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Research Article

Macroeconomic Effects of Oil Price Fluctuations in Colombia

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Abstract

This research aims to study the effects of oil price changes on the Colombian economy during 2001:Q1 to 2016:Q2. A structural vector auto-regression model in the spirit of Blanchard and Galí (2010) is estimated under a recursive identification scheme, where unexpected oil price variations are exogenous relative to the contemporaneous values of the remaining variables. Drawing on impulse-response estimates, a 10% increase in the oil price generates the following accumulated orthogonalized responses: i) a contemporaneous 0.4% increase in GDP growth, later on the effect reaches its maximum in the first quarter (1.7% increase) and starts to decay after two quarters; ii) a contemporaneous 1.2% decrease in unemployment, then the effect remains slightly negative and reaches its maximum after ten quarters (5.1% decrease); iii) a contemporaneous 0.9% decrease in inflation, followed by an 0.2% increase by quarter three, and thereafter the effect remains slightly negative.

Resumen

Esta investigación busca estudiar los efectos de las variaciones en el precio del petróleo en la economía Colombiana durante 2001:T1 a 2016:T2. Un modelo estructural de vectores auto-regresivos, similar al de Blanchard y Galí (2010), es estimado bajo un esquema de identificación recursiva, donde las variaciones inesperadas en el precio nominal del petróleo, son exógenas con respecto a los valores contemporáneos del resto de las variables. Con base a las funciones de impulso-respuesta, un aumento del 10% en el precio del petróleo genera las siguientes respuestas acumuladas ortogonalizadas: i) incremento contemporáneo de 0.4% en el crecimiento del producto, luego el efecto alcanza su máximo en el

primer trimestre (incremento de 1.7%) y comienza a decaer luego de dos trimestres; ii) disminución contemporánea de 1.2% en el desempleo, seguidamente el efecto se mantiene ligeramente negativo y alcanza su máximo luego de diez trimestres (disminución de 5.1%); iii) disminución contemporánea de 0.9% en la inflación, seguida de un aumento de 0.2% en el tercer trimestre, y luego el efecto se mantiene ligeramente negativo.

1. INTRODUCTION

Oil is a key component of the global economy, and the relationship between its price and macroeconomic indicators has been addressed by economic researchers since the late 1970s, such as Hamilton (1983, 1996), Rotemberg and Woodford (1996), Kilian (2009), Blanchard and Galí (2010), among many others. However, most of the research on the subject has focused on advanced economies (especially the U.S.), which have been historically net-importers of oil. For emerging and developing economies, the effects of oil price fluctuation have been explored to a much lesser extent in recent work, for example by Lorde, Jackman and Thomas (2009) for Trinidad and Tobago, and Farzanegan & Markwardt (2009) for Iran.

Previous work has presented a variety of results, which suggest that the responses to oil price fluctuations might be heterogeneous from one country to another, depending on the characteristics of the economy, including whether it is emerging or developed, a net oil-exporter or a net oil-importer.

There were three main motivations for conducting this research. First, Colombia represents an interesting country for a case study, as it is an emerging market economy with relatively low oil reserves (when compared to other oil giants such as Venezuela and Mexico) that has managed to obtain a place among the largest oil exporters in the Latin American region during last years (BP, 2016). Second, although the oil sector in Colombia is substantial, the country has a somewhat diversified economy, which is not common among major oil producers; for instance, oil revenues as a percentage of GDP have consistently been less than 9% during 1970-2014 (World Bank, 2016). Third, as stated previously, the majority of journal articles on this subject have been focused on the U.S. or other industrialized economies, and to the best of my knowledge, the Colombian case has not been widely explored in the empirical macroeconomic literature. That said, this work aims to make another contribution to the understanding of the oil prices-macroeconomy relationship, focusing on Colombia.

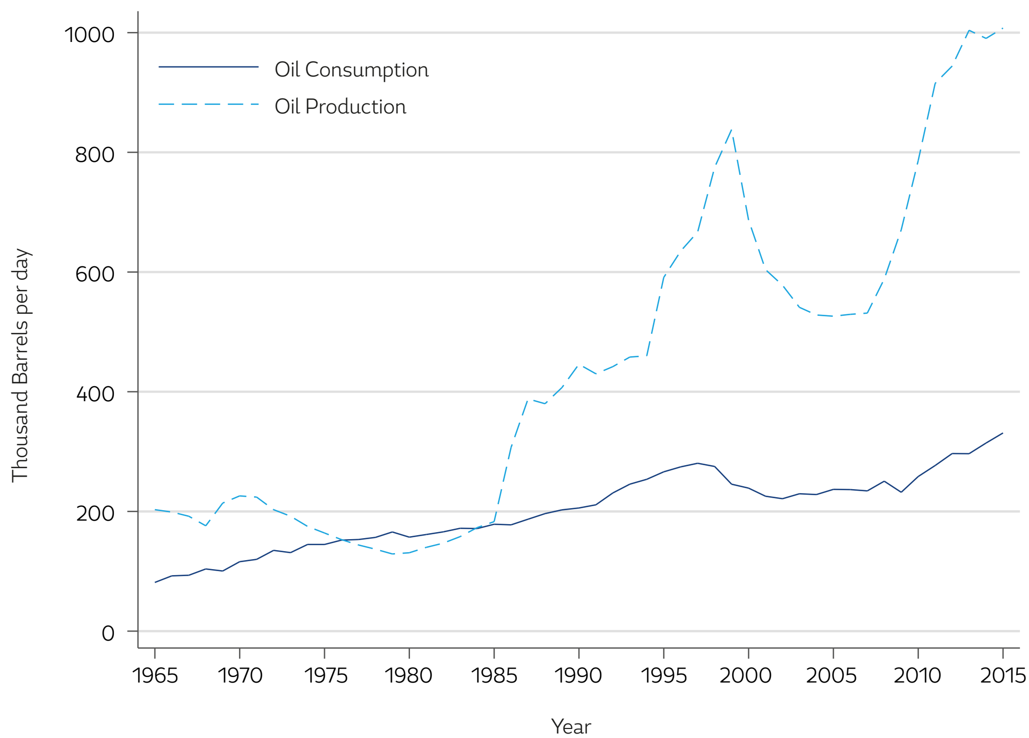
The empirical strategy used here relied on the standard structural vector auto-regression (SVAR) methodology, a heavily-used tool in modern macroeconomic research. I began the empirical analysis by examining the statistical properties of each time series and estimating a simple, unrestricted vector auto-regression. After this model was tested and accepted, I proceeded to estimate a structural specification in the spirit of Blanchard & Galí (2010), under the identification assumption that unexpected variations in the nominal price of oil are exogenous relative to the contemporaneous values of the main macroeconomic variables for Colombia.

