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RELATIONSHIP BETWEEN OIL PRICES SHOCKS AND STOCK PRICE INDEXES IN IRAN

Abstract. This research examines the long run and short run dynamics among oil prices, interest rates and stock prices in Iran over the most recent 15-year period 1999–2014. Using Johansen's Co integration test we find the existence of long run equilibrium relationship between oil market and capital market in Iran. The short-term dynamics between the two markets are analyzed using Auto regression, VAR causality. We find unidirectional causality from capital market to oil market. The domino impact of up-waves in capital market is positive for oil market and remains statistically significant for few weeks, while being of opposite tendency in foreign interest rate. These results have wider implications for market integration, policy makers and analysts at large. Since these markets are integrated rather than segmented, from the perspective of investments, risk reduction cannot be achieved in the long run by holding assets from these markets in the same portfolio. However, diversification opportunities are not ruled out in the short run.

Keywords: Oil prices, interest rate, market integration, causal relationship, Co integration, Vector auto regression.

JEL Classification No. G10, G11, G14, G15

Introduction

In the last four years, oil prices has gone from \$ 60 in March 2007 to \$ 145 in July 2008, fallen back to \$ 40 in March 2009, and risen once again to \$ 110 in April 2011. The first increase proceeded the global recession, and the second may derail the recent recovery. This relationship between oil prices and the macro economy has been observed for all but one recession since 1950(Hamilton 1983). Changes in oil prices can affect the economy through multiple channels. These include a rise in the costs of production, a rise in inflation, uncertainty regarding investment, or a transfer of wealth from oil exporting countries to oil importing countries.

The financial crisis instigating in early 2008, erupted like a volcano in mid of the year and shook up almost entire world instantly. The wave was not only a testimony of the mammoth significance of finance in today's world but also gave an atrocious demonstration of how strongly the economies are interwoven in the new world because of globalization. The volatilities pre observed and probably ignored were relooked by various agencies, academicians and government for the interest of all. The literature is full of studies related to various aspects diagnosing the roots, the impact, solutions and above all the preventive measures-how could it have been avoided. The gravity

and intensity emphasizes the need to study the channels through which this crisis became contagious. The precariousness of oil prices, mounting stock prices and strange behavior of interest rates even before detonation of the crisis raises the eyebrows. This calls for a deeper understanding for the contagion relationship of real market, capital market and interest rate movements.

The intensity, gravity and the direction of relationship between these two markets withholds invaluable information not only for the analysts, but also for the policy makers, multinational corporations and government at large. The implications are rigorous for everyone. For the multinationals, they can assess their exposure to foreign contracts. For the analyst, it enables him assess his investment portfolio. For oil importers, fluctuations in oil price affect their trade balance and net foreign assets position. For the citizen, it could reduce their disposable income and corporate profitability. Policymakers have to take serious account of the developments in the oil market, as a rise in the world price of oil imposes macroeconomic costs in two ways. First, to the extent that oil is both an important input to production and consumer goods (i.e. petrol and heating oil), results in a reduction in economic activity as energy becomes more expensive. Second, rising oil prices contribute directly to the level of inflation,

particularly in energy dependent countries. Over time, the impact on activity and inflation will also depend on policy responses and supply-side impacts'. (Masih et al., 2011, Bernanke et al., 1997). Paramount among the reasons is that such knowledge can aid in the prevention of an economic crisis. Strong relationship implies these as important factors to be considered for decision-making policymakers to minimize the contagious impact.

Understanding the relationship between oil prices, interest rates and emerging capital market prices is an important topic to study in context of Iran because as emerging economies continue to grow and prosper, they will exert a larger influence over the global economy (Basher et al, 2011:1). The growth trajectory of Iran has been impressive in the past decade. The crisis period too witnessed a remarkable above seven percent growth of GDP. The escalating capital market of Iran has been a favorite destination for analysts worldwide. It ranks fourth in world's consumption of oil (3.1 million barrels per day) as per the estimates of EIA, thus contributing for pull of prices being an oil importing nations. The currency contribution of Iran Rial (IRR) has increased from 0.1 percent in 1999 to 0.9 percent in global currency turnover (Bank of International Settlements) and transaction of Dollar vs. Iran Rial remain even higher than Chinese Yen. The rising demand of oil, volatile capital performance and increasing role of Iran currency in global trading and transactions, accentuate the necessity to understand the relationship in context of Iran.

