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Impact of Oil Prices on Stock Markets in Major Latin American Countries (2000-2015)

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ABSTRACT

This paper studies how sensitive are the stock market returns of Argentina, Brazil, Chile, Colombia, Mexico, and Peru to international oil price fluctuations (West Texas Intermediate). A panel data analysis with a random effects model, using the world stock market index Morgan Stanley Capital International World Index, domestic money market rates, and currency exchange rates as control variables suggests that, after controlling for the individual countries non-observed characteristics, oil prices explain positively monthly returns of the stock markets. The rest of the control variables have the desired sign and statistical significance; the sample data includes monthly observations from 2000 to 2015. The main finding of this research is that it does not matter if countries are exporters (Brazil, México, Venezuela, Colombia and Argentina) or importers (Peru and Chile) of oil, in the region as a whole, an increase of oil prices has a positive effect on stock returns.

Keywords: Oil Prices, Stock Market, Panel Data Analysis, Latin America
JEL Classifications: N26, C33, Q42

1. INTRODUCTION

Oil prices and stock market returns are intrinsically linked with the economy as the former influence costs of production and transportation, but are also influenced by economic activity, while the latter are acknowledged as leading indicators of economic growth. There is abundant evidence documenting a strong relationship between oil and other energy sources and economy performance (e.g., Angeliki and Ozturk, 2016; Solarin et al., 2016; Cuñado and Pérez de Gracia, 2000; Hamilton, 2003; and Kilian and Park, 2009), as well as between oil prices and the stock market. Stock market returns are driven by a variety of factors, oil prices are definitely one of these factors, acting either directly, by changing the performance expectations of public corporations, or indirectly, through the response of monetary policy to inflationary pressures caused by sudden oil price increases (Ozturk and Feridun, 2010; Dotsey and Reid, 1992; Friedman, 2005; and Filis et al., 2011).

The relationship between oil prices and stock markets has been extensively documented, but the evidence of the direction in which one influences the other and in what measure is still inconclusive. Oil prices impact on stock market has found to be positive in some studies, negative in some others, and still other reports suggest there is not a significant relation (Serkan et al., 2013, Acaravcı et al., 2012, Kilian and Park, 2009, and Gencer and Demiralay, 2014). This work studies the sensitivity of the stock market returns of six Latin American countries (Argentina, Brazil, Chile, Colombia, Mexico and Peru) in response to oil prices fluctuations (West Texas Intermediate (WTI), using as control variables the world stock market Morgan Stanley Capital International World Index (MSCWI), domestic money market rates, and currency exchange rates. The sample data includes monthly observations from February 2000 to October 2015, and was retrieved from Bloomberg and the International Monetary Fund (IMF). A panel data analysis of a random effects (REs) model suggests that, after controlling for individual countries non-observed characteristics, and controlled for the global stock market performance, domestic interest rates and currency exchange fluctuations, then oil prices explain the monthly returns of the different stock market in a positively statistically significant way. The rest of the control variables present the desired sign and are also statistically highly significant. Thus, our empirical findings suggest that oil price fluctuations have a positive and significant influence on the returns of stock markets in Latin American countries.

The rest of the paper contains, in the following section, a literature review of studies of the oil price fluctuations relationship with the stock market is documented. The review is organized in three subsections: The impact of oil prices on the stock market returns of developed countries, their impact on the stock markets of emerging countries, and a shorter section on the impact they have on Middle East countries. Subsequently, the panel data model is developed and empirical findings are discussed. Finally, conclusions are provided.

2. LITERATURE REVIEW OF OIL PRICES IMPACT ON STOCK MARKET

2.1. Oil Prices Impact on Stock Market Returns of Developed Countries

The impact that oil prices have on the stock market has been extensively documented since the 1990s. Until then, most studies had focused on the macroeconomic consequences of oil prices fluctuations (Ewing and Thompson, 2007; Hamilton, 1983 and 1988; Keane and Prasad, 1996; and Rotemberg et al., 1996), but an increasing globalization pattern, a growing integration of financial markets, and a noticeable effect oil price shocks on stock markets attracted the attention of a growing number of academic studies; see, for instance: Kilian (2009), Papapetrou (2001), Jones and Kaul (1996), and Huang et al. (1994).

Among those first studies, Jones and Kaul (1996) provide an insightful interpretation of what channels may conduct the effect of oil price shocks to the stock markets. First, these authors express there are two features of the postwar world economy that make it particularly sensitive to oil prices: (1) Oil is a major resource that is used around the world in many different industries, and (2) oil price shocks are mostly exogenous to the rest of the economy. The authors suggest that the reaction of international stock markets to innovations in the oil price may be interpreted in terms of the classical simplified valuation model of discounted cash flow, and report evidence of a negative relation between oil price shocks and stock prices using data from United States (US), United Kingdom, Japan, and Canada. They find that, in the case of the United States and Canada that the impact of oil movements on the price of stocks can be accounted for completely from the impact they have on future expected real cash flows, but in the case of the other two countries, oil price movements cause larger responses in stock prices than can be attributed to subsequent changes in cash flows, or changing required rates of return, i.e., there may be an overshooting in these cases.

Huang et al. (1996) examine the effects of energy shocks on financial markets focusing on the interaction between oil futures contracts traded in the New York Mercantile Exchange, stock market indices, and individual stock prices for companies that, given their normal activity, are exposed to oil price unexpected fluctuations. In particular, they explore the information transmission mechanism between oil futures markets and stock prices, and focus their attention on the extent to which contemporaneous correlation between these markets can be confirmed. A second issue that occupies the attention of Huang et al. (1994) has to do with the efficiency of oil futures and stock markets in terms of which of the two leads the other. They use daily data on stock prices and oil futures prices to examine the relationship between oil prices and the stock market at three levels of aggregation: (a) A comprehensive stock price index Standard and Poor (S and P) 500; (b) 12 industry specific indices; (c) three oil company stock prices (Chevron. Exxon, and Mobil); daily interest rates (1-month T-Bill rates) are used as control variables. The results reported in the paper suggest that oil futures prices Granger-cause the stock prices of oil companies. The authors find that oil specific information first impacts the market with which it has a more direct relationship, the future market, and through it is transmitted to oil companies' stocks. Oil price changes are not found to Granger-cause the rest of the stock market proxy iables. Surprisingly, the stocks of transportation companies that are intensive users of oil-based products (turbosine, diesel, gasoline, lubricants), exhibit no lead-lag relationship with oil futures.

