some studies above, the quarterly data is used in this paper since the effects found using VAR model in annual data concludes for the longer period of a year due to lags and that is avoided when the quarterly data is used. The following factors have been chosen to be included in the paper: Exports, Imports, Crude oil prices, Nominal exchange rate, Inflation rate and Money supply. The data on Exports, Imports in US million dollars are from Azerbaijan State Statistical Office. Nominal exchange rate (AZN per US dollar), Inflation rate (CPI changes in percentage) and Money supply (M2 in million AZN) information are obtained from the Central Bank of Azerbaijan. Nominal exchange rate is included even though Azerbaijan has had fixed exchange rate for most of the years of the period studied, because the paper aims to study the oil price reflection on imported inflation through the transmission channel which includes nominal exchange rate in it. For the oil prices variable the prices of the Brent oil are added in US dollar per barrel to the model. The quarterly data for oil prices variable in US dollar per barrel is taken from Bloomberg database for the determined period of time.

In order to investigate the effect of oil price shock to the inflation and analyze the transmission channel processes in detail from oil price shocks to imported inflation in Azerbaijan, the paper utilize VAR model. The VAR models are mainly used for forecasting the time series and also to evaluate the responses of variables against shocks in interested variables. Based on the economic theory, time series model to be structural is a common practice among the economic studies (Widarjono, 2007). Reviewing the historical use of the econometric methodology, the VAR model in 1980s is built to avoid the issues related to structural analysis of traditional simultaneous models and single regression models. With this VAR, Sims (1980) aimed to cover the entire economic phenomenon within one model.

Based on the explanation above, VAR is useful to investigate the research topic since the paper examines the interrelationship among oil price, money supply, imports, exports, inflation and exchange rate. In order to show the relationship among variables, there are several steps taken throughout the model building. First, the optimal lag number have to be determined. The number of lags is included into the model to define the effect of those variables to the other variables in the system.

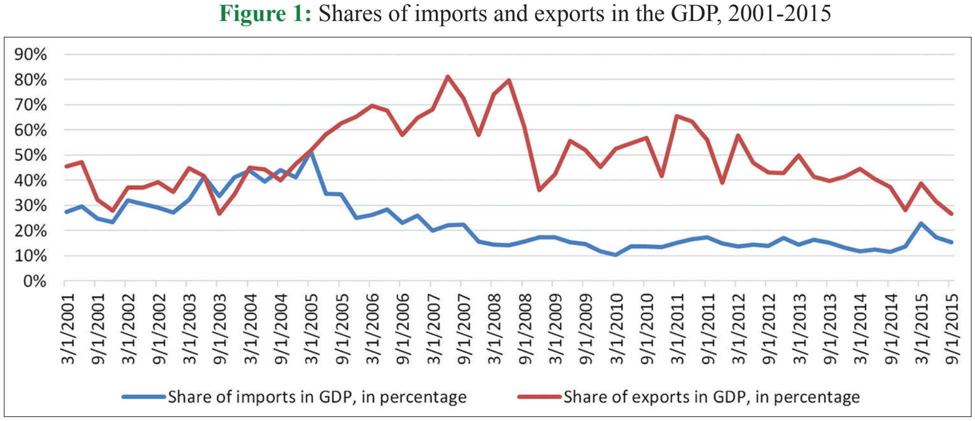
Standart n-equation VAR model based on Enders (2004):

Can also be written as follows:

$$x_t = A_0 + \sum_{1}^{n} A_i x_{t-i} + e_t$$

Where: x_t is an ($nx1$) vector containing each of the n variables employed in the VAR,

Figure 1: Shares of imports and exports in the GDP, 2001-2015



Source: The State Statistical Committee of the Republic of Azerbaijan

A_0 is an (*nx1*) vector of intercept terms

$$\begin{bmatrix} x_{1t} \\ x_{2t} \\ . \\ x_{nt} \end{bmatrix} = \begin{bmatrix} A_{10} \\ A_{20} \\ . \\ A_{n0} \end{bmatrix} + \begin{bmatrix} A_{11}(L) & A_{12}(L) & . & A_{1n}(L) \\ A_{21}(L) & A_{22}(L) & . & A_{2n}(L) \\ . & . & . & . \\ A_{n1}(L) & A_{n2}(L) & . & A_{nn}(L) \end{bmatrix} \begin{bmatrix} x_{1t-1} \\ x_{2t-1} \\ . \\ x_{nt-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \\ . \\ e_{nt} \end{bmatrix}$$

Where: x_{it} are the variables employed in the VAR, *i*
A_{i0} are the intercept terms
A_{ij}(L) are the polynomials in the lag operator
e_{it} are white-noise disturbances that may be correlated.

The n-equation VAR derived from Enders (2004),
A_i are (*nxn*) matrices of coefficients
e_{it} is an (*nx1*) vector of error terms

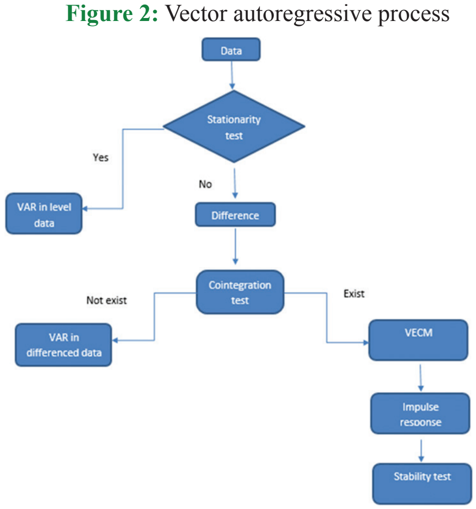
The observation matrices are x_t = [Azerbaijan`s Inflation, Real exchange rates, imports, exports, money supply and oil price].

