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Shahil Sharma

The University of Texas Rio Grande Valley

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Oil Price Shocks and American Depository Receipt Stock Returns

Shahil Sharma[†]

Abstract

In this paper we examine the impact of oil price shocks on twelve countries American Depository Receipt (ADR) returns using monthly data from 1999.01 to 2014.12. The results show that oil price shocks have a positive and statistically significant impact on ADR return in all twelve countries. These results are robust to the inclusion of other explanatory variables such as oil price volatility and the spillover of the United States stock market. Further analysis shows that this effect is stronger in the post financial crisis time period compared to the pre-financial crisis time period.

JEL Classification: F30, G12, G15, Q43

Keywords: Oil price shocks, ADR returns, Financial crisis, Oil price volatility

[†] Department of Economics and Finance, The University of Texas Rio Grande Valley, Edinburg, TX 78539, Phone (956) 665-2590, Fax: (956) 665-5020, Email: shahil.sharma@utrgv.edu

Introduction

This paper examines the impact of oil price shocks on American Depository Receipt (ADR)¹ returns. Recently there has been an increase in oil price volatility with the price of UK Brent crude oil falling from \$133 per barrel in July 2014 to less than \$27 per barrel in January 2016. This increase in instability has amplified the importance of being able to diversify against oil price volatility. As such, investors who are looking to diversify their portfolio by investing in ADR's may look to invest in countries whose economy is less tied to crude oil such as Germany or Japan, instead of oil producing countries such as Norway, Russia, or the United Kingdom, but is this an effective strategy? Additionally, as global economies are intertwined due to importing and exporting of goods and services, ADR's present an inquisitive study beyond examining a countries' aggregate stock market because the stock is dually listed in the home country and the United States and is subject to the impact of both countries' stock market.

There is a large body of existing literature on the impact of oil price on real economic activity. Examining data from post-World War II, Hamilton (1983) finds an inverse relationship between United States GNP growth and crude oil prices. Furthermore, Jimenez-Rodriguez and Sanchez (2005) find that oil price increases have a negative impact on GDP growth in the United States, France, Italy, Germany, and the United Kingdom, with no significance for Japan, and a positive impact on Norway. Additionally, Cavalcanti and Jalles (2013) find no evidence that oil prices have any impact on Brazilian GDP.

Oil prices not only impact macroeconomic factors such as real economic activity, but also financial variables, such as stock market returns. Jones and Kaul (1996) show that it is rational

¹ An ADR is a certificate that represents equity in a non-United States company issued by United States Bank that is backed by a fixed number of underlying shares of the firm in its domestic market. ADR's are cross listed on both their domestic market and any of the United States exchanges.

for investors to react to oil price shocks in the stock market, as changes in oil prices can directly influence future cash flows. A large amount of literature examines the impact of oil price shocks on stock market returns throughout many countries, such as the United States (Sadorsky, 1999), European nations (Park and Ratti, 2008; Cunado and Perez de Gracia 2014), and Asia (Fang and You 2014; Wang et al. 2013) with the majority of results showing that oil importing countries have a negative response to oil price shocks, while oil exporting countries have a positive response. Therefore, the relationship between oil price shocks and ADR returns should also hold. However, no study has examined the impact of oil price shocks on ADR stock returns.

We examine the impact of oil price shocks on ADR returns using both real world and national oil prices by utilizing an ADR index for each of the twelve countries from 1999:01 – 2014:12². We argue that it is important to examine the impact of oil price shocks on ADR stock prices across importing and exporting countries as well as developed and emerging countries as the effect may be systematic across countries. Additionally, the recent financial crisis of 2007 – 2008 has made drastic changes in several asset class relationships. We suspect that there is a time-varying impact of the financial crisis on the relationship between oil price shocks and ADR returns. Therefore, the sample is divided into sub-categories: pre-crisis (January 1999 – November 2007) and post-crisis (July 2009 – December 2014) to analyze any permanent shift in relationship between oil price shocks and ADR returns while controlling for macroeconomic factors³.

Our main finding is that the ADR returns have positive and significant response to oil price shocks for all twelve countries examined during the full sample period. This finding is robust to the inclusion of other variables such as the spillover effect from the United States stock

² The beginning period for the sample is based on the first available date of the euro currency.

³ The dates of the recession of December 2007 – June 2009 follow U.S. NBER dateline.

market and oil price volatility. Additionally, the variance decomposition shows that oil price contributes a statistically significant amount of variance to the ADR stock returns of all twelve countries ranging from 9.6% to 24.6%. Furthermore, this finding is examined in the context of pre-financial crisis and post-financial crisis periods. Results from the pre-crisis time period show that China, Italy, Norway, and South Korea demonstrate a positive and statistically significant response to real world oil price while controlling for the spillover effect of the U.S. stock market, while China shows a positive response when examining national oil price shock. This indicates that during the pre-crisis time period ADR returns are highly correlated with the United States stock market and provides the implication that ADR's provide very little diversification against oil price shock for investors during the pre-crisis time period.

The examination of the post-financial crisis time period shows that eight of the twelve countries, including Germany and Japan, have a positive and significant response to oil price shocks, even after accounting for the spillover from the United States stock market. This implies that oil price shocks still have a positive and significant impact on ADR returns even after controlling for the impact of the United States stock market. Therefore, in the post-financial crisis time period, investors cannot disregard the impact of oil price shocks on ADR returns. This result shows that investors can't diversify their portfolio against oil price shocks by investing in oil importing countries such as Germany and Japan. Several explanations are given for the results, such as economic structure, causes of shocks, a possible emerging market crisis, and how oil price can be tied to global demand for goods.

The structure for the remainder of this paper is as follows. Section 2 provides an overview of the literature. Section 3 puts forth the methodology employed. Section 4 presents the empirical analysis. Finally, Section 5 provides the conclusion.

2. Overview of Literature

Research shows that oil price shocks have a negative impact on the United States stock market returns (Park and Ratti, 2008; Sadorsky, 1999). In fact, Chen (2010) uses a Markov switching model and finds that as oil prices increase there is a higher probability of a bear market in the United States. Conversely, research shows that subsequently following the start of the United States recession, oil price changes have a positive impact on the United States aggregate markets (Mollick & Assefa, 2013) and industry returns (Tsai, 2015), which provides evidence that there may be a time varying impact of the United States recession on the impact of oil price shocks and stock market returns.

Park and Ratti (2008) examine oil price shocks from January 1986 to December 2005 in European countries and find a negative response of oil price shocks on the stock markets in France, Germany, and Italy, a positive response in Norway, and no response in the United Kingdom. Similarly, Cunado and Perez de Gracia (2014) examine the impact of different types of oil shocks on European countries from February 1973 to December 2012. They find a negative response of oil price shocks on the aggregate stock markets in France, Germany, Italy, and the UK.

Wang et al. (2013) studies oil price shocks in oil importing and exporting countries from January 1999 to December 2012. Their results show that oil demand shocks and oil specific shocks have a positive impact on the stock return of oil exporting countries such as Mexico, Norway, and Russia and no impact on oil importing countries such as France, Germany, Italy, Japan, South Korea, UK, and USA demonstrating the fact that since the late 1990's, research no longer finds the consistent negative relationship between oil price shocks and the stock market returns in oil importing countries.

Nandha and Faff (2008) find an inverse relationship to oil prices and all DataStream global industry indices, except for the oil and gas and mining industries, from 1983 - 2005. Similarly, Scholtens and Yurtsever (2012) examine industry level returns in the European countries from 1983 – 2007 and find a negative linear relationship for all industries except for oil intensive industries (oil and gas producing, oil equipment, and mining).

Basher et al. (2012) find that oil price shocks decrease emerging market's stock prices measured by the MSCI emerging stock market index from 1988 - 2008. However, Cong et al. (2008) find that oil price shocks do not impact the majority of Chinese stock market indices when examining monthly data from 1996 - 2007. In contrast, Fang and You (2014) find that oil specific demand shocks have a negative impact on the Chinese stock market. Additionally, the Russian stock market has a negative response to global oil demand shocks and a positive response to oil specific supply shocks.

Theory suggests that companies that cross list on the U.S. stock exchange should have their returns predominately influenced by their domestic market because this is where they conduct their operations. Hauser et al. (1998) examine Israeli ADR's and find that the causality of price changes is unidirectional from the Israeli market to the United States, showing that Israeli ADR's stock prices follow their home country stock market and not the United States stock market.

On the other hand, Wang et al. (2002) explore the return behavior of dually traded stocks in Hong Kong and London and find a spillover effect for both markets, showing that ADR returns are caused by both the Hong Kong and London markets. Additionally, Alaganar and Bhar (2002) examine Australian ADR's and find that the information flow is unidirectional from the United States to Australia stock market, showing that the return of Australian ADR's is caused

by the U.S. market. Similarly, Chen et al. (2009) find that the returns of UK ADR's are more driven by the U.S. market than by the UK market. Therefore, if ADR returns follow their home country they should show similar responses to oil price shocks as their aggregate market. Conversely, if ADR returns follow the United States stock market, the ADR returns will show a similar response to oil price shocks as the U.S. stock market.

3. Methodology

3.1 Data

We examine the impact of oil price shocks on the returns of ADR indices for twelve countries that cross list in the United States with monthly data from 1999.01 to 2014.12⁴. ADR returns are created by using the ADR index for each country created by Bank of New York (BNY) Mellon collected from Datastream⁵. In addition to ADR indexes, seasonally adjusted industrial production and consumer price index are collected from Datastream. The short term interest rates, exchange rates, oil price, and the United States producer price index are collected from the Federal Reserve Economic Data published by Federal Reserve Bank of St. Louis. Finally, crude oil imports and exports are collected from U.S. Energy Information Administration.

The BNY Mellon ADR Index for each country tracks all ADR's listed on The New York Stock Exchange, The New York Stock Exchange Market, and NASDAQ Stock Market for each country. Additionally, each ADR must have a 3-month average daily trading volume of 100,000 to ensure proper liquidity. Furthermore, the free-float adjusted market capitalization must be greater than \$250 million. This index uses all ADR's that meet this requirement and is

⁴ The sample starts in May 1999 for India as it is the first month of available data for the ADR index.

⁵ This index has been used in other financial studies such as He and Yang (2012) and Gupta et al. (2016).

capitalization-weighted using the number of shares outstanding times the price per share⁶. The ADR's that comprise each country's ADR index, provided by Bank of New York Mellon, is shown in Appendix A.

This study uses the following twelve countries: Brazil, China, France, Germany, India, Italy, Japan, Mexico, Norway, Russia, South Korea, and United Kingdom. France, Germany, Italy, Japan, and United Kingdom are selected as they are G-7 economies⁷. Norway is selected due to being the highest oil producing developed country. Brazil, China, India, and Russia are selected as part of the BRIC countries that are high growth emerging countries. Finally, Mexico and South Korea are selected because they are two of the most developed emerging economies.