A possible explanation of the divergence between Huang et al.'s (1994) findings and those from Jones and Kaul (1996) may have to do with the different periodicity of the data employed (daily data in the former study, and quarterly data in the latter). Another possible explanation has to do with the selection of Jones and Kaul (1996) of a broad index of fuel prices that is directly affected by macroeconomic conditions that influence the stock market. Interestingly, the findings of Huang et al. (1994)) suggest that including futures contracts in a portfolio provide diversification benefits.

Sadorsky (1999) investigates the interaction between oil prices, the S and P 500 returns, economic activity levels (proxied by an industrial production index), and the 3 months US treasury interest rates, applying an unrestricted vector autoregression (VAR) model. Using data for the period between January, 1947 and April, 1996, the author finds that sudden increases in oil prices have a positive correlation with the 3 months US Treasury interest rates and a negative correlation with real stock prices.

The analysis of the different channels through which oil prices impact the economy suggests that an upward shock affects economic activity raising costs of production, and reducing the earnings of those firms that use oil as an input. As a result, and given the generalized use of oil in many industrial processes and transportation services, an increase in oil prices is expected to affect the valuation of stocks downwards. Rising oil prices will also affect interest rates positively, since they often are a precursor of cost-push inflation in the economy. In turn, interest rates affect stock returns for three reasons: (a) Rising interest rates are likely to increase the cost of borrowing, having a negative impact on corporate earnings and new investment projects decisions; (b) rising interest rates affect the attractiveness of stocks as both compete for investors' dollars; and (c) speculators frequently use margin accounts to take long positions, which augment demand and stock prices, but when faced with a higher cost of opportunity, they will lose the incentive to speculate as potential profits from that activity will be reduced.

According to Sadorsky (2003), stock prices reflect the present value of anticipated future profits of companies and, since business cycle conditions impact profitability, expectations about the business cycle also affect stock prices. The author studies the macroeconomic determinants of US technology stock price by using the Pacific Stock Exchange Technology 100 Index between July 1986 and December 2000, and several other macroeconomic variables. The author introduces an innovative approach by incorporating a link between technology stock price movements and oil price movements. The author recognizes oil prices do not have a direct influence on technology stocks because of the low energy intensity of the latter's productive process. However, oil price fluctuations do have an impact on prices, and inflation affects the economic cycle, thus indirectly affecting technology companies' stocks. The main findings are that the conditional volatilities of oil prices, the term premium, and the consumer price index each of them have an impact on the conditional volatility of technology stock prices. While industrial production and inflation have the largest direct impact, oil prices influence the conditional volatility of technology stock prices significantly.

Park and Ratti (2008) conduct a multivariate VAR analysis with linear and non-linear specification of oil price shocks with daily spot of futures crude oil prices for the period from January 1986 to December 2005. They argue that the effect of oil prices on stock markets should be studied in several countries simultaneously, in order to detect those effects that have a systematic nature across borders rather than country specific effects, and find that oil price shocks have a statistically significant impact on real stock returns. This effect either takes place contemporaneously or during the next month in a sample that includes the United States and 13 European countries. In the case of Norway, an oil exporting country, oil price increases result in a significantly positive response of that country's stock market. For several European countries, but not the United States, oil prices volatility significantly depresses stock markets. The median result from variance decomposition analysis is that oil price shocks account for a statistically significant 6% of the volatility in real stock returns. Surprisingly, oil price shocks impact on the variability of stock market returns in the United States is greater than that of interest rates. However, in less than half of the European countries oil price variability impacts stock returns less than interest rates, probably reflecting the fact that the United States stock market has a significantly larger size relative to the economy than is the case in Europe.

Kilian and Park (2009) suggest there is a limitation of previous studies on the relationship between oil prices and the stock market that consists in considering the price of oil as an exogenous variable. In reality, oil prices respond to several of the same factors that drive the stock market performance, thus, cause and effect cannot be easily disentangled. The authors mention that previous studies assume that it is possible to evaluate the impact of an oil price shock without considering what are its causes. Previous work confirmed that demand and supply shocks in the oil market have different effects on the United States economy (Kilian and Park, 2009), and that the intensity of these shocks is not constant through time (Sadorsky, 1999), thus classical regressions analysis between the stock market and oil prices is likely to produce no significant statistical relationships. They address these limitations by relating United States stock market evolution to measures of demand and supply in the global oil market with a structural VAR decomposition of the real price of oil (following Kilian and Park, 2009) using monthly data, and they find that a stock market negative response happens only when the price of oil rises in response to market demand conditions like, for example, an increase in "precautionary" demand in prevision of a possible market disarray. Another interesting finding of their work is that the response of industry-specific stock returns indicates considerably stronger and more significant responses to oil demand shocks than to oil supply shocks. According to their results, the demand and supply shocks observed in the oil market account as much as 22% of the long-run variation in US real stock returns.

Lee and Chiou (2011) develop a univariate Markov switching generalized autoregressive conditional heteroskedasticity (GARCH) model that focuses on oil price volatility to examine the relationship between the oil price and stock returns. They consider expected, unexpected and negatively unexpected oil price fluctuations to study how oil spot and oil futures price fluctuations affect the stock market. Their analysis reports that when there are asymmetric unexpected oil spot and futures prices changes, they have a negative impact on S and P 500 returns. By contrast, unexpected changes in oil spot and futures prices do not impact the S and P 500 significantly when a regime of low oil price volatility prevails.