3.1. Identification and Restriction

Unlikely to Sims (1980) who criticized the use of restricted VARs, Enders (2004) stated that researchers may face with identification problems occurring out of the model. The model may be under or over-identified the system. Thus, there may be a need for imposing restrictions to escape from identification problem.

Figure 2 depicts the process of VAR system. First of all the set of data should be test for stationarity. If the data is stationary in level, then VAR is present in level that is unrestricted VAR. On the other hand, if the data is not stationary in level, then the data should be differenced by the following order until it is stationary. The next step when after having stationary data in difference, the cointegration in order should be tested to check whether there is cointegration among variables or not. If the result of cointegration test states about cointegration among variables, then the VECM approach is applied to the model. If cointegration doesn't exist, then VAR in differenced data is applied for the estimation. As it is mentioned above, before estimating VAR/VECM model, the appropriate number of lag has to be chosen for the model estimation. Throughout the empirical analysis, the IRF and stability test are implemented to the model as well.

Figure 2: Vector autoregressive process



3.2. Unit Root Test

There are a number of tests to check the stationary of the variables such as non-formal and formal tests. Augmented Dickey Fuller (ADF) test is performed to investigate the stationarity of the variables in the model.

The paper investigates six variables which are inflation (as INF), exchange rate (as Exrate), exports (as exports), imports (as imports), money supply (as M2) and oil price (as Oil price). Based on standard model specification ADF, the equation can be written as follows:

$$\Delta INF_t = \beta_1 + \beta_2 t + \delta INF_{t-1} + a_i \sum_1^m \Delta INF_{t-i} + \varepsilon_t$$

$$\Delta \text{Exrate}_t = \beta_1 + \beta_2 t + \delta \text{Exrate}_{t-1} + a_i \sum_1^m \Delta \text{Exrate}_{t-i} + \varepsilon_t$$

$$\Delta \text{exports}_t = \beta_1 + \beta_2 t + \delta \text{exports}_{t-1} + a_i \sum_1^m \Delta \text{exports}_{t-i} + \varepsilon_t$$

$$\Delta \text{imports}_t = \beta_1 + \beta_2 t + \delta \text{imports}_{t-1} + a_i \sum_1^m \Delta \text{imports}_{t-i} + \varepsilon_t$$

$$\Delta M2_t = \beta_1 + \beta_2 t + \delta M2_{t-1} + a_i \sum_1^m \Delta M2_{t-i} + \varepsilon_t$$

$$\Delta \text{Oil price}_t = \beta_1 + \beta_2 t + \delta \text{Oil price}_{t-1} + a_i \sum_1^m \Delta \text{Oil price}_{t-i} + \varepsilon_t$$

Equations above show the model specification for ADF test for inflation, exchange rate, exports, imports, money supply and oil prices.

3.3. Cointegration Test

Non stationary variables in level is differenced by first order before applied to the model. Differenced variables let the author to perform cointegration analysis to reveal the long run relationship with other variables. Cointegration test is implemented for this purpose. Presence of cointegration in differenced variables requires VECM approach to be applied. On the other hand, absence of the cointegration keeps the model to be estimated with VAR in differenced data.

Before the cointegration test, lag order should be specified for further estimation process and for checking cointegration. There are several methods such as final prediction error (FPE), Akaike's information criterion (AIC), Schwarz's Bayesian information criterion (SBIC), and the Hannan and Quinn information criterion (HQIC) to determine the lag order. In order to choose the appropriate number of lags for the model, the value of the FPE, AIC, Schwarz's and the HQIC lag order selection statistics out of the lag-order test should be checked. The optimal lag is the one is indicated by the most of the criterions or by the author specifically.

As the fitted lag is specified, cointegration test is implemented. Johansen (1988), Johansen and Juselius (1990) have revealed an approach of the cointegration test based on Trace statistic and Maximum Eigenvalue statistic. The Trace statistic or Maximum Eigenvalue statistic is compared with their 5% critical values for their statistical significance. Johansen test aims to state the number of cointegration vectors in the model. Absence of cointegration implies the absence of long run relationship between variables.

The test itself includes the rank, eigenvalue, trace statistic and critical value with the null hypothesis that the number of cointegrating relationships is equal to *r*. The alternative hypothesis states for more than *r* cointegrating relationships. The null is rejected if the trace statistic is greater than the critical value. It starts with testing H_0: $r = 0$. If the null is rejected, then goes with H0: $r = 1$. The first *r* in the order with the accepted null is the main result of the test that shows the least number of cointegration vectors in the model.

3.4. VECM

As the existence of cointegrated vectors is proven, VECM model is built for identifying the long-run relationships. VECM model is chosen since it is one of relevant models of VAR with the cointegrated data. The VECM model equation is as follows:

$$\Delta x_t = \pi x_{t-1} + \sum_{1}^{p} \pi_i \Delta x_{t-i} + \varepsilon_t$$

There are three important parts of the VECM model. The short run coefficient matrices, the long run cointegration matrix and the matrix of the speed of adjustment terms. The coefficient of the speed of adjustment has to be negative and statistically significant, since it depict the correction of any deviation from the long run equilibrium.