[Insert Table 1 here]

Table 1 displays the net crude oil exports for each country. Mexico, Norway, and Russia are net exporting countries as they export more crude oil than they import. Brazil was a net importer from 1999 through 2005, however recently has become a net exporter from 2006 through 2012, except for 2007. Similarly, The United Kingdom was a net exporter from 1999 to 2004 and has been a net importer since 2005. Finally, China, France, Germany, India, Italy, Japan, and South Korea are oil importing countries.

For each country, ADR returns represent the difference between the continuously compounded return of the ADR index and the inflation rate specified by the first log difference in the consumer price index. This definition is used in previous empirical literature (Park & Ratti, 2008; Cunado & Perez de Gracia, 2014). The real national oil price is used for each country and is defined as the UK Brent nominal oil price adjusted by exchange rate and the

⁶ The number of shares outstanding represents all shares that are traded in the home market and U.S. market.

⁷ Canada does not have an ADR index and United States is the cross listing country therefore not used in this study.

consumer price index of each country, consistent with previous literature (For example, Park & Ratti, 2008; Cunado & Perez de Gracia, 2014). Following Park and Ratti (2008) and Cunado and Perez de Gracia (2014) we use world real oil price, which is defined as the nominal price of UK Brent in USD (\$) adjusted by the United States producer price index. The following notation will be utilized for further analysis:

r: first log difference of short-term interest rate

op: first log difference of real oil price (national or world)

ip: first log difference of industrial production

rar: real ADR returns

Figure 1 depicts the real world oil price from 1999 – 2014. The figure shows the rise of oil prices from the start of the sample in 1999 until the financial crisis in 2007, where the price of oil fell until 2009. Following 2009, the real oil price rises until a small decline at the end of our sample.

[Insert Figure 1 here]

3.2 Time series properties

Unit roots are tested for each country using Augmented Dickey-Fuller (ADF, Dickey & Fuller, 1981) and the Phillips and Perron (PP, Phillips & Perron, 1988) unit root tests with constant. Table 2 provides the results for ADF and PP for each variable in log level (except for real ADR returns) and first difference⁸. The null hypothesis that a unit root is present is rejected for national real oil price in Brazil at the 1% level for ADF and PP test and in Russia for PP test.

⁸ Unit root tests are run using constant and trend. We find that the results are similar and only the model with constant is reported.

Additionally, the results show that national real oil price does not contain a unit root in 6 of the remaining 10 countries at the 5% level, which provides weak evidence of stationarity. When examining interest rates, Russia rejects the null hypothesis of a unit root using ADF and PP, and India using PP. Table 2 shows that China and India reject the null hypothesis of unit root for real industrial production, but only using the PP test. The results show that overall real oil price, interest rate, and real industrial production are not stationary at the log level. Table 2 shows that all variables reject the null hypothesis of a unit root at the 1% level in first differences, thus accepting that the variables are an $I(1)$ process and stationary in log first differences.

[Insert Table 2 here]

Cointegration test (Johansen and Jeselius, 1990) is conducted since it is assumed that all variables contain a unit root in log form using both the trace and maximum eigen value statistics. Table 3 displays the results for the cointegration test with the null hypothesis, being there is no cointegration between interest rates, real oil prices, and industrial production for each country. Panel A shows that the null hypothesis is rejected for India and South Korea at 1% level for both trace and maximum Eigen value statistics and Brazil at the 5% level for trace statistics for the model with an intercept when examining world oil prices. Additionally, Panel B shows that the null hypothesis is rejected for national oil prices at the 1% level for India, and South Korea for both trace and maximum Eigen statistics and Norway for trace statistics. Therefore, the null hypothesis of no cointegration is rejected in 6 out of 24 countries, providing very weak evidence that interest rates, industrial production, and oil prices are cointegrated. Engle and Yoo (1987) provide evidence that when examining short horizons, unrestricted VAR models are superior when it comes to forecast variance compared to the restricted VECM. Similarly, Naka and Tufte (1997) find that the performance is nearly identical when comparing the unrestricted VAR and

VECM performance of impulse response analysis in short time frames. Therefore, this study will run an unrestricted VAR on all countries similar to Park and Ratti (2008) and Cunado and Perez de Gracia (2014) who use VAR models after finding weak evidence of cointegration in a minority of countries examined.

[Insert Table 3 here]

3.3 Oil Price Variables and Model

3.31 Non-Linear Oil Price Variables

We implement two widely used oil price transformation techniques employed in the oil price shock literature to examine if there are any non-linear impacts of oil price shocks. The first transformation technique is scaled real oil price change (SOP) following Lee et al. (1995) as they argue that oil price shocks will have more of an impact when oil prices have been stable compared to when oil prices have been moving frequently and erratically. For this oil price variable, a GARCH (1, 1) model is employed for each country. The model is given by:

$$\begin{aligned}
 op_t &= \alpha + \sum_{i=0}^q \alpha_i op_{t-i} + \sum_{i=0}^q \beta_i z_{t-i} + \varepsilon_t, \quad \varepsilon_t | I_{t-1} \sim N(0, h_t) \\
 h_t &= \gamma_0 + \gamma_1 \varepsilon_{t-1}^2 + \gamma_2 h_{t-1}
 \end{aligned} \tag{1}$$

Where op_t is the first log difference of world or national real oil price, ε_t is an error term and z_{t-1} : $i \geq 1$ represents a properly selected vector enclosed in information set I_{t-1} ⁹. The lags p and q are chosen accordingly for each country by AIC. Scaled oil price is defined as the following:

$$SOP_t = \hat{\varepsilon}_t / \sqrt{\hat{h}_t} \tag{2}$$

⁹ This study uses interest rates and industrial production

The second oil price transformation variable is net oil price increase (NOPI), originally proposed by Hamilton (1996), which is intended to represent how unsettling oil price increase may influence the spending decisions of consumers and firms. The rationale behind NOPI is that if current oil prices are higher than previous prices, then a positive oil price shock will impact decisions differently than if the current price of oil is lower than in the recent periods. NOPI is defined as¹⁰:

$$NOPI_t = \max(0, \log P_t - \max(\log P_{t-1} \dots \log P_{t-6})) \quad (3)$$

Where $\log P_t$ is the log of level real oil price at time t .

3.32 VAR Model

We implement an unrestricted VAR model with the following four variables in order: the first log difference of the short-term interest rate (r), the first log difference of real oil price (op), the first log difference of industrial production (ip), and real ADR returns (rar). The order of variables in our VAR model is motivated from similar studies (Sadorsky 1999; Park and Ratti 2008). The VAR (r, op, ip, rar) is given by:

$$Z_t = A_0 + \sum_{i=1}^k A_i Z_{t-i} + u_t \quad (4)$$

Where $Z_t = (r, op, ip, rar)$, op is the first log difference of oil prices or non-linear transformations of the real oil price defined as either SOP or NOPI (in both national and world prices). A_0 is a

¹⁰ 6 lags are used following Park and Ratti (2008)

column vector of constant terms, A_i is a 4x4 matrix of unknown coefficients, and u_t is a column vector of errors with the following properties¹¹:

$$\begin{aligned}
 E(u_t) &= 0 & \forall t \\
 E(u_t, u_s) &= \Omega & \text{if } s = t \\
 E(u_t, u_s) &= 0 & \text{if } s \neq t
 \end{aligned}$$

4. Empirical Analysis

4.1 World Real Oil Price Shock on ADR returns

Figure 2 shows the orthogonalized impulse response of real ADR returns from a one standard deviation shock to real world oil price with 99% confidence bounds for each country in our sample. For all twelve countries studied in this paper, a world oil price shock has a positive and statistically significant impact on real ADR returns at the 1% level.

[Insert Figure 2]

Table 4 provides the results of oil price shocks on ADR returns for the full sample period from 1999.01 – 2014.12. Panel A provides the results for world oil price. The first row provides the summary of the results in figure 2. Rows 2 and 3 provide the summary of results of the response of ADR returns to a shock in world oil price using the non-linear transformations of world real oil price, SOP and NOPI, from the model VAR (r, SOP, ip, rar) and VAR(r, NOPI, ip, rar) respectively¹². The results show that both SOP and NOPI have a statistically significant and positive impact on ADR returns in all countries, except for Germany where the shock due to

¹¹ Optimal lag length for each country and oil price VAR models is checked based upon AIC and BIC criteria provide results ranging from 1 to 3 lags. 2 lags is thus selected as some countries provide more and some less, similar to Park and Ratti (2008).

¹² For sake of brevity, figures showing the orthogonalized impulse responses for SOP and NOPI are not reported, but from Table 4 it can be easily inferred that they are similar to impulse responses presented in Fig. 2

NOPI is not significant. Few other countries, such as South Korea and Russia, are statistically significant at 10% and 5% level respectively.

[Insert Table 4 here]

4.2 National Real Oil Price Shock

Table 4 Panel B displays the results of statistical significance of linear and non-linear measures of national oil price shocks on ADR returns. The results in Panel B are similar to those in Panel A showing that both world and national oil price has a similar effect on ADR returns. However, several countries show a lower level of significance, such as Brazil, whose significance level dropped from 1% level for world oil price to 10% level for national oil price and is no longer significant when examining the shock due to NOPI. Additionally, other countries ADR returns, such as Russia and South Korea, follow a similar pattern where the shock to NOPI has no significant effect on ADR returns. Finally, the findings suggest that world real oil price shocks have significantly more influence to ADR returns compared to national oil prices for several countries.

Mexico, Norway, and Russia are big oil exporting countries, therefore it is expected that their ADR returns will have a positive response to oil price shocks. However, it is unexpected that the remaining nine countries show the same response due to being oil importing countries. To find the logical justification of such phenomena, we examine the ADR indices construction. Nandha and Faff (2008) and Scholtens and Yurtsever (2012) find that the industries of oil and gas producing, oil equipment, and mining have positive returns to oil price increases. Therefore, if the ADR index is highly composed of these industries, it could explain the phenomenon of all countries showing positive response to oil price shocks.

France, Italy, and Norway's ADR indices have a large proportion of oil companies in their index, which can explain their positive response to oil price shocks. On the other hand, the ADR indices from Brazil, China, South Korea, and United Kingdom are composed of ADR's that are oil or mining companies, however they do not make up a large portion of the index and therefore cannot explain our results. Furthermore, Germany, India, and Japan have zero oil or mining companies that comprise the index, but still show positive response to oil price shocks. Therefore, the constituents of the ADR index can't explain the positive responses for the entire sample, hence there must be another explanation.

4.3 Split Sample

Mollick and Assefa (2013) find evidence that during the recent United States recession, from December 2007 to June 2009, oil prices are positively related to changes in the U.S. stock market indices with weak levels of significance. This effect is amplified with a strong positive relationship between oil prices and the stock market in the time period following the recession. Similarly, this phenomenon is shown by Tsai (2015) who finds a statistically different impact of oil prices on United States industry stock returns in the pre-crisis and post-crisis time periods. Therefore, based upon these studies we split our sample into pre-recession (January 1999 to November 2007) and post-recession (July 2009 to December 2014) to examine if ADR returns have a different impact in the two time periods, as it is possible the full sample may be misspecified as it does not account for the crisis.