The direction of impact of changing oil prices on stock prices and interest rates will differ from country to country depending on whether the country is an oil-exporter or oil-importer. In oil-exporting countries, a rise in world oil prices improves the trade balance, leading to a higher current account surplus and an improving net foreign asset position. At the same time, increase in oil prices tends to increase private disposable income in oil-exporting countries. This increases corporate profitability, raises domestic demand and stock prices thereby causing interest rate to appreciate. In oil-importing countries, the process works broadly in reverse: trade deficit are offset by weaker growth, over time, real interest rate depreciates, and stock prices decrease.

While there exists some literature on the relationship between oil prices and stock prices, and a separate literature on the relationship between oil prices and interest rates, the relationship between these two streams has, however, not been that closely studied, especially within the context of emerging market stock prices.

There is a sizable literature showing that oil price movements affect stock prices. While most of the research investigating the relationship between oil prices and stock prices has been conducted for developed economies (see for example: Chen 2010, Park, & Ratti 2008, Ely-

siani et al. 2011, Sadorsky 1999, Narayan & Sharma 2011, Oberndorfer 2009, Malik & Ewing 2009), there is some research looking into the relationship between oil prices and emerging capital markets (see for example Mohanty et.al 2011, Arouri et al 2011, C. Zhang and X. Chen 2011, S.A. Basher and P. Sadorsky 2006, Masih et al.2011). The studies also compare the relationship for oil importing (Fayoumi 2009) and oil exporting countries and comparing both (Fayyad & Daly 2011, Filis et al.2011). On balance, these researches provide evidence that changes in oil prices affect do stock prices.

The idea that there is a relationship between oil prices and interest rates has been around for some time (early researches, for example, include, Golub, 1983 and Krugman 1983). Bloomberg and Harris (1995) provide a good description, based on the law of one price, of how interest rate movements can affect oil prices. Commodities like oil are homogeneous and internationally traded. The law of one price asserts that as the US dollar weakens relative to other currencies, *ceteris paribus*, international buyers of oil are willing to pay more US dollars for oil. Bloomberg and Harris (1995) find that, empirically the negative correlation between commodity prices and the US dollar increased after 1986. Zhang, Fan, Tsai and Wei (2008) reported a significant influence of the US dollar interest rate on international oil prices in the long run, but short run impacts are limited. Akram (2009) also finds that a weaker dollar leads to higher commodity prices.

Golub (1983) and Krugman (1983) put forth compelling arguments as to why movements in oil prices should affect interest rates. Golub reasons that since oil prices are denominated in U.S. dollars, an increase in oil prices will lead to an increase in demand for U.S. dollars. This analysis depends upon the crucial assumption that the demand for oil in oil-importing countries is price inelastic and if the price elasticity is greater than one (in absolute value) an increase in oil prices will lower total expenditure on oil and the demand for U.S. dollars would fall. Krugman's (1983) analysis is based on the relationship between the investment portfolio preferences of oil exporters and movements in interest rates. Rising oil prices will increase the investment portfolio possibilities of oil exporters. In this analysis, primarily current account movements determine interest rate movements. If rising oil prices lead to a country's current account deterioration, then interest rates will fall.

This discussion on the relationship between oil prices and interest rates highlights that there are strong theoretical arguments for why interest rates should affect oil prices as well as why oil prices should affect interest rates.

There also exists some literature studying three factors (oil price, interest rate and stock prices) simultaneously (see Basher et al.2011, Adebisi et.al 2009,). Basher

et al (2011) establishes a short-term relationship among three as rising oil prices tend to depress emerging market stock prices and US dollar interest rates in the short run.

The present paper aims at examining the dynamic relationship (long run as well as short run) among oil price, interest rate and aggregate stock prices in Iran, one of the fastest growing emerging markets in the world. As already mentioned the results of the study have wider implications for market integration, market efficiency, policy makers, regulators and investing community at large.

The rest of the paper is organized as follows. Section 2 describes data and their sources while section 3 highlights the methodology followed. Empirical results are discussed in section 4. Finally, section 5 provides conclusions and policy implications.

