



## The Effects of Global, Regional, and Local Macroeconomic Events on the Price of the Colombian Castilla Blend

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### ABSTRACT

The Castilla blend is a heavy crude produced in the plain fields of Colombia and is similar to the heavy crudes produced in other countries in the Western hemisphere. One characteristic of this type of crude is that it is sold at a discount rate that can oscillate between a 4- and 10-dollar discount from benchmark indices such as the intercontinental exchange index and the West Texas Intermediate Index. In the present study, we used event study methodology to determine the impact of global, regional, and local macroeconomic news, as well as the Organization of the Petroleum Exporting Countries (OPEC) announcements on the Castilla blend price. We found that even though OPEC announcements have a higher impact on prices, macroeconomic news that comes as a surprise from global and regional players had a significant impact on the Castilla blend price for the period under study from 2010 to 2019.

**Keywords:** Oil, Colombia, Macroeconomic Events

**JEL Classifications:** G1, G14

### 1. INTRODUCTION

According to the Energy Information Administration (EIA), in 2017, fossil fuels accounted for nearly 80% of the primary energy production in the USA, and, from this percentage, oil accounts for at least 37% of that (EIA, 2018). Since oil is the most traded commodity in the world, its prices are highly volatile. There is a substantial body of research concerning the impact of economic announcements and oil-related news on the variability of oil prices. Of special interest is the link between oil prices and financial markets and its impact on the real economy. For instance, there is evidence that a long-term drop in oil prices can lead to lower interest rates and lower inflation (Mohaddes and Pesaran, 2017). These same authors also found a significant positive relationship between the high price of oil and the rise in equity prices before the global financial crisis of 2008—a fact that can be explained by the amount invested in equities by the large sovereign funds of oil-exporting countries. Another study shows that a long-term rise in oil prices has a negative effect on the real economy due to a tightening up of monetary policy;

the reason being that an increase in oil prices eventually raises the production costs of many raw materials (Tsai, 2013). These studies are divided into two types: (1) The impact of leading economic indicators (gross domestic product [GDP], the consumer price index [CPI], consumer confidence, volatility indexes, etc.) on the volatility of oil prices (oil returns); and (2) the impact of idiosyncratic events on the volatility of oil prices (the Organization of the Petroleum Exporting Countries [OPEC] announcements, supply-and-demand announcements, natural disasters, and war).

There are other avenues of research that are focused on investor sentiment and the modeling of oil supply and demand. For example, Han et al. (2017) used Google analytics to construct a Search Volume Index related to oil-related information (West Texas Intermediate [WTI] Index prices, other spot and futures indices), and the authors found that the Index was a useful tool for modeling the behavior of oil prices in the short term. In the case of modeling the supply and demand of oil, a recent study by Monge et al. (2017) employed wavelet analysis to model the trends for US domestic oil

production and their relation to the WTI Index. The authors found that US domestic production was a good predictor of the WTI Index from 2003 to 2009, but that after this period this correlation disappeared, and the conclusion was that US supply was not able to explain the variation in oil prices. Another example can be found in Prest (2018), in which the author used an instrumental variable (IV) regression to control for the effects of the US oil supply on the demand for Brent crude. The author found that the decline in oil prices could not be entirely attributed to the shale revolution that led to higher US production. Finally, Byrne et al. (2018) attempted to measure the impact that refinery production had on oil prices, finding that its effect on prices was negligible.