Table 5 presents the results for pre-crisis and post-crisis time periods. Analysis of the pre-crisis time period shows fewer positive and statistically significant response of ADR returns to oil price shocks. For example, when examining world oil price, Brazil, India, and Russia are not statistically significant in pre-crisis time period, and Germany shows a negative and significant

response at the 10% level. Furthermore, Germany, India, Japan, Mexico, Russia, and South Korea do not show a significant response to national oil price shocks (linear or non-linear) in the pre-crisis time period, while Brazil has a negatively significant response to both nonlinear variables.

[Insert Table 5]

The results in the pre-crisis time period are more consistent with expectations based upon the previous literature that shows a negative response of the aggregate stock market to the oil price shock in oil importing countries. The positive response in France, Italy, and Norway can be explained because they have a large proportion of oil companies that comprise their ADR index. Similarly, Mexico and the United Kingdom are both oil exporting countries during this time period, which can explain why increases in oil prices help move ADR prices higher for these countries. However, Russia is the largest oil exporter in the world, but shows no significant response to oil price shocks. One explanation for this is that the Russian stock market is highly integrated with the United States stock market and since Russia has no oil ADR's listed in its ADR index, Russian ADR's may follow the United States stock market.

The impact of oil price shocks on ADR returns changes considerably in post-crisis period. Table 5 shows that all countries ADR's show a positive and statistically significant response to both world and national linear oil prices at 5% level, except for India and South Korea. Furthermore, all of the countries that show a significant response to linear oil price shocks show positively significant response to nonlinear world oil price shocks except for SOP in China and NOPI in China and Russia. These results provide clear evidence that there is a distinct difference in the impact of oil price shocks on ADR returns when comparing the pre-crisis and post-crisis time periods.

4.4 Spillover Effects from United States Stock Market

During the beginning of post-crisis time period, world production of oil and gas changed significantly as many countries which were never major producer of energy commodities before emerged as major producers. For example, the United States and Brazil increased their oil and gas production significantly, while Mexico, UK, and Norway decreased their production. This means that the United States market is more intertwined with the oil market, providing a possible explanation for the co-movement between oil price and United States stock market.

Theory states that ADR firms should follow their home stock market, but empirical evidence shows that the cross listed country influences the ADR returns (Wang et al., 2002; Alaganar & Bhar, 2002; Chen et al., 2009). Therefore, as previous literature shows that the United States stock market has a positive response to oil price shocks, ADR's could be following the United States stock market. Consequently, it is important to examine if these results are caused by the co-movement and spillover between ADR's and the United States stock market. As such, we employ a five variable VAR (r , op , ip , rsr_{us} , rar) where rsr_{us} is the real stock returns of the United States stock market, following Park and Ratti (2008), to examine if there is a spillover effect from the U.S. stock market to the real ADR indices' returns¹³.

Table 6 provides the results of the spillover effect for the full sample time period. There does not appear to be a spillover effect as all twelve countries continue to show a positive and significant response to world oil price shock at the 1% level. Furthermore, after directly accounting for exchange rates in the national real oil price, only Brazil does not show a

¹³ rsr_{us} is calculated the same as rar which is stock returns minus the first log difference of CPI. The S&P 500 is used as the index for the United States stock market.

significant response while six of the countries show significance at the 1% level, with South Korea and United Kingdom at the 5% level and Germany and India at the 10% level.

[Insert Table 6]

Table 7 displays the results from the split sample to examine the differences in the pre-crisis and post-crisis time periods after accounting for the spillover effect of the United States stock market. The results for the response of ADR returns due to the shock to world oil prices during the pre-crisis time period show that France, Japan, Mexico, and the United Kingdom no longer show a positive and significant response to oil price shocks as compared to the full sample time period. This leaves China, Italy, Norway, and South Korea with positive and significant results. Even though France's ADR index is highly composed of oil ADR's, the index lacks significance demonstrating that the United States stock market may be driving their ADR returns. Similarly, the puzzling result of Japan being positive and significant when not controlling for the spillover effect is now gone; however, South Korea still shows a positive and significant response. Furthermore, after controlling for spillover effect from the U.S. stock market, oil exporting countries such as Russia and the United Kingdom are no longer significant, justifying the fact that their ADR returns are positively correlated to the United States stock market. Table 7 shows that Germany is the lone country that displays a negative and significant response to world oil prices. Therefore, if investors are looking to diversify their portfolio to oil price shocks, German ADR's may be their best option; however, this only applies for the pre-crisis time period.

When examining the ADR returns response due to a shock in national real oil price during the pre-crisis period, only China shows a positive and significant result, whereas Brazil and Germany show negative and significant responses. Overall, the results show that if investors

account for the co-movement between ADR's and the United States stock market, they do not need to account for oil price shocks during the pre-crisis time period.

Table 7 shows that when examining the post crisis time period with the spillover effects, all countries ADR returns except Brazil, India, South Korea, and United Kingdom show a positive and significant response to world oil price shocks. This shows that oil price shocks have a direct impact on ADR returns that cannot be explained by the co-movement of the United States stock market during the post-crisis time period. Given the research that shows that the United States has a positive relationship to oil prices in the post crisis period, this implies that even accounting for such relationship, and controlling for the spillover effect, ADR's still have a positive response to oil price shocks signifying the importance of oil price shocks on ADR returns. Therefore, investors that are looking to diversify against oil price shocks in the international market may look towards Brazil, India, South Korea, or the United Kingdom ADR's instead of ADR's from countries such as Germany and Japan during the post crisis time period.

[Insert Table 7]

Table 7 shows that when examining national real oil price, Brazil and Russia both show a negative response to oil price shocks. This is puzzling given that these are both oil exporting countries. However, the impact of the United States stock market must be causing such occurrence. Nevertheless, China, Japan, Mexico, and Norway still show a positive and significant response to shocks in national real oil price shocks.

Therefore, these results imply that after the financial crisis, something other than the United States stock market alone is causing the positive responses during the post-crisis time

period. This suggests that in the post-crisis time period investors can no longer disregard oil price shocks when investing in ADR stocks, even after controlling for the co-movement of the United States stock market. Furthermore, the results show that investing in ADR's from oil importing countries, such as Germany or Japan, may not help diversify a portfolio against oil price shocks.

Blanchard and Gali (2013) examine the different impacts of oil price shocks between the 1970's and the 2000's. They find that in the 1970's large increases in oil price are related to sharp declines in the output of countries; however, between 2000 and 2007 the relationship is much weaker. They identify the change in structure of the economy which could cause this different relationship can be tied to vanishing wage indexation and improvement in the credibility of monetary policy. Similarly, Hamilton (working paper) finds that the 2007-2008 oil price shock is caused by strong demand straining stagnant world production as previous oil price shocks are primarily caused by disruptions in supply. Therefore, the positive responses to oil price shocks might be explained by the differences in economic structure and the causes of the shock.

Furthermore, an additional explanation is that when commodities, such as oil, had a sharp downturn during the financial crisis countries like Russia, Venezuela, Brazil and others that rely highly on their ability to export oil to keep their economy going, may not be able to repay their debt which could cause a new emerging market debt crisis. This crisis may have a spillover effect to other markets resulting in correlated movement of oil prices and stock markets. Similarly, as oil prices decrease, the risk of oil company debt in both developed and emerging countries increases which can cause another crisis. A third potential explanation lies in global demand. If global demand for goods is lower, both the price of oil and corporate profits will

drop. Therefore, these potential issues may cause investors to use oil price as a proxy for investor sentiment.

4.5. Alternative VAR specifications discussion

As a robustness check the impact of an oil price shock on real adr returns from alternative VAR models are analyzed. The first alternative model, VAR(oil price shock, r, ip, rar), places oil price shocks ahead of the interest rate in order of the variables and the second alternative model, VAR(oil price shock, r, ip, rsr_{us}, rar) has five variables with the introduction of U.S. stock market spillover (rsr_{us}) into the basic model. The emphasis is on whether the outcomes regarding the impact of linear and non-linear measures of world real oil price and national real oil price on real stock returns for the basic VAR model carry over for alternative specifications of the VAR. The results from alternative VAR specifications are reported in Appendix (Table A1 and A2).

Table A1 presents an alternative specification results for the impact on real adr returns of a one standard deviation increase in world real oil price and national real oil price, measured by op, sop, and nopi, from the model VAR(oil price shock, r, ip, rar). The results are essentially the same as that for the basic VAR shown in Table 4, except in some cases where the impulse response function have higher statistical significance while comparing with the previous specification. For example, India and Mexico statistical significance increased from 90% to 95% level, while considering national real oil price, for shock to nopi specification. However, the positivity (or negativity) of response remains same for all countries in all specifications. Besides that, Germany shows positive and statistical significant response at 90% level in shock to nopi specification, while considering world real oil price model. With an alternative VAR specification we observe that the impact of oil price shock seems to pronounce more, however the pronouncement is limited to increment in statistical power only.

For the VAR specification with U.S. stock market spillover, VAR(oil price shock, r, ip, rsr_{us} , rar), results for linear and non-linear (sop and nopi) world real oil price and national real oil price shocks on real adr returns are presented in Table A2. While comparing alternative Table A2 results to Table 6, we find that results are very similar in majority of countries except in few cases, e.g., India where the statistical power increased from 95% to 99% level, while considering world real oil price VAR model. However, the positive (or negative) impacts of oil price shocks on real adr returns are same as in Table 6. Furthermore, few oil exporting countries like: Mexico and Russia shows improved statistical power while predicting alternative model with nopi specification. Thus, in overall we conclude that the finding of statistically significant impact of oil price shock on real adr returns is not sensitive to reasonable changes in the VAR specification.

