The Interaction between Oil Price and Economic Growth

Latife Ghalayini
Economic Department, Lebanese University, Beirut Lebanon
E-mail: lghalayini@yahoo.com
Tel: 961 3627319 Fax: 961 6443411

Abstract

Most of the existing studies in theoretical and empirical understanding of the macroeconomic consequences of oil price shocks have been focused on the US economy. In contrast to these studies, the purpose of this paper is to investigate whether economic world growth can be explained by changes in the oil price. We will also investigate if there are any differences in oil price effects on economic growth between different countries and group of countries. A possible reason for these differences was oil exports/imports countries. For the oil importer countries, oil price increase and economic growth are negatively correlated while all things being equal, the relation is positively correlated for oil exporter countries. The data used in this paper covers the G-7 group, OPEC countries in addition to Russia, China and India. The main findings may be summarized as follows: Our use of Granger causality-tests allows us to conclude that the interaction between oil price changes and economic growth is not proved for most countries but for the G-7 group where, a unidirectional relation from oil price to gross domestic product is proven.

Keywords: Oil price, Gross domestic product, Oil exporter countries, Oil importer countries, inflation.

1. Introduction

From the middle of twentieth century onwards, crude oil has become one of the main indicators of economic activity worldwide, due to its outstanding importance in the supply of the world's energy demands. Nowadays, the importance of crude oil as the main source of energy has waned somewhat, due to the appearance of alternative forms of energy (such as wind, water, and solar power). Notwithstanding this, the importance of oil exceeds economic aspects and affects social life in general. Thus, the prevailing view among economists is that there is a strong relationship between the growth rate of a country and oil-price changes. Precisely what form this relationship takes, and how it might be modified, and other such questions are issues of outstanding value.

A large body of research suggests that oil price fluctuations have considerable consequences on economic activity. These consequences are expected to be different in oil importing and in oil exporting countries. Whereas an oil price increase should be considered good news in oil exporting countries and bad news in oil importing countries, the reverse should be expected when the oil price decreases. The transmission mechanisms through which oil prices have an impact on real economic activity include both supply and demand channels. For this reason, the theoretical literature has been of a general equilibrium nature, with different authors assigning different weights to the supply and demand channels. See, for example, Rasche and Tatom (1977, 1981), Kim and
crude oil is a basic input to production, and consequently an increase in oil price leads to a rise in production costs that induces firms to lower output. Oil prices changes also entail demand-side effects on consumption and investment. Consumption is affected indirectly through its positive relation with disposable income. The magnitude of this effect is in turn stronger the more the shock is perceived to be long-lasting. Moreover, oil prices have an adverse impact on investment by increasing firms’ costs. It is worth noting that, in addition to the previously discussed impacts of oil prices on supply and demand, oil price changes influence foreign exchange markets and inflation, giving thus rise to indirect effects on real activity.

The purpose of this paper is to investigate if economic growth can be explained by changes in the oil price. We will also investigate if there are any differences in oil price effects on economic growth between countries. We begin by analyzing the impact of an oil price changes on the economy, followed by an explanation of the country and group of country economies chosen to test the relation between oil price and economic growth. The paper is organized as follows: section 2 presents the related literature background. Section 3 reviews the oil price and economic growth trends. Section 4 analyzes the relation between economic growth and oil price while, section 5 overviews the background of the country and group of country economies chosen to test this relation. The empirical part and tests are presented in section 6 to finally conclude in section 7.

2. Literature Reviews
Since the World’s high dependence on oil products, the relation between oil prices and economic growth has received a great deal of attention from economist over the years, and there is a large technical literature on various aspects of the subject. But whether the oil price can be seen as an economic indicator on GDP growth is however not as clear.

The economic importance of oil price shocks has been examined utilizing the neoclassical theory in attributing the macroeconomic significance to such events. The related empirical studies started by finding a linear negative relationship between oil prices and real activity in oil importing countries. Those studies include Rasche and Tatom (1981), Darby (1982), Hamilton (1983), Burbidge and Harrison (1984), and Gisser and Goodwin (1986). Hamilton’s (1983) study identified a robust relationship between oil price increases and subsequent economic downturns for majority of the post-World War Two recessions in the United States (US) economy. Subsequently, a large literature has considered the oil price-economic growth nexus for a number of developed countries based on various theoretical linkages. Studies linking oil prices to the macro-economy through the channels of labor market dispersion (Loungani, 1986; Finn, 2000; Davis and Haltiwanger, 2001), investment uncertainty (Bernanke, 1983; Dixit and Pindyck, 1994; International Monetary Fund, 2005), consumption smoothing in durable goods (Hamilton 1988a, 2003; Lee and Ni, 2002) and the consequences for inflation (Pierce and Enzler, 1974; Mork, 1981; Bruno and Sachs, 1982) suggest that indirect transmission mechanisms may be the crucial means by which oil price shocks have macroeconomic consequences.

However, by the mid-1980s, the estimated linear relationship between oil prices and real activity began to lose significance. In fact, the declines in oil prices occurred over the second half of the 1980s were found to have smaller positive effects on economic activity than predicted by linear

Loungani (1992), and Rotemberg and Woodford (1996). One of the key common features of these models is the linearity assumed between the logarithm of real GDP and the logarithm of the price of oil. For these models, an oil price decline of a given size is as beneficial to economic activity as an oil price increase of the same size is detrimental to it.

Some of these indirect effects may involve economic policy reactions. For instance, authors like Bohi (1991) and Bernanke et al. (1997) argue that economic downturns observed after oil price shocks are caused by a combination of direct impacts of the shocks themselves and the monetary responses to them.