The conclusions are driven mainly by an impulse-response analysis with a time horizon of 10 periods (quarters) ahead, which also applies for the structural forecast error variance decomposition. A unit shock in the oil price (1% increase) generates a contemporaneous increase in GDP growth (which starts to decay after one or two quarters) and contemporaneous decreases in unemployment and inflation (thereafter both effects remain slightly negative). Such results are inspected and discussed to a larger extent in the last two sections. Additionally, oil price innovations do not explain a significant share of the structural forecast error variance in the GDP growth rate, the unemployment rate, and the inflation rate.

2. THE OIL SECTOR IN THE COLOMBIAN ECONOMY

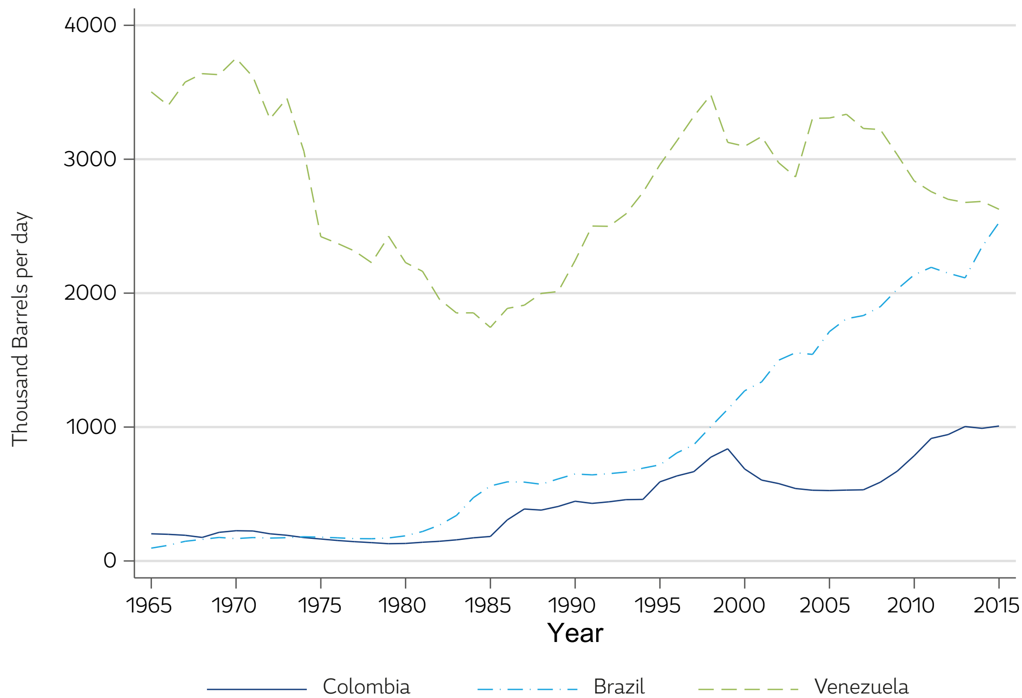
Colombia's proved reserves of oil are not as large as those of other major oil producers, such as Venezuela or Mexico. Nevertheless, its production has increased sharply during the last decades. According to BP (2016), Colombia is the third largest oil producer in South America, after Venezuela and Brazil, and the fourth largest in Latin America if Mexico is included. Oil production in Colombia increased about 400% between 1965 and 2015, and between 2005 and 2015 it increased about 92%. Oil consumption has been increasing since 1965, but at a much slower pace; the gap between supply and demand reached its historic peak in 2015.

Figure 1. Oil Production and Consumption in Colombia.



Source: Author's elaboration. Data: BP (2016).

Figure 2. Oil Production in Colombia, Brazil and Venezuela.