In the present study, we use event study methodology to analyze the impact of relevant economic news on oil price returns. Particularly, we examine the relation between relevant events (such as OPEC announcements) and the volatility of oil prices for the Castilla blend variety, which is the main source of revenue for the Colombian oil industry. For instance, Draper (1984) was one of the first authors to apply the methodology of event studies to the prices of heating oil in the USA, and found that the market was informationally efficient and that the prices of heating oil futures anticipated and reflected all the available information of scheduled and unscheduled OPEC meetings. However, it is important to point out that there is no general agreement among researchers about the impact of OPEC meetings on oil prices. The empirical evidence regarding OPEC's announcements and the volatility of oil prices can be divided into two positions: (1) OPEC does not exert market control, so its decisions do not affect oil prices (Bina and Vo, 2007); (2) certain decisions such as an increase in production can lead to long-term effects on oil prices (Schmidbauer and Rösch, 2012). The choice of the type of market model employed also has an effect on the results, for example, Loutia et al. (2016) used an exponential generalized autoregressive conditional heteroskedasticity (AR-GARCH) specification in their choice of a proxy for a market model to measure the effect of surprises from OPEC announcements and their relevance in terms of oil price returns. They concluded that the reaction of oil prices to the different types of decisions is asymmetric depending on the type of decision (example of this are surprises in production cuts vs. maintaining the level of production). López (2018) points out that OPEC announcements bring stability to the markets and found evidence that, after an announcement that eases uncertainty, volatility-related indices tended to fall. Another avenue for event studies is concerned with the impact of extreme events (natural disasters, war, and terrorism) on oil prices. For example, Orbaneja et al. (2018) developed a regression model to measure the impact of terrorist acts in the Middle East and their effect on oil prices and found that on the day of the attacks these types of events were statistically significant in relation to oil prices. Using an AR-GARCH model specification as a proxy for a market model for oil prices, Ji and Guo (2015) found that extreme events such as hurricanes, the global financial crisis, and the prospect of war (in their specific case, it was the Libyan war) had a positive effect on the volatility of returns for oil prices. The authors employed a novel approach in which they used the level of internet searches as a proxy for investor sentiment and as a contagion channel for the volatility of oil prices.

As we can observe, the literature tends to focus mainly on the impact of US macroeconomic indicators and OPEC

announcements. It tends to exclude the news of other market participants that can have a significant impact on the price of oil (consumers such as China and the EU, and producers such as Russia are a good example of this). There is increasing interest in the role of China in the oil markets. For example, Bénassy-Quéré et al. (2007) found that there is evidence of a negative causality between the dollar exchange rate and oil prices due to the role of Chinese exports on the US trade deficit, and the authors imply that in the long run, the Chinese demand for oil will be a driver of oil prices, second only to the USA. In the case of Russia, Rutland (2008) analyses the leading role of Russia as a major superpower in the supply of gas and oil around the globe. In the present study, we will try to account for common macroeconomic news from global players such as the USA, China, and the Eurozone while controlling for non-OPEC producers such as Russia. Additionally, we will control for confounding effects by analyzing the impact of regional economic news in Brazil and Mexico as well as local news that originates from the producing country of Colombia. The remainder of the paper is divided as follows. Section II describes our dataset and the particularities of the Colombian oil market. Section III describes the method employed in the event study and the selection of the events and their controls for confounding events. Section IV presents our results and Section V concludes.

## 2. DATASET

Our dataset consists of a series of macroeconomic and energy events extracted from Bloomberg as well as the historical series of the WTI Index and the Castilla Blend Index for the period 2010-2019. According to Ecopetrol (2015), the Colombian-run state oil company, it produces the Castilla blend, which is a heavy crude produced in the plain fields of Colombia and is similar to the heavy crudes produced in other countries of the Western hemisphere (Colombia's direct competitors for this type of oil are Venezuela, Canada, and Mexico). One characteristic of this type of crude is that it is sold at a discount that can oscillate between a 4- and 10-dollar discount from benchmark indices such as the intercontinental exchange index and the WTI Index. To see the real impact of energy-related news and events (i.e. OPEC meetings and the US EIA) on the Castilla blend price, we have to control for confounding effects from other types of macroeconomic events at the local, regional, or global level. In order to select which events are relevant (Table 1), we decided to select the events according to their relevance to the market. To determine the relevance, we used a function provided by Bloomberg that ranks the importance of the event according to the number of subscriptions made by market analysts to a particular event.

For example, in the case of the USA, the most relevant macroeconomic news within our window of observation was news related to employment (changes in non-farm payrolls and jobless claims), monetary policy (the Federal Open Market Committee decision), and GDP growth. The same procedures were carried out with all the countries that conform the global and regional groups in order to select the most relevant events (four for each country<sup>1</sup>). In the case of energy-related events,

1 The exception is the Eurozone in which we just consider one type of event, the reason being that all the other relevant events such as the level of Italian or German manufacturing are country specific rather than Eurozone related.