While all these contributions consider the case of the US, Darby (1982) and Burbidge and Harrison (1984) also analyzed other developed countries (Japan, Germany, the UK, Canada, France, Italy, and the Netherlands in the former case, and Japan, Germany, the UK and Canada in the latter).
models. Mork (1989) by specifying increases and decreases in the real price of oil as separate variables allowed for an asymmetric response of the US economic activity to oil price changes. He found that the effects of oil price increases are different from those of decreases, and that oil price decreases are not statistically significant in the US. This implied a departure from the linear specifications, in which oil price rises and falls have symmetrically equal impacts on real activity. Mork's contribution has proved influential in that many authors have thereafter not even considered the possibility of effects derived from a decrease in oil prices. Given that the asymmetry is a very special case of non-linear relationship between GDP and oil prices, the literature has proposed two other non-linear transformations, namely: scaled specification (Lee et al., 1995), taking the volatility of oil prices into account; and net specification (Hamilton, 1996), which considers the amount by which oil prices have gone up over the last year, to re-establish the negative relationship between increases in oil prices and economic downturns, as well as to analyze Granger causality between both variables. Hamilton (2003) and Jiménez-Rodríguez (2004) also found evidence of a non-linear relationship between the two variables for the US economy. Jimenez-Rodriguez's paper found that there is a significant relationship between oil prices and macroeconomic variables in some of the OECD countries, with regard to oil importing countries, except Japan. These results were obtained through a Granger causality test, followed by a multivariate VAR analysis. However, the effects of decreases and increases in oil price, has different effects in different countries. More recently, Hamilton (2008), in the paper "Oil and the Macroeconomy", discusses the effects of oil price changes on economic growth in the US economy. He clearly states that there are several research studies carried out on this subject with results arguing that the relationship between oil price changes and economic growth is hard to determine, at least through statistical analyses. There might be another force affecting both economic growth and oil price that currently is undetectable. The effects of heavy oil price changes have a great influence on unemployment in capital and energy intensive industries (Davis-Haltiwanger, 2001).

The studies mentioned above leaves no clear solution whether oil price affects economic growth, vice versa or whether there is an unknown variable steering them in certain directions. A possible reason why there are so many different results regarding the subject is the usage of several different models. By using one model a certain solution is found and in another one might find the opposite results.

While the recent empirical literature has thus developed into the area of non-linear modeling, the theoretical literature is normally not explicit about asymmetries in the response of real activity to oil prices. The main exception to this is given by one economic justification for an asymmetric relationship that has been offered in the literature. For instance, Lilien (1982) has formulated the so-called dispersion hypothesis, which relies on the argument that a change in oil price alters the equilibrium allocation across various sectors. More concretely, this explanation relates to adjustment costs resulting from the implied sectoral reallocation of resources. According to this argument, an increase (decrease) in oil prices would lead to a contraction (expansion) in sectors that make use of oil in the production process. Moreover, the increase (decrease) in oil prices would generate an expansion (contraction) of energy-efficient sectors relative to energy-intensive sectors. However, given that in the

---

4 Mork et al. (1994) documented the asymmetry in the inverse relationship between oil price and aggregate economic activity for countries other than the US (including both oil-importing and oil-exporting countries). In particular, they found asymmetry in the cases of Norway and all G-7 countries but Italy.

5 Fereder (1996) also considers oil price volatility, albeit in a different way. He constructs a measure of it and plugs it into the empirical model alongside the level of oil prices. As the author recognizes, this procedure is confronted with the difficulty usually found in isolating the level and volatility channels.

6 For related approaches, see Loungani (1986), and Davis (1987), Hamilton (1988), and Davis et al. (1997). In addition to the theoretical reason for the asymmetric real effect given in the text, the presence of an asymmetric pattern in the changes of prices of crude and oil refining products themselves may provide a further, in this case empirical, justification. In this regard, Bacon (1991), Karrenbock (1991), and Balke et al. (2002) have all found evidence of asymmetric response in gasoline prices. Their common finding is that gasoline prices rise more quickly when oil prices are increasing than they fall when oil prices are decreasing.
short run the cost of reallocation of resources between sectors is high, oil shocks that imply readjustment between energy-efficient and energy-intensive sectors will give rise to an overall loss in output. While this loss will aggravate the economic contraction when oil prices increase, it will constrain the economic expansion when oil prices decline, thereby giving rise to the asymmetric effect.

Unlike most of the existing literature, which focuses on the oil importing and industrialized countries, the present paper extends the existing empirical literature to include OPEC countries as well as Russia, India, and China. Our main findings is that Granger causality analysis permits us to conclude that the interaction between oil prices and economic growth is proved for G-7 countries, with the direction of causality going from oil price to economic growth. All tests are carried out with Eviews.

3. Economic Growth and Oil Price Trends

Oil has always been an indicator for economic stability in modern times, much due to the World’s high dependence on oil products. Furthermore, the price of oil is of critical importance to today’s world economy, given that oil is the largest internationally traded good, both in volume and value terms (creating what some analysts have called a "hydrocarbon economy"). In addition, the prices of energy-intensive goods and services are linked to energy prices, of which oil makes up the single most important share. Finally, the price of oil is linked to some extent to the price of other fuels (even though oil is not fully substitutable for natural gas, coal, and electricity, particularly in the transportation sector). For these reasons, abrupt changes in the price of oil have wide-ranging ramifications for both oil producing and consuming countries. Thus, the prevailing view among economists is that there is a strong relationship between the growth rate of the world and oil-price changes. But whether the oil price can be seen as an economic indicator on GDP growth is however not as clear (Adelman, 2004).