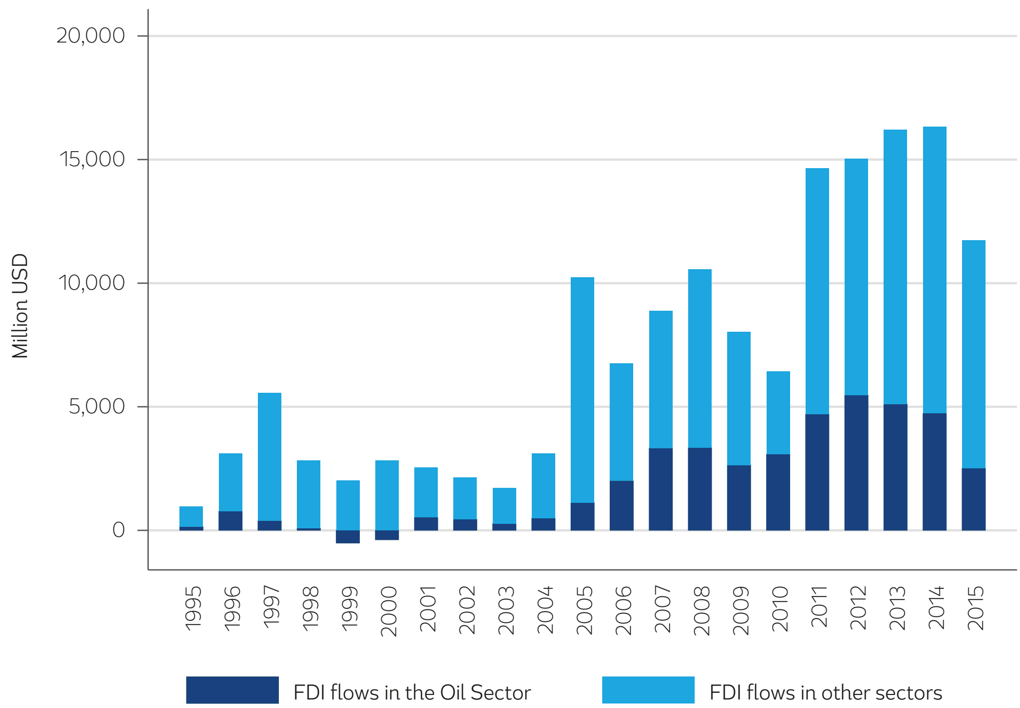


Source: Author's elaboration. Data: BP (2016).

According to the U.S. Energy Information Administration (2016), Colombia's oil production grew rapidly from 2007 to 2013 in response to increased exploration and development. New exploration and development were spurred by the regulatory reforms of 2003. Its main oil export destinations are the United States and Panama, and in 2015, China expressed interest in financing new infrastructure projects in Colombia to transport oil to the Pacific coast for export.

The Americas Society (2010) gave the name of *Energy Renaissance* to the post-2003 period, which was preceded by an era where production started to decline (mainly by the end of the 1990's and early 2000's) due to geological setbacks and security problems, as the upstream activity was often located in remote places where the State had limited presence, thereby increasing the likelihood of kidnappings, pipeline bombings, extortions, etc. Following the sharp decline in oil production, reforms took place in 2003 to revisit the regulatory and fiscal framework to account for Colombia's less competitive geology. Such reforms were accompanied by other actions in the security sphere. Moreover, since the 2003 reforms, the Colombian oil sector has attracted a total of 38.8 billion USD of foreign direct investment (FDI) during 2003-2015 (Banco de la República de Colombia, 2016), and additionally the share of investment out of total FDI increased. The years of high foreign direct investment flows in the petroleum sector are linked with years of rapid growth in crude production, as shown in Figures 1 and 3.

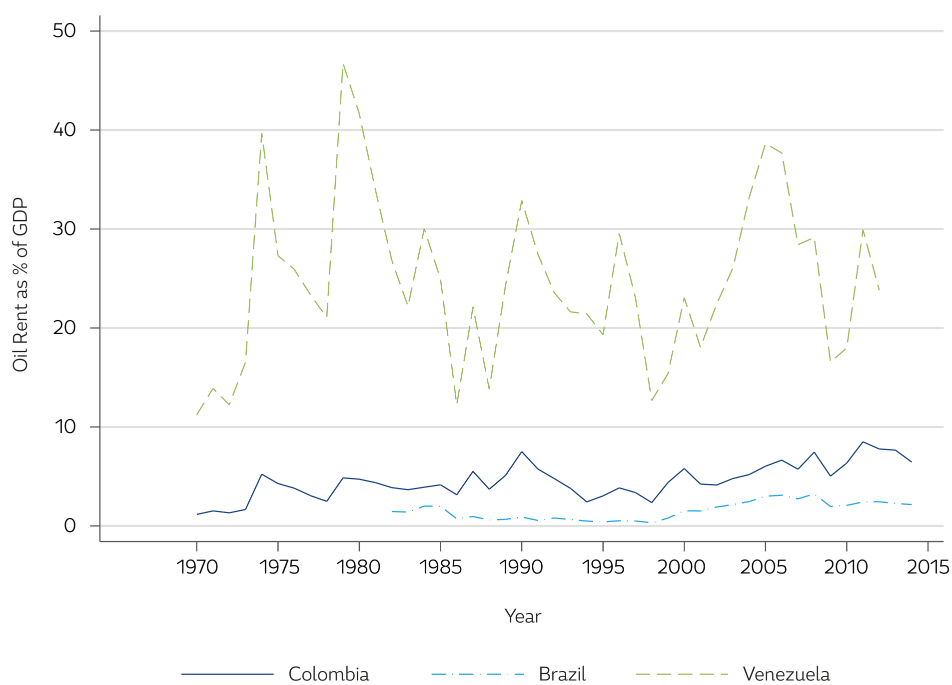
Figure 3. Foreign Direct Investment Flows in the Colombian Oil Sector.



Source: Author's elaboration. Data: Banco de la República de Colombia (2016).

Regarding the oil revenues, they represented 6.4% of Colombian GDP in 2014 and consistently accounted for less than 9% of the GDP during 1970-2014, which is not a common trend among major oil producers; that fact makes Colombia less exposed to oil price risk when compared to Venezuela, where the oil revenues accounted for 38% of GDP in 2005 and 23% in 2012.

Figure 4. Oil Revenues as % of GDP in Colombia, Brazil and Venezuela.



Source: Author's elaboration. Data: World Bank (2016).