3.5. IRF

In order to avoid the difficulty of interpretation of unexpected shocks, individual coefficients in the VAR models, the IRF analysis has been implemented. Being an important part of the VAR/VECM model, IRF depicts the reflection of endogenous variables in the model against the shocks or changes in some other variable (Widarjono, 2007).

3.6. Stability Test

Stability test is performed to know whether the model is well-specified. The model is stable if the r eigenvalues are lower than one or they are placed in the circle in the polynomial.

4. RESULTS

The section examines the result of the study conducted within the framework of the methodology mentioned in previous section. As it has been stated, the VAR model is implemented in the analysis of oil price shocks on imported inflation.

4.1. Stationarity Test

The unit root test is checked for all variables via ADF test including intercept in test equation as the precondition to start the VAR process. Table 1 shows the results of the ADF test in level data for all the variables. As shown on Table 1, only Inflation variable in level is significant at 5% and 10% significance levels of the ADF test. However other variables are not significant in all critical values which means that we fail to reject the null hypothesis that there is a unit root for these variables. Since there is a unit root in Exchange rate, Exports, Imports, money supply (M2) and Oil prices variables, they are considered not stationary in level.

Due to non-stationary data in level, the data is transformed into their first differences in order to further continue the processes. Table 2 shows the result of ADF test in first differenced variables. All variables are statistically significant in the following test which means that we reject the null hypothesis of the presence of the

Table 1: ADF test in level

Variable	ADF test	Critical value (%)			Result
		1	5	10	
Exchange rate	−2.016851	−3.536587	−2.907660	−2.591396	Unit root
Exports	−1.720145	−3.530030	−2.904848	−2.589907	Unit root
Imports	−1.586793	−3.536587	−2.907660	−2.591396	Unit root
Inflation	−2.996703**	−3.531592	−2.905519	−2.590262	No unit root
Money supply	−0.857204	−3.531592	−2.905519	−2.590262	Unit root
Oil prices	−2.039848	−3.530030	−2.904848	−2.589907	Unit root

ADF: Augmented Dickey fuller

Table 2: ADF test in first differences

Variable	ADF test	Critical value (%)			Result
		1	5	10	
D (Exchange rate)	−2.833725*	−3.534868	−2.906923	−2.591006	No unit root
D (Exports)	−7.038238***	−3.533204	−2.906210	−2.590628	No unit root
D (Imports)	−4.126694***	−3.536587	−2.907660	−2.591396	No unit root
D (Money supply)	−5.986183***	−3.531592	−2.905519	−2.590262	No unit root
D (Oil prices)	−7.362218***	−3.531592	−2.905519	−2.590262	No unit root

ADF: Augmented Dickey fuller

unit root, so all variables are stationary in their first differences. Exchange rate by 1st difference is the only variable having a weak stationary in 10% significance level only. However, other variables in their first differences are stationary even in 1% significance level of ADF test which are considered to be strong stationarity.

4.2. Determine Lag Order Selection

The results of the lag order selection criteria for VAR (Appendix 1), the FPE and likelihood ratio show that the appropriate number of lag is 4 lags. Since other criteria have close values at this lag level to their lowest, lag 4 is chosen to be the optimal lag structure of the model and to be included in Johansen test of cointegration.

4.3. Cointegration Test

Cointegration test for the model states about two valid cointegration vectors in the model. The processes is gone through testing the number of cointegration vectors starting from 0:

- H_0: $r = 0$ is rejected at the 5% level (131.2951 > 95.75366).
- Then the case of $r = 1$ is tested and since the trace statistic is greater than its critical value (77.54790 > 69.81889), we reject the null hypothesis again.
- Continuing with $r = 2$, it is found that the trace statistic is less than its critical value (46.80394 < 47.85613). Thus, null hypothesis is accepted. It results that there are two cointegration vectors in the model.

The presence of cointegration vectors (two cointegration in our model) is the existence of a long run relationship between the variables and hence, VECM) methodology should be implemented for the model.

As the results of cointegration tests have been obtained, VEC model may be built. Throughout the VEC estimation, the main points such as the short-run coefficients and long run relationship between the variables are estimated (Table 3).

4.4. VECM Estimation

As the paper aims to study one of the main causes of the imported inflation in Azerbaijan which is the decrease in oil prices, the transmission channel of this case should be reviewed first. Through the transmission channel and based on the economic situation in the country, oil price drops is expected to cause to very high inflation in the country in a short period.

Before analyzing the transmission channel, there are some facts have to be considered as given:

- According to the Statistical Bulletins of the Central Bank of Azerbaijan, the average share of the oil and gas sector in overall exports is about 92% for the period from beginning of 2013 to the end of 2017.
- Petroleum products are traded in US dollar, also called petrodollar.
- Another main fact should be mentioned is that imports are more of an inelastic to the changes in oil prices, while the exports move in accordance with the oil prices. Currently, there is a floating exchange rate regime in Azerbaijan. Thus, the significant effects of oil prices on the exchange rate are highly expected. These immediate effects are seen in their curves in the Figure 3. (Rustamov, 2017).