**Table 1: The number of relevant global, regional, local macroeconomic, and energy announcements from 2010 to 2019**

	Country	Ticker	News name	Total		
Global events	US	FDTR index	FOMC rate decision	72		
		GDP CQOQ	GDP QoQ (Annualized)	35		
		INJCJC In	Initial jobless claims	470		
		NFP TCH I	Change in nonfarm payrolls	108		
		DOEASCRD index	Crude inventories US	470		
		DOEASMGS index	Gas inventories US	470		
		DOEASCUS index	Cushing crude inventories US	470		
		DOENUSCH index	Natural gas inventories US	470		
		Eurozone	FRCPIYOY index	Eurozone CPI YoY	108	
			China	CNCPIYOY index	China CPI YoY	108
	CNGDPYOY index	China GDP YoY		35		
	MPMICNMA index	Caixin China manufacturing index		36		
	CHEFTYOY index	China PPI		108		
	CNIVCRUO index	China crude imports		108		
	CNEVDF index	China diesel exports		107		
	CNEVREFO index	China refined oil exports		108		
	RUREFEG index	Russia level of international reserves		469		
	RUCPIYOY index	Russia CPI YoY		108		
	RUUER index	Russia unemployment rate index		107		
	Regional events	Russia	RURSRYOY index	Russia retail sales YoY	107	
Brazil			BZSTSETA index	Brazil selic target rate	72	
			BZGDYOY% index	Brazil GDP YoY	35	
			BZIPYOY% Index	Brazil manufacturing index YoY	107	
			BZRTRYOY index	Brazil retail sales YoY	107	
			Mexico	MXONBR index	Mexico official overnight rate index	76
		MXCPYOY index		Mexico CPI YoY	108	
MXGCTOT index		Mexico GDP YoY		35		
MXCPCCHNG index		Mexico CPI MoM		108		
Local events		Colombia		CORRRMIN index	Colombia Minimum Repo Rate	104
				COCPIYOY index	Colombia CPI YoY	108
			COCIPIBY index	Colombia GDP YoY	34	
	COCPIMOM index		Colombia CPI MoM	108		

Source: Own with data extracted from Bloomberg. The choice of relevant economic and energy announcements is based on the relevance that the news has for the market. The Bloomberg system ranks the macroeconomic and energy-related announcements in order of importance by the number of market analysts that ask for regular updates regarding a particular announcement. GDP: Gross domestic product, CPI: Consumer price index

we followed the same procedure and found that the only relevant related energy events were those related to the USA and China (i.e. US crude inventories and China's crude imports). Interestingly, in oil-producing economies such as Russia, Mexico, and Colombia, local energy-related news was not as relevant as specific macroeconomic events, suggesting that at some point, and besides the obvious effect of OPEC meetings, most of the time the price seems to be driven by demand events rather than by supply events. Finally, in the case of OPEC, there were 12 meetings within the window of observation with the first being on October 27, 2011 and the last one being on June 7, 2018, and in all but one of the meetings, OPEC maintained a neutral outlook regarding the supply of oil. The exception being the one on September 28, 2016, in which the member countries decided to cut the output level in an effort to increase prices (OPEC, 2019).

### 3. MARKET MODEL AND EVENT METHODOLOGY

In line with the event study method, we want to see if an event has a significant effect on the Castilla blend oil price in the form of positive or negative abnormal returns. In this paper we use the standard methodology of MacKinlay (1997) for economic event

studies. The first step is to model the correlation between the Castilla blend price and relevant market factors using the model in Equation (1):

$$R_{c,t} = \alpha_i + \beta_i R_{m,t} + \beta_i R_{WTI,t} + R_{c,t-1} + e_{i,t} \quad (1)$$

Where  $R_{c,t}$  is the Colombian Castilla price blend returns at time  $t$ ,  $R_{m,t}$  is the return of the S&P 500 ETF, which acts as a market proxy,  $R_{WTI,t}$  is the return of the WTI Index, which acts as a proxy for non-discounted oil prices,  $R_{c,t-1}$  is the AR(1) term to control for problems of serial correlation, and  $e_{i,t}$  is the idiosyncratic error term  $e_{i,t}$  is equivalent to the abnormal return since equation (1) can be rearranged into Equation (2):

$$e_{i,t} = R_{c,t} - (\alpha_i + \beta_i R_{m,t} + \beta_i R_{WTI,t} + R_{c,t-1}) \quad (2)$$