4.6 Asymmetric Effects of Oil Price Shocks

Research finds that oil price increases have a greater impact than oil price decreases on macroeconomic aggregates in the United States (Mork, 1989; Hooker, 1996; Davis and Haltiwanger, 2001; Balke et al., 2002), Japan (Lee et al., 2001), Canada (Huang et al., 2005) and most European countries (Cunado and Perez de Gracia, 2003). However, Kilian (2008a) finds no evidence of asymmetric response to oil price shocks in the United States, and Park and Ratti (2008) find no evidence in European countries. To eliminate the possibility that our results are being caused by asymmetric effects, we follow Park and Ratti (2008) and separate the first log difference in oil price into positive and negative price changes. Both positive and negative oil price changes are examined in a linear and scaled oil price shock models given by:

$$opp_t = \max(0, op_t) \text{ and } opn_t = \min(0, op_t) \quad (5)$$

$$sopp_t = \max(0, sop_t) \text{ and } sopn_t = \min(0, sop_t) \quad (6)$$

Furthermore, a five variable VAR is estimated including both the positive and negative oil price shock: VAR(r, opp, opn, ip, rar) and VAR(r, sopp, sopn, ip, rar). A chi-square (χ^2) test is implemented to test for asymmetry with the null hypothesis being that the coefficients for the positive and negative oil price shocks will be equal. The equation can be written as:

$$rar_t = \alpha_0 + \sum_{i=1}^2 \alpha_1 r_{t-i} + \sum_{i=1}^2 \alpha_2 OP_{t-i} + \sum_{i=1}^2 \alpha_3 ON_{t-i} + \sum_{i=1}^2 \alpha_4 ip_{t-i} + \sum_{i=1}^2 \alpha_5 rar_{t-i} + u_t \quad (7)$$

Where OP_{t-i} and ON_{t-i} are the positive and negative world real oil price shocks (as either linear or scaled). Chi-square (χ^2) test results of the null hypothesis $H_0 : \alpha_{2i} = \alpha_{3i}, i = 1, 2$

[Insert Table 8]

Table 8 provides the results obtained by carrying out the test of pair-wise equality of the coefficients on positive and negative oil price shocks. When examining the full sample time period, there are no significant figures showing that there is no asymmetry in the returns of oil price shocks. Furthermore, the results for the pre-crisis time period show that France and Norway reject the null hypothesis of symmetry at the 1% and 5% levels, respectively. Additionally, when examining the post-crisis time period, Japan and Norway show asymmetric responses to linear oil price shocks at the 10% level. Thus, we conclude that there is no evidence for asymmetric effects of oil price shocks on ADR returns, providing robustness to our previous findings.

4.7. Oil Price Volatility

4.7.1 Definition of Oil Price Volatility

Finally, we examine the impact of oil price volatility on ADR returns. Increased volatility in oil price increases uncertainty about product demand and future return on investment, which then affects the present value of future cash flows. Bernanke (1983) and Pindyck (1991) claim that as uncertainty increases, firms may delay future investment in capital equipment. Jo (2014) uses a realized volatility measure on oil prices by developing a stochastic volatility measure and finds a negative impact of oil volatility on world industrial production and if oil price volatility doubles, there is a 0.3 percentage point decline in world industrial production. Additionally, Elder and Serletis (2010) use GARCH-in-Mean errors to measure oil price volatility as the conditional standard deviation of forecasting error on oil prices. Using a VAR model, their results show that oil volatility has an inverse relationship to investment, durable consumption, and GDP.

This study follows Merton (1980), Andersen et al. (2003), and Park and Ratti (2008) to develop a measure of oil price volatility using daily oil price data. Monthly oil price volatility is constructed by the sum of squared first log differences in daily oil price following:

$$Vol_t = \sum_{d=1}^{s_t} (\text{Log}(P_{t,d+1} / P_{t,d}) / \sqrt{s_t})^2 \quad (8)$$

Where $P_{t,d}$ is the price of oil on day d of month t , and s_t is the number of trading days in month t .

4.7.2 Effect of Oil Price Volatility

Table 9 provides the results for the impact of oil price volatility on ADR returns for the full sample, pre-crisis and post-crisis time period. In the first model, volatility of oil price (Vol_t) replaces linear oil price shock in the basic VAR model: VAR (r, Vol, ip, rar). Panel A shows that in the full sample period, all countries ADR returns have a negative and statistically significant

response to oil price volatility at the 5% level. In contrast, Panel B shows that during the pre-crisis period India, Italy, and Norway have a negative and significant response at 5% level and South Korea at the 10% level. However, Panel C shows that during the post-crisis period, all countries have a negative and significant response to oil price volatility at the 5% level except for Brazil, China, and South Korea, who are significant at the 10% level. This result implies that volatility is more important to real ADR returns in the post-financial crisis time period compared to the pre-financial crisis time period.

[Insert Table 9]

Model 2 includes both the oil price volatility and oil price variable in the VAR model: VAR (r, op, Vol, ip, rar). Panel A shows that for Model 2 the ADR response to a shock due to oil price volatility is negative and statistically significant at 5% level for all countries, except Brazil and China. Panel B shows that fewer countries' ADR returns have a response to oil price volatility shock, as the UK is positive and significant at 5% level, while India and Italy are negative and significant at 5% level, and South Korea and Norway are negative and significant at 10% level. Finally, Panel C shows that the response of ADR returns due to oil price volatility drastically changes in comparison to pre-crisis period. Countries such as Brazil, China, Italy, Mexico, Norway, and South Korea are negative and statistically significant at 5% level, while Germany, Russia, and UK are negative and significant at 10% level. Thus, again showing oil price volatility is more important in the post financial crisis time period.

Furthermore, the shock due to linear world oil price is reported in all time periods for model 2. Panel A shows a similar result to previous results as all twelve countries' ADR returns show a positive and significant response to oil price shocks at the 1% level even with the inclusion of oil price volatility. Panel B shows that China, France, Italy, Japan, Mexico, Norway,

South Korea, and the United Kingdom have a positive and significant response to oil price shocks. Furthermore, Panel C shows that all countries' ADR returns demonstrate a positive and significant response to oil price shocks, except for India. The accumulated results in this section show that the impacts of a shock to real world oil price on real ADR returns are robust to the inclusion of a measure of oil price uncertainty in the model.

4.8 Variance Decomposition

Table 10 reports the forecast error variance decomposition (FEVD) of real ADR returns due to interest rate and oil price shocks. Each percentage represents how much of the unexpected changes of real ADR returns are explained by the variables indicated over a 24-month horizon. Reported results are based on two models, the first uses the linear world real oil price (op) and the second uses the nonlinear scaled world oil price shock (SOP) specifications of order VAR (r, op, ip, rar) or VAR (r, SOP, ip, rar).

[Insert Table 10]

For full sample, the contribution of oil price shock to the ADR returns ranges from 9.6% for India to 24.6% for Norway in case of linear oil price shock. All twelve countries examined in this study are statistically significant at 1% level for real oil price shock, except India which is significant at 5% level. The analysis for oil price shock reveals a different story during the pre-crisis time period, as the results show that the variation of ADR return response to oil price shock is in between 1.5% for the Brazil and 12.3% for Norway; only Norway and Italy are statistically significant at 5% and 10% levels, respectively. Furthermore, Table 10 shows that during post-crisis period, ADR return response to oil price shock is drastically different as it ranges from

5.3% for the India and 27.8% for the Norway with all countries being statistically significant at the 5% level, except China, Japan, Mexico, and South Korea.

Examination of the non-linear scaled oil price shock (SOP) in full sample period shows a similar pattern as all countries show that oil price shocks provide statistically significant amount of variation to the ADR returns. During pre-crisis period, Italy and Norway have a statistically significant amount of the variance in their ADR returns due to oil. Finally, during the post-crisis time period seven of the twelve countries 'ADR returns show that oil price shocks make up a statistically significant amount of their variation.

The variance decomposition suggests that oil price shocks are a significant source of monthly variation in real ADR returns and are a prime factor when considering real ADR returns. Similar to our previous findings, this effect is different when comparing the two time periods, thus providing robustness to the finding that since the financial crisis, oil price shocks are an essential element that needs to be considered when examining ADR returns. These results provide important information for investors looking to hedge against oil price shocks. While oil price is a significant source of variation among ADR returns, investors looking to hedge against oil price shocks could invest in countries that have a lower variance, opposed to investing in ADR's from Norway. We additionally report FEVD results with an alternative specification, where oil price shock enters VAR equation before the country specific interest rate, $VAR(op, r, ip, rar)$.¹⁴ In few cases increment in the impact of oil price shock and decrement in the impact of interest rate is observed but by very small percentage. For example, Brazil, China, Norway, and Russia shows increment in impact from oil price shock when we use alternative FEVD specifications. However, the range of increment of impact of oil price shock (while comparing to

¹⁴This result is reported in Appendix A3. To maintain brevity sub-samples periods are not reported for alternative specifications. However, it is very similar to reported FEVD specifications.

prior specification) is significantly small, i.e., between 2.4% for Russia to 0.2% for Norway. Furthermore, when we consider the model with scaled oil price the range of increment of impact of scaled oil price shock on stock market varies between 2.1% to 0.1% for Russia and Mexico, respectively. Thus, we conclude that FEVD findings from prior and alternative models are not significantly different.

5. Conclusion

There is a vast amount of literature across many countries linking the effects of oil price shocks and stock market returns, which implies that such relationships should hold between oil price shocks and ADR returns. Therefore, we estimate the effects of oil price shocks on the real ADR returns of twelve emerging and developed nations over 1999.01 – 2014.12 using a multivariate VAR analysis.

The main finding is that oil price shocks have a positive and statistically significant influence on real ADR returns on all countries examined during the full sample period. This result is robust to including a spillover effect of the United States stock market on ADR returns, as well as reasonable changes in the VAR model. Overall, our results demonstrate the importance of oil price shocks on ADR returns that investors need to be aware of, even in oil importing countries.

The full sample of the variance decomposition reveals that all twelve countries ADR returns are significantly impacted by oil price ranging from 9.6% to 24.6% with the median of 13.3%. The fact that the variance decomposition results show such a drastic difference between pre and post-crisis figures is likely due to changes in dynamic relation between oil price and stock market after 2007 – 2008 crisis.

The results from the pre-crisis time period show that after controlling for the spillover effect of the United States stock market, four of the twelve countries show a positive response to world oil price shock and one to national oil price shocks. However, when examining the post-crisis period, all countries except Brazil, India, South Korea, and the United Kingdom show a positive and significant response to world oil price shock after controlling for the spillover effect. Additionally, the variance decomposition in the post-crisis time periods shows that China, India, Japan, and South Korea do not have a significant amount of their monthly ADR returns due to oil price shocks. Therefore, investors may look to countries that do not have a significant response to oil price shocks or a significant amount of their returns due to oil prices to try to internationally diversify against oil price shocks.

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References

- [1] Alaganar, V. T., & Bhar, R. (2002). Information and volatility linkage under external shocks: Evidence from dually listed Australian stocks. *International review of financial analysis*, 12(1), 59-71.
- [2] Andersen, T. G., Bollerslev, T., Diebold, F. X., & Labys, P. (2003). Modeling and forecasting realized volatility. *Econometrica*, 71(2), 579-625.
- [3] Balke, N. S., Brown, S. P., & Yücel, M. K. (2002). Oil price shocks and the US economy: Where does the asymmetry originate? *The Energy Journal*, 27-52.
- [4] Basher, S. A., Haug, A. A., & Sadorsky, P. (2012). Oil prices, exchange rates and emerging stock markets. *Energy Economics*, 34(1), 227-240.
- [5] Bernanke, B. S. (1983). Non-monetary effects of the financial crisis in the propagation of the Great Depression.
- [6] Blanchard, O. J., & Riggi, M. (2013). Why are the 2000s so different from the 1970s? A structural interpretation of changes in the macroeconomic effects of oil prices. *Journal of the European Economic Association*, 11(5), 1032-1052.
- [7] Cavalcanti, T., & Jalles, J. T. (2013). Macroeconomic effects of oil price shocks in Brazil and in the United States. *Applied Energy*, 104, 475-486.
- [8] Chen, J., Tse, Y., & Williams, M. (2009). Trading location and equity returns: Evidence from US trading of British cross-listed firms. *Journal of International Financial Markets, Institutions and Money*, 19(5), 729-741.
- [9] Chen, S. S. (2010). Do higher oil prices push the stock market into bear territory?. *Energy Economics*, 32(2), 490-495.
- [10] Cong, R. G., Wei, Y. M., Jiao, J. L., & Fan, Y. (2008). Relationships between oil price shocks and stock market: An empirical analysis from China. *Energy Policy*, 36(9), 3544-3553.
- [11] Cuñado, J., & Perez de Gracia, F. (2003). Do oil price shocks matter? Evidence for some European countries. *Energy Economics*, 25(2), 137-154.
- [12] Cunado, J., & Perez de Gracia, F. (2014). Oil price shocks and stock market returns: Evidence for some European countries. *Energy Economics*, 42, 365-377.
- [13] Davis, S. J., & Haltiwanger, J. (2001). Sectoral job creation and destruction responses to oil price changes. *Journal of monetary economics*, 48(3), 465-512.
- [14] Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica: Journal of the Econometric Society*, 1057-1072.
- [15] Elder, J., & Serletis, A. (2010). Oil price uncertainty. *Journal of Money, Credit and Banking*, 42(6), 1237-1259.