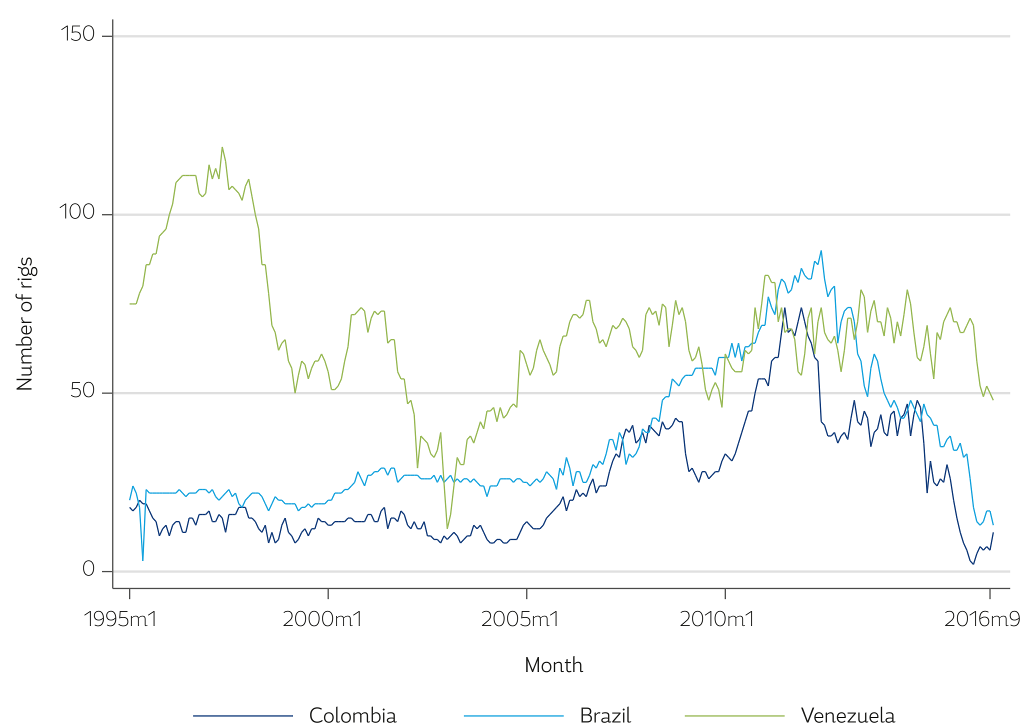
The Colombian oil sector is dominated by *Ecopetrol*, which is a public stock-holding corporation, 88.5% percent state-owned, and associated with the Ministry of Energy. According to its management report (Ecopetrol S.A., 2015), the company ranks 19th in the *Platts Top 250 Global Energy Company Rankings* and has a value of USD 2.0 billion. The company has the capacity to participate in every stage of the hydrocarbons chain, including both upstream (exploration and production) and downstream (trading, lubricants, petrochemicals) activities.

By the end of 2015, Colombia produced around one million barrels of oil per day and had 290,850 barrels per day of crude oil refining capacity at five refineries owned by *Ecopetrol*. The company aims to increase the refining capacity and improve the ability to process heavier crude oils by expanding the *Barrancabermeja* refinery, located in Santander Department. It has just started operations in the new *Cartagena* refinery, located in Bolívar Department (U.S. Energy Information Administration, 2016).

Despite being a state-owned company and unlike similar peers such as *PDVSA* in Venezuela and *Petrobras* in Brasil (which have been linked to corruption scandals by the international press), *Ecopetrol* is run in a business-oriented manner, with clear corporate strategies and values. It aims to increase its production by 1-2% up to 2020, maintain its current credit rating, invest 5 billion USD every year, and cut costs by 1 billion USD every year (Ecopetrol S.A., 2015).

Much of Colombia's crude oil production takes place in the Andes foothills and in the eastern Amazonian jungles. Meta Department, in central Colombia, is also an important production area where heavy crude oil predominates. The Llanos basin contains the Rubiales oilfield, the largest producing oil field in the country. Also, it should be noted that the number of operating oil rigs has declined recently, as Figure 5 shows, but that is a common trend among South American producers.

Figure 5. Oil rigs in Colombia, Brazil and Venezuela.



Source: Author's elaboration. Data: Baker Hughes (2016).

The petroleum sector faces a number of limitations, including a still deficient infrastructure. Pipelines and other energy facilities have been the target of attacks by anti-government guerrillas for many years, which have caused an important number of unplanned production disruptions: around 41 000 barrels per day (U.S. Energy Information Administration, 2016). Also some local communities oppose energy projects on their lands for spiritual beliefs about protecting natural resources, a concern that oil-related activity will attract criminal or violent groups to their territory (Americas Society, 2010), or a concern about the adverse effects of operating in environmentally-sensitive areas.

3. METHODOLOGY

This analysis of the effect of oil prices on the macroeconomy follows the Structural Vector Autoregression (SVAR) tradition, a well-known multivariate time series framework heavily-used in modern empirical macroeconomics. This methodology was initially developed by Christopher Sims (1980, 1986), but it has been extended by many other contributors. A full review of the estimation, identification strategies, benefits and drawbacks of SVARs can be found in work done by Lütkepohl (2005) and Kilian (2013).

SVARs are *data-driven* but still incorporate meaningful elements from economic theory or intuition just by setting a minimum quantity of restrictions, an appealing feature to establish cause-effect relationships. According to Kilian (2013), despite the increase in the use of dynamic stochastic general equilibrium models, SVARs continue to be the main tool for empirical work in macroeconomics. That said, the decision of selecting the empirical strategy was not a difficult task as it coincides with previous work done by Kilian (2009) on the same subject, and especially by Blanchard and Galí (2010), the main empirical reference for this paper.