Therefore, we can determine if an abnormal return  $i$  at time  $t$  is significant due to additional information due to an event that is not captured by our market model using Equation (3):

$$t - stat = \frac{e_{i,t}}{\sigma_{est}} \quad (3)$$

Where  $\sigma_{est}$  is the standard error of the regression obtained from estimating equation (1) using all the returns in series  $R_{c,t}$  that do not contain an event and then using the forecasted

coefficients to predict the returns of the excluded observations that contain an event. Therefore, if we reject the null hypothesis that the abnormal return ( $e_{i,t}$ ) of a particular event is not statistically different to zero, we can infer the significance of the abovementioned event  $i$  at time  $t$ . In this way, we can identify which global, regional, and local events are statistically significant based on the t-stat of a particular day. Once we define which events are statistically significant, we can then determine the direct impact of that particular event on the Castilla blend price.

#### 4. RESULTS

In Table 2 we summarize the results obtained from applying the market model in Equation (1).

As we can observe from Table 2, our market model has good explanatory power, with a high  $R^2$ . As expected, the WTI Index and the S&P 500 are both significant, as well as our AR(1) term used to control for serial correlation. In Table 3 we summarize the impact of the significant events on the Castilla blend price.

As we can observe from Table 3, the number of statistically relevant events varies by type of news. For global news, of the total events analyzed, just 11% of them were not accounted for by the market model. For regional news, this figure goes up to 12%, and finally, for local news, the figure stands at 13%. When we analyze the countries and regions that compose each group, we can observe that in the case of global news for the USA, the percentage of events that are not accounted for by the model is 11%, for the Eurozone it is 5%, and for China it is 11%. In the case of regional news, for Russia the model does not account for 18% of the events, for Brazil this figure is 17%, and for Mexico, 14%. Finally, for local news in which the country is Colombia, 13% of the events were not accounted for by the market model. To interpret the results, we categorize an event as positive when the result is higher than market expectations and negative when it is lower. Therefore, it is important to remember that for some economic indicators, such as the CPI, a negative event is actually a positive event (if actual inflation (CPI) is lower than market expectations then this is good news for the market given that this

reduces the probability of the central bank raising interest rates in the short term).

In the case of global news, the event that has the highest impact on the Castilla blend price is positive news related to China's GDP growth. This is interesting, because even low variations in this particular event against market expectations<sup>2</sup> can represent a 5.19% average daily price increase on the day of the event. In second place is news concerning negative Eurozone CPI results. This means that when the actual result is lower than the expected result in the market, which in the case of inflation can be interpreted as good news, it can represent a 5.19% average daily price increase on the day of the event with a level of variation in the actual results against market expectations of -15.19%. The third highest impact is negative Chinese CPI results when the actual result is lower than the expected result in the market, which, as is the case with the Eurozone, can be interpreted as good news, and can represent a 3.22% average daily price increase on the day of the event. In the case of the Chinese CPI, the level of variation in the actual results against market expectations is around 5.81%. In fourth place, we have positive news related to US GDP, which has an average impact of 2.95% on the price with a level of variation against market expectations of 13.95%. Other relevant global news events with price impacts above 1% for positive events are the Caixin China Manufacturing Index at 2.59%, China's Producer Price Index (PPI) at 1.56%, and the Cushing crude and natural gas US inventories at 1.45% and 1.03%, respectively. The level of variation against market expectations are the Caixin China Manufacturing Index at 0.76%, China's PPI at 5.59%, and the Cushing crude and natural gas US inventories at -55.65% and 1.38%, respectively.