- [16] Engle, R. F., & Yoo, B. S. (1987). Forecasting and testing in co-integrated systems. *Journal of econometrics*, 35(1), 143-159.
- [17] Fang, C. R., & You, S. Y. (2014). The impact of oil price shocks on the large emerging countries' stock prices: Evidence from China, India and Russia. *International Review of Economics & Finance*, 29, 330-338.
- [18] Gupta, R., Yuan, T., & Roca, E. (2016). Linkages between the ADR market and home country macroeconomic fundamentals: Evidence in the context of the BRICs. *International Review of Financial Analysis*, 45, 230-239.
- [19] Hamilton, J. D. (1983). Oil and the macroeconomy since World War II. *The Journal of Political Economy*, 228-248.
- [20] Hamilton, J. D. (1996). This is what happened to the oil price-macroeconomy relationship. *Journal of Monetary Economics*, 38(2), 215-220.
- [21] Hamilton, J. D. (2009). *Causes and Consequences of the Oil Shock of 2007-08* (No. w15002). National Bureau of Economic Research.
- [22] Hauser, S., Tanchuma, Y., & Yaari, U. (1998). International transfer of pricing information between dually listed stocks. *Journal of Financial Research*, 21(2), 139-157.
- [23] He, H., & Yang, J. (2012). Day and night returns of Chinese ADRs. *Journal of Banking & Finance*, 36(10), 2795-2803.
- [24] Hooker, M. A. (1996). This is what happened to the oil price-macroeconomy relationship: Reply. *Journal of Monetary Economics*, 38(2), 221-222.
- [25] Huang, B. N., Hwang, M. J., & Peng, H. P. (2005). The asymmetry of the impact of oil price shocks on economic activities: an application of the multivariate threshold model. *Energy Economics*, 27(3), 455-476.
- [26] Jiménez-Rodríguez, R., & Sánchez, M. (2005). Oil price shocks and real GDP growth: empirical evidence for some OECD countries. *Applied economics*, 37(2), 201-228.
- [27] Jo, S. (2014). The effects of oil price uncertainty on global real economic activity. *Journal of Money, Credit and Banking*, 46(6), 1213-1235.
- [28] Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration—with applications to the demand for money. *Oxford Bulletin of Economics and statistics*, 52(2), 169-210.
- [29] Jones, C. M., & Kaul, G. (1996). Oil and the stock markets. *The Journal of Finance*, 51(2), 463-491.
- [30] Kilian, L. (2008a). The economic effects of energy price shocks. *Journal of Economic Literature* 46: 871-919.

- [31] Lee, B. R., Lee, K., & Ratti, R. A. (2001). Monetary policy, oil price shocks, and the Japanese economy. *Japan and the World Economy*, 13(3), 321-349.
- [32] Lee, J., & Strazicich, M. C. (2001). Break point estimation and spurious rejections with endogenous unit root tests. *Oxford Bulletin of Economics and Statistics*, 63(5), 535-558.
- [33] Lee, K., Ni, S., & Ratti, R. A. (1995). Oil shocks and the macroeconomy: the role of price variability. *The Energy Journal*, 39-56.
- [34] Merton, R. C. (1980). On estimating the expected return on the market: An exploratory investigation. *Journal of financial economics*, 8(4), 323-361.
- [35] Mollick, A. V., & Assefa, T. A. (2013). US stock returns and oil prices: The tale from daily data and the 2008–2009 financial crisis. *Energy Economics*, 36, 1-18.
- [36] Mork, K. A. (1989). Oil and the macroeconomy when prices go up and down: an extension of Hamilton's results. *Journal of Political Economy*, 97(3), 740-744.
- [37] Naka, A., & Tufte, D. (1997). Examining impulse response functions in cointegrated systems. *Applied Economics*, 29(12), 1593-1603.
- [38] Nandha, M., & Faff, R. (2008). Does oil move equity prices? A global view. *Energy Economics*, 30(3), 986-997.
- [39] Park, J., & Ratti, R. A. (2008). Oil price shocks and stock markets in the US and 13 European countries. *Energy economics*, 30(5), 2587-2608.
- [40] Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, 75(2), 335-346.
- [41] Pindyck, R. S. (1991). Irreversibility, uncertainty, and investment. *Journal of Economic Literature*. 29(3), 1210-1248.
- [42] Sadorsky, P. (1999). Oil price shocks and stock market activity. *Energy Economics*, 21(5), 449-469.
- [43] Scholtens, B., & Yurtsever, C. (2012). Oil price shocks and European industries. *Energy Economics*, 34(4), 1287-1295.
- [44] Tsai, C. L. (2015). How do US stock returns respond differently to oil price shocks pre-crisis, within the financial crisis, and post-crisis?. *Energy Economics*, 50, 47-62.
- [45] Wang, S. S., Rui, O. M., & Firth, M. (2002). Return and volatility behavior of dually-traded stocks: the case of Hong Kong. *Journal of International Money and Finance*, 21(2), 265-293.
- [46] Wang, Y., Wu, C., & Yang, L. (2013). Oil price shocks and stock market activities: Evidence from oil-importing and oil-exporting countries. *Journal of Comparative Economics*, 41(4), 1220-1239.

Manuscript Title:
Oil Price Shocks and American Depositary Receipt Stock Returns

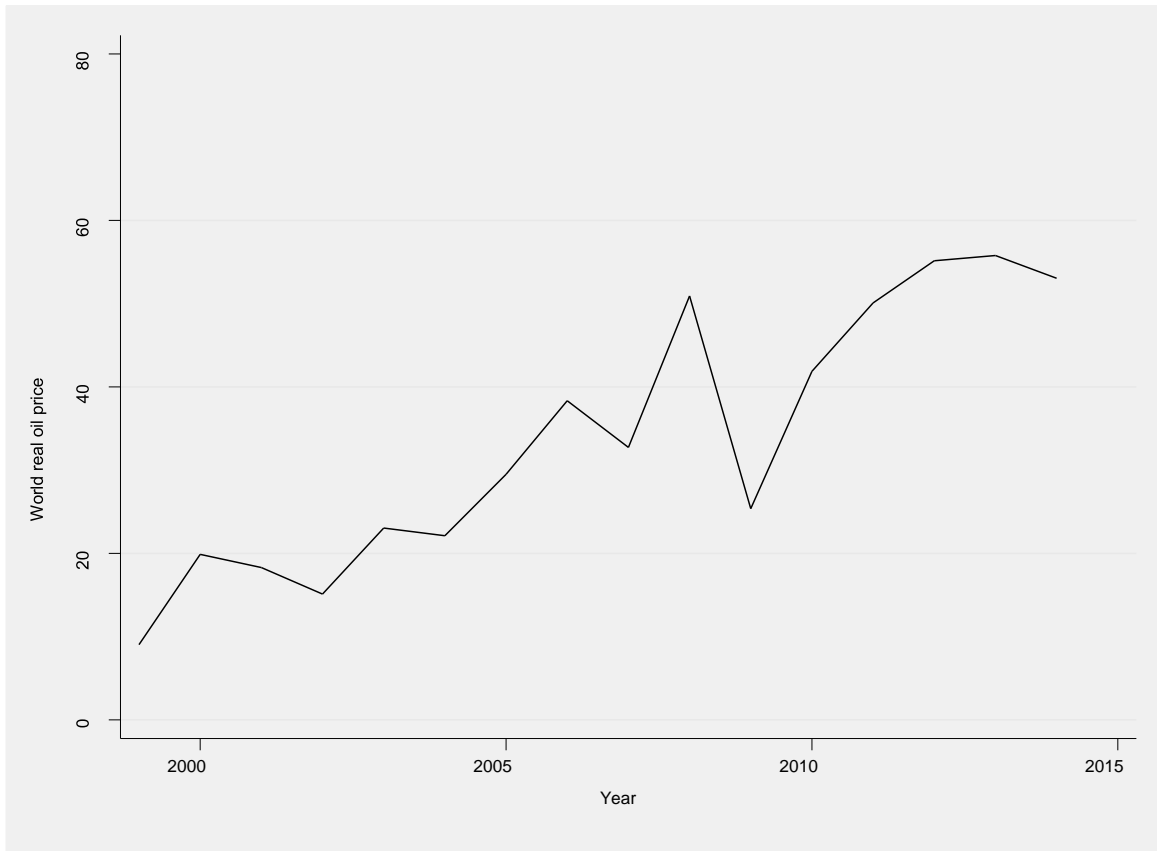


Figure 1. World real oil price calculated by UK Brent in United States dollars divided by United States Producer Price Index for all commodities (PPI 1982 = 100)