For Gencer and Demiralay (2014), oil is a source of energy that has become the most important production factor at a global level. For that reason its price fluctuations have simultaneous effects over all industries. Those effects are transmitted through two channels: In first instance, the business earnings and cash flows; and, in secondly, the investor's required rate of return which, in turn, is a function of inflation, risk and interest rates, since all these variables are influenced by oil prices. To prove their point, these authors undertake the examination of the shock and volatility spillovers between oil prices and five different sectors in the Turkish equity market using a bivariate GARCH model for a period that goes January 04, 2005-June 12, 2013, under which important ups and downs in the oil market took place. They report significant unidirectional transmission from oil market to all the stock market sectors.

An interesting approach proposed by Ewing and Malik (2016) employs univariate and bivariate GARCH models to study the volatility of oil prices and the United States stock market prices. Using a modified Iterated Cumulative Sums of Squares algorithm, proposed in Aggarwal et al. (1999), these authors report significant structural breaks in the volatility of the studied series, which is consistent with their own previous findings for the variance of oil prices (Ewing and Malik, 2010), and other authors' findings on stock market returns (Perron and Qu, 2016). The detected structural breaks are introduced into univariate GARCH models to capture the impact of news arrival on volatility, and then into bivariate GARCH models to estimate the volatility spillovers across markets with the intention to examine the existence of volatility interactions between oil prices and the stock market. To that end, they use the daily spot price for WTI, and the S and P 500 Index to track the US stock market with data from July 1st, 1996 to June 30th, 2013. They claim that, until the publication of their paper, there were no studies that examined the volatility between crude oil prices and stock market prices allowing for structural breaks in volatility, and they argue their work fills that gap in the literature. The most relevant finding is that when the GARCH models do not take into account the presence of structural breaks, the GARCH models reveal no volatility spillover. However, when they do account for structural breaks, the presence of strong volatility spillovers between the two markets is clearly confirmed. Such results are relevant for portfolio managers, concerned by risk management and asset allocation decisions and highlight the potential errors that can result from not taking into account structural breaks.

As evidenced by the previous works on the subject, the impact of oil shocks on the stock market is a controversial subject and, while there are many statistically significant findings, most support seemingly contradictory conclusions. Although a wide variety of statistical techniques have been used to sort out a more consistent response for different periods and different markets. The empirical analysis of the relationship between oil prices and the stock market remains a field open to novel methodological proposals. This paper's aim is to contribute to the analysis by presenting the findings of a panel analysis approach to the stock market sensitivity of six Latin American countries in response to international oil prices.

2.2. Oil Prices Impact on Stock Market Returns of Emerging Countries

In recent years, the most advanced economies implemented new policies and mechanisms that allowed them to become more efficient users of energy than less developed economies. They also diversified their energy sources by heavily investing in renewable energy sources using solar energy, geothermal sources, wind fields, and biomass. By contrast, emerging economies lag significantly behind in both, efficiency and diversity of energy sources and, contrary to economic sense, when they are large producers of oil, they largely subsidize their domestic consumption, instead of making a rational use of their natural resources. Therefore, emerging countries stock prices should be expected to be more exposed to the fluctuation of oil prices, a subject that deserves further analysis (Basher and Sadorsky, 2006).

According to Amoateng and Kargar (2004), compared to more developed exchanges, cross-border correlations in most emerging markets have been below average, providing significant diversification opportunities to investors. Until recently many emerging countries restricted investment by foreign investors in their domestic stock markets, reducing transparency and liquidity in the formation of stock prices. However, increasing deregulation has opened these markets to foreign investors and created "a unique opportunity to examine (the) cross-sectional variation of stock returns."

One of the most relevant seminal studies on the subject of measuring the impact of oil prices on the stock market of emerging countries is that of Basher and Sadorsky (2006). They study twenty-one cases (Argentina, Brazil, Chile, Colombia, India, Indonesia, Israel, Jordan, Korea, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, South Africa, Sri Lanka, Taiwan, Thailand, Turkey, and Venezuela), and argue that countries undergoing a fast economic growth process are likely to substantially augment their oil consumption but, in a world with a (temporarily) finite supply of oil, growing demand for oil often leads to higher prices, which, in turn, act as a tax on consumption, reducing disposable income and raise the costs of production of those industries dependent on oil (or derivatives) consumption. Companies are frequently unable to pass-through those cost increases to consumer prices and see their profit margins and free cash flow diminished, affecting their stock prices. Additionally, the world's supply and demand of oil is affected by geopolitical factors, such as the important influence of OPEC, making this market particularly volatile and risky.

Basher and Sadorsky (2006) paper uses daily closing prices on twenty-one emerging stock markets and the MSCI World Index, for the period from December 31, 1992 to October 31, 2005, and they use an international multi-factor model that allows for both unconditional and conditional risk factors. They follow a Fama and MacBeth (1973) two-step modeling strategy that first uses ordinary least squares (OLS) to estimate a multifactor model, including the world market excess returns, the exchange rate for each country *vis à vis* the United States dollar, and oil prices as explanatory variables of emerging markets returns. In a second stage, unconditional and conditional cross section regressions are performed for realized stock returns and risk parameters, where betas from period t are matched with realized stock returns from period $t + 1$. Their results suggest the existence of a strong positive conditional relationship between the oil price beta and the stock market returns, but only when oil prices move upwards. In contrast, when oil prices move downwards, the relationship between oil price beta and stock market returns is found to be negative in five of the six models, but statistically insignificant at the 10% level. The above reveals that for both unconditional and conditional cases, oil price beta plays a significant role in determining returns in the emerging stock markets and, apparently, there is an asymmetric response to up and down movements.

