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Consequences of Oil and Food Price Shocks on the Ecuadorian Economy

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ABSTRACT

In this study, I investigated the short run impact on macroeconomics variables in Ecuador, economic growth and inflation specifically, due to world oil price and global food price shocks, considered these last two, as external variables. The model used to explain the dynamic of variables was the structural vector auto-regression, with annual data from 1980 to 2015. I concluded that oil price shocks affect positively to economic growth in Ecuador during two consecutive years, and then it returns to its natural state gradually. No enough statistically significant evidence was found, to conclude the global food index affect economic growth or inflation in Ecuador. Inflation neither showed significant response to oil price shocks. Considering the small sample in this study, due to unavailability of domestic economic data, the model resulted stable, and it is in line with arguments from other authors. Oil price shocks are a very important variable to keep watching, as Ecuador still depends on it, any government macroeconomic policy should be focus to it.

Keywords: Oil Price, Food Price, Structural Vector Auto-regression, Impulse-response Function, Forecast Error Variance Decompositions, Ecuador
JEL Classifications: C32, 040, F20

1. INTRODUCTION

Though there is a current trend from many years ago to start using renewable sources of energy, the crude oil is still the focus of many studies, due to the relationship between the oil price, and some macro-economic variables. Researchers as (Hamilton, 1996; Bernanke, et al., 1997; Kilian, 2008; Mork, 1989; Papapetrou, 2001; Lee and Ni, 2002; Paladines, 2017) have demonstrated that fluctuations on oil prices have influence in the domestic economy.

In the last years, oil price was about $100 per barrel, which was considerably higher than the last decade. The market of oil affects everything that is related to it, as transportation, heating bill, etc. Henceforth, oil prices are responsible for diminish the real economic growth, as many studies have demonstrated (Galesi and Lombardi, 2009; Abbott et al., 2009; Headey and Fan, 2008).

Crude oil importing countries depend on oil prices, as high oil prices could shock the economy, increasing domestic prices and diminish output (Doğrul and Soytas, 2010). These countries must forecast oil prices increases as this may lead to instability. (Mork, 1989; Hamilton, 1996; Rodriguez and Sanchez, 2004; Burbidge and Harrison, 1984; Berument, et al., 2010).

Exporting crude oil countries, as Ecuador, the aim of this study, which is a net oil exporter, benefits of higher oil prices, that is as Kilian (2005) explained, translated into more money to expend, but the inefficient use of this revenue may cause a long recession, difficult to overcome, as it is happening right now in Venezuela. Higher prices can lead to inflation but from different mechanisms o channels (Huseynov and Ahmadov, 2013).

But this mechanisms are difficult to capture, without a fully specified model (Bjørnland, 2000), but according to some authors like (Jones et al.; 2004; Tang et al., 2010; Brown and Yüce, 2002), have identified a few of these transmission channels, that would include the supply side effect, wealth transfer effect, inflation, real balance, sector adjustment and the unexpected effect.

One of these channels that is the inflation, it is accepted that may be transmitted through three different channels, the first one is the cost channel; higher oil prices can lead to higher cost production for oil import countries, as this increase in oil prices generate high inflation, in concordance with (Kilian, 2005), and may reduce output (Chuku et al., 2011).

Similarly, in exporting oil countries, higher oil prices can lead to higher cost production, in spite, the energy price is subsidized by government in oil exporting countries, the imported goods used for production do increases, or are components of the consumer price index (CPI) (Hooker, 2002; Tang, et al., 2010).

The second channel is the impact on exchange rate, as oil price increases the local currency for an oil exporting country can appreciate. But the opposite can exist when oil price falls, devaluation on the local currency is highly to happen due to over-pressure on inflation. And the third one is the fiscal channel, in spite of being an oil exporting country, if government exceeds its capacity of purchase, can trigger inflation easily, during high oil prices, due to the dependency on oil (Farzanegan, 2011).

All this background deserves that we watch carefully fluctuations of oil prices, in order to study the shocks that can impact on the economy. In this investigation I use the structural vector autoregressive (SVAR) to analyze the impact on Ecuadorian macroeconomic variables due to changes in oil prices.

This study involves the following macroeconomic variables from Ecuador; inflation, measured as changes in CPI, Economic growth measured as changes in real gross domestic product (GDP) per capita, world oil price and global food index. All series are annual from 1980 to 2015. Impulse response functions (IRFs) and forecast error variance decompositions (FEVDs) are explored to evaluate the short run dynamic among variables.