The mentioned facts help to understand and build the transmission channel from oil price shocks to imported inflation in Azerbaijan. Oil price drops in the world affects trade balance of all oil importer and exporter countries. As an oil exporter country, Azerbaijan is affected negatively by oil price drops, since >90% of the exports belong to oil and gas sector. It means the income of the country getting lower respectively which also leads to the loss of the value of the local currency. On the other side, it makes imports more expensive to country which is usually experienced having less imports during that time. However another fact is that Azerbaijan is strongly dependent on imports. Thus, the country still imports more, but for much expensive prices. That in turn, affects the prices in the country automatically and makes the prices increase very high.

4.5. Short Run Analysis

In order to conduct a short-run analysis, the VECM estimation has been established first. Since there are six variables included in the model, there have been six equations under VECM estimation model. Out of them, the ones with dependent variables of oil prices

Table 3: Johansan cointegration test

Sample (adjusted): 2002Q3 2018Q1				
Included observations: 63 after adjustments				
Trend assumption: Linear deterministic trend				
Series: D_EXCHANGERATE D_EXPORTS D_IMPORTS D_M2 D_OILPRICE INFLATION				
Lags interval (in first differences): 1-4				
Unrestricted cointegration rank test (trace)				
Hypothesized	Eigenvalue	Trace	0.05	P value**
Number of CE (s)		Statistic	Critical value	
None*	0.573921	131.2951	95.75366	0.0000
At most 1*	0.386147	77.54790	69.81889	0.0106
At most 2	0.322921	46.80394	47.85613	0.0626
At most 3	0.232464	22.23603	29.79707	0.2856
At most 4	0.045854	5.568123	15.49471	0.7459
At most 5	0.040598	2.611010	3.841466	0.1061

Trace test indicates 2 cointegrating eqn (s) at the 0.05 level, * denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p values and inflation are chosen to be studied, since the paper aims to analyze their relationship with other variables in order to explain the transmission channel empirically. Thus, chosen equations are estimated again with OLS method in order to interpret the short-run coefficients of the lagged variables on the dependent variables.

There are also cointegration equations which help to identify the speed of adjustment terms. In other words, they are error correction terms. If there is a deviation from the long run equilibrium, it will be corrected gradually through short run adjustment:

1. CointEQ1=INFLATION(−1)−0.0167428135618*D_EXPORT(−1)v0.0120880414524*D_M2(−1)+5.91900962612*D_OILPRICE(−1)+360.207300916*D_EXCHANGERATE(−1)−12.1027056866.
2. CointEQ2 = D_IMPORTS(−1)+0.127211408192*DE_XPORTS(−1)−0.131813668837*D_M2(−1)+5.1505360495*D_OILPRICE(−1)+1587.5019638*D_EXCHANGERATE(−1)−40.2786591496.

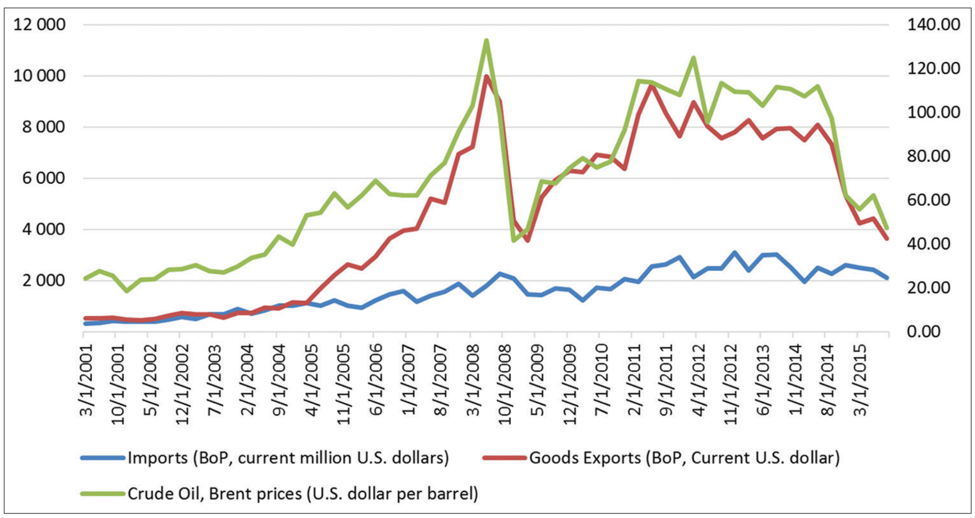
The Wald test also has been conducted in order to analyze the short-term effects of the chosen independent variables together with its lags on dependent variables. Considering that the quarterly data is used for the paper, then the analysis of 4 lags together may be considered as a short-run analysis as well.

Table 4 states about short-run analysis of the VECM equations (the ones with dependent variables of oil price and inflation). While conducting the analysis, the significance of the joint effects of the lagged coefficients of each including variable have been tested in each equation via the Wald test. From the first equation, it may be seen that the lags of exports, money supply and oil price have statistically significant short-term relationships with oil price variable. In the meantime, the second equation states that there are statistically significant short-term relationships between the lags of exchange rate, imports and inflation variable.

The signs of the each coefficient can be seen in the table put in the Appendix 2 of the paper where analysis for the short-run analysis of two mentioned equations has been conducted using Eviews.