1. Data

The study uses weekly data from Jan 3 1997 to Oct 28 2011 i.e. for about 15 years. Weekly OPEC Countries Spot Price FOB Weighted by Estimated Export Volume (Dollars per Barrel), which is applicable for Iran economy, is used as oil prices and have been downloaded from website eia.com (U.S. Energy Information Administration). The weekly Interest rate (IRR/USD) data has been collected from website ONADA.com. A higher interest rate here implies a stronger US dollar and a weaker IRR (i.e. Iran Rial). TEPIX, the oldest and most widely used index comprising thirty representative capitals, which account for nearly sixty percent of total market capitalization on Bombay capital exchange, has been used as a proxy for aggregate stock prices in Iran. The data for TEPIX has been downloaded from website yahoofinance.com.

The raw data regarding TEPIX values, interest rates and oil prices are then converted into their return counterparts by taking first difference of their log values. Specifically

$$\begin{aligned} \text{TEPIX Return (or Dlog(TEPIX))} &= \\ &= \ln(TSE_t / TSE_{t-1}) \end{aligned} \quad (1)$$

For $t = 1, 2, 3, \dots, 772$

Where

TSE_t refer to TEPIX index value at time t ;
 TSE_{t-1} refers to TSE index value at time $t-1$.

$$\begin{aligned} \text{Interest rate Return (or Dlog(Interest _ rate))} &= \\ &= \ln(ER_t / ER_{t-1}) \end{aligned} \quad (2)$$

Where

ER_t refer to IRR/USD rate at time t ;
 ER_{t-1} refers to IRR/USD rate at time $t-1$.

$$\text{Oil Return (or Dlog(Oil))} = \ln(OIL_t / OIL_{t-1}) \quad (3)$$

Where

OIL_t refer to OPEC Countries Spot Price FOB Weighted by Estimated Export Volume (Dollars per Barrel) at time t .

OIL_{t-1} refers to OPEC Countries Spot Price FOB Weighted by Estimated Export Volume (Dollars per Barrel) at time $t-1$.

In total there are 772 observations for price factors and 771 observations for return factors.

2. Methodology

We begin with the graphical analysis, descriptive statistics and Karl Pearson's coefficient of correlation analysis of all the six factors under study viz. TEPIX, interest rate, oil prices, TEPIX return, interest rate return and oil return. For the purpose of comprehensive and meaningful analysis we divide the total study period (1999–2014) into the following five sub periods-

1. Sub period 1 (1999–2003)
2. Sub period 2 (2003–2007)
3. Sub period 3 (2007–2011)
4. Sub period 4 (2011–2012)
5. Sub period 5 (2012–2014)

Vector Auto regression and VECM

Short run equilibrium relationship is tested using vector auto regression model and error correction mechanism. For this purpose the three factors viz. oil price, interest rate and stock prices are assumed endogenous.

Our VAR model is based on $y_t = f$ (oil returns, Interest rate returns, and capital returns). The reduced form of VAR is given by Eq. (6) as above:

$$y_t = c + \sum_{i=0}^p A_i y_{t-i} + e_t \quad (4)$$

Where c is a vector of constants, p denotes the lag length, A_i are the 3×3 coefficient parameter matrices and e_t is a vector of error shocks.

A Vector Error Correction Model (VECM) can lead to a better understanding of the nature of any non-stationarity among the different component series and can improve longer term forecasting over an unconstrained model.

The VECM(p) form is written as

$$\Delta y_t = \delta + \prod y_{t-1} + \sum_{i=1}^{p-1} \varphi_i \Delta y_{t-i} + e_t \quad (5)$$

where Δ is the differencing operator, such that: $\Delta y_t = y_t - y_{t-1}$.

It has an equivalent VAR(p) representation:

$$y_t = \delta + \left(I_k + \prod \varphi_i \right) y_{t-1} +$$

$$+ \sum_{i=2}^{p-1} (\varphi_i - \varphi_{i-1}) y_{t-1} - \varphi_{p-1} y_{t-p} + \varepsilon_t \quad (6)$$

3.4: VAR causality (Block Exogeneity) Wald Tests:

We use VAR causality test to establish any causal relationship among the factors. In VAR model, the causality can be evaluated by examining the joint significance of lagged coefficients of one factor in the equation of another factor. This kind of significance testing is called the Block significance test and it can be performed with the usual F test or Wald test used for evaluation of parameter restrictions.