The figure below provides a starting point to the analysis of oil price behavior and world economic growth relation over the last 25 years. The graph shows that quarterly oil prices of West Texas Intermediate (WTI) crude—one of the marker crudes—and quarterly world gross domestic product have experienced an upward trends.

Variation of World GDP and oil price from 1986Q1 to 2010Q2.
4. The Relation between Economic Growth and Oil Prices

A. The Impact of Economic growth on Oil Prices

The impact of world economic growth on oil price can be seen in the light of the oil market power. In fact, as World economic growth increases the demand for oil increases which pushes up oil prices. Oil prices then, tend to be volatile, at least partly due to variations in the business cycle.

In the last quarter of 1998, economic growth decreased and pushed down the demand for oil and therefore reduced oil price to 20$ per barrel (see the figure above). While the world economy continued its recovery in 2003 and through the year 2004 and 2005 with gross domestic product (GDP) growth rates increasing in many regions, the world oil market was characterized by strong oil demand growth and the oil price increased from 27 to 35$ the barrel. In the first quarter of 2005, the oil price increased to $50 per barrel approximately $15 per barrel higher than in the first quarter of 2004, and remain above this level for the rest of 2005 and 2006. Leading up to 2008, a strong world economic growth driving growth in oil use, thus crude oil prices increased dramatically during 2007, with oil prices climbing from an average of nearly $55 per barrel in the first quarter of 2007 to over $95 per barrel in the last quarter of 2007. The decline in the value of the dollar against other currencies supports continued oil consumption growth in foreign countries because oil is traded globally in dollars, and a declining dollar has made the increase in oil prices less severe in foreign currencies. Oil prices fell to less than $62 a barrel in last quarter of 2008 amid continuing concerns about a global economic recession while the hope in an economic recovery increases oil prices in the second quarter of 2009 to continue in 2010.

B. The Impact of Oil Prices on Economic Growth

While the increase in GDP growth and economic activity in general, has led to increases in energy demand, a feedback relationship exists which can mitigate this effect. The perception that oil price spikes have a serious negative effect on the economies is based largely on the close correlation in the timing of oil price spikes and economic downturns. This fact was experienced in 2000, 2004 and 2008(see the figure above). Price elasticity of demand is always thought of as negative - that is demand falls by a certain percentage for a certain percentage price rise of some factor input, in this case oil. Conventional economic reasoning, embodied in the notion of "price elasticity" of demand, is that large oil price rises will necessarily cut oil demand and reduce economic growth.

All things being equal, an oil price increase should be considered, positive in oil exporting countries and negative in oil importing countries, while the reverse should be expected when the oil price decreases. An oil price increase leads to a transfer of income from importing to exporting countries through a shift in the terms of trade. The global demand impact would depend on how much of the extra revenue accruing to oil exporters is re-spent; typically, such revenues are not fully re-spent in the short term. The boost to economic growth in oil-exporting countries provided by higher oil prices in the past has always been less than the loss of economic growth in importing countries, such that the net effect has always been negative. The growth of the world economy has always fallen sharply in the wake of each major run-up in oil prices. This is mainly because the propensity to consume of net importing countries that lose from higher prices is generally higher than that of the exporting countries. Demand in the latter countries tends to rise only gradually in response to higher prices and export earnings, so that net global demand tends to fall in the short term.

B.1. Impact of an oil price increase for exporter countries

For net oil-exporting countries, a price increase directly increases real national income through higher export earnings, though part of this gain would be later offset by losses from lower demand for exports generally due to the economic recession suffered by trading partners. The danger for these nations is that if prices go too high, and stay high, GDP growth in the consuming nations might decline, reducing the demand and price of oil. An additional factor is that high prices lead to increases in exploration and
development budgets around the world. As new oil is found and brought to market, supply increases and prices might be reduced, damaging the oil exporting nation’s growth. High oil prices can also stimulate industrial countries to develop and use alternative fuels (oil substitutes) more competitive potentially reducing the demand for oil.

**B.2. Impact of oil importer countries**

**B.2.1. Direct effect**

The direct effect of a given oil price increase for importer countries is an income losses. This loss in income depends on the oil-intensity of production and the degree to which the demand for oil is price inelastic. It also depends on the secondary impact on core inflation from changes in oil prices, - the extent to which gas prices rise in response to an oil-price increase, the gas-intensity of the economy and the impact of higher prices on other forms of energy that compete with or, in the case of electricity, are generated from oil and gas. Then if oil product prices rise, and consumers are unable or unwilling to reduce oil product consumption, consumers may reduce expenditures on other goods and services, potentially slowing the rate of GDP growth. Naturally, the bigger the oil-price increase and the longer higher prices are sustained, the bigger the macroeconomic impact.

Domestically, in the case for final consumption products such as gasoline the income loss arising from the price increase would be borne by consumers since the demand for oil and oil price products is inelastic in the short run. As far as headline consumer price inflation is concerned, taxes on oil products help to insulate the price level from oil price changes, fundamentally by helping to reduce oil intensity in the longer run, but also statistically in the short term, since the proportional impact of an oil price rise is inversely related to the tax content of the retail price. Whether the increase in the price level translates into a shift in core inflation depends on the "second round" effects -- i.e. whether workers and/or enterprises are able to compensate for the income loss through higher wages and prices -- which, in turn, depends on the monetary policy regime in place.