The mentioned short-run analysis above concludes that there is no statistically significant short-term relationship between exchange rate and oil prices variables. It is because Azerbaijan has had fixed exchange rate until 21st of December 2015 and that also makes data to be fixed and stable. Thus, there were no significant dynamic changes in data and it led to not valid results out of econometric analysis. It is also important to note that nominal exchange rate variable (knowing that most of its observations are in the period of fixed exchange rate) is added to the model since it has an important role in transmission channel of the oil price drops to imported inflation. As the domestic exchange rate loses its value, imports get to be more expensive. At this stage, above mentioned 2nd equation helps to conclude that there is a short-term statistically significant relationship between imports and inflation. All the coefficients of imports with its lags are positive. The more imports (in million US dollars) is the more inflation in the country. The imports variable added to the model being in US dollars, the value of foreign exchange rate getting increased after the oil price drops and imports variable being inelastic lead to imports value to be high in local currency. Higher value of imports in local currency, having short-term positive statistical significant relationship between imports and inflation give a conclusion that there is imported inflation in short-run in Azerbaijan.

Figure 3: Comparative trend lines of crude oil prices, imports and exports in Azerbaijan over the period of 2001-2015



Source: The State Statistical Committee of the Republic of Azerbaijan

Table 4: Short-run analysis of the model

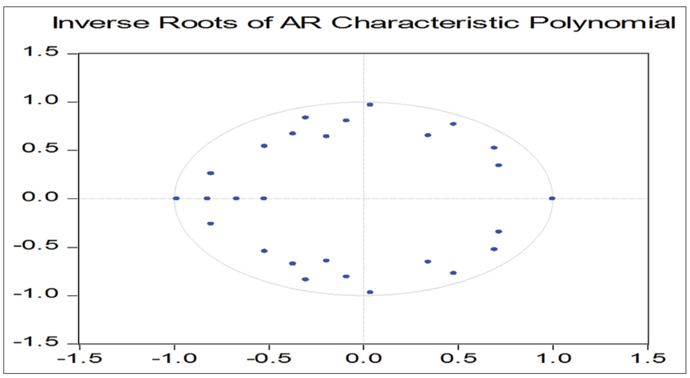
Variables	Exchange rate	Exports	Imports	Money supply	Oil prices	Inflation
1st equation (Dependent variable is oil price)						
Wald test (P value)	0.8660	0.0028***	0.2780	0.0424**	0.0085***	0.8674
2nd equation (Dependent variable is inflation)						
Wald test (P value)	0.0874*	0.3343	0.0921*	0.2648	0.7793	0.6444

***Significant at 1% significance level, **Significant at 5% significance level, *Significant at 10% significance level

Table 5: Johansen normalization restrictions imposed

Cointegrating equation	Cointegrating Eq. 1	Cointegrating Eq. 2
Inflation(−1)	1.000000	0.000000
D_IMPORTS(−1)	0.000000	1.000000
D_EXPORTS(−1)	0.016743	0.127211
	(0.02523)	(0.14398)
	[−0.66354]	[−0.88353]
D_M2(−1)	−0.012088	−0.131814
	(0.01090)	(0.06222)
	[−1.10860]	[−2.11852]
D_OILPRICE(−1)	5.919010	5.150536
	(1.80684)	(10.3102)
	[3.27589]	[0.49956]
D_EXCHANGERATE(−1)	360.2073	1587.502
	(157.119)	(896.547)
	[2.29258]	[1.77068]
C	−12.10271	−40.27866

Figure 4: Stability test of the model



Concluding above findings, there is an imported inflation getting roots from oil price drops in a short-run in Azerbaijan. It is proved econometrically as shown above. Only incompatible results are about exchange rate which is explained to be mostly during the fixed exchange rate period.

4.6. Long Run Anaysis

The long run relationship in the VECM model is analyzed through cointegration equations. The order of variables is set based on what to analyze due to the placement of the variables in the cointegration equations. Since the paper aims to analyze the long-run relationship between oil prices and inflation, the order of variables put in the model is as follows: Inflation, Imports, Exports, Money supply, Oil price, Exchange rate.

In this part, the order of restrictions is set to analyze the impact of Oil price, Exchange rate, Money supply and Exports to the Inflation and Imports in a long run. Since there are two cointegration vectors, the Johansen test automatically restricts two restriction in each cointegration equation.

Considering the two short-run equations from previous paragraphs, the coefficients of the cointegration equations should be reviewed. In order to conclude for the long-run causality, the coefficients should be negative and statistically significant, since they are error corrections for the long run relationship. Analysis shows that coefficient of cointegration equation 1 only in the 1st short-run equation (the one with dependent variable of oil prices) in the table in Appendix 3 has negative and statistically significant value. So it states that there is a long-run causality running from Exports, Money supply, Oil prices and Exchange rate to Inflation and the coefficient of the cointegration equation shows the speed of adjustment in case of any deviation from the long-run equilibrium (Table 5).

4.7. Post Estimation

After having VEC Model and estimating the parameters of cointegrating VECMs, the stability of the model is checked. The stability test is run to verify whether we have correctly specified the number of cointegrating equations in the system. The result states for a correctly specified number and stable processes in the model if the *r* eigenvalues in Figure 4 are <1.

Figure 4 shows that the eigenvalues exist inside the circle. No eigenvalues appear outside the circle. We can conclude from the stability check that our model is stable or well-specified.