3.1 Identification and Estimation

Although SVARs are structural models, they depart from reduced-form vector autoregressions (VARs). Hence, following Lukthepohl (2005), the empirical workflow of this paper begins with the estimation of a simple VAR, which is tested, before proceeding to perform structural analysis.

After that, a structural model is set up consisting of $Y_t=(OIL_t, GDP_t, UNEMP_t, CPI_t)'$, where OIL_t is the percent change of the WTI crude price in USD; GDP_t and CPI_t, are percent changes of the —seasonally adjusted- GDP and the consumer price index, respectively; and $UNEMP_t$, the averaged-by-quarter unemployment rate. Thus, The SVAR representation is:

$$A_0 Y_t = a + \sum_{i=1}^{p=4} A_i Y_{t-i} + \varepsilon_t \, . \tag{1}$$

a is a vector of constants or intercept terms, A_i is a matrix of coefficients in period t-i,and ε_t is a four-dimensional vector with serially uncorrelated and mutually uncorrelated errors. It is assumed that A_0 has a recursive structure, such that the reduced form errors e_t can be decomposed according to $e_t = A_0^{-1} \varepsilon_t$:

$$\begin{pmatrix} OIL_t \\ GDP_t \\ UNEMP_t \\ CPI_t \end{pmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} \begin{pmatrix} \varepsilon_t^{OIL\text{-}shock} \\ \varepsilon_t^{GDP\text{-}shock} \\ \varepsilon_t^{UNEMP\text{-}shock} \\ \varepsilon_t^{CPI\text{-}shock} \end{pmatrix} \tag{2}$$

Following a recursive structure, restrictions placed on matrix A imply that unexpected variations in the nominal price of oil are exogenous relative to the contemporaneous value of the remaining macroeconomic indicators included in the SVAR, which is consistent with Blanchard and Galí (2010). They explain that such identification assumption would be clearly incorrect if macroeconomic developments in the country of consideration affect the world price of oil contemporaneously. This may be either because the economy under consideration is large, or because developments in the country are correlated with world developments. Thus, their research explored alternative assumptions and obtained nearly identical results among them. In the case of Colombia, a small open economy, it is unlikely that national macroeconomic fluctuations have a direct and contemporaneous effect on the global price of oil. Note that matrix B was set to an identity as no restrictions were imposed on it.

As stated in equation (2), the model can account for four shocks, however the empirical effort of this paper will focus on $\varepsilon_t^{OIL\text{-}shock}$ or the *oil price shock*, as it is the most relevant with regard to the purpose of the study. *A priori*, given the importance of the oil sector in Colombia and also considering the relevance of the country in terms of crude production, following oil price increases, there were expected an increase in GDP growth, a decline in the unemployment rate, and a slight decrease in the inflation rate. Additionally, increases in oil prices increase oil exports, which is expected to strengthen the Colombian currency, causing a deflationary effect on domestic prices.

4. DATA

Preliminarily, the following time series were collected: (i) from Banco de la República de Colombia (2016), quarterly data on the real seasonally-adjusted gross domestic product, and monthly data on the consumer price index and the unemployment rate; (ii) from the International Monetary Fund (2016), quarterly data on the nominal West Texas Intermediate crude global price (period averages).

Subsequently, some transformations were applied to the time series in order to account for unit roots and to convert them to quarterly frequency where applicable. The resulting dataset covers the period 2001:Q1 to 2016:Q2, and includes: OIL_t, the percent change (%) of the nominal WTI crude price in USD; GDP_t and CPI_t, percent changes (%) of the real —seasonally adjusted- GDP and the consumer price index, respectively; and $UNEMP_t$, the averaged-by-quarter unemployment rate (%). In the specific case of CPI_t, the end-of-quarter values were used to construct the final time series.

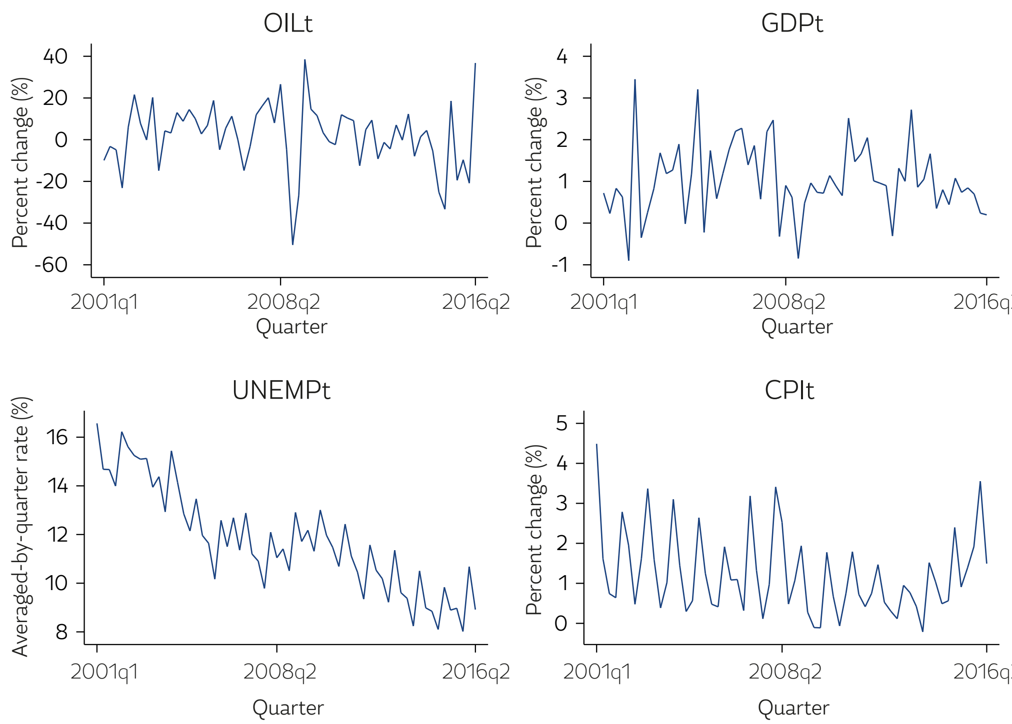
The stationarity of every series was confirmed by means of the KPSS test developed by Kwiatkowski et al. (1992), whose null hypothesis is that the tested time series is stationary. Every test included automatic lag selection procedure by Newey and West (1994). The results are shown in Table 1.