2.3. Oil Prices Impact on Stock Market Returns of Latin American Countries

Latin American stock markets are sensitive to oil prices volatility since a large number of the region's public corporations are exposed to oil imports and/or exports. The case of a Latin American country with a balanced oil current account is atypical but happens approximately, as in the case of Brazil, whose domestic oil production is very important, but not enough to generate significant exports.

Net oil export emerging economies are benefited when oil prices increase, but are also frequently affected by the sometimes drastic down movements since the fiscal balance in most of them is highly dependent on oil exports revenues and taxes. By contrast, emerging economies that are net importers of oil experience a severe trade balance stress during periods of high oil prices, while they benefit during periods with low prices. This may lead to the conclusion that there should be a highly significant response of stock markets of emerging economies to fluctuations in oil prices.

There are not many studies that focus on the relationship between oil prices fluctuations and stock market returns for Latin America as a region and not for individual countries. There are two studies that explicitly address that relationship, Valdés et al. (2012), and Hernández-Gamarra et al. (2015). Latin America is a prosperous region, with abundant natural resources and a large population, representing a large economic growth potential. However, the region's stock markets still do not represent a significant proportion of the capital sources for public corporations.

Valdés et al. (2012) examine the relationship between oil prices (Brent) and the returns of thirty companies listed in the Mexican Stock Market. They use a GARCH-BEKK model with stock weekly closing prices for a period from 2006 to 2010. The mean returns are modeled using a first order autoregressive model. To estimate the conditional correlations matrix with a maximum likelihood method, they assume normally distributed errors. Their conditional variance estimation reveals that the GARCH(1,1) BEKK parameters are in most cases statistically significant and that the leverage effect parameter is positive.

Hernández-Gamarra et al. (2015) study whether there is Granger-causality between oil price changes, copper prices and the returns of the stocks that conform the Integrated Latin American Market (MILA) index. Using data for a period from March, 2011 to February, 2014, they use a method developed by Hatemi (2003; 2012) that combines bootstrapping and optimal lag-selection techniques to identify and measure the presence of Granger causality. The authors conclude that, according to the Efficient Markets Hypothesis, it is not possible to develop a trading strategy supported with evidence about a Granger-causality between oil prices and copper priced, over the MILA index returns.

2.4. Oil Prices Impact on Stock Market Returns of Middle East Countries

An interest to learn about the nature of the relationship between oil prices and the stock market returns among Middle East countries has produced a large number of research papers. A selection of representative studies includes those of Amoateng and Kargar (2004), Arouri et al. (2011), Arouri and Rault (2012), and Paythakhti (2012). Most of them find that stock market returns are associated in greater or lesser degree with oil price fluctuations, as would be expected from a region where the most important economic activity is, precisely, oil production and export. Using different methodological approaches these studies corroborate that in most cases, there is a positive relationship between oil prices and stock market returns.

For example, Amoateng and Kargar (2004) use data from January 1999 to December 2002 to study the relationship among oil, currency exchange rates, and stock prices in the four largest Middle East markets: Egypt, Saudi Arabia, Israel and Jordan. Using end-of-month index prices in local currencies for Jordan and Saudi Arabia, and foreign currencies for Egypt and Israel, from January 1999 to December 2002, they test for the presence of cointegration between local stock market returns, exchange rates, spot oil price changes, and futures oil prices. In those cases when cointegration is confirmed among pairs of variables, they proceed to estimate a vector error correction model which provides them with insights regarding the speed of the correction adjustments. It should be mentioned that the cointegration test used by these authors is that of Engle and Granger (1987), which cannot determine when more than one cointegrating relationship exists among a group of variables, and that could be considered a limitation of the results of this study. The authors report that Israel's shekel exchange rate explains that country's market index, and that crude oil future prices significantly account for Saudi and Egyptian equity prices. The authors conclude that "it takes a long-time for crude oil futures prices to reach equilibrium with stock prices in Israel when there is a shock to the system", but it takes a relatively short-time for crude spot oil prices and currency price to reach equilibrium with stock prices in the presence of a shock to the system in the cases of Saudi Arabia and Egypt.

Arouri et al. (2011) investigate the return links and volatility transmission between oil prices and stock market returns for the Gulf Cooperation Council (GCC), a group of Middle East oil producing countries including Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates (UAE). Together, the GCC members produce about one fifth of the world's oil, account for more than one third of oil exports and possess almost half of the proven world oil reserves. For all those reasons, it is understandable that oil prices have a more-than-average influence on their stock markets as oil exports are the main source of hard currency, government income and aggregate consumption demand. They utilize a generalized VAR(1)-GARCH(1,1) model to investigate the interdependence of oil and stock markets among GCC countries using daily prices for a period that goes from June 7, 2005 to February 21, 2010, subdivided for analytical purposes in sub-periods of observations of calm and crisis. The model allows for transmissions in return and volatility, and its results indicate there is substantial spillover of both between world oil prices and GCC members' stock market returns. They find that lagged oil returns positively influence the stock market returns in Bahrain, Oman, and Qatar, with the strongest reaction of the stock market to oil price changes corresponding to the latter country. They do not find shock spillovers from oil to stock over the whole period in the cases of Kuwait, Saudi Arabia, and the UAE, and explain that evidence by the smaller participation of oil companies in the stock market (in the case of Kuwait, a market largely dominated by services and banking firms), and low annual turnover (in the case of Saudi Arabia and the UAE). Finally, the authors use their model's conditional variances and covariances to compute optimal weights for a portfolio that combines oil and stocks, as well as an optimal hedge ratio.