2. LITERATURE REVIEW

The study of effect of the oil price on macroeconomic variables dates from 1970s. Hamilton (1996) concluded that US recessions after WWII were preceded by increases in the oil price, determined a correlation between the impact of oil prices and recessions on the US economy. And more recently Brown and Yüce (2002) concluded related results.

Recessions was also studied by Blanchard and Gali (2007) that characterized the macroeconomic performance of a set of industrialized economies in the aftermath of the oil price shocks of the 1970s and of the last decade, using a six-variable VAR model. They found a significant role of oil prices in the economic downturns. Besides they concluded these impacts may be reducing with time due to the flexibility of the labor market.

The most relevant literature about oil price shock on macroeconomic variables for this study, was Kilian (2008) who showed evidence that the recent increase in crude oil prices was driven primarily by global aggregate demand shocks helps explain why this oil price shock so far has failed to cause a major recession in the U.S. Using a SVAR model decomposing the real oil price.

Investigations like (Rodriguez and Sanchez, 2004) in line with (Kilian, 2005; Hooker, 2002) who concluded that oil price shocks on economic recession in G7 countries. Similar to Du et al. (2010) and Gómez-Loscos et al. (2011) that determined a direct relationship between the same variables.

(Lescaroux and Mignon, 2008). (Berument, et al., 2010) concluded the price of oil could be considered as bad for oil importing countries but good for oil exporting countries, as it was demonstrated as well, by Aydın and Acar (2011) who concluded there is a negative effect on GDP in terms of variations in the price of oil in Turkey. In line with Burbidge and Harrison (1984), who argued based on a VAR model, that oil price has adverse effects on the macroeconomic variables in five Organization for Economic Co-operation and Development (OECD) countries.

Above literature can be confirmed besides by Taghizadeh-Hesary et al. (2013) evaluated the impact of oil price shocks on oil producing and consuming economies; the study used a simultaneous equation framework for different countries with business relations. As expected, the results showed that oil producers (Iran and the Russian Federation) benefit from oil price shocks; similar to (Huseynov and Ahmadov, 2013), who confirm that a rise in oil prices is a positive shock which boosts the domestic economy, but in general leads to higher inflation.

Oil price increases are expected to affect net oil importers countries negatively, through rising import bills leading to inflation, reducing output and unemployment (Bacon and Kojima, 2008). Similar to Chang and Wong (2003) indicated that impact of oil volatilities on GDP, inflation and unemployment have been significant. Cuñado and Pérez de Gracia (2005) concluded that oil prices have a significant effect on both economic activity and price indexes although the impact is limited to the short-run for some Asian countries. And Tang et al. (2010) who studies short and long run effects of oil price in China; by using SVAR model, he showed that increases of oil price negatively affect output and investment but positively affect inflation and interest rate.

Other works by Bjørnland (1998) concluded that for Germany, UK and US, an adverse oil price shock has had a negative effect on output in the short run, but, for the US it was in the long run. Similar works about impact on output to oil prices shocks in Saudi Arabia, Indonesia, Iran, Kuwait were Mehrara and Oskui (2007), who using a SVAR, concluded that, oil price shocks are shown to be the main source of output fluctuations in Saudi Arabia and Iran. But in Kuwait and Indonesia, output fluctuations were mainly found due to aggregate supply shocks. Moreover, their results show that oil price shocks in Saudi Arabia steadily expand prices while such impact on the long run prices in Iran, Kuwait and Indonesia is not approved.

Structural VAR models allow to forecast scenarios based on hypothetical future structures, as it was demonstrated by Baumeister and Kilian (2016) who studied the causes of the steep decline in the Brent price of oil between June and December 2014. Their analysis shows that more than half of this decline was predictable in real time as of June 2014.

3. METHODOLOGY

The SVAR model, introduced by Sims (1980) have been used widely, two of them are the most important works used in these study, which are the studies by Kilian (2008) and Alom (2013), who used a SVAR, for studying the impact on macro-economic variables due to shocks in oil price.

This paper uses a SVAR model to measure the impact on macroeconomic variables for changes in supply and oil prices, as there is enough evidence confirming the correlation between the variables studied by Kilian (2008), for example (Fueki, 2016; Lorusso and Pieroni, 2015; Roach, 2014; Lanteri, 2014; Lamazoshvili, 2014; Bjørnland, 2000; Alom, 2013).