Table 1. KPSS stationarity test

Series	t statistic	Critical value*	I(n)	Decision
OILt	0.233	0.739	I(0)	Null is not rejected
GDPt	0.378	0.739	I(0)	Null is not rejected
UNEMPt	0.113	0.216	I(0)	Null is not rejected
CPIt	0.297	0.739	I(0)	Null is not rejected

Source: Author's elaboration. Null hypothesis: Variable is stationary. *At 1%

Figure 6. Variables for estimation, 2001:Q1 to 2016:Q2.



Source: Author's calculations using data from Banco de la República de Colombia (2016) and the International Monetary Fund (2011).

There was no particular reason for selecting the 2001:Q1 to 2016:Q2 period besides the availability of reliable data, as both Banco Central de la República de Colombia (2016) and the International Monetary Fund (2016) offer the possibility of accessing such time series with ease. Notwithstanding what coincidentally makes the selected period interesting is the fact that it includes both low and high oil price sub-periods. For instance, the crude price went from 28.7 USD in 2001:Q1 to its peak of 123.9 USD in 2008:Q2, and some years later it started to decline by around 50% by the end of 2014. That oil price *roller* coaster was accompanied by internal developments and reforms in Colombia that made oil take a more important role in the national macroeconomy; as seen in Figure 1 and 3 (previous section), the oil production and foreign direct investment flows in the oil sector increased during the selected period, although unlike other Latin American peers, oil revenues as a share (%) of GDP remained low and relatively stable.

5. RESULTS

The first part of this section addresses the evaluation process of a preliminary VAR estimation, while the second one covers the final SVAR results.

5.1. Preliminary VAR results

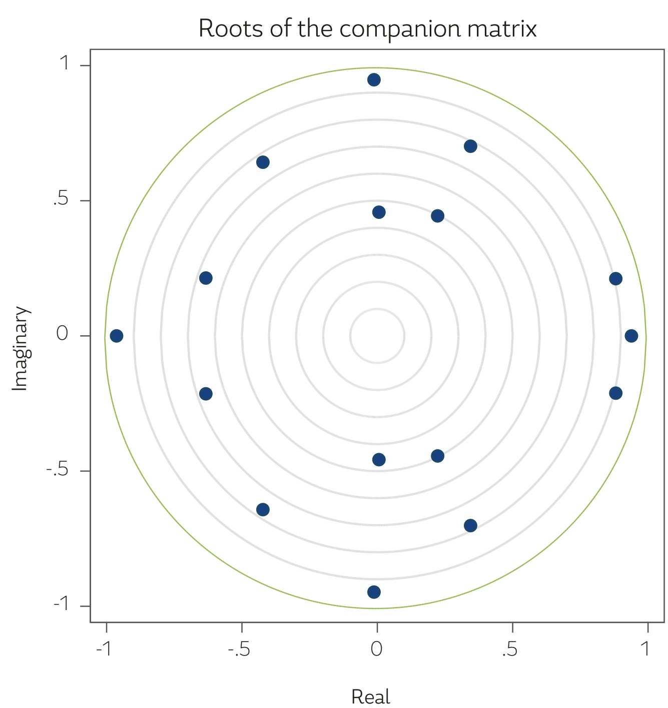
Given the frequency of the data and following the Akaike and Hannan & Quinn information criteria for lag order selection, a VAR of order 4 was estimated. The following checks were performed: a) the absence of serial correlation was confirmed by means of the Lagrange-multiplier test; b) the model satisfied the stability condition, as all the roots of the companion matrix were inside the unit circle, i.e. less than one; c) the multivariate version of the Jarque-Bera test suggested the presence of normality in the residuals, although Lutkepohl (2011) explains that normality is not a *sine qua non* condition for the validity of statistical procedures related to VARs.

Table. 2. Serial Correlation test related to the VAR

Lag	chi2	Prob > chi2	Decision
1	17.5182	0.35285	Null is not rejected
2	19.6896	0.23453	Null is not rejected
3	8.2259	0.94185	Null is not rejected
4	16.1718	0.44104	Null is not rejected
5	16.9833	0.38668	Null is not rejected
6	16.7916	0.3992	Null is not rejected
7	19.3118	0.25283	Null is not rejected
8	18.5574	0.29228	Null is not rejected

Source: Author's elaboration. Null hypothesis: no autocorrelation at lag order

Figure 7. Stability condition related to the VAR.



Source: Author's elaboration.