The IRF permits observing how the model responds over time to shocks applied to the model variables. In this paper, the IRF was analyzed over a period of 63 quarters. Figure 5 shows the time behavior of the endogenous variables in response to a shock applied to the oil prices.

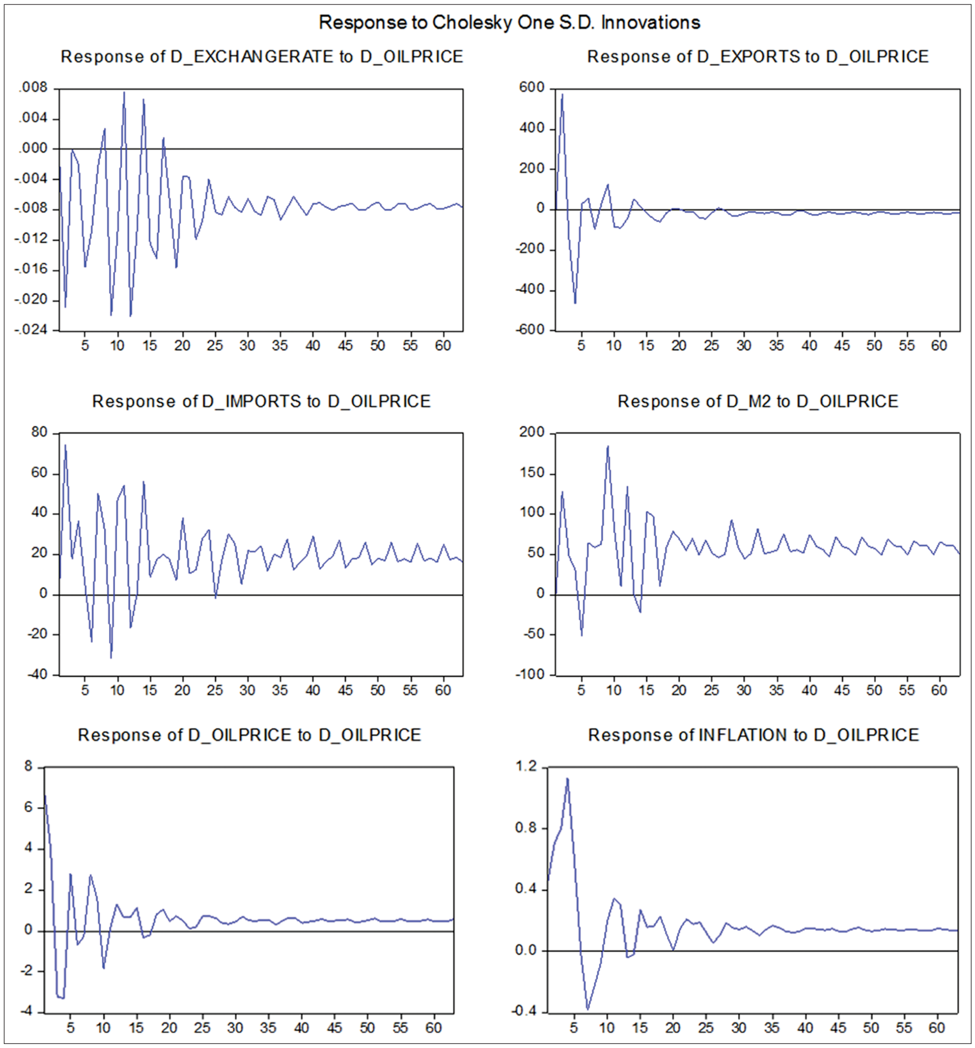
It can be seen that in the case of a shock to the oil price variable, the exports and even the inflation variables tend towards equilibrium more quickly while the imports, money supply and exchange rate variables tend to have a long-term memory. It is interesting to note that the exchange rate, exports and imports variables tend to return to pre-shock levels after oscillations while money supply, inflation and oil price have a change on their levels after the shock.

5. DISCUSSION

To recap, this study applied the VECM method to investigate the impact of oil price drops to imported inflation in Azerbaijan. The short run result shows that in a short-run oil price and exchange rate variables have insignificant statistical relationship. However, the reasons of incompatible result has been explained in details that it is due to fixed exchange rate system of the long period in Azerbaijan. Another contributing finding is that the imports and inflation has positive statistical significant relationship in a short-run. These findings lead to the conclusion that there is an imported inflation in Azerbaijan through the oil price drops.

It is also supported by long-run analysis. So, the long-run relationship has been found running from Exports, Money supply, Oil prices and Exchange rate to Inflation. Besides, with the help of IRF it can be seen how the model responds over time to oil price shocks applied to the model variables. The exports and even the inflation variables tend towards equilibrium more quickly while the imports, money supply and exchange rate variables reveal themselves to have a long-term memory.