In this work, domestic economic variables used to explain oil price shocks were: The real GDP per capita and inflation, both from Ecuador, all data is annual from 1980 to 2015, data was obtained from El Instituto Nacional de Estadísticas y Censos (www.ecuadorencifras.gob.ec). It also can be said, that it is a small sample as Kilian (1998).

Inflation was calculated from the log-differenced of the CPI of Ecuador and the real GDP per capita was calculated in log-differenced, in order to express the economic growth.

Following Kilian (2008) work, who postulated a recursive structure such that, the form error e_t, can be decomposed according to $(e_t = A_0^{-1}\varepsilon_t)$, taking the following scheme:

$$e_t \equiv \begin{pmatrix} e_t^{\Delta prod} \\ e_t^{rea} \\ e_t^{rpo} \end{pmatrix} = \begin{bmatrix} \alpha_{11} & 0 & 0 \\ \alpha_{21} & \alpha_{22} & 0 \\ \alpha_{31} & \alpha_{32} & \alpha_{33} \end{bmatrix} \begin{pmatrix} \varepsilon_t^{\text{oil supply shock}} \\ \varepsilon_t^{\text{aggregate demand shock}} \\ \varepsilon_t^{\text{oil-specific demand shock}} \end{pmatrix}$$

I developed a structural VAR with variables similar to (Alom, 2013; Khan, 2011; Omojolaibi, 2013; Taghizadeh-Hesary et al., 2013), with world oil price and world food index, as exogenous variables. In order to have a consistent model, I determined a recursive identification scheme, assuming that A matrix is an identity, while B matrix is upper triangular, capturing contemporaneous relationships. The impact matrix with the restrictions imposed can be seen below:

$$e_t \equiv \begin{pmatrix} e_t^{rpo} \\ e_t^{fin} \\ e_t^{gdp} \\ e_t^{inf} \end{pmatrix} = \begin{bmatrix} \alpha_{11} & 0 & 0 & 0 \\ \alpha_{21} & \alpha_{22} & 0 & 0 \\ \alpha_{31} & \alpha_{32} & \alpha_{33} & 0 \\ \alpha_{51} & \alpha_{52} & \alpha_{53} & \alpha_{54} \end{bmatrix} \begin{pmatrix} \varepsilon_t^{\text{world oil price}} \\ \varepsilon_t^{\text{world food index}} \\ \varepsilon_t^{\text{real gdp per capita shock}} \\ \varepsilon_t^{\text{inflation shock}} \end{pmatrix}$$

This scheme follows an order from exogenous to endogenous, related to the respective responses of variables to temporary shocks. Four restrictions according to theory were applied, which its estimation suggest that, the first and second row, these are, the oil supply and the world food index shocks, they are place on top because they are considered macro variables. Oil price does not respond to innovations to the other macroeconomic variables in the period t. (Lee and Ni, 2002). Food price responds to oil price shocks, although there is no evidence that the food index may be impacted by oil price shocks (Baumeister and Kilian, 2014), this variable may affect domestic variables in Ecuador. It is expected that a positive shock in food index, impacts on inflation positively and a positive shock in oil price, would cause a positive impact on economic growth of Ecuador.

The third row, it is the Ecuador economic growth, proxied by the real GDP per capita, it's assumed this variable it is only affected by itself, oil price and food index, according to Jiménez-Rodríguez (2007) and Alom (2013).

And finally, inflation receives contemporaneous effects of all the remaining variables in the system, similar to (Alom, 2013; Khan, 2011; Jiménez-Rodríguez, 2007). I assumed oil price shocks could affect CPI indirectly.

Oil price, refers to the real oil price, this is measure as the average price in dollars for equal weights of oil according to Brent, Dubai and WTI prices. Both, oil price and food index, were obtained from the OECD (www.oecd.org). Time series in logs were used, from 1980 to 2015.

4. FINDINGS

4.1. Unitary Root Test

There are important differences between stationary and non-stationary time series. Changes in stationary series are necessarily temporary, over time, the effects of shocks will dissipate and the series will return to their mean level in the long run. While a non-stationary series necessarily has permanent components. The mean and variance of a non-stationary series are time dependent (Enders, 2015).