Table 3. Normality test related to the VAR

	chi	Prob > chi	Decision
VAR system	5.94	0.65395	Null is not rejected
OILt equation	0.24	0.88705	Null is not rejected
GDPt equation	3.625	0.16326	Null is not rejected
UNEMPt equation	0.944	0.62365	Null is not rejected
CPIt equation	1.131	0.56804	Null is not rejected

Source: Author's elaboration. Null hypothesis: Skewness and excess kurtosis are zero, i.e. residuals follow a normal distribution

5.2 SVAR results

After having tested and accepted the preliminary VAR model, it is possible to proceed with the underlying structural estimation, which follows the identification strategy explained previously. The following Â matrix was obtained:

$$\hat{A}=\begin{bmatrix} -0.08548505 & 0 & 0 & 0 \\ -0.00515696 & 1.3962177 & 0 & 0 \\ 0.01959192 & -0.04876581 & 1.7716763 & 0 \\ 0.01959192 & 0.03737936 & 0.03737936 & -2.1447715 \end{bmatrix}, \quad (3)$$

and the corresponding estimated contemporaneous impact matrix is:

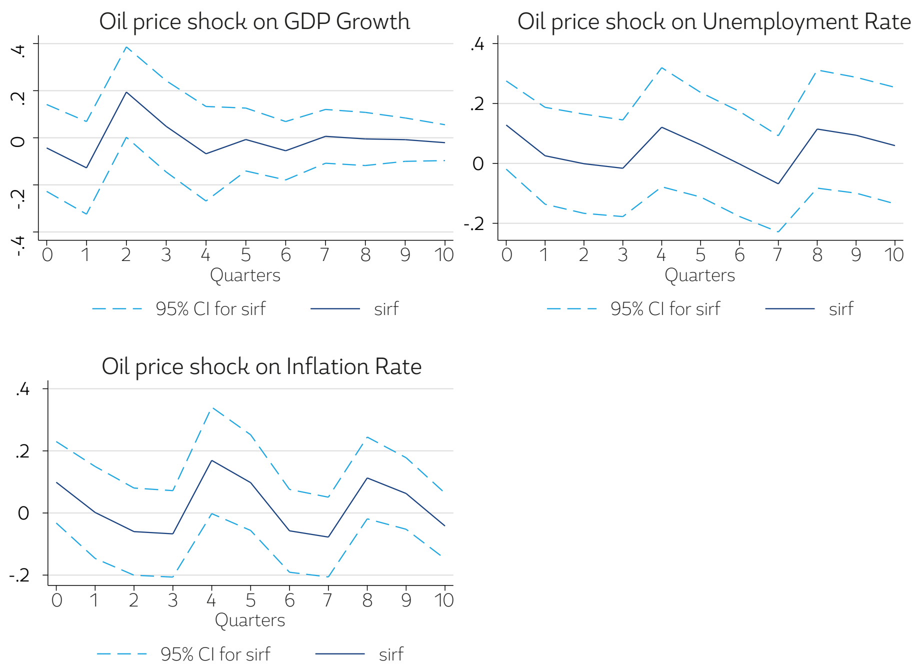
$$\hat{A}^{-1}B=\begin{bmatrix} 11.697951 & 0 & 0 & 0 \\ 0.04320662 & 0.71622069 & 0 & 0 \\ -0.12817143 & 0.01971413 & 0.56443704 & 0 \\ -0.09886095 & 0.01918957 & 0.1920341 & 0.46625011 \end{bmatrix}. \quad (4)$$

Given the estimated matrix A, or Â, SVAR coefficients a_{21} and a_{41} (effect of oil price changes on GDP growth and inflation, respectively) were negative, and coefficient a_{31} (effect of oil price changes on unemployment) was positive. However, the coefficients were not statistically significant at conventional levels.

To better observe the effects of structural shocks across time, impulse-response functions are often more informative than estimated structural parameters themselves (Breitung, Brüggemann & Lütkepohl, 2004). Both structural and cumulative orthogonalized impulse-response functions were estimated with a time horizon of 10 quarters ahead in order to inspect visually the effect of $\varepsilon_t^{OIL\text{-}shock}$ on macroeconomic variables.

According to the structural impulse-response functions in Figure 8, following an oil price shock, the GDP growth rate declines immediately but increases after one quarter, and the positive effect reaches its peak around quarter two; after that, the effect starts to decay. On the other hand, the response in the unemployment rate and the inflation rate are quite similar: following an oil price shock, both variables decline up to quarter three, and then increase to a maximum around quarter four; the effects are time-varying and do not decay even after ten quarters.

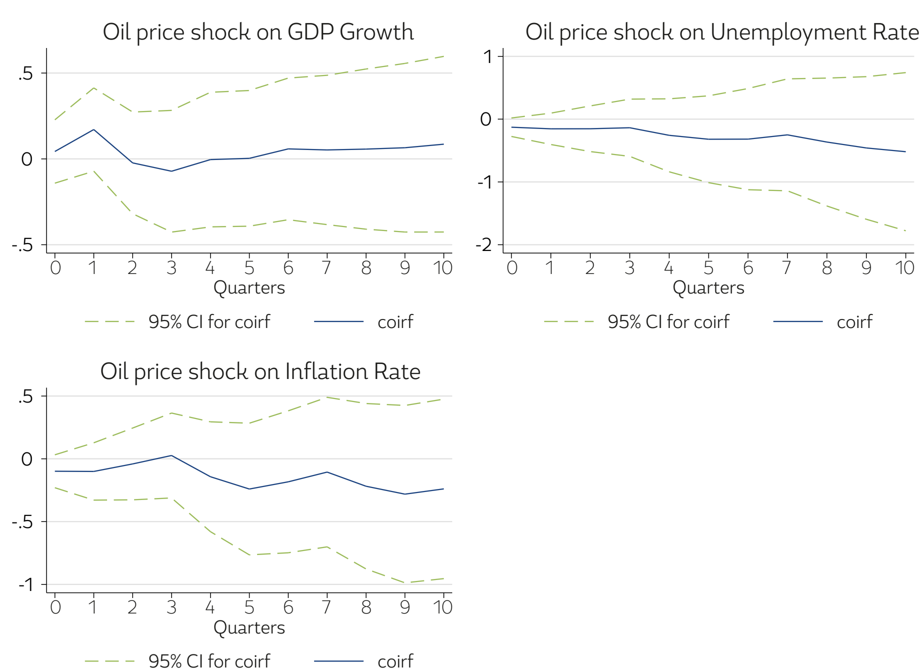
Figure 8. Structural impulse-response functions (SIRF) to an Oil Price Shock.