Arouri and Rault (2012) review the recent literature on developed and emerging countries studies on the impact of oil prices over the stock market and find that among emerging stock markets there seems to be some consensus regarding the existence of a significant short-term link. However, the few available studies they find on

GCC countries report very different results. For that reason, they commit themselves to add to the literature on the subject with an examination of the long-term links between oil prices fluctuations and stock market returns in only four of the six GCC countries included in the Arouri et al. (2011) paper, i.e., Bahrain, Kuwait, Oman and Saudi Arabia. To that end, they implement a bootstrap panel unit root test developed by Smith et al. (2004) that accounts for time series and cross-section dependence simultaneously. The authors also use the two-panel cointegration test from Westerlund (2005), and the bootstrap second-generation panel cointegration test from Westerlund and Edgerton (2007). Their cointegration analysis concludes there is evidence of cointegration between oil prices fluctuations and the returns of the stock market in GCC countries; and, the SUR results indicate that oil prices fluctuations have a positive influence on the stock market of the sample countries, except for Saudi Arabia.

Using weekly data from January, 1999 to December, 2010, Paythakhti (2012) uses a causality approach in mean and variance to study the relationship between international oil prices and the Iranian stock market, another important oil-exporting country in the Middle East. This author employs a two-step procedure that is designed based on the cross-correlation between the residuals of the conditional mean and variance equations for each variable, and is considered to be robust to distributional assumptions. First, conditional mean (with an auto regressive integrated moving average specification) and conditional variance (with a GARCH specification) are estimated for both the stock returns and oil price changes and, secondly, a test for causality-in-mean is performed using the cross-correlations of the standardized residuals. As the approach takes into consideration both the first and second moment dynamics, it allows for potential interactions between series. The author chooses this approach because its main advantage is the "flexible specification of innovations process and the non-dependence on normality assumption of series distribution (Cheung and Ng, 1996)". In comparison to the more traditional Granger causality approach, Cheung and Ng (1996) also incorporates ARCH effects, contributing to a better understanding of the dynamics of the system variables. The results reported indicate the variance of oil price changes does not cause the variance of the Iranian stock exchange, i.e. there is no volatility spillover effect between that country's stock market and the international oil market, a finding that was intuitively straight forward.

As the previous short review confirms, the relationship between oil price movements and the stock markets has been extensively discussed in the literature during the last decade, but the results are inconclusive. Several works find there is a negative relation while some others report a positive relation, and even some others find no significant relation. The diversity of results found mainly stems from the different data sets and methodological approaches used. Apart from the time span of the data set, the choice of either the market level data or the industry level data has had a significant effect on the outcomes of the research.

3. ECONOMETRIC METHODOLOGY (PANEL DATA MODEL)

Panel data analysis is a powerful econometric tool to study the relationship between a dependent variable, and one or several explanatory variables for a group of entities that share some similarities. In this study the dependent variable corresponds to the monthly returns of six Latin American countries stock markets indices (all converted to be expressed in USD, making strict comparability possible). The explanatory variables include the International Oil Price WTIevolution in time, as well as several other control variables, as the Global Stock Market performance, measured by the MSCWI Index, orthogonalized with a RE panel regression between individual country stock markets returns and the MSCWI returns to eliminate potential endogeneity from the model. Other control variables are: Money market interest rates, indicative of the financial market conditions in each country, and the corresponding domestic currency exchange rates with respect to the USD fluctuations, usually important for imports and exports supply and demand conditions.

Panel data analysis combines time-series and cross-sectional data to maximize the information available to estimate the true (population) parameters of the statistical relationship among variables. In this study, the time-series data consists of monthly observations for all the explained and explanatory variables, and the cross-sectional dimension refers to the six Latin American countries of the sample. The simple representation of the model is as follows:

$$y_{it} = \alpha + \beta X_{it} + u_{it} \qquad (1)$$

Where, y_{it} stands for the monthly logarithmic returns of the six countries stock market indices (i= 1, 2, 6), t refers to the monthly periodicity included in the sample, X_{it} is a vector that includes the exogenous variables, and $u_{it} \sim N(0,\sigma)$. The pooled OLS regressions frequently results in errors correlated with the cross-sectional explanatory variables and, as a consequence, the parameter estimates are biased. The use of fixed effects (FEs) and REs models can solve that problem and produce consistent parameter estimates.

Panel data analysis takes advantage of an enlarged number of observations, by combining different cross-section entities, minimizing multicollinearity between the explanatory variables, which allows a more efficient estimation. Additionally, fixed and REs techniques solve the problem of omitted variables. However, when not all the explanatory variables are observable in a pooled regression, the errors will be correlated with the exogenous variables, and the OLS estimates will be inconsistent. So the use of a FE model can solve that limitation, since it implies fewer assumptions about the nature of the residuals. Thus, the model to estimate is as follows:

$$Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it}$$

$$\varepsilon_{it} = v_i + u_{it} \qquad (2)$$

i.e., the statistical error can be decomposed into a component that is idiosyncratic, and a random component, for each unit of observation. After replacing the error term, it follows:

$$y_{it} = \alpha + \beta X_{it} + v_i + u_{it} \qquad (3)$$

That is, the error term, ε_{it}, may be decomposed in two components, one fixed and constant for each country, v_i and a second component which is a random term u_{it} meets the OLS assumptions ($\varepsilon_{it} = v_i + u_{it}$) which is equivalent to running a regression and giving each observation entity a different intercept. This captures the characteristics that are different from one entity to another, as well as the missing information of potential omitted variables, so that the coefficients of the exogenous variables reflect their contribution to the explained variable. The REs model has a similar specification as the FEs, except that the term v_i instead of being a fixed value for each country and constant over time, is a random variable with a mean value $E[v_i]$ and variance $Var(v_i) \neq 0$. Then, the specification of the model is:

$$y_{it} = \alpha + \beta X_{it} + v_i + u_{it} \quad (4)$$

Where, v_i is now a random variable. The RE model is more efficient[1], but less consistent than the FE model[2].