Oil Price Shocks and American Depository Receipt Stock Returns

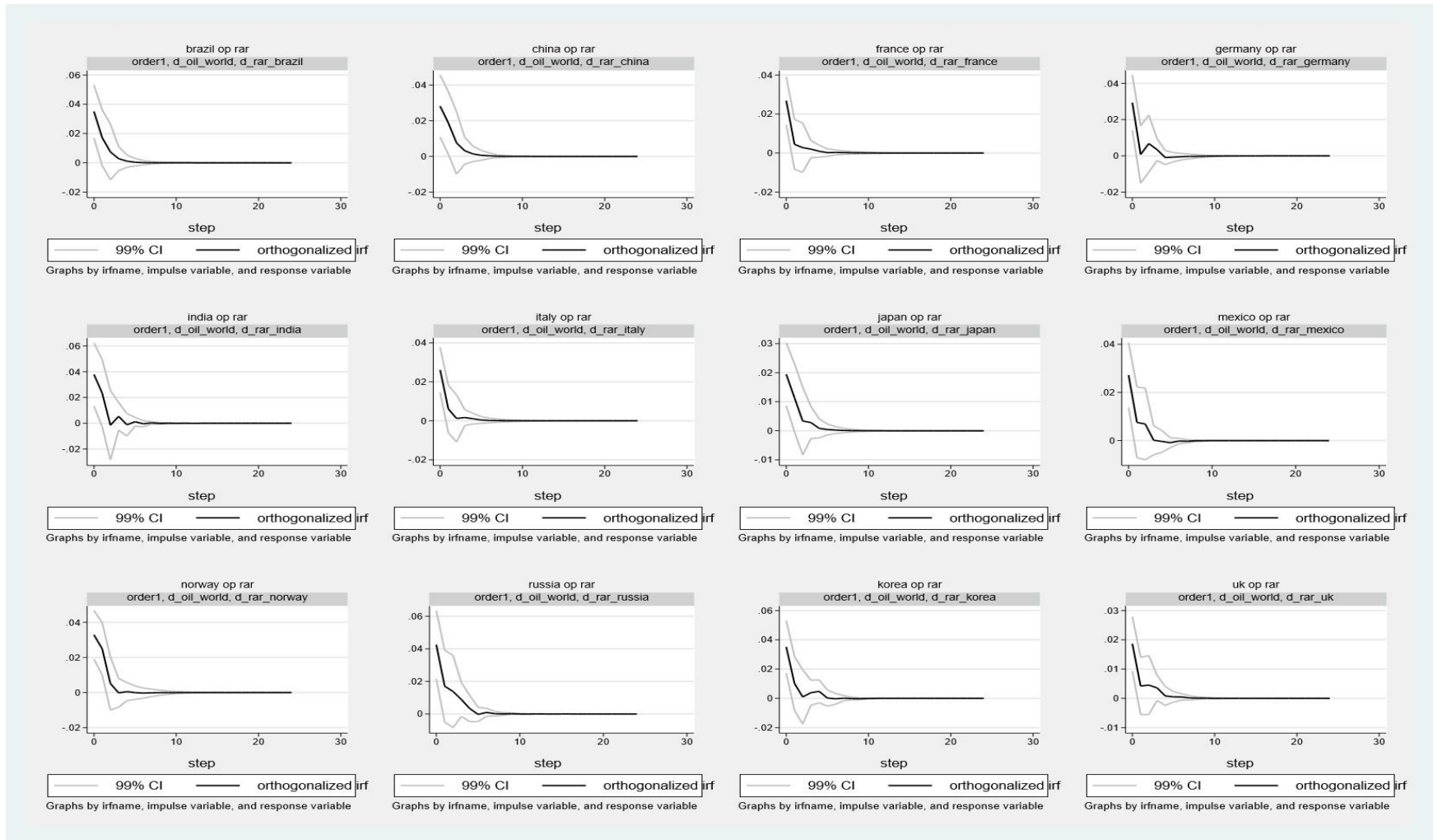


Figure 2. Orthogonalized impulse responses of real ADR returns to linear world real oil price shocks in VAR (r, op, ip, rar). Figures are first row- Brazil, China, France, Germany; second row-India, Italy, Japan, Mexico; third row- Norway, Russia, South Korea, United Kingdom

Table 1**Crude oil net exports from 1999 - 2012**

This table provides the crude net exports (imports - exports) for all countries listen from 1999 - 2012. Data collected from U.S. Energy Information Administration website.

Volume of crude oil net exports (thousand barrels per day)														
Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brazil	-482	-379	-399	-147	-109	-220	-109	2	-9	15	151	292	272	151
China	-601	-1195	-1202	-1242	-1643	-2339	-2438	-2778	-3186	-3493	-3978	-4693	-4875	-3978
France	-1649	-1701	-1720	-1625	-1735	-1733	-1714	-1666	-1634	-1689	-1459	-1305	-1304	-1158
Germany	-2086	-2050	-2126	-2114	-2147	-2207	-2266	-2211	-2149	-2127	-1978	-1869	-1820	-1884
India	-827	-1337	-1574	-1610	-1789	-1912	-1938	-2156	-2412	-2557	-3185	-3267	-3355	-3185
Italy	-1776	-1826	-1838	-1807	-1848	-1872	-1912	-1866	-1913	-1772	-1625	-1703	-1559	-1493
Japan	-4350	-4350	-4303	-4111	-4345	-4236	-4304	-4249	-4192	-4225	-3724	-3755	-3644	-3724
Mexico	1620	1756	1778	1842	2099	2089	2030	1967	1781	1490	1292	1395	1357	1270
Norway	2832	3052	3182	2984	2764	2716	2361	2205	1992	1684	1781	1617	1434	1296
Russia	2557	3035	3260	3831	4405	5127	5149	5060	5118	5072	4855	4857	4879	4835
South Korea	-2429	-2473	-2393	-2179	-2210	-2305	-2369	-2439	-2418	-2355	-2343	-2392	-2526	-2567
United Kingdom	1083	968	782	659	454	98	-21	-114	-77	-192	-169	-241	-486	-512

Table 2: ADF and PP Unit Root Tests

This table shows the Augmented Dickey Fuller (ADF) and Phillips - Perron (PP) unit root tests for the full sample (January 1999 - December 2014). Real oil price is measured as the first log difference of oil price adjusted by exchange rate and CPI for each country. World oil price is the price of UK Brent in \$USD deflated by United States PPI. Interest rate and industrial production are measured in first log difference. Real adr returns are measured as the first log difference of adr index price minus first log difference in consumer price index. The numbers of lags in all tests are selected according to Akaike Information Criteria (AIC), although further analysis shows that the results are robust regardless of the number of lags chosen. All tests are run with constant and with constant and trend. The results are shown with constant. All variables are in log level. Significance is shown at the 5% (b) and 1% (a) level.

Country	Real Oil Price				Interest Rates			
	Log Level		First Log Difference		Log Level		First Log Difference	
	ADF	PP	ADF	PP	ADF	PP	ADF	PP
Brazil	-3.593 ^a	-4.322 ^a	-11.974 ^a	-11.974 ^a	-1.845	-2.247	-8.224 ^a	-7.111 ^a
China	-2.539	-2.727	-8.072 ^a	-10.628 ^a	-2.787	-2.530	-13.257 ^a	-13.257 ^a
France	-2.909 ^b	-3.209 ^b	-8.469 ^a	-11.351 ^a	-0.260	-0.870	-4.442 ^a	-6.904 ^a
Germany	-2.902 ^b	-3.203 ^b	-8.442 ^a	-11.304 ^a	-0.260	0.870	-4.442 ^a	-6.904 ^a
India	-2.964 ^b	-8.577 ^a	-3.151 ^b	-11.233	-1.121	-1.559	-7.166 ^a	-9.860 ^a
Italy	-2.945 ^b	-3.234 ^b	-8.491 ^a	-11.377 ^a	-0.260	0.870	-4.442 ^a	-6.904 ^a
Japan	-2.497	-2.725	-8.144 ^a	-10.869 ^a	-2.339	-2.427	-8.310 ^a	-10.193 ^a
Mexico	-2.257	-2.324	-9.358 ^a	-11.799 ^a	-2.222	-2.536	-12.200 ^a	-12.200 ^a
Norway	-2.839	-3.119 ^b	-9.006 ^a	-11.769 ^a	-1.236	-1.037	-5.779 ^a	-6.085 ^a
Russia	-3.471 ^b	-3.578 ^a	-12.720 ^a	-12.720 ^a	-2.966 ^b	-3.988 ^a	-6.863 ^a	-16.145 ^a
South Korea	-3.125 ^b	-2.867	-12.004 ^a	-12.007 ^a	-1.214	-1.273	-6.753 ^a	-6.989 ^a
United Kingdom	-2.638	-2.846	-8.723 ^a	-11.890 ^a	-0.681	-0.547	-5.608 ^a	-11.992 ^a
World	-1.676	-1.425	-8.975 ^a	-12.097 ^a				
Country	Real Industrial Production				Real ADR Returns			
	Log Level		First Log Difference		First Log Difference			
	ADF	PP	ADF	PP	ADF	PP		
Brazil	-2.111	-1.955	-14.327 ^a	-14.327 ^a	-8.649 ^a	-12.178 ^a		
China	-2.246	-6.843 ^a	-9.114 ^a	-30.956 ^a	-13.177 ^a	-13.177 ^a		
France	-1.491	-1.204	-5.351 ^a	-17.096 ^a	-13.669 ^a	-13.669 ^a		
Germany	-1.883	-1.498	-4.883 ^a	-14.659 ^a	-13.112 ^a	-13.112 ^a		
India	-1.499	-1.153	-12.144 ^a	-19.665 ^a	-5.536 ^a	-15.051 ^a		
Italy	-1.275	-0.638	-3.903 ^a	-15.018 ^a	-14.035 ^a	-14.035 ^a		
Japan	-2.877	-2.669	-7.228 ^a	-11.562 ^a	-5.733 ^a	-12.791 ^a		
Mexico	-0.807	-0.772	-4.565 ^a	-16.048 ^a	-13.372 ^a	-13.372 ^a		
Norway	0.317	-0.023	-9.084 ^a	-19.864 ^a	-13.314 ^a	-13.314 ^a		
Russia	-1.039	-1.616	-10.951 ^a	-19.486 ^a	-8.164 ^a	-12.143 ^a		
South Korea	-1.976	-2.209	-13.458 ^a	-13.458 ^a	-6.587 ^a	-13.984 ^a		
United Kingdom	-1.618	-1.800	-10.636 ^a	-17.746 ^a	-13.373 ^a	-13.373 ^a		

Table 3**Johansen and Joselius Cointegration Tests (Variables: Oil Prices, Industrial Production, and Interest Rates)**

This table presents the Johansen and Joselius cointegration test with all variables in log level for the full sample (January 1999 - December 2014). Two models are used. Model (1) includes an intercept and model (2) uses an intercept and linear trend. R denotes the number of cointegrating vectors. Rejection of the null hypothesis is signified at 5% (b) and 1% (a) level. The lag lengths in all tests are selected using Akaike Information Criteria (AIC).