A VAR can be estimated with non-stationary variables in level and the resulting impulse responses in the short- and medium-run are then reliable estimators of the true impulse responses. This holds also with cointegrated variables. This result comes from the fact that the VAR in level takes implicitly account of the cointegrated relationships. Similarly, as pointed out by Sims et al. (1990), the common practice of transforming models into stationary representations by first-differencing or using cointegration operators is often unnecessary even if data appear likely to be integrated (at least asymptotically).

Variables were tested by both the Dickey-Fuller Augmented Test and the Phillips-Perron test (Phillips and Perron, 1998), these tests showed that only oil price, has a unit root in levels.

4.2. SVAR Analysis

The main and unique objective of this paper is to study the impact of oil price shocks on the economic growth and inflation in Ecuador, using the IRF.

It was chosen 4, as the lag length, in order to remove residual correlation properly, given by the Akaike Information Criterion.

Table 1 shows the coefficients of the SVAR model, according to the order of variables in the two matrixes.

4.3. Impulse-response Function (FIR)

Since the individual coefficients in the estimated VAR models are often difficult to interpret, practitioners often estimate the FIR (Gujarati and Porter, 2010).

(Pesaran and Shin, 1998) they propose a type of impulse - generalized response that consists in constructing a set of orthogonal innovations (shocks), such that they do not depend on the ordering in the VAR.

It is important to remind that for software limitation, it is just calculated a positive one unit standard deviation shock to oil prices. As I studied the impact on macroeconomic variables due to shocks to oil market, the following graph does no show impacts on oil prices, as it was discussed before.

The result about the impact on GDP to shocks to oil price, are almost the same as Paladines (2017), and similar to (Taghizadeh-Hesary et al. 2013; Du et al., 2010; Gómez-Loscos et al., 2011; Lescaroux and Mignon, 2008; Berument, et al., 2010; Chang and Wong, 2003), GDP reaches its peak in 2nd year; after that results suggest that GDP declines gradually.

The GDP response to world food index shocks, shows a negative effect, this is according to theory, until the 5th year, then it returns to zero, but it is not statistically significant all the 10 periods forecast, similar to Alon (2011), the impact on inflation due to shocks in oil and food prices, both have positive effects as (Huseynov and Ahmadov, 2013) and later negative effects, but still it is not statistically significant (Figure 1).

4.4. Analysis of FEVD

The prediction of error variance decompositions are also popular tools for interpreting VAR models (Lütkepohl and Krätzig, 2004).

The variance decomposition offers a slightly different method for examining the dynamics of a VAR system. They give the proportion of the movements in the dependent variables that are due to their own shocks, to shocks of other variables. A shock to the variable ith will directly affect that variable, but will be transmitted to all other variables in the system through the dynamic structure of the VAR (Brooks, 2008).

When analyzing the Table 1, it is observed that the variability of the economic growth of Ecuador can be explained until 22% approximately the oil price shocks, but food index, could explain until 11% of its variability. Oil price and food price are shock 1 and shock 2 respectively.

Domestic inflation is not almost explained by oil price shocks, but a positive shock in the world food index could affect it by 13% approximately, but according to the IRF respective, these results cannot be definite (Table 2).

Table 1: SVAR results

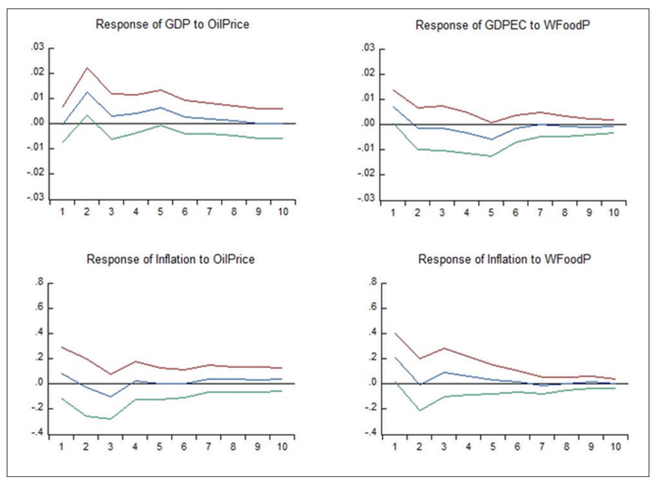
Estimated A matrix			
1.000000	0.000000	0.000000	0.000000
−0.087912	1.000000	0.000000	0.000000
0.009797	−0.083635	1.000000	0.000000
−0.018392	−3.304943	10.48118	1.000000
Estimated B matrix			
0.242940	0.000000	0.000000	0.000000
0.000000	0.083687	0.000000	0.000000
0.000000	0.000000	0.018574	0.000000
0.000000	0.000000	0.000000	0.501514