3.1. Presentation of Data

This paper studies the monthly returns of the stock market index sensitivity of six Latin American countries (Argentina, Brazil, Chile, Colombia, Mexico and Peru) to international oil price fluctuations (the price of one barrel of WTI grade oil). Several control variables are introduced in the model to account for information that exerts influence on the domestic stock market of the sample countries, but is not captured by the oil price only. Among those variables, the MSCIWI is included in the model to contribute with information that regards the global economic and financial conditions that prevail at every moment. Domestic interest rates and exchange rates incorporate information about the domestic financial market conditions and, along with the MSCIWI represent control variables that permit a more specific identification and precise measurement of the effect attributable to the fluctuations of the WTI over the performance of domestic indices. The period of analysis includes monthly data observations for a period from February 2000 to October 2015. The study concentrates on the effects of oil price fluctuations on the returns of Latin American domestic stock market indices, so first differences for those two variables and for the other control variables are convenient to that objective.

The research model conceptualization is based on the proposal that oil prices are important for both net exporter and net importer countries because the former benefit and receive an extraordinary windfall from upward movements in prices, which, in turn, generate different multiplier effects throughout the economy, while the latter benefit when oil prices recede since that reduces their transportation and other industrial activities costs. Among, the six major Latin American economies there are three net exporters (Argentina, Colombia and Mexico), two net importers (Chile and Peru), and Brazil, a net oil importer until approximately 2011, and then a net exporter, but almost always very close to achieving a net annual oil current account balance equilibrium during the whole period of analysis. In all cases, changes to international oil prices have had an impact on their economy, as documented by Santillán and Venegas-Martínez (2016), and most likely on their stock market, which is precisely the objective that this work aims to unveil. The following model is proposed to quantify the stock market reaction to changes in energy costs in the case of net importers, or additional hard-currency income in the case of net exporters:

$$mkt = c + wti + msciwi + mmkt + dcpusd + e \quad (5)$$

Where, *mkt* represents the domestic stock market index, *wti* corresponds to the end-of-the-year price of one barrel of WTI oil, *msciwi* stands for the Morgan Stanley World Composite Index, and *dcpusd* refers to the exchange rate per U.S. dollar, expressed in terms of local currency units.

Using panel data analysis, and allowing for individual country differences to be captured by FE or REs allows a move objective measurement of the importance of oil prices on the domestic stock market of a country. In effect, this analysis postulates that, in the aggregate, oil prices upward movement may bring along multiplier effects that benefit not only the stock market of those countries that are net exporters but also, indirectly affect net importers through increased demand for the goods and services they produce (e.g., Argentina and Brazil are part of Mercosur, Mexico and Chile, and Mexico and Colombia, have free-trade agreements). The direct impact of oil price fluctuations on the stock prices of Latin American large public oil companies as Petrobras from Brazil, EcoPetrol from Colombia, and Yacimientos Petrolíferos Fiscales (YPF) from Argentina, is also evident, and the relative importance they have in their domestic indices is significant.

In the case of Brazil, for example, Petrobras is the largest publicly traded companies in its respective stock market[3], so its relative importance over the stock market performance goes without doubt, and its stock price is certainly sensitive to upward and downward movements in oil prices. Ecopetrol, the Colombian national oil company, is the fourth most important company in the relative weight in the composition of the COLCAP Index (6.2%)[4]. Or, YPF in Argentina, with a relative influence on the MERVAL of 19%, only second to Petrobras, which is also traded in the Buenos Aires Stock Exchange[5]. While PEMEX, Mexico's oil monopoly, is a rather large multinational company, it is wholly owned by the government and it does not participate in that country's stock market index.

The series are initially tested for the presence of unit roots, and the tests results indicate that they are mainly non-stationary, except for the case of money market rates. However, as was to be expected, when first differences are calculated, all the variables become stationary (Table 1).

1 The variance of the estimate is smaller, that is, more efficient.

2 See, for example, Baltagi (2005), Phillips and Moon (2000), and Arellano and Bond (1991).

3 With a weight of approximately 11% of the BOVESPA, and only comparable to the large bank ITAUUNIBANCO (http://www.bmfbovespa.com.br/en_us/products/indices/broad-indices/indice-ibovespa-ibovespa-composition-index-portfolio.htm).

4 Information retrieved from: http://www.rankia.co/blog/analisis-colcap/1591934-que-empresas-cotizan-colcap.

5 Information retrieved from: http://blog.analisistecnico.com.ar/2015/ponderacion-de-acciones-en-el-merval-para-el-segundo-trimestre/ponderacion-de-acciones-en-el-merval-para-el-segundo-trimestre.

Table 1: Unit root tests for variables in levels

Fisher-type unit-root tests, based on augmented Dickey-Fuller tests							
H_0: All panels contain a unit root							
Test summary		***mkt***	***msciwld***	***wti***	***dcpusd***	***mmrate***	***ir***
Levels							
Inverse normal (Z)							
Statistics		0.497	1.916	−0.513	2.758	−4.450	−0.374
P value		0.690	0.972	0.304	0.997	0.000***	0.354
Inverse logit (L*)							
Statistics		0.446	1.759	−0.459	2.989	−6.617	−0.403
P value		0.671	0.956	0.325	0.997	0.000***	0.345
Log-returns	**adjmkt**	**mktlr**	**msciwldlr**	**wtilr**	**dcpusdlr**	**mmratelr**	**irlr**
Inverse normal (Z)							
Statistics	−19.904	−19.904	−19.904	−19.904	−19.197	−17.787	−17.382
P value	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
Inverse logit (L*)							
Statistics	−49.431	−49.431	−49.431	−49.431	−46.503	−42.197	−40.327
P value	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***

Source: Authors own elaboration with data form Bloomberg and IMF by using EViews 9.5. IMF: International Monetary Fund

The structural model (5) is expressed in level terms, to emphasize the nature of the economic relationship that prevails between the domestic stock market and the explanatory variables. However, the main interest of this work lies in determining what is the influence of oil price fluctuation (and the other explanatory variables fluctuations) over the stock market returns and, for that reason, for estimation purposes, all variables are transformed to their first differences.