On the other hand, if the monetary authorities interpret increasing oil costs as generalized price inflation, they may adopt restrictive policies which could slow the economy’s growth. Overly restrictive monetary and fiscal policies to contain inflationary pressures could exacerbate the recessionary income and unemployment effects. However, expansionary monetary and fiscal policies may simply delay the fall in real income necessitated by the increase in oil prices, stoke up inflationary pressures and worsen the impact of higher prices in the long run. Also, in terms of the state of the economy, if the economy is already suffering from high inflation and unemployment, then the oil price increases have the potential to cause severe damage by limiting economic policy options and affect the overall economic impact of higher oil prices over the longer term.

**B.2.2. Adjustment Effect**

Adjustment effects, which result from real wage, price and structural rigidities in the economy, add to the direct income effect. To the extent that labor market institutions inhibit the adjustment of real wages to shocks, the deterioration in the terms of trade following an oil shock can affect equilibrium employment, since it creates a wedge between value-added and consumer prices. In fact, oil is a vital input for the production of a wide range of goods and services, because it is used for transportation in businesses of all types. Higher oil prices therefore increase the cost of inputs; and if the cost increases cannot be passed on to consumers, economic inputs such as labor and capital stock may be reallocated.

Where oil is an input into price-elastic final goods, the negative revenue effects would initially be borne by producers in a competitive market, regarding that they would be unable to pass on the higher costs due to the costs of changing “menu” prices. In other hand, there is resistance on the part of workers to real declines in wages, oil price increases typically lead to upward pressure on nominal wage levels. To the extent that producers are affected, profit margins and returns on capital will fall, with effects on the allocation of capital. While capital is the most flexible and footloose of the factors of production in the longer run, and would move from energy-intensive areas to areas with higher rates of return, in the short term capital in energy-intensive sectors is relatively inflexible, which makes it
bear an income loss. Changes in oil prices can then cause economic losses when macroeconomic frictions prevent rapid changes in nominal prices for final goods or for key inputs, such as wages. Thus, higher oil prices can cause worker layoffs and the idling of plants, reducing economic output in the short term.

In general, the short-term economic impact of an oil shock on output and employment would be smaller, the higher the proportion of the price rise that can be passed on to consumers and/or the more flexible are wages if the price rise cannot be passed on. The negative impact of an oil price rise on domestic demand and income will diminish over time as consumers and producers modify their behavior. However, research seems to indicate that oil demand does not revert to its initial level as oil prices fall. Nominal price “stickiness” is asymmetric, in that firms, unions, and other organizations are much more reluctant to lower nominal prices and the wages they receive than they are to raise them. Thus, the income losses experienced by energy importers may eventually be partly reversed. The loss of business and consumer confidence resulting from an oil shock could lead to significant shifts in levels and patterns of investment, savings and spending. A loss of confidence and inappropriate policy responses, could amplify the economic effects in the medium term. Where fluctuations in oil prices create uncertainty, there may be a reduction in trend investment activity, but it is less clear that the effects on profitability or capacity utilization are asymmetric.

Furthermore, in terms of oil price increase nature, sudden large price increases create widespread uncertainty about appropriate production techniques, purchases of new equipment and consumer durable goods like automobiles, and wage and price negotiations. As firms and households adjust to the new conditions, some plant and equipment will remain idle, some workers will be temporarily unemployed, and the economy may no longer operate along its long-run production-possibility frontier. Although it is easy to differentiate gradual from rapid price increases on a conceptual basis, empirical differentiation is more difficult.

C. Impact of oil price increase on financial market and exchange rate

Currencies would adjust to changes in trade balances. Since oil contracts are settled in US dollar and oil exporters invest part of their windfall earnings in US dollar dominated assets, higher oil prices would lead to raise the value of US dollar by increasing the transactions demand for it. A stronger dollar would raise the cost of servicing the external debt of oil-importing developing countries, as that debt is usually denominated in dollars, exacerbating the economic damage caused by higher oil prices. Past oil shocks provoked debt-management crisis in many developing countries.

In other hand, to the extent that changes in oil prices have impact on economic activity, corporate earnings and inflation, financial markets would be affected – notably equity values and exchange rates– even, as assumed here, if there are no changes in monetary policies. In fact, higher oil prices would be revised downwards the international capital market valuations of equity and debt in oil-importing countries and upwards those in oil-exporting countries. To the extent that the creditworthiness of some importing countries that are already running large current account deficits is called into question, there would be upward pressure on interest rates. Tighter monetary policies to contain inflation would add to this pressure but would also increase the value of domestic currencies.

Throughout the world, the countries dependencies of oil products are diverse and fluctuations in oil prices can have different effects. Thus, the following section overviews the economic background of some different countries and group of countries. A short history of each countries relationship to oil will also be presented to clarify the status of the today’s oil dependency in these countries.
5. Countries economic background

A. The oil exporter Countries

While, oil reserves will probably remain relatively ample, their distribution is likely to be increasingly concentrated on the Middle Eastern members of OPEC\(^7\), which already account for around two-thirds of global proved reserves. Outside the Middle East, newly discovered resources have tended to become smaller and more expensive to develop, being increasingly offshore, and the costs of exploration, development and production are higher than in the reserve-rich Middle East.