Figure 5: Impulse Responses of the variables to oil price shocks



6. CONCLUSIONS

In this paper a VAR model, VECM have been estimated for Azerbaijan in order to verify if the oil price drops have been transmitted to imported inflation. Not only long-run but also short-run relationships have been analyzed. The results suggest that, for Azerbaijan an unexpected oil price drops is followed by an increase in inflation rate and a decline in output growth. The exports of Azerbaijan is much dependent on oil and gas and oil prices are determined globally. Thus, having oil price drops, Azerbaijan has received the signals for Dutch disease and have passed strong laws and reforms such as establishing Strategic Road Map covering national economic perspectives and strategic road maps on 11 economic sectors consisting of 12 documents and was approved by the President of the Republic of Azerbaijan Mr. Ilham Aliyev on December 6, 2016. For the sort-run tourism and agricultural production sectors have been developed, since they are related with exports of goods and services which brings foreign currency to the country. In the meantime, a number of import tariffs have been set in order to lower the import dependency.

Moreover, the paper opens a path for the future research of exchange rate regulation; exchange rate pass-through; the linkage between non-oil exports, exchange rate and oil prices; analysis of import dependency and etc. It is also strongly believed that the recent econometric techniques based on multivariate regime switching models are able to better represent the dynamics of major macroeconomic variables.

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APPENDIX

Appendix 1: Lag order selection criteria

VAR lag order selection criteria						
Endogenous variables: D_EXCHANGERATE D_EXPORTS D_IMPORTS D_M2 D_OILPRICE INFLATION						
Exogenous variables: C						
Date: 08/20/18-Time: 00:53						
Sample: 2001Q1 2018Q1						
Included observations: 62						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	−1810.082	NA	1.12e+18	58.58329	58.78914	58.66412
1	−1703.191	189.6450	1.14e+17	56.29649	57.73745*	56.86225*
2	−1665.885	58.96831	1.13e+17	56.25435	58.93042	57.30504
3	−1618.045	66.35836	8.38e+16	55.87242	59.78360	57.40805
4	−1565.871	62.27257*	5.89e+16*	55.35067	60.49696	57.37123
5	−1532.038	33.83320	8.53e+16	55.42056	61.80197	57.92606
6	−1478.297	43.33873	7.97e+16	54.84831*	62.46482	57.83874

*Indicates lag order selected by the criterion, LR: Sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

Appendix 2: Short-run equations

1st equation: D (D_OILPRICE)=C (109)*(INFLATION(−1)−0.0167428135618*D_EXPORTS(−1)−0.0120880414524*D_M2(−1)+5.91900962612 *D_OILPRICE(−1)+360.207300916*D_EXCHANGERATE(−1)−12.1027056866)+C (110)*(D_IMPORTS(−1)+0.127211408192 *D_EXPORTS(−1)-0.131813668837*D_M2(−1)+5.1505360495*D_OILPRICE(−1)+1587.5019638*D_EXCHANGERATE(−1)−40.2786591496) +C (111)*D (INFLATION(−1))+C (112)*D (INFLATION(−2))+C (113)*D (INFLATION(−3))+C (114)*D (INFLATION(−4))+C (115) *D (D_IMPORTS(−1))+C (116)*D (D_IMPORTS(−2))+C (117)*D (D_IMPORTS(−3))+C (118)*D (D_IMPORTS(−4))+C (119) *D (D_EXPORTS(−1))+C (120)*D (D_EXPORTS(−2))+C (121)*D (D_EXPORTS(−3))+C (122)*D (D_EXPORTS(−4))+C (123) *D (D_M2(−1))+C (124)*D (D_M2(−2))+C (125)*D (D_M2(−3))+C (126)*D (D_M2(−4))+C (127)*D (D_OILPRICE(−1))+C (128) *D (D_OILPRICE(−2))+C (129)*D (D_OILPRICE(−3))+C (130)*D (D_OILPRICE(−4))+C (131)*D (D_EXCHANGERATE(−1))+C (132) *D (D_EXCHANGERATE(−2))+C (133)*D (D_EXCHANGERATE(−3))+C (134)*D (D_EXCHANGERATE(−4))+C (135)

Observations: 63				
R-squared	0.676909	Mean dependent variable	0.028571	
Adjusted R-squared	0.443565	SD dependent variable		18.30923
Standard error of regression	13.65769	Sum squared residual		6715.169
Durbin-Watson stat	1.973506	-	-	

2nd equation:

D (INFLATION)=C (1)*(INFLATION(−1)−0.0167428135618*D_EXPORTS(−1) −0.0120880414524 *D_M2(−1)+5.91900962612*D_OILPRICE(−1)+360.207300916*D_EXCHANGERATE(−1)−12.1027056866)+C (2) *(D_IMPORTS(−1)+0.127211408192*D_EXPORTS(−1)−0.131813668837 *D_M2(−1)+5.1505360495*D_OILPRICE(−1)+1587.5019638*D_EXCHANGERATE(−1)−40.2786591496) +C (3)*D (INFLATION(−1))+C (4)*D (INFLATION(−2)+C (5)*D (INFLATION(−3))+C (6)*D (INFLATION(−4))+C (7) *D (D_IMPORTS(−1))+C (8)*D (D_IMPORTS(−2))+C (9)*D (D_IMPORTS(−3))+C (10)*D (D_IMPORTS(−4))+C (11) *D (D_EXPORTS(−1))+C (12)*D (D_EXPORTS(−2))+C (13)*D (D_EXPORTS(−3))+C (14)*D (D_EXPORTS(−4))+C (15) *D (D_M2(−1))+C (16)*D (D_M2(−2))+C (17)*D (D_M2(−3))+C (18)*D (D_M2(−4))+C (19)*D (D_OILPRICE(−1))+C (20) *D (D_OILPRICE(−2))+C (21)*D (D_OILPRICE(−3))+C (22)*D (D_OILPRICE(−4))+C (23)*D (D_EXCHANGERATE(−1))+C (24) *D (D_EXCHANGERATE(−2))+C (25)*D (D_EXCHANGERATE(−3))+C (26)*D (D_EXCHANGERATE(−4)+C (27)