A potential endogeneity problem exists in the structural model in (5), due to the fact that, in an increasingly globalized financial market, domestic stock market returns are likely to be strongly correlated with the world capital market returns, thus, in terms of the sample of six Latin American stock exchanges, their individual returns are likely correlated with the MSCI World Index (*msciwld*). To overcome the endogeneity potential problem, the domestic capital market returns (*mktlr*) are regressed against the MSCI World Index returns (*msciwldlr*), so the residuals represent that part of total domestic market volatility that cannot be explained by global factors, i.e., is orthogonal to the world market. The residuals from the procedure are then used to generate a new variable, *adjmkt*, expressing the domestic market response to oil and the rest of the environmental control variables, once the influence of the world market is filtered. That procedure filters the influence of the global stock market, and contributes to clarify the explanatory role of international oil prices, as well as the influence played by domestic money market interest rates and the currency exchange rate fluctuations, on domestic stock market returns dynamics.

4. EMPIRICAL RESULTS AND DISCUSSION

The econometric analysis of the data takes place in a two-step process. The theoretical model presented in equation (5) suggests that the stock market returns may be explained by oil prices, the world stock market, domestic money market rates and the exchange rate of the local currency with respect to the USD. However, the possibility of an endogenous relationship between the domestic stock market and the world stock market creates a serious econometric problem, which is solved by running a regression

Table 2: Pooled regression to obtain residuals of local market to global market

Dependent variable: *mktlr*				
Variable	**Coefficient**	**Standard error**	**t-statistic**	**P**
C	0.4884	0.2145	2.2765	0.0230
msciwldlr	1.2332	0.0471	26.1555	0.0000
R^2	0.3686		F-statistic	684.1106
Adjusted R^2	0.3680		P (F-stat)	0.0000

Source: Authors own elaboration with data form Bloomberg and IMF by using EViews 9.5. IMF: International Monetary Fund

between the two variables. To that end, a pooled regression, a FEs regression and a REs regression are used to filter the domestic stock market volatility that is explained by the global market to keep only the residuals, and use them as a new variable that is then free of endogeneity. In all cases, the significance of the world market index is highly significant and has a positive sign. However, the possibility to improve the precision of the coefficient estimates, and the residuals required to create the orthogonal variable requires a comparison of the different possibilities. Table 2 presents the pooled regression results which, when compared with Table 3 results. Regarding the FE panel regression using a redundancy test (presented in Table 4), it indicates that FE is preferred. However, RE, presented in Table 5 again must be compared with FE, since the former is a more efficient model and is preferred if there is no correlation between the explanatory variable and the residual term. In effect, as presented in Table 6, the Hausman test confirms that RE is preferred to FE. Finally, Table 7 shows the results of a Breusch-Pagan lagrange multiplier test, which validates that RE is preferred to a simple pool regression. Accordingly, the residuals of the RE regression are used as the orthogonal variable to be explained by oil price returns, money market interest rate variations and the exchange rate of local currencies with respect to the USD.

In the second stage of the analysis, a panel data analysis is used to estimate the coefficients of the domestic returns components that are orthogonal to the world market index to the WTI price fluctuations and to the control explanatory variables (money

Table 3: FE regression to obtain residuals of local market to global market

Dependent variable: *mktlr*				
Variable	**Coefficient**	**Standard error**	**t-statistic**	**P**
C	0.4884	0.2148	2.2737	0.0232
msciwldlr	1.2328	0.0472	26.1114	0.0000
Effects specification				
Cross-section fixed (dummy variables)				
R^2	0.3696		F-statistic	114.0289
Adjusted R^2	0.3663		P (F-statistics)	0.0000

Source: Authors own elaboration with data form Bloomberg and IMF by using EViews 9.5. FE: Fixed effects, IMF: International Monetary Fund

Table 4: Redundant FE tests

Effects test	Statistic	df	P
Cross-section F	0.3765	−51.167	0.8651
Cross-section Chi-squared	1.8921	5	0.8639

Source: Authors own elaboration with data form Bloomberg and IMF by using EViews 9.5. IMF: International Monetary Fund, FE: Fixed effects

Table 5: RE regression to obtain residuals of local market to global market

Dependent variable: *mktlr*				
Variable	**Coefficient**	**Standard error**	**t-statistic**	**P**
C	0.4884	0.2148	2.2735	0.0232
msciwldlr	1.2332	0.0472	26.1207	0.0000
Effects specification			SD	Rho
Cross-section random			0.0000	0.0000
Idiosyncratic random			7.3569	1.0000
R^2	0.3686		F-statistic	684.1106
Adjusted R^2	0.3680		P (F-statistics)	0.0000

Source: Authors own elaboration with data form Bloomberg and IMF by using EViews 9.5. SD: Standard deviation, RE: Random effects, IMF: International Monetary Fund

Table 6: Hausman test for correlated RE

Test summary	Chi-square. statistic	Chi-square df	P
Cross-section random	0.4681	1.0000	0.4939

Source: Authors own elaboration with data form Bloomberg and IMF by using EViews 9.5. RE: Random effects, IMF: International Monetary Fund

Table 7: Lagrange multiplier test for RE

H_0: No effects	Cross-section	Time	Both
BP	1.4157	195.0363	196.4520
P (BP)	−0.2341	0.0000	0.0000

Source: Authors own elaboration with data form Bloomberg and IMF by using EViews 9.5, RE: Random effects, BP: Breusch-Pagan, IMF: International Monetary Fund

Table 8: Pooled regression of *adjmkt* to *wtilr* and control variables

Dependent variable: *adjmkt2*				
Variable	**Coefficient**	**Standard error**	**t-statistic**	**P**
C	0.2028	0.1907	1.0634	0.2878
wtilr	0.0671	0.0204	3.2917	0.0010
mmratelr	−0.0435	0.0120	−3.6140	0.0003
dcpusdlr	−0.8302	0.0516	−16.0814	0.0000
R^2	0.2168		F-statistic	102.4236
Adjusted R^2	0.2147		P (F-statistics)	0.0000