SVAR: Structural vector autoregressive

Table 2: Variance decomposition

Period	S.E.	Shock 1	Shock 2
GDP			
1	0.019858	0.089463	12.42324
2	0.026685	22.02441	7.301726
3	0.027271	22.08870	7.371997
4	0.028322	22.25212	8.434969
5	0.029683	24.30358	11.93930
Inflation			
1	0.580793	1.958429	12.24329
2	0.591269	2.201948	11.85744
3	0.612331	5.030766	12.92291
4	0.616520	5.084973	13.63427
5	0.620564	5.024468	13.65459

Figure 1: Response-Impulse Functions with ± 2 S.E



4.5. Diagnostic Tests

As the VAR technique is relatively flexible and dominated by the endogeneity of the variables, it is not customary to analyze the estimated regression coefficients and their statistical significance; Nor is the goodness of the fit (R^2, it is usual to verify that the absence of serial correlation of the residuals of the individual equations of the model and the normal multivariate distribution of the variables is observed. Sometimes the variables are expected to reflect behaviors consistent with the expected some researchers perform additional tests, such as the stability of the model, the joint significance of the variables considered, their direction of causality, the cointegration of the residuals of the individual regressions and the decomposition of variance of the forecast error (DV) (Arias and Torres, 2004).

4.5.1. Normalily

It is necessary the normality of the underlying data of the generated processes, for example to establish forecast intervals (the forecast errors used in the construction of forecast intervals are weighted sums of the Ut). Non-normal residuals may indicate that the model is not a good representation of the processes of the generated data. For this reason, testing this distribution assumption is desirable (Lütkepohl and Krätzig, 2004).

The normality test by the structural factorization method, showed a P-value of 0.1189 for the Jarque-Bera (JB) statistic, this result means I cannot reject the null hypothesis that residuals are multivariate normal, but this result it is taken with carefully, as the JB statistic follows an asymptotic distribution.

4.5.2. Autocorrelation

Results from the LM test of autocorrelation of residuals, suggest in non-rejection of the null hypothesis of non-autocorrelation until the 4th lag. So, I can conclude the absence of correlation among residuals.

4.5.3. Heteroskedasticity

The test of white without cross-terms, which null hypothesis is the absence of heteroskedasticity in the VAR, is not rejected in this model, the test showed a P-value of Chi-square, equals to 0.2340.

4.5.4. Stability model

The estimated VAR is stable (stationary) if all roots have modules <1 and lie within the unit circle. If the VAR is not stable, certain results (such as standard impulse response errors) are not valid (Eviews, 2016).

According to the Table 3, I can conclude that the model is dynamically stable.

5. CONCLUSION

The dynamic relationship between the two global variables, oil price and the food index, with the domestic variables that are the economic growth, proxied by the real GDP per capita, and inflation of Ecuador, are very important issues, to take into account for economic policies. This research was carried out, taking annual data from 1980 to 2015, and using level of the variables, I tried to explain the behavioral of these ones, using two econometric tools as, the FIR and the DV, in base of a SVAR model, I concluded a short run relationship among variables, according to the restrictions used in the model.

Table 3: Stability test

Root	Modulus
0.856327-0.172954^{i}	0.873619
0.856327+0.172954^{i}	0.873619
0.205494-0.618241^{i}	0.651498
0.205494+0.618241^{i}	0.651498
−0.388256-0.508515^{i}	0.639789
−0.388256+0.508515^{i}	0.639789
0.220959-0.435324^{i}	0.488191
0.220959+0.435324^{i}	0.488191

Since the stability tests of the SVAR were significant, the model is good specified. Results from the FIR indicate that, a positive shock in oil prices, the economic growth of Ecuador if affected positively and other results were inconclusive, as there was no much statistically significant evidence, to prove correlation between oil production with both GDP and Inflation, like wise no significant relationship was found between oil price shocks and inflation.

The most change in economic growth in Ecuador can be explained by oil price shocks by 24% approximately. As FIR did not show significant values with inflation, the DV lacks of veracity. Although this model could be improved later by adding more data this paper accomplished its purpose to explain any short run relationship among the variables studied, in spite this was a small sample.

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