Source: Author's elaboration.

Cumulative orthogonalized impulse-response functions are shown in Figure 9. The accumulated response in GDP growth reaches its maximum around quarter one, and thereafter starts to decay. Once again, the responses in the unemployment rate and inflation are quite similar: the accumulated responses in those two variables remain close to zero, although slightly negative even after ten quarters.

Figure 9. Cumulative orthogonalized impulse-response functions (COIRF) to an Oil Price Shock.



Source: Author's elaboration.

Regarding innovations accounting, the structural forecast error variance decomposition was estimated. It should be noticed that in such case the forecast errors are not decomposed into contributions of the different variables (as in regular forecast error variance decomposition) but into the contributions of structural innovations. Table 4 shows that $\varepsilon_t^{OIL\text{-}shock}$ innovations do not explain a significant share of structural forecast error variance in either GDP_t, $UNEMP_t$, or CPI_t. In general, each variable's structural forecast error is highly affected by own structural shocks of the variable.

Table 4. Structural forecast error variance decomposition (SFEVD) based on the identification scheme

		Proportions of structural forecast error variance, h periods ahead, accounted by innovations in			
Structural forecast error in	Forecast horizon (h)	OILt	GDPt	UNEMP	CPIt
OILt	1	1	0	0	0
	2	0.97953	0.007376	0.012775	0.000318
	4	0.880324	0.078049	0.026878	0.014748
	8	0.773964	0.124526	0.052747	0.048763
	10	0.754451	0.12082	0.059245	0.065484
GDPt	1	0.003626	0.996374	0	0
	2	0.032412	0.955353	0.011591	0.00064
	4	0.089191	0.858383	0.022895	0.029531
	8	0.079396	0.710262	0.028958	0.181384
	10	0.076427	0.694099	0.035348	0.194125
UNEMP	1	0.048979	0.001159	0.949862	0
	2	0.045601	0.002689	0.948635	0.003076
	4	0.037328	0.015048	0.928985	0.018639
	8	0.045101	0.035754	0.767172	0.151974
	10	0.048492	0.026568	0.601388	0.323552
CPIt	1	0.036964	0.001393	0.139471	0.822173
	2	0.031101	0.001533	0.119439	0.847927
	4	0.050076	0.041995	0.129859	0.778071
	8	0.108571	0.058563	0.117119	0.715747
	10	0.118061	0.06225	0.118942	0.700747

Source: Author's elaboration.

6. CONCLUSIONS

This analysis examines the effect of world oil price shocks on the Colombian economy. The identification assumptions used in the analysis were motivated by the work done by Blanchard and Galí (2010), and are consistent with the well-known fact that Colombia is a small open economy; therefore internal economic fluctuations are unlikely to generate an effect in the global economy, or in the price of oil.

A priori, given the importance of the oil sector in Colombia and also considering the relevance of the country in terms of crude production, following oil price increases, there were expected an increase in GDP growth, a decline in the unemployment rate, and a slight decrease in the inflation rate. The estimated effects were consistent with these expectations.

Based on the SVAR estimation, a unit price shock in the oil price (1% increase) generates the following accumulated orthogonalized responses: i) GDP growth shows a contemporaneous increase of 0.04%, then the effect reaches its maximum in the first quarter (0.17% increase) and starts to decay after two quarters; ii) The unemployment rate decreases by 0.12% contemporaneously, and later on the effect remains negative, reaching its maximum after ten quarters (0.51% decrease); iii) Inflation decreases 0.09% contemporaneously, but increases by 0.02% by quarter three, thereafter the effect remains negative. Moreover, the structural forecast error variance decomposition suggests that each variable's structural forecast error is highly affected by the own structural innovations of the variable.

Impulse-response analysis is regularly based on unit price shocks or innovations, which in this case would be a 1% increase in the oil price. However, it is relevant to consider that changes in the oil price are often larger than 1%; for instance, from 2002:Q1 to 2002:Q2 the oil price increased by 21%, and from 2008:Q3 to 2008:Q4 it declined by 50%. Hence, following a 10% oil price increase, the maximum positive effect on GDP growth would be around 1.7% after one quarter, and accordingly, the negative effect on unemployment rate and inflation would be larger too. Furthermore, as shown in Figure 8 and 9, the effect of $\varepsilon_t^{OIL\text{-}shock}$ on GDP_t starts to decay after two quarters, approximately, while the effects on $UNEMP_t$ and CPI_t seem to last longer and remain slightly negative.

Although it was possible to analyze other shocks from the estimated SVAR (e.g. GDP growth shock, unemployment rate shock), such impulse-responses are not reported both for space and convenience reasons, as the main focus of this work was to evaluate the effect of oil price shocks, $\varepsilon_t^{OIL\text{-}shock}$.

In spite of the fact that Colombia's economy does not rely on oil as much as Venezuela or Mexico, both upstream and downstream petroleum sectors are key players in the country, so an increase (although moderate and not long-lasting) in GDP growth after an oil price shock was reasonably expected, and the results also match the expectation that output increases are often accompanied by reductions in unemployment. With regard to inflation, the obtained estimates match the a priori expected response too, as the variable increases slightly but just by quarter three.

7. REFERENCES

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