Source: Authors own elaboration with data form Bloomberg and IMF by using EViews 9.5. IMF: International Monetary Fund

market interest rates changes, and exchange rate fluctuations with respect to the USD). The analysis follows a similar sequence as that of the first stage, beginning with the pooled regression (Table 8), a FE regression (Table 9), and a RE regression (Table 10). In all three cases, the coefficients of the WTI price fluctuations are positive and highly significant (at <0.2%). In order to verify if there is a need for a FE procedure instead of a simple OLS estimation, we use a redundancy test (Table 11) that indicates that FE is preferred to a pool. To verify that the regression residuals are not correlated with any of the explanatory variables, we estimate a Hausman test (Table 12), effectively confirming that RE is preferred to FE, because it is a more efficient estimation and it has no econometric problems. Finally, a Breusch-Pagan test (Table 13), is run to challenge if RE is also preferred to an OLS (or pooled) regression, finding that, indeed, that is the case.

The RE regression is the most efficient methodology to estimate the determinants of the stock market returns of our sample of six Latin American countries is confirmed by both the redundancy test, the Hausman test, and the Breusch-Pagan test. However, the surprising congruency of the three panel methodologies is comforting, as it supports the general findings of previous works, and contributes to the understanding of the region's markets determinants. With almost negligible differences in the coefficients for the fluctuations of the WTI price, the pooled regression, as well as the FE and RE Regressions, suggest the significant role the volatile price of oil has over the evolution of the six Latin American exchanges in the study.

While the sample includes three net oil exporters (Argentina, Colombia and Mexico), two net oil importers (Chile and Peru), and Brazil, a net importer during most of the period of analysis that becomes an exporter in more recent years, the results obtained

Table 9: FE regression of *adjmkt* to *wtilr* and control variables

Dependent variable: *adjmkt2*				
Variable	**Coefficient**	**Standard error**	**t-statistic**	**P**
C	0.2038	0.1909	1.0674	0.2860
wtilr	0.0668	0.0204	3.2749	0.0011
mmratelr	−0.0439	0.0121	−3.6337	0.0003
dcpusdlr	−0.8334	0.0519	−16.0529	0.0000
Effects specification				
Cross-section fixed (dummy variables)				
R^2	0.2183		F-statistic	38.5775
Adjusted R^2	0.2127		P (F-statistics)	0.0000

Source: Authors own elaboration with data form Bloomberg and IMF by using EViews 9.5. FE: Fixed effects, IMF: International Monetary Fund

Table 10: RE regression of *adjmkt* to *wtilr* and control variables

Dependent variable: *adjmkt*				
Variable	**Coefficient**	**Standard error**	**t-statistic**	**P**
C	0.2028	0.1909	1.0620	0.2885
wtilr	0.0671	0.0204	3.2875	0.0010
mmratelr	−0.0435	0.0121	−3.6093	0.0003
dcpusdlr	−0.8302	0.0517	−16.0607	0.0000
Effects specification		SD	Rho	
Cross-section random		0.0000	0.0000	
Idiosyncratic random		6.3401	1.0000	
R^2	0.2168		F-statistics	102.4236
Adjusted R^2	0.2147		P (F-statistics)	0.0000

Source: Authors own elaboration with data form bloomberg and IMF by using EViews 9.5. SD: Standard deviation, RE: Random effects, IMF: International Monetary Fund

Table 11: Redundant FE tests

Effects test	Statistic	df	P
Cross-section F	0.4281	−51,105	0.8293
Cross-section Chi-square	2.1557	5	0.8272

Source: Authors own elaboration with data form Bloomberg and IMF by using EViews 9.5. FE: Fixed effects, IMF: International Monetary Fund

Table 12: Hausman test for correlated RE

Test summary	Chi-square statistic	Chi-square. df	P
Cross-section random	0.9111	3	0.8227

Source: Authors own elaboration with data form Bloomberg and IMF by using EViews 9.5. RE: Random effects, IMF: International Monetary Fund

Table 13: Lagrange multiplier test for RE

H_0: No effects	Cross-section	Time	Both
BP	1.2338	141.1757	142.4095
P (BP)	−0.2667	0.0000	0.0000

Source: Authors own elaboration with data form bloomberg and IMF by using EViews 9.5. BP: Breusch-Pagan

from panel analysis confirm that, for the region as a whole, oil price increases have a positive effect on the local stock markets' returns.

As could be expected, the sign of the coefficients that correspond to the fluctuations of money market rates are negative and highly significant. The fact that stocks and fixed income securities are close substitutes, and that the investor is inclined to shift from one market to the other in response of even small increases of the money market interest rates, explains the negative valued of that variable coefficients. Finally, the sign of the coefficient that corresponds to exchange rate fluctuations is also negative due to the trade-off faced by international investors who, in response to the local currency, sell their local assets and seek the protection of safe havens.

5. CONCLUSIONS

The literature on the impact of oil price fluctuations on the returns of the stock market has extensively documented that increases in oil prices benefit the stock markets of oil exporting countries and, oftentimes, negatively affect the stock market returns of oil importing countries. Most of them have centered on the more developed economic countries, and in the Middle East countries. In general, both find oil prices to be highly significant and provide insights that help portfolio managers anticipate and hedge their stock positions and stock market authorities react when oil price experiences fluctuations.

The main finding of this research is that it does not matter if countries are exporters or importers of oil, in the region as a whole, an increase of oil prices has a positive effect on the stock markets' returns. It is important to point out that our results deepen the understanding of oil price fluctuations impact on the stock market using panel data. This econometric approach allows an interpretation of the impact of oil prices on the stock market of a group of countries that, besides their regional closeness, they share many institutional, historical and cultural features. A better knowledge of Latin American stock markets reaction to oil price fluctuations is also relevant for country-funds and regional-funds managers, as well as any other institutional investors who hold Latin American stocks.

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