		$r = 0$		$r \leq 1$		$r \leq 2$	
Panel A: World Oil Prices		(1)	(2)	(1)	(2)	(1)	(2)
Brazil	Trace Statistic	35.299 ^b	36.497	14.225	14.554	2.391	2.568
	Max-Eigen Stat	21.074	21.943	11.834	11.986	2.391	2.568
China	Trace Statistic	34.126	40.388	13.467	19.258	2.896	6.353
	Max-Eigen Stat	20.659	21.130	10.571	12.906	2.896	6.353
France	Trace Statistic	32.608	41.109	17.673	18.799	4.657	5.395
	Max-Eigen Stat	14.935	22.310	13.016	13.403	4.657	5.395
Germany	Trace Statistic	23.025	33.760	11.843	16.233	4.483	5.676
	Max-Eigen Stat	11.182	17.527	7.360	10.557	4.483	5.676
India	Trace Statistic	47.057 ^a	32.506	20.327 ^b	15.004	4.657	3.789
	Max-Eigen Stat	26.730 ^a	17.501	15.670	11.215	4.657	3.789
Italy	Trace Statistic	32.956	39.189	16.889	16.701	4.389	6.905
	Max-Eigen Stat	16.067	22.488	12.500	9.796	4.389	6.905
Japan	Trace Statistic	27.239	31.665	12.372	16.910	4.087	4.432
	Max-Eigen Stat	14.867	14.755	8.285	12.478	4.087	4.432
Mexico	Trace Statistic	26.371	32.812	15.035	12.760	6.104	5.612
	Max-Eigen Stat	11.336	20.052	8.931	7.149	6.104	5.612
Norway	Trace Statistic	34.809	39.070	13.852	19.462	4.820	6.898
	Max-Eigen Stat	20.957	19.607	9.032	12.564	4.820	6.898
Russia	Trace Statistic	30.925	36.412	13.024	18.380	5.128	7.176
	Max-Eigen Stat	17.901	18.031	7.896	11.204	5.128	7.176
South Korea	Trace Statistic	47.54 ^a	37.588	19.424	21.209	7.215	7.901
	Max-Eigen Stat	28.116 ^a	16.379	12.209	13.308	7.215	7.901
United Kingdom	Trace Statistic	32.355	27.756	14.752	13.619	5.454	4.688
	Max-Eigen Stat	17.603	14.137	9.298	8.931	5.454	4.688

Table 3 Continued.		r = 0		r ≤ 1		r ≤ 2	
Panel B: National Oil Prices		(1)	(2)	(1)	(2)	(1)	(2)
Brazil	Trace Statistic	29.243	30.417	13.336	14.461	3.050	3.162
	Max-Eigen Stat	15.906	15.956	10.286	11.299	3.050	3.162
China	Trace Statistic	33.792	40.876	13.370	19.614	3.083	6.814
	Max-Eigen Stat	20.422	21.262	10.287	12.799	3.083	6.814
France	Trace Statistic	33.497	36.988	17.771	18.345	4.868	6.371
	Max-Eigen Stat	15.726	18.643	12.903	11.974	4.868	6.371
Germany	Trace Statistic	27.154	32.333	13.255	16.941	4.385	5.336
	Max-Eigen Stat	13.899	15.392	8.870	11.605	4.385	5.336
India	Trace Statistic	45.767 ^a	32.015	19.475	15.427	4.898	3.918
	Max-Eigen Stat	26.291 ^a	16.588	14.577	11.509	4.898	3.918
Italy	Trace Statistic	35.076	36.943	17.615	16.360	4.256	5.994
	Max-Eigen Stat	17.461	20.583	13.359	10.366	4.256	5.994
Japan	Trace Statistic	28.590	42.077	12.186	20.615	4.921	5.072
	Max-Eigen Stat	16.404	21.462	7.265	15.543	4.921	5.072
Mexico	Trace Statistic	21.982	28.265	12.536	10.759	4.778	4.198
	Max-Eigen Stat	9.446	17.505	7.758	6.561	4.778	4.198
Norway	Trace Statistic	41.012 ^a	43.907 ^b	20.374	22.299	4.638	8.344
	Max-Eigen Stat	20.639	21.608	15.736	13.955	4.638	8.344
Russia	Trace Statistic	32.478	37.403	15.418	19.184	6.772	8.335
	Max-Eigen Stat	17.059	18.219	8.647	10.849	6.772	8.335
South Korea	Trace Statistic	52.363 ^a	44.558	26.105 ^a	24.880	11.151 ^b	9.488
	Max-Eigen Stat	26.257 ^a	19.679	14.954	15.391	11.151 ^b	9.488
United Kingdom	Trace Statistic	35.961	31.911	18.320	17.642	5.925	4.402
	Max-Eigen Stat	17.641	14.268	12.395	13.240	5.925	4.402

Table 4

Statistically significant orthogonalized impulse response of real adr returns to real oil price shocks

VAR (r, oil price shock, ip, rar) for January 1999 - December 2014

where r and ip are the first log difference of short term interest rates and industrial production respectively and rar is real adr, returns measured as the adr returns minus first log difference of consumer price index. Oil price shock (op) is real world oil price shock, log first difference of the price of UK Brent in \$USD deflated by United States PPI, or in national real oil price shock, measured as the first log difference of oil price adjusted by exchange rate and CPI for each country, or nonlinear oil price variables scaled oil price change (sop) or net oil price change (nopi). N (P) denotes negative (positive) statistically significant orthogonalized impulse response of real adr returns to oil price shock. Significance is shown at the 10% (c) 5% (b) and 1% (a) levels.

	Brazil	China	France	Germany	India	Italy	Japan	Mexico	Norway	Russia	South Korea	United Kingdom
Panel A: World real oil price												
Shock to op	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a
Shock to sop	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a
Shock to nopi	P ^a	P ^a	P ^a		P ^b	P ^a	P ^a	P ^a	P ^a	P ^b	P ^c	P ^a
Panel B: National real oil price												
Shock to op	P ^c	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a
Shock to sop	P ^c	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a
Shock to nopi		P ^a	P ^b		P ^c	P ^c	P ^a	P ^c	P ^b			P ^b

Table 5

Statistically significant orthogonalized impulse response of real adr returns to real oil price shocks

VAR (r, oil price shock, ip, rar)

where r and ip are the first log difference of short term interest rates and industrial production respectively and rar is real adr returns measured as the log first difference of adr index price minus first log difference of consumer price index. Oil price shock (op) is real world oil price shock, log first difference of the price of UK Brent in \$USD deflated by United States PPI, or in national real oil price shock, measured as the first log difference of oil price adjusted by exchange rate and CPI for each country, or nonlinear oil price variables scaled oil price change (sop) or net oil price change (nopi). N (P) denotes negative (positive) statistically significant orthogonalized impulse response of real adr returns to oil price shock at time 0 or 1-month lag. Reported are the split sample for pre-crisis (January 1999 - November 2007) and post-crisis (July 2009 - December 2014) Significance is shown at the 10% (c) 5% (b) and 1% (a) levels.

Country	January 1999 - November 2007						July 2009 - December 2014					
	World Real Oil Price			National Real Oil Price			World Real Oil Price			National Real Oil Price		
	Op	Sop	Nopi	Op	Sop	Nopi	Op	Sop	Nopi	Op	Sop	Nopi
Brazil			P ^c		N ^c	N ^c	P ^a	P ^a	P ^b	P ^b	P ^b	
China	P ^b	P ^b	P ^c	P ^c	P ^b	P ^c	P ^b			P ^b		
France	P ^b	P ^b		P ^b			P ^a	P ^b	P ^c	P ^b	P ^c	
Germany	N ^c						P ^a	P ^b	P ^b	P ^c		
India												
Italy	P ^a	P ^a		P ^b	P ^b		P ^a	P ^a	P ^c	P ^a	P ^b	
Japan	P ^c						P ^b	P ^c	P ^a	P ^a	P ^a	P ^a
Mexico	P ^c	P ^c					P ^b	P ^c	P ^c	P ^b	P ^b	
Norway	P ^a	P ^a	P ^b	P ^c	P ^c	P ^b	P ^a	P ^a	P ^b	P ^a	P ^a	
Russia							P ^b	P ^b		P ^b	P ^b	
South Korea	P ^b	P ^b										
United Kingdom	P ^b	P ^b	P ^b	P ^b	P ^c	P ^c	P ^b	P ^b		P ^b		

Table 6

Statistically significant orthogonalized impulse response of real adr returns to real oil price shocks

VAR (r, oil price shock, ip, rsr_{us} , rar) for January 1999 - December 2014

where r and ip are the first log difference of short term interest rates and industrial production respectively. Rsr_{us} is the returns of the United States stock market (S&P 500) minus the first log difference of consumer price index. Rar is real adr, returns measured as the adr returns minus first log difference of consumer price index. Oil price shock (op) is real world oil price shock, log first difference of the price of UK Brent in \$USD deflated by United States PPI, or in national real oil price shock, measured as the first log difference of oil price adjusted by exchange rate and CPI for each country, or nonlinear oil price variables scaled oil price change (sop) or net oil price change (nopi). N (P) denotes negative (positive) statistically significant orthogonalized impulse response of real adr returns to oil price shock. Significance is shown at the 10% (c) 5% (b) and 1% (a) levels.

	Brazil	China	France	Germany	India	Italy	Japan	Mexico	Norway	Russia	South Korea	United Kingdom
World real oil price												
Shock to op	P ^a	P ^a	P ^a	P ^a	P ^b	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a
Shock to sop	P ^a	P ^a	P ^a	P ^a	P ^b	P ^a	P ^b	P ^a	P ^a	P ^a	P ^a	P ^a
Shock to NOPI	P ^a	P ^a			P ^b	P ^c	P ^b		P ^a			P ^b
National real oil price												
Shock to op		P ^a	P ^a	P ^c	P ^c	P ^a	P ^a	P ^a	P ^a	P ^a	P ^b	P ^b
Shock to sop		P ^a	P ^a	P ^c		P ^a	P ^b	P ^a	P ^a	P ^b	P ^b	P ^b
Shock to NOPI		P ^a					P ^c					

Table 8

Coefficient tests of asymmetric effect of world oil price shocks on ADR returns

$$rar_t = \alpha_0 + \sum_{i=1}^2 \alpha_1 r_{t-i} + \sum_{i=1}^2 \alpha_2 OP_{t-i} + \sum_{i=1}^2 \alpha_3 ON_{t-i} + \sum_{i=1}^2 \alpha_4 ip_{t-i} + \sum_{i=1}^2 \alpha_5 rar_{t-i} + u_t$$

$H_0 : \alpha_{2i} = \alpha_{3i}, i = 1, 2$ where op and on are positive and negative oil price shocks (linear or scaled) respectively. World Oil price shock (op) is measured as the log first difference of the price of UK Brent in \$USD deflated by United States PPI, and the scaled oil price (sop), which represents the nonlinear transformation of real world oil price. r and ip represent the short term interest rate and industrial production respectively, in first log difference and rar is real adr returns. Reported are the full sample (January 1999 - December 2014), pre-crisis (January 1999 - November 2007) and post-crisis (July 2009 - December 2014). Significance is shown at the 10% (c), 5% (b) and 1% (a) levels.