In the case of regional news, the event that has the highest impact on the Castilla blend price is positive news related to the Brazilian Manufacturing Index that can represent a 3.62% average daily price increase on the day of the event with variations against market expectations of 15.97%. The second highest impact is positive changes in Russia's Retail Sales with a price increase of 2.41% with a level of variation of actual results against market expectations of 28.34%. The third event with the highest impact is Russia's Unemployment Rate Index, which represents a 2.10% average daily price increase on the day of the event with no level of variation against market expectations. In fourth place, we have positive news related to Brazil's GDP, which has an average impact of 2.00% on the price with a level of variation against market expectations of -4.35%. Other relevant global news events with price impacts above 1% for positive events are Russia's CPI at 1.73% and Mexico's CPI at 1.68%. The level of variation against market expectations are Russia's CPI at -0.42% and Mexico's CPI at -0.52%. Finally, in the case of local news, the most relevant ones are the Colombian minimum repo rate with an increase of 2.99% and the negative events of the Colombian CPI. As mentioned before, in the case of inflation, a negative event can be interpreted as good news, which can represent a

**Table 2: Summary of significant results obtained from the market model**

Dependent variable CASTILLA BLEND PRICE RETURNS ( $R_{c,t}$ )	Coefficients
Independent variables	
$\alpha_t$	-0,0004 (0,0002)
$R_{m,t}$	0,0986*** (0,0301)
$R_{WTI,t}$	0,9695*** (0,0141)
$R_{c,t-1}$	-0,0198*
Adjusted $R^2$	0,7971
Error	0,0100
Number of observations	1418

The results in this table are obtained from running the market model regression  $R_{c,t} = \alpha_t + \beta_1 R_{WTI,t} + \beta_2 R_{c,t-1} + e_{i,t}$ , where  $R_{c,t}$  is the Colombian Castilla price blend returns at time  $t$ ,  $R_{m,t}$  is the return of the S&P 500 ETF, which acts as a market proxy,  $R_{WTI,t}$  is the return of the West Texas Intermediate Index, which acts as a proxy for non-discounted oil prices,  $R_{c,t-1}$  is the AR (1) term to control for problems of serial correlation, and  $e_{i,t}$  is the idiosyncratic error term

2 The variation in this particular event against market expectations is just 0.45%, as observed from Table 3.

**Table 3: Number of statistically Global, regional, local macroeconomic, and energy events from 2010 to 2019 by type of news and their effect on the Castilla blend price**

Country	News name	Number of statistically relevant events	Number of positive events	Number of negative events	Positive event-average effect on price (%)	Negative event-average effect on price (%)	Average level of variation against expectations for a particular event (%)
US	FOMC Rate Decision	12	None	None	None	None	-0,19*
	GDP QoQ (Annualized)	4	2	2	2,95	0,41	13,95
	Initial Jobless Claims	54	28	26	0,87	0,03	-0,41
	Change in Nonfarm Payrolls	12	5	7	0,98	1,76	10,70
	Crude inventories US	54	19	35	-0,02	0,72	87,89
	Gas Inventories US	54	32	22	0,53	0,36	4,79
	Cushing crude inventories US	17	10	7	1,45	-0,37	-55,65
	Natural Gas Inventories US	54	25	29	1,03	-0,03	1,38
	Eurozone	Eurozone CPI YoY	5	4	1	2,70	5,19
China	China CPI YoY	8	3	5	0,21	3,22	5,81
	China GDP YoY	3	1	2	5,19	-0,44	0,45
	Caixin China manufacturing index	4	2	2	2,59	-1,50	0,76
	China PPI	9	2	7	1,56	0,94	5,59
	China Crude Imports	7	None	None	None	None	1,84*
	China Diesel Exports	12	None	None	None	None	0,205*
	China refined oil exports	12	None	None	None	None	0,205*
Russia	Russia Level of international reserves	54	None	None	None	None	0,04*
	Russia CPI YoY	12	6	6	1,73	1,15	-0,42
	Russia Unemployment Rate index	10	5	5	2,10	0,53	0
	Russia Retail Sales YoY	12	5	7	2,41	0,74	28,34
Brazil	Brazil Selic Target Rate	None	None	None	None	None	None
	Brazil GDP YoY	4	3	1	2,00	0,71	-4,35
	Brazil Manufacturing Index YoY	12	4	8	3,62	0,35	15,97
Mexico	Brazil Retail Sales YoY	12	6	6	-0,31	3,19	-5,64
	Mexico Official Overnight Rate Index	2	1	1	0,52	-1,60	0,00
	Mexico CPI YoY	12	8	4	1,68	0,95	-0,52
	Mexico GDP YoY	4	None	4	None	1,68	28,65
	Mexico CPI MoM	12	8	4	1,68	0,95	-23,98
Colombia	Colombia Minimum Repo Rate	3	1	2	2,99	0,98	1,76
	Colombia CPI YoY	12	7	5	0,92	2,17	-2,43
	Colombia GDP YoY	4	2	2	1,79	1,56	10,75
	Colombia CPI MoM	12	7	5	0,92	2,17	-22,34