Observations: 63				
R-squared	0.552712	Mean dependent variable	0.019048	R-squared
Adjusted R-squared	0.229670	SD dependent variable	2.831440	Adjusted R-squared
Standard error of regression	2.485111	Sum squared residual	222.3279	Standard error of regression
Durbin-Watson stat	1.882277			

APPENDIX 3: The signs of the short-run coefficients

System: UNTITLED				
Estimation method: Least squares				
Sample: 2002Q3-2018Q1				
Included observations: 63				
Total system (balanced) observations 126				
1st equation analysis				
Variables	**Coefficient**	**Standard error**	**t-Statistic**	**P value**
CointEQ1	−0.495180	0.143174	−3.458579	0.0009
CointEQ2	0.060829	0.026894	2.261812	0.0267
EXCHANGERATE(−1)	−42.43166	73.53497	−0.577027	0.5657
EXCHANGERATE(−2)	−21.45751	66.75719	−0.321426	0.7488
EXCHANGERATE(−3)	−45.71213	61.20665	−0.746849	0.4576
EXCHANGERATE(−4)	−19.33827	42.83203	−0.451491	0.6530
EXPORTS(−1)	−0.021357	0.006471	−3.300527	0.0015
EXPORTS(−2)	−0.011034	0.007675	−1.437693	0.1549
EXPORTS(−3)	−0.002916	0.006827	−0.427091	0.6706
EXPORTS(−4)	−0.003209	0.004081	−0.786484	0.4342
IMPORTS(−1)	−0.050647	0.024060	−2.105004	0.0388
IMPORTS(−2)	−0.043985	0.020229	−2.174342	0.0330
IMPORTS(−3)	−0.030368	0.016649	−1.824019	0.0723
IMPORTS(−4)	−0.019446	0.011607	−1.675359	0.0982
M2(−1)	−0.006954	0.004241	−1.639751	0.1054
M2(−2)	0.006482	0.003421	1.894463	0.0622
M2(−3)	0.007910	0.003279	2.412545	0.0184
M2(−4)	−0.003295	0.004530	−0.727287	0.4694
OILPRICE(−1)	2.214192	0.689552	3.211060	0.0020
OILPRICE(−2)	1.562151	0.689591	2.265330	0.0265
OILPRICE(−3)	0.628033	0.626047	1.003172	0.3191
OILPRICE(−4)	0.324620	0.368003	0.882112	0.3807
INFLATION(−1)	0.123923	1.034716	0.119765	0.9050
INFLATION(−2)	0.259959	1.021117	0.254583	0.7998
INFLATION(−3)	−0.140511	1.045570	−0.134387	0.8935
INFLATION(−4)	1.057201	0.998838	1.058431	0.2934
Intercept (1st equation)	−0.068895	1.770390	−0.038915	0.9691
2nd equation analysis:				
CointEQ1	0.012585	0.026052	0.483073	0.6305
CointEQ2	−0.006201	0.004894	−1.267251	0.2091
EXCHANGERATE(−1)	33.47915	13.38019	2.502143	0.0146
EXCHANGERATE(−2)	28.36118	12.14693	2.334844	0.0223
EXCHANGERATE(−3)	23.31859	11.13697	2.093800	0.0398
EXCHANGERATE(−4)	19.06509	7.793582	2.446255	0.0169
EXPORTS(−1)	0.001523	0.001177	1.293543	0.2000
EXPORTS(−2)	0.001613	0.001396	1.154928	0.2519
EXPORTS(−3)	0.000223	0.001242	0.179316	0.8582
EXPORTS(−4)	0.000451	0.000743	0.607787	0.5452
IMPORTS(−1)	0.006846	0.004378	1.563702	0.1223
IMPORTS(−2)	0.005294	0.003681	1.438396	0.1547
IMPORTS(−3)	0.006449	0.003029	2.128699	0.0367
IMPORTS(−4)	0.004743	0.002112	2.245910	0.0278
M2(−1)	0.001340	0.000772	1.736727	0.0867
M2(−2)	−6.37E-06	0.000623	−0.010240	0.9919
M2(−3)	−0.000351	0.000597	−0.588482	0.5581
M2(−4)	0.001557	0.000824	1.888471	0.0630
OILPRICE(−1)	−0.027003	0.125469	−0.215216	0.8302
OILPRICE(−2)	−0.038219	0.125476	−0.304590	0.7616
OILPRICE(−3)	0.032692	0.113914	0.286989	0.7749
OILPRICE(−4)	0.036646	0.066961	0.547280	0.5859
INFLATION(−1)	0.277179	0.188274	1.472211	0.1453
INFLATION(−2)	0.039715	0.185799	0.213751	0.8313
INFLATION(−3)	−0.066472	0.190249	−0.349398	0.7278
INFLATION(−4)	0.093184	0.181745	0.512715	0.6097
Intercept (2nd equation)	−0.035988	0.322135	−0.111718	0.9114
Determinant residual covariance		368.9351	-	