With reserves concentrated in a limited number of OPEC countries, where investment is not allocated according to market forces, investment in the energy sector may not be sufficient. Global investment, supply and price extrapolations are contingent upon the extent to which OPEC (or a subset of OPEC countries) will exercise its market power. Exploration, development, and extraction costs in the Middle East are reported to be less than $5 per barrel, while short-run marginal costs are generally estimated to be below $2 per barrel. Other suppliers face much higher, and probably more steeply increasing marginal costs than OPEC and the reserve-rich producers in the Middle East have incentives to exploit this cost advantage by trading off market share for a higher price.

However, Geopolitical tensions and uncertainty stemming from acts of sabotage on oil facilities in the Middle East and fears of disruption in other oil producing countries constitute an additional "risk premium" to the oil price, related to the possibility of a significant disruption to supply capabilities. The less elastic global oil demand and non-OPEC supply are in the long run, the greater are OPEC’s incentives to restrict output and thus raise prices in the face of rising world demand.

While, the sharp decline in world oil prices at the end of 2008 and into 2009, combined with OPEC-imposed production cuts, declines demand for other exports, and reduced capital inflows, slowed economic growth to its lowest rate since 1994. Stimulus funding from Saudi Arabia, the United Arab Emirates, and other countries in the region helped to keep GDP from falling lower, a raise in oil production and prices helps boost economic growth in the oil-exporting countries, many of these countries also may benefit from spillover effects on trade, tourism, and financial flows from the region’s oil exports.

B. The G-7 countries

The G-7 consist of a group of seven countries founded in 1975 by 7 major industrialized economies; United States of America, Canada, Japan, Germany, France, Italy and the United Kingdom. These countries got together in order to cooperate more fully on the economy with a main goal to control the current exchange rates between the US dollar, Yen and Euro. The control of exchange rate is in fact very important for these countries, since oil contract are priced and settled in US dollar. A decrease in the dollar value, all thing being equal, an increase in other currency value, offset the impact of the increase in oil price for these countries. In other hand, the home currency value is a determinant variable for the home exports and economic growth therefore. As the world has become increasingly interconnected in terms of economic progress their work together has had a great influence on international economic policies and global economic governance\(^8\). Therefore, the influence of the G7 has expanded exponentially on the economy, especially in situations which could result in a global economic crisis. The G7 countries accounts for roughly 40% of the world’s total oil consumption, which implies that the G7 countries are very dependent on oil\(^9\). An oil price increase can damage these economies which are affected by a recession, after the global financial crisis, and not yet totally recovered.

\(^7\) Organization of oil exporting countries, composed from 11 countries: Iran, Libya, Saudi Arabia, United Arab Emirates, Qatar, Indonesia, Venezuela, Algeria, Nigeria and Iraq. Actually Indonesia is not part of OPEC.

\(^8\) Fratzscher, 2009

\(^9\) U.S. Energy Information Administration, 2006
C. Economic Background of Russia

After the fall of the Soviet Union the Russian Federation has undergone significant changes moving from a globally-isolated, centrally-planned economy to a more market-based and globally-integrated economy. Economic reforms in the 1990s privatized most industry, with notable exceptions in the energy and defense-related sectors. Although the transition to a market economy is moving slow, fueled by high oil prices and a cheap Russian ruble in, the economy had averaged 7% growth since the 1998 Russian financial crisis, resulting in a doubling of real disposable incomes and the emergence of a middle class.

During the last decade the economic development in Russia has improved the Russian wealth, the real personal income has increased by 12% to $10,700 in terms of PPP and the poverty is continuously declining, the Russian economy has been formed by an increasing investment and consumer-driven demand\(^{10}\). In 2008 economic growth was driven by non-tradable services and domestic manufacturing instead of the export sector of oil and gas\(^{11}\). Furthermore Russia's foreign debt has significantly been reduced and the current account balance measures up to $89.31 billion (2008) even though governmental control and restricted economic freedom are still present.

The oil and gas production in Russia is one of the highest in the world. Accounting for 80 percent of the country's export in 2009, Russia was the world's largest exporter of natural gas and the second largest exporter of oil\(^{12}\). Thus, the Russian reserves of oil and gas are the driving force of the economy, which indirectly makes the country vulnerably to fluctuations in world energy and fuel prices. The case of a fall in the price of oil can be reduced by usage of a foreign ex-change reserve, which can cover the losses. The government since 2007 has embarked on an ambitious program to reduce this dependency and build up the country's high technology sectors, but with few results so far. The Russian economy, therefore, was one of the hardest hit by the 2008-09 global economic crisis as oil prices plummeted and the foreign credits that Russian banks and firms relied on dried up. The Central Bank of Russia spent one-third of its $600 billion international reserves, the world's third largest, in late 2008 to slow the devaluation of the ruble. The economic decline bottomed out in mid-2009 and the economy began to grow in the first quarter of 2010. However, a severe drought and fires in central Russia reduced agricultural output, prompting a ban on grain exports for part of the year, and slowed growth in other sectors such as manufacturing and retail trade. High oil prices buoyed Russian growth in the first quarter of 2011 and could help Russia reduce the budget deficit inherited from the lean years of 2008-09, but inflation and increased government expenditures may limit the positive impact of these revenues. Russia's long-term challenges include a shrinking workforce, a high level of corruption, difficulty in accessing capital for smaller, non-energy companies, and poor infrastructure in need of large investments.