3. Empirical Results Descriptive Statistics

Table 1 presents the summary statistics for all the six factors for the total study period as well as all the five sub periods. The average oil price during the period is USD 46.39 with a maximum of 137.18 (as on 4th July 2008) and a minimum of 9.41 (as on 12th Feb 1999). The average value of TEPIX is about 8620 with a maximum of 21004 (as on 5th Nov 2010) and a minimum of 2600 (as on 21st Sept 2001) over the same period, while the average IRR/USD interest rate is 44.52 with a maximum of 52.62 (as on 22nd July 2005) and a minimum of 35.70 (as on 25th July 1997). The mean weekly returns of TEPIX, Interest rate and oil have been found to be 0.22 percent, 0.04 percent and 0.20 percent respectively. The standard deviation is highest in oil market followed by capital market and foreign interest rate. As expected, the volatility is highest in all the two markets during the crisis period (2008–09). However, volatility in post crisis period does not appear to be significantly different from that of pre-crisis period.

Correlation analysis

Table 2 shows cross correlations (Karl Pearson's Correlation coefficients) matrix for the level and return factors. As expected, there is very high and positive correlation between oil prices and stock prices for the total period (0.91) and pre crisis period (0.82) in Iran. However, it is relatively lower during crisis period (0.529) and is drastically low in post crisis period (0.08). It shows that the relationship between the capital market and oil market has reduced significantly post financial crisis of 2008. However, in terms of returns, the correlation coefficients between both these markets have actually increased.

Stock prices and Interest rates are positively related while capital returns and interest rate returns show negative correlation for the total period. This negative correlation has become relatively higher in post crisis period.

Regarding oil prices and interest rates, we find a positive relationship in terms of level factors but negative correlation in terms of return factors. Hence, the returns

in capital market and oil market on one hand and returns in foreign interest rate on the other hand are negatively correlated suggesting diversification benefits for analysts who hold assets in either capital market and foreign interest rate or oil market and foreign interest rate.

4. Conclusions and policy implications

Realizing the vibrant relationship of aggregate stock prices and oil prices, the study is a contribution to the existing literature in many aspects. One, it studies the liaison of three factors taken together, in reference to an emerging economy of Iran. The implications are crucial in context of emerging contribution of Iran to global economy and investment avenues it offers for multinationals, global institutions and analysts. Two, it studies the long term relationship as well as during different periods covering pre, during and post crisis period, which of course would offer great lessons for all concerned.

The relationship has been studied for the five sub periods, viz. 1997–2000 (post south east Asian financial crisis), 2001–04 (dotcom crisis and worldwide boom) 2005–07 (pre financial crisis) 2008–09 (during crisis) and 2010–11 (post crisis period). The factors were modeled in VAR (unrestricted as well as error correction mechanism) in order to analyze the short-term dynamics. VAR results show that in the short run oil returns are affected significantly by their lagged values, lagged TEPIX returns and lagged interest rate returns in case of total period.

VAR causality/ Block Exogeneity Wald test and Impulse response analysis exhibit unidirectional causality from capital market to oil market. This result although looks inconsistent with the general perception that oil market causes capital market, yet makes sense within the context of global oil market and global economic activity. Oil consumption in most of the developed economies is flat or in decline and as result emerging market economic growth (as proxy by their stock prices) is likely to be an important source of demand side pricing pressure in the oil market. Iran being one of the largest importers of oil in the world, it is obvious that stock prices in Iran, reflecting the magnitude of economic activities in Iran, exert significant influence on oil prices. Further, we find some evidence that interest rate causes oil prices and stock prices. Either the capital returns in Iran are not affected significantly by the oil returns or interest rate returns during the sub periods. During the recent financial crisis period, stock prices are explained by their own two week lagged values casting doubts on market efficiency during crisis period. Post crisis results show that oil prices are caused by both stock prices and interest rates.

Lagged capital returns have a statistically negative influence on interest rate returns in total period and during the recent global financial crisis period. It implies that

before the recent period of crisis the interest rate market was governed by factors beyond the oil market and capital market. The central bank and government thus need to consider for formulation of policies.