Country	Jan 1999 - Dec 2014		Jan 1999 - Nov 2007		July 2009 - Dec 2014	
	op (linear)	SOP (scaled)	op (linear)	SOP (scaled)	op (linear)	SOP (scaled)
Brazil	0.25	0.00	2.49	1.61	2.41	2.33
China	0.02	0.02	1.02	1.16	1.64	1.53
France	0.07	0.00	4.29 ^a	2.81 ^c	1.02	1.20
Germany	0.11	0.66	1.06	0.68	0.36	0.79
India	0.00	0.43	0.99	0.36	0.34	4.25 ^b
Italy	0.05	0.06	2.08	1.90	2.49	2.35
Japan	0.55	1.93	0.06	0.03	2.77 ^c	2.49
Mexico	0.27	0.69	0.33	0.00	0.70	0.05
Norway	0.29	0.13	7.45 ^a	5.96 ^b	3.27 ^c	1.48
Russia	1.61	2.17	1.49	0.97	1.61	1.73
South Korea	0.20	0.23	3.23 ^c	1.81	0.36	1.15
United Kingdom	0.01	0.47	1.79	1.61	0.64	2.23

Table 9: Statistically significant orthogonalized impulse response of real adr returns to real oil price shocks

Model 1: VAR (r, Vol, ip, rar), Model 2: VAR (r, op, Vol, ip, rar)

where r and ip are the first log difference of short term interest rates and industrial production respectively and rar is real adr returns measured as the first log difference of adr index price minus first log difference of consumer price index. Op is real world oil price and is measured as the log first difference of the price of UK Brent in \$USD deflated by United States PPI. Vol is oil price volatility measured as the normalized sum of squares of first log difference in daily spot oil price. N (P) denotes negative (positive) statistically significant orthogonalized impulse response of real adr returns to oil price shock at time 0 or one-month lag. Reported are full sample (January 1999 - December 2014) pre-crisis (January 1999 - November 2007) and post-crisis (July 2009 - December 2014) Significance is shown at the 10% (c) 5% (b) and 1% (a) levels.

	Brazil	China	France	Germany	India	Italy	Japan	Mexico	Norway	Russia	South Korea	United Kingdom
Panel A: January 1999 - December 2014												
Model (1) sign of statistically significant effect on real adr returns												
Shock to vol	N ^a	N ^a	N ^a	N ^a	N ^a	N ^a	N ^a	N ^a	N ^a	N ^a	N ^a	N ^a
Model (2) sign of statistically significant effect on real adr returns												
Shock to vol		N ^c	N ^b	N ^a	N ^a	N ^a	N ^b	N ^a	N ^a	N ^a	N ^a	N ^a
Shock to op	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a
Panel B: January 1999 - November 2007												
Model (1) sign of statistically significant effect on real adr returns												
Shock to vol					N ^b	N ^a			N ^b		N ^c	
Model (2) sign of statistically significant effect on real adr returns												
Shock to vol					N ^b	N ^a			N ^c		N ^c	P ^b
Shock to op		P ^b	P ^b			P ^a	P ^c	P ^c	P ^b		P ^b	P ^b
Panel C: July 2009 - December 2014												
Model (1) sign of statistically significant effect on real adr returns												
Shock to vol	N ^c	N ^b	N ^b	N ^b		N ^a		N ^b	N ^a	N ^b	N ^c	N ^b
Model (2) sign of statistically significant effect on real adr returns												
Shock to vol	N ^b	N ^b		N ^c		N ^b		N ^b	N ^a	N ^c	N ^b	N ^c
Shock to op	P ^a	P ^b	P ^a	P ^b		P ^a	P ^a	P ^b	P ^a	P ^a	P ^c	P ^a

Table 10**Variance decomposition of variance in real adr returns due to world real oil price and interest rate shocks**

This table presents the variance decomposition of real adr returns due to world real oil price (op) measured as the log first difference of the price of UK Brent in \$USD deflated by United States PPI or scaled oil price (sop) and short term interest rates (r) which is measured as the first log difference of short term interest rate. Real adr returns (rar) is real adr returns calculated by first log difference in ADR index price minus first log difference of CPI for each country. IP is the first log difference of industrial production. Reported are the full sample (January 1999 - December 2014), pre-crisis (January 1999 - November 2007) and post-crisis (July 2009 - December 2014). Significance is denoted at the 10% (c) 5% (b) and 1% (a) levels.

Var Model Country	Percentage of variation in real adr returns due to shocks of oil price or interest rate (24-month horizon)											
	January 1999 - December 2014				January 1999 - November 2007				July 2009 - December 2014			
	Var (r, op, ip, rar)		Var (r, sop, ip, rar)		Var (r, op, ip, rar)		Var (r, sop, ip, rar)		Var (r, op, ip, rar)		Var(r, sop, ip, rar)	
	r	op	r	sop	r	op	r	sop	r	op	r	sop
Brazil	0.049	0.146 ^a	0.028	0.108 ^b	0.080	0.015	0.029	0.010	0.016	0.176 ^b	0.019	0.131 ^c
China	0.005	0.132 ^a	0.004	0.104 ^b	0.016	0.062	0.020	0.060	0.030	0.084	0.032	0.059
France	0.002	0.159 ^a	0.003	0.114 ^a	0.049	0.060	0.042	0.051	0.015	0.142 ^b	0.016	0.147 ^b
Germany	0.008	0.125 ^a	0.007	0.097 ^b	0.014	0.053	0.021	0.044	0.047	0.166 ^b	0.038	0.167 ^b
India	0.049	0.096 ^b	0.050	0.075 ^b	0.123 ^c	0.057	0.116 ^c	0.051	0.025	0.053	0.027	0.031
Italy	0.005	0.169 ^a	0.006	0.160 ^a	0.043	0.108 ^c	0.041	0.114 ^b	0.013	0.196 ^a	0.014	0.197 ^a
Japan	0.009	0.132 ^a	0.008	0.086 ^b	0.012	0.042	0.019	0.015	0.013	0.089	0.018	0.075
Mexico	0.123 ^a	0.126 ^a	0.117 ^a	0.092 ^b	0.170 ^a	0.032	0.161 ^b	0.032	0.020	0.105 ^c	0.021	0.075
Norway	0.010	0.246 ^a	0.009	0.224 ^a	0.018	0.113 ^b	0.020	0.103 ^c	0.047	0.278 ^a	0.036	0.260 ^a
Russia	0.041	0.169 ^a	0.045	0.128 ^a	0.011	0.023	0.013	0.013	0.167 ^b	0.135 ^b	0.161 ^b	0.147 ^b
South Korea	0.010	0.131 ^a	0.009	0.084 ^b	0.037	0.057	0.042	0.049	0.104	0.071	0.110 ^c	0.037
United Kingdom	0.051 ^c	0.134 ^a	0.052 ^c	0.095 ^b	0.097 ^c	0.060	0.097 ^c	0.051	0.009	0.116 ^b	0.019	0.100 ^c

Appendix A

Table A1: Statistically significant orthogonalized impulse response of real adr returns to real oil price shocks

VAR (oil price shock, r, ip, rar) for January 1999 - December 2014

where r and ip are the first log difference of short term interest rates and industrial production respectively and rar is real adr, returns measured as the adr returns minus first log difference of consumer price index. Oil price shock (op) is real world oil price shock, log first difference of the price of UK Brent in \$USD deflated by United States PPI, or in national real oil price shock, measured as the first log difference of oil price adjusted by exchange rate and CPI for each country, or nonlinear oil price variables scaled oil price change (sop) or net oil price change (nopi). N (P) denotes negative (positive) statistically significant orthogonalized impulse response of real adr returns to oil price shock. Significance is shown at the 10% (c) 5% (b) and 1% (a) levels.

	Brazil	China	France	Germany	India	Italy	Japan	Mexico	Norway	Russia	South Korea	United Kingdom
Panel A: World real oil price												
Shock to op	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a
Shock to sop	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a
Shock to nopi	P ^a	P ^a	P ^a	P ^c	P ^b	P ^a	P ^a	P ^a	P ^a	P ^b	P ^c	P ^a
Panel B: National real oil price												
Shock to op	P ^c	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a
Shock to sop	P ^c	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a
Shock to nopi		P ^a	P ^b		P ^b	P ^c	P ^a	P ^b	P ^b			P ^b

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Table A2: Statistically significant orthogonalized impulse response of real adr returns to real oil price shocks

VAR (oil price shock, r, ip, rsr_{us}, rar) for January 1999 - December 2014

where r and ip are the first log difference of short term interest rates and industrial production respectively. Rsr_{us} is the returns of the United States stock market (S&P 500) minus the first log difference of consumer price index. Rar is real adr, returns measured as the adr returns minus first log difference of consumer price index. Oil price shock (op) is real world oil price shock, log first difference of the price of UK Brent in \$USD deflated by United States PPI, or in national real oil price shock, measured as the first log difference of oil price adjusted by exchange rate and CPI for each country, or nonlinear oil price variables scaled oil price change (sop) or net oil price change (nopi). N (P) denotes negative (positive) statistically significant orthogonalized impulse response of real adr returns to oil price shock. Significance is shown at the 10% (c) 5% (b) and 1% (a) levels.

	Brazil	China	France	Germany	India	Italy	Japan	Mexico	Norway	Russia	South Korea	United Kingdom
World real oil price												
Shock to op	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a	P ^a
Shock to sop	P ^a	P ^a	P ^a	P ^a	P ^b	P ^a	P ^b	P ^a	P ^a	P ^a	P ^a	P ^a
Shock to nopi	P ^a	P ^a			P ^b	P ^c	P ^b	P ^b	P ^a	P ^b		P ^b
National real oil price												
Shock to op		P ^a	P ^a	P ^c	P ^c	P ^a	P ^a	P ^a	P ^a	P ^a	P ^b	P ^b
Shock to sop		P ^a	P ^a	P ^c		P ^a	P ^b	P ^a	P ^a	P ^b	P ^b	P ^b
Shock to nopi		P ^a					P ^c			P ^b		

Table A3: Variance decomposition of variance in real adr returns due to world real oil price and interest rate shocks

This table presents the variance decomposition of real adr returns due to world real oil price (op) measured as the log first difference of the price of UK Brent in \$USD deflated by United States PPI or scaled oil price (sop) and short term interest rates (r) which is measured as the first log difference of short term interest rate. Real adr returns (rar) is real adr returns calculated by first log difference in ADR index price minus first log difference of CPI for each country. IP is the first log difference of industrial production. Reported are the full sample (January 1999 - December 2014), pre-crisis (January 1999 - November 2007) and post-crisis (July 2009 - December 2014). Significance is denoted at the 10% (c) 5% (b) and 1% (a) levels.

Percentage of variation in real adr returns due to shocks of oil price or interest rate (24-month horizon)					
January 1999 - December 2014					
Var Model	Var (op,r,ip, rar)			Var (sop,r,ip, rar)	
Country	r	op	r	sop	
Brazil	0.032	0.163 ^a	0.027	0.108 ^b	
China	0.003	0.151 ^a	0.004	0.119 ^b	
France	0.003	0.159 ^a	0.003	0.114 ^a	
Germany	0.008	0.125 ^a	0.007	0.097 ^b	
India	0.050	0.097 ^b	0.050	0.075 ^b	
Italy	0.005	0.169 ^a	0.006	0.160 ^a	
Japan	0.007	0.133 ^a	0.007	0.087 ^b	
Mexico	0.122 ^a	0.127 ^a	0.119 ^a	0.093 ^b	
Norway	0.010	0.248 ^a	0.009	0.224 ^a	
Russia	0.018	0.193 ^a	0.023	0.149 ^a	
South Korea	0.007	0.133 ^a	0.007	0.086 ^b	
United Kingdom	0.036	0.148 ^a	0.044 ^c	0.103 ^b	