D. Economic background of China

In the last 25 years the average annual GDP growth rate has been approximately 9.4% and today China is the second largest economy in the world after the U.S\(^{13}\). In 2010, with export sector measures up to $1.435 trillion, China became the world's largest exporter. Although the fast economic growth, the income level per capita is still lower middle-income\(^{14}\). In 2009, the global economic downturn reduced foreign demand for Chinese exports for the first time in many years, but China rebounded quickly, outperforming all other major economies in 2010 with GDP growth around 10%. In July 2005 the Chinese government revalued its currency towards to the U.S dollar by 2.1% and moved to an exchange rate system that is dependent of a basket of currencies after having it fixed to the U.S dollar,

\(^{10}\) Cheng et al, 2007  
\(^{11}\) The CIA World Fact Book, 2009  
\(^{12}\) The CIA World Fact Book, 2009  
\(^{13}\) Cheng et al, 2007  
\(^{14}\) The CIA World Fact Book, 2009
but the exchange rate remained virtually pegged to the dollar from the onset of the global financial crisis until June 2010, when Beijing allowed resumption of a gradual appreciation.

The energy demand in China has surged to fuel the fast expansion of the industrial and commercial sector as the economy is growing. China is the second largest consumer of energy products in the world behind United States\textsuperscript{15}. The majority of the energy consumption in China originates from coal, which China is the largest producer and consumer in the world of. The oil consumption is the second largest energy source and China has emerged from being a net oil exporter to becoming the world’s third-largest net importer of oil\textsuperscript{16}. The Chinese government is seeking to add energy production capacity from sources other than coal and oil, focusing on nuclear and alternative energy development. The high-energy demand in China is expected to increase in the future and the government has declared interests in oil exploration and production abroad, as well as strengthening their current agreements with oil production countries and regions such as Russia, Central Asia, Iran, Venezuela and Myanmar\textsuperscript{17}.

Two economic problems China currently faces are inflation - which, late in 2010, surpassed the government's target of 3% - and local government debt, which swelled as a result of stimulus policies, and is largely off-the-books and potentially low-quality. An oil price increase may deep these two problems.

E. Economic Background of India

With its 1 billion inhabitants the main sectors of the Indian economy are village farming, modern agriculture, handicrafts, diversified manufacturing industries and the service sector. India has capitalized on its large educated population to become a major exporter of information technology services and software workers. Thus services are the major source of economic growth, accounting for 53.4 percent of GDP\textsuperscript{18}, with only one-third of Indian labor force. Unlike China, India's economy is not as dependent on export revenues with slightly more than half of the work force is in agriculture. As a result, India was affected far less by the global economic downturn than were many other nations of the world. India's GDP grew by about 6.0 percent in 2008 and 2009. In 2010, the Indian economy rebounded robustly from the global financial crisis - in large part because of strong domestic demand - and growth exceeded 8% year-on-year in real terms. Merchandise exports, which account for about 15% of GDP, returned to pre-financial crisis levels. An industrial expansion and high food prices, resulting from the combined effects of the weak 2009 monsoon and inefficiencies in the government's food distribution system, fueled inflation which peaked at about 11% in the first half of 2010, but has gradually decreased to single digits following a series of central bank interest rate hikes. In 2010 New Delhi reduced subsidies for fuel to lower the government's deficit. The Indian Government seeks to reduce its deficit to 5.5% of GDP in fiscal year 2010-11, down from 6.8% in the previous fiscal year. India's long term challenges include widespread poverty, inadequate physical and social infrastructure, limited non-agricultural employment opportunities, insufficient access to quality basic and higher education, and accommodating rural-to-urban migration. However, as oil importer country, an increase in oil price can damage the social Indian policy and increase public deficit.

6. Empirical study
A. Methodology

Our objective is to investigate if there is any direct influence of the explanatory variable which is the oil price on economic growth or vice versa. A formal way to statistically test for whether one variable

\textsuperscript{15} Crompton & Wu, 2004
\textsuperscript{16} U.S energy information administration, 2009
\textsuperscript{17} Bhar & Nikolova, 2009
\textsuperscript{18} Desilva, 2006
leads another are known as Granger Causality tests. In the Granger-sense X is a cause of Y if it is useful in forecasting Y. In this framework "useful" means that X is able to increase the accuracy of the prediction of Y with respect to a forecast, considering only past values of Y. Such a test will not only test the relationship between two variables but which of the variables that affect each other. For example, changes in the oil price might affect GDP, but changes in GDP might not affect the oil price. Testing causality, in the Granger sense, involves using F-tests to test whether lagged information on a variable Y provides any statistically significant information about a variable X in the presence of lagged X. If not, then "Y does not Granger-cause X". The formula for Granger Causality is as follows:

1) \[ GDP_t = C_0 + \sum \alpha_i GDP_{t-i} + \sum \beta_i P_{t-i} + \epsilon_t \quad i = 1 \text{ to } p \]

2) \[ P_t = C_0 + \sum \alpha_i P_{t-i} + \sum \beta_i GDP_{t-i} + \epsilon_t \quad i = 1 \text{ to } p \]

Where the unidirectional causality from oil price to GDP is specified if, the sum of the estimated coefficients on lagged oil price are statistically different from zero and the sum of coefficients on lagged GDP is not statistically different from zero, equation 1. The counterpart that GDP is affecting the oil price is specified if the opposite results are obtained, equation 2. If both coefficients are statistically different from zero we will have bilateral causality where both variables are affecting each other (Gujarati, 2005).