An assessment of impulse response graphs in pre-crisis, during crisis and post crisis period exhibits that the response of all the factors to a shock generating from within stays for a relatively longer period during crisis as compared to pre and post crisis period.

These results have wider implications for market integration, policy makers and analysts at large. Since these markets are integrated rather than segmented, from the

perspective of investments, risk reduction cannot be achieved in the long run by holding assets from these markets in the same portfolio. However, diversification opportunities are not ruled out in the short run. In the short run, analysts can reap the benefits of diversification by investing in both oil and foreign interest rate or in capital and foreign interest rate. Capital market turns out to be the leader in all the two markets especially after the recent financial crisis. Rapidly rising stock prices in Iran signal the expectation of higher economic growth ahead. If the stock prices are trapped in a bubble, however, oil prices will overshoot in relation to economic fundamentals.

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Tables and Figures

Table 1: Data Series

	Source	Availability*
Oil Prices		
Refiner Acquisition Cost	CENTRAL BANK OF IRAN Department of Energy	January 1999 - December 2014
Oil Production		
World Crude Oil Production	OPEC	January 1999 - December 2014
Economic Activity		
Real GDP	IMF International Financial Statistics Database	January 1999 - December 2014
Consumer Prices		
IRR CPI	CENTRAL BANK OF IRAN Department of Energy	January 1974 - December 2013
Sectoral Composition		
GDP Sector Shares	World CIA Factbook	Varies by country
Computed Series		
Real Oil Prices	Refiner Acquisition Cost * 100/ IRR CPI	
Real Baltic Dry Index	Baltic Dry Index * 100/ IRR CPI	

*Monthly series are made into quarterly series using midmonth observations

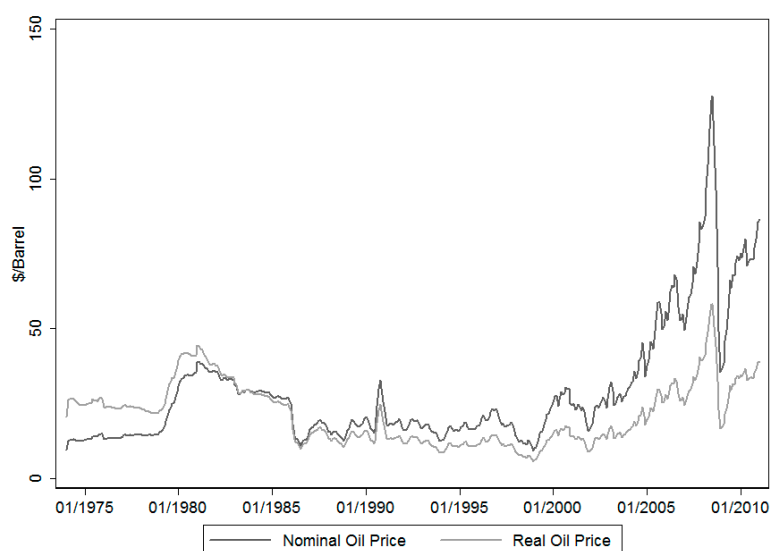


Figure 1: Historical Trends in Oil Prices

Table 2: Descriptive Statistics

	Level Factors			Return Factors		
	Interest rate	Oil	TEPIX	Interest Returns	Capital Returns	Oil Returns
Mean	44.5208	46.3913	8619.9990	0.0004	0.0022	0.0020
Median	45.1283	33.1850	5670.9250	0.0000	0.0052	0.0036
Maximum	52.6286	137.1800	21004.9600	0.0428	0.1317	0.2098
Minimum	35.6995	9.4100	2600.1200	-0.0644	-0.1738	-0.1645
Std. Dev.	3.4202	30.3988	5746.4780	0.0084	0.0366	0.0421
Skewness	-0.7700	0.8612	0.6741	-0.2768	-0.3586	-0.2761
Kurtosis	3.4350	2.7841	1.8805	13.8363	4.8598	4.6631
Jarque-Bera	82.3756	96.9243	98.7747	3782.1670	127.6302	98.6488
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