The results in this table report on the statistically significant abnormal returns obtained using the procedure detailed in equations (1) to (3). Once the abnormal returns for an event are identified, we proceed to classify the event as being positive or negative depending on the type of news associated with that particular event. Then we measure the average effect on price of both positives and negatives and finally we measure the average level of variation of a particular event against previous market expectations (market surveys). In the case of events \* that do not report market surveys, we just report the total effect on price. GDP: Gross domestic product, CPI: Consumer price index

2.17% average daily price increase on the day of the event, with a level of variation of actual results against market expectations of -22.34%. In the case of events that have a negative impact on price, the most relevant are the Caixin China Manufacturing Index with an impact of -1.50%, Mexico's Official Overnight Rate Index with an impact of -1.60%, and in all other cases, the negative impact is less than -0.5%. In Table 4 we can observe the impact of statistically significant OPEC meetings on the Castilla blend price.

During the observation period, there were 162 OPEC announcements and 12 of them were statistically significant.

As we can observe from Table 4, for all the significant events, the outlook on production was neutral with the exception of one positive outlook event on September 28, 2016. Five of the 12 events had a positive effect on price, with an impact of 3.67%, and with the remainder of the events having an impact of -2.58%. Interestingly, the announcements that had a negative impact on prices were related to releases regarding OPEC anniversaries and new members joining the organization. The events with positive price impacts were related to political news among member countries and measures to reduce production. Finally, OPEC news related to the release of statistical bulletins had both a negative and positive impact on prices.

**Table 4: Number of statistically significant OPEC meetings from 2010 to 2019 by type of news and their effect on the Castilla blend price**

Date	Outlook	Effect on price	(%) Change in price
27/10/2011	Neutral	Positive	1,71
24/10/2013	Neutral	Negative	-1,44
4/12/2013	Neutral	Negative	-1,39
1/09/2015	Neutral	Negative	-9,54
22/06/2016	Neutral	Negative	-1,16
30/06/2016	Neutral	Negative	-1,60
28/09/2016	Positive	Positive	7,41
21/11/2016	Neutral	Positive	5,77
26/06/2017	Neutral	Positive	2,47
5/09/2017	Neutral	Positive	1,06
14/09/2017	Neutral	Negative	-0,34
7/06/2018	Neutral	Positive	3,60

Source: Own with data extracted from the OPEC website. In the outlook column, neutral means that the production level of member countries remains unchanged and positive means that the member countries have agreed to reduce production levels.

## 5. CONCLUSIONS

On average, 12% of the events under scrutiny were not accounted for by the proposed market model for modeling Castilla blend oil prices. The proposed market model failed to account for 11% of globally-related events, 12% of regional news events, and 12% of local news events. We found that during our period of observation, the event that had the highest impact on the Castilla blend price was a cut in OPEC production and a meeting in Algiers concerning OPEC and non-OPEC members' collaboration. However, in the case of the Castilla blend, global macroeconomic news such as positive news related to Chinese GDP had a higher impact than that related to the USA and the Eurozone. In the case of Russia, all relevant positive economic news had a positive effect on the Castilla blend price. The only type of global news that had a negative effect on price was that related to the Chinese Manufacturing Index and OPEC accepting new members. Other relevant news at the regional and local level was economic news related to Brazilian manufacturing and the Colombian minimum repo rate.

Finally, a question for future research relates to why positive economic news at the global and regional level concerning inflation, which in our study represents an increase in inflation, has a positive impact on oil prices.

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