Another caveat is that Granger-causality tests are very sensitive to the choice of lag length and to the methods employed in dealing with any non-stationarity of the time series. The usage of lags in a regression model within economics plays an important role. Mainly because people will not change their habits immediately after a change has been made. One major influence is whether the change is temporary or permanent; for example a sudden increase in income. If this income is not known to be permanent, one might not increase their personal expenditures directly. However, if this increase in income is proven to be permanent, one might increase the expenditures in succeeding periods. Thus there is a time-lag between the actual income change and actions taken by the affected individual. But also institutional effects, such as contractual obligations may prevent a direct change of actions (Gujarati, 2005). We choose the lag in each equation by Applying the Akaike Information Criterion. The prior step is to analysis whether individual series are stationary. The standard test for the presence of a unit root is the "Augmented Dickey Fuller test".

B. Data background

The oil price can fluctuate quite heavily over short periods of time, thus quarterly data was the maximum time period we found suitable for our analysis. Some country data chosen are quarterly while others are yearly since quarter data are not available for all countries. However, the test period is chosen to be long enough but also homogenous.

For G-7 countries, quarterly data from the beginning of 2000 to the end of 2010 are used for gross domestic product and oil spot price variables. We choose 2000 as starting year because strategies to face changes in oil prices are nearly the same during this period in this group of countries. In other hand this period is long enough to carry valid test and obtained accurate results. Data of spot oil price are obtained from the EIA (U.S. Energy Information Administration) while, data of gross domestic product are from the OECD statistics.

Quarterly GDP data for India are available through Q1-2010 only from OECD statistics; while for Russia GDP data are available starting Q1-2003 through Q3-2010.

---

19 See Granger, C. W. J., 1969, Investigating causal relations by econometric models and cross-spectral methods, Econometrica 37, 424-438
20 Gujarati, 2005
Since, quarterly GDP data are not available for China, we use in our study yearly data collected from IMF covering the period of rapid industrial and economic changes in China from year 1986 to year 2010.

Quarterly data from the beginning of 1998 to the end of 2010 are used for world GDP. These data are based on yearly data published by IMF and generated by statistical methods and is largely based on averaging procedures.

From IMF and World Bank we collect yearly GDP data for OPEC countries starting year 1986 through 2010. In order to fill out the missing values in Iraq GDP, from 1991 to 1996, we used linear interpolation. This is a commonly used method to find unknown variable estimates through the use of a straight line between two known values. The value that lies in between is the estimated value. The formula for linear interpolation reads: \( \text{Unknown value} = V_1 + \frac{(V_2 - V_1) \times (t_n - t_1)}{(t_2 - t_1)} \) Were \( V_1 \) is value 1, \( V_2 \) is value 2, \( t_2 \) time at 2, \( t_1 \) at time 1 and \( t_n \) is the time value at the unknown point. All variables are taken in Log.

**C. Results**

**C.1. Stationary test Results**

According to computed ADF value presented in table 1, hypothesis of a unit root cannot be rejected for all variables in levels. The results further suggest that taking first differences remove these roots from the series implying that all individual series are integrated of order 1 (I(1)).

**Table 1:** Unit Root Tests for individual series in Log

<table>
<thead>
<tr>
<th>Variables</th>
<th>Models</th>
<th>m</th>
<th>Calculated ADF in levels</th>
<th>m</th>
<th>Calculated ADF in Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \log P_t )</td>
<td>Intercept</td>
<td>0</td>
<td>-1.346487</td>
<td>1</td>
<td>-8.75412***</td>
</tr>
<tr>
<td></td>
<td>Trend &amp; Intercept</td>
<td>0</td>
<td>-2.735735</td>
<td>1</td>
<td>-8.724693***</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>0</td>
<td>0.769072</td>
<td>1</td>
<td>-8.654441***</td>
</tr>
<tr>
<td>( \log GDP_t )</td>
<td>Intercept</td>
<td>4</td>
<td>0.386453</td>
<td>3</td>
<td>-2.627848*</td>
</tr>
<tr>
<td></td>
<td>Trend &amp; Intercept</td>
<td>4</td>
<td>-1.747728</td>
<td>3</td>
<td>-2.649587***</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>4</td>
<td>2.090150</td>
<td>3</td>
<td>-1.612958***</td>
</tr>
<tr>
<td>OPEC countries</td>
<td>Intercept</td>
<td>0</td>
<td>1.876192</td>
<td></td>
<td>-3.819062***</td>
</tr>
<tr>
<td></td>
<td>Trend &amp; Intercept</td>
<td>0</td>
<td>-0.774528</td>
<td></td>
<td>-5.047501***</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>0</td>
<td>2.495043</td>
<td></td>
<td>-3.386044***</td>
</tr>
<tr>
<td>G-7 countries</td>
<td>Intercept</td>
<td>0</td>
<td>-1.378357</td>
<td>0</td>
<td>-5.070644***</td>
</tr>
<tr>
<td></td>
<td>Trend &amp; Intercept</td>
<td>0</td>
<td>-1.374701</td>
<td>0</td>
<td>-5.043631***</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>0</td>
<td>0.975675</td>
<td>0</td>
<td>-5.047603***</td>
</tr>
<tr>
<td>Russia</td>
<td>Intercept</td>
<td>2</td>
<td>-1.895021</td>
<td>1</td>
<td>-3.163075</td>
</tr>
<tr>
<td></td>
<td>Trend &amp; Intercept</td>
<td>2</td>
<td>-0.434462</td>
<td>1</td>
<td>-3.802767*</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>2</td>
<td>1.333054</td>
<td>1</td>
<td>-2.849071</td>
</tr>
<tr>
<td>China</td>
<td>Intercept</td>
<td>0</td>
<td>1.355913</td>
<td>3</td>
<td>-4.505847***</td>
</tr>
<tr>
<td></td>
<td>Trend &amp; Intercept</td>
<td>0</td>
<td>-1.169227</td>
<td>3</td>
<td>-4.887868***</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>0</td>
<td>6.500252</td>
<td>3</td>
<td>0.482407*</td>
</tr>
<tr>
<td>India</td>
<td>Intercept</td>
<td>4</td>
<td>0.536946</td>
<td>3</td>
<td>-2.778292*</td>
</tr>
<tr>
<td></td>
<td>Trend &amp; Intercept</td>
<td>4</td>
<td>-2.070848</td>
<td>3</td>
<td>-2.843199</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>4</td>
<td>2.937061</td>
<td>3</td>
<td>0.135865</td>
</tr>
</tbody>
</table>