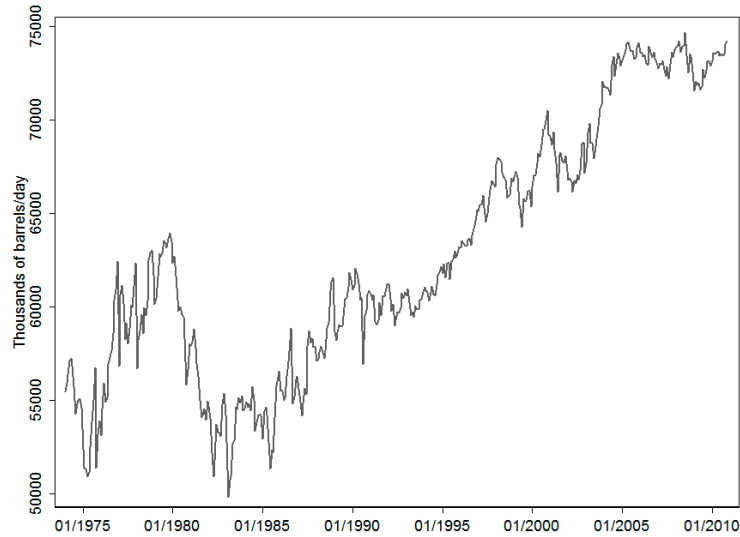


Figure 2: Historical Trends in World Oil Production

Table 3: Cross Correlation Matrix

	1999–2014		1999–2003		2004–2007		2008–2010		2011–2012		2013–2014	
	In rate	oil	In rate	oil	In rate	oil	In rate	oil	In rate	oil	In rate	oil
TEPIX	0.05	0.91*	0.27*	0.68*	-0.86*	0.72*	-0.60*	0.82*	-0.72*	0.59*	-0.51*	0.09
In rate		0.10		0.39*		-0.63*		-0.56*		-0.81*		-0.04
	In ret	oil ret	In ret	In ret	In ret	oil ret	In ret	oil ret	In ret	oil ret	In ret	oil ret
TEPIX ret	-0.36*	0.05	-0.21*	-0.05	-0.33*	-0.01	-0.25*	-0.05	-0.53*	0.22*	-0.50*	0.23*
In ret		-0.16*		-0.07		0.09		-0.09		-0.28*		-0.40*

*significant at 5% level.

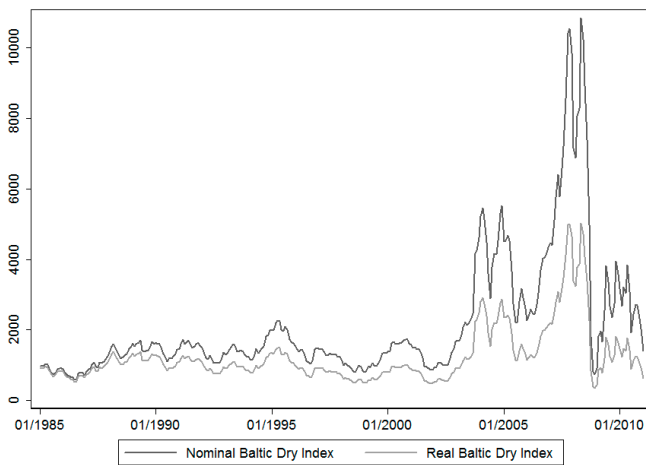


Figure 3: Trends in Global Freight Rates

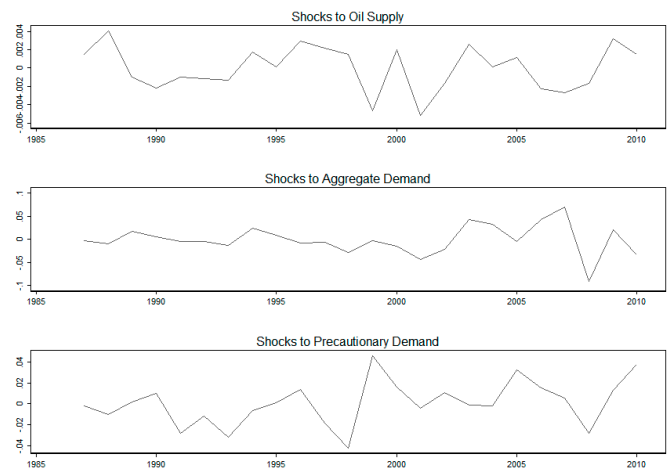


Figure 4: Structural Shocks to the Real Price of Oil