*** Significant at the 1% level, ** Significant at 5% level, * Significant at10% level

Source: Author calculation
C.2. Causality test Results

Table 2: Granger Causality Tests

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Obs</th>
<th>Lags</th>
<th>F-Statistic</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>D(LogGDP) does not Granger Cause D(LogP)</td>
<td>93</td>
<td>4</td>
<td>1.96193</td>
</tr>
<tr>
<td></td>
<td>D(LogP) does not Granger Cause D(LogGDP)</td>
<td>0.92</td>
<td>H0 accepted</td>
<td></td>
</tr>
<tr>
<td>OPEC countries</td>
<td>D(LogGDP) does not Granger Cause D(LogP)</td>
<td>23</td>
<td>1</td>
<td>0.26367</td>
</tr>
<tr>
<td></td>
<td>D(LogP) does not Granger Cause D(LogGDP)</td>
<td>0.46041</td>
<td>H0 accepted</td>
<td></td>
</tr>
<tr>
<td>G-7 countries</td>
<td>D(LogGDP) does not Granger Cause D(LogP)</td>
<td>41</td>
<td>2</td>
<td>1.15406</td>
</tr>
<tr>
<td></td>
<td>D(LogP) does not Granger Cause D(LogGDP)</td>
<td>12.1835</td>
<td>H0 rejected</td>
<td></td>
</tr>
<tr>
<td>Russia</td>
<td>D(LogGDP) does not Granger Cause D(LogP)</td>
<td>26</td>
<td>4</td>
<td>2.28760</td>
</tr>
<tr>
<td></td>
<td>D(LogP) does not Granger Cause D(LogGDP)</td>
<td>2.69976</td>
<td>H0 accepted</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>D(LogGDP) does not Granger Cause D(LogP)</td>
<td>23</td>
<td>1</td>
<td>0.00246</td>
</tr>
<tr>
<td></td>
<td>D(LogP) does not Granger Cause D(LogGDP)</td>
<td>0.02353</td>
<td>H0 accepted</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>D(LogGDP) does not Granger Cause D(LogP)</td>
<td>33</td>
<td>4</td>
<td>2.48138</td>
</tr>
<tr>
<td></td>
<td>D(LogP) does not Granger Cause D(LogGDP)</td>
<td>0.05053</td>
<td>H0 accepted</td>
<td></td>
</tr>
</tbody>
</table>

Source: Author calculation

According to the results presented in table 2, we cannot reject the hypothesis that changes in gross domestic product does not granger causes changes in oil price for the world, G-7 and OPEC countries as well as individual countries as India, China and Russia. We cannot reject also the hypothesis that changes in oil price does not Granger causes changes in gross domestic product for the world, OPEC countries and India Russia and China but for G-7 countries.

We note therefore, as presented in table 3, that for Russia, if we consider the variable oil price without log the Granger causality runs two-way from oil price to gross domestic product and the other way.

Table 3: Granger causality test for Russia considering the variable oil price without log

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>D(P) does not Granger Cause D(LOG(GDP))</td>
<td>26</td>
<td>4.97633</td>
<td>0.00768</td>
</tr>
<tr>
<td>D(LOG(GDP)) does not Granger Cause D(P)</td>
<td>4.03714</td>
<td>0.01762</td>
<td></td>
</tr>
</tbody>
</table>

7. Conclusion

The purpose of this paper is to investigate if world economic growth can be explained by changes in the oil price. We also investigate if there are any differences in oil price effects on economic growth between countries, with a focus on the selected countries and group of countries. Thus, we cannot confirm the findings by Jimenez-Rodríguez and Sánchez state that there is a relationship between oil price and economic growth.

The overall results proved to show that there is not a clear relationship between oil price and world economic growth. For exporter countries we found that the increase in oil price didn’t cause the increase in economic growth. In fact the inflows of funds to oil exporter countries after an increase of oil price found their way outside these countries and do not perform economic development goals. These countries need to develop institutions in order to channel the capital inflows to profitable economic projects.

Although strategies and policies to face the changes in oil price adopted by G-7 countries, we found that changes in oil price imply changes in gross domestic product, the reason is probably the already existing oil-dependency. Changes in oil price affect the economic growth of G-7 countries because consumers and producers behavior change to adjust with changes in oil price. While we cannot confirm this finding for Russia, China and India, since the market in these countries is more controlled.
by government regulations which means that inflation can be better controlled. Thus, the G-7 countries are the only countries investigated in this paper which in order to sustain economic growth, have interest to keep oil price at low level. Furthermore, the currency appreciation for Eurozone as response to an increase in oil price, make their products more expensive and therefore less competitive. As consequences, the transfer of income from oil importer countries to oil exporter countries, the extra revenue accruing to oil exporters after an oil price increase may be re-spent on Chinese or Indian or other nation products supporting their economic growth and making an oil price increase not significant for world economic growth but for G-7 countries.

References