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Oil price fluctuations and its effect on GDP growth

A case study of USA and Sweden

Bachelor thesis within Economics

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Abstract

During the year of 2008, the world has experienced historically high oil prices reaching an all time high of 147 USD per barrel in midsummer. The extreme volatility of what is consider the number one source of energy reopened discussions about energy sustainability and the plausible effects of an oil shock in the global economy.

How reliable oil price is as an economic variable predicting fluctuations in GDP growth remains controversial. Several models have been developed by scholars targeting different relations between oil price and GDP growth, from its effects on stock markets to its effect to unemployment. The authors extended the model of Mork & Olson (1994) since it focuses on the consequences that an oil shock effect on GDP growth. The model is extended from 1993 to the third quarter of the year 2008 in order to draw conclusions and test crude oil prices fluctuations affect GDP growth in the modern economy.

The U.S.A and Sweden were chosen to compare their GDP sensitiveness to oil price volatility. The reason is that the U.S.A remains as the largest economy and consumes 25% of the oil produced in the world and is the most oil dependent among developed countries according to the EIA. Sweden on the contrary energy efficient and consumes relatively less oil per capita than many developed countries, it is also believed to be one of the most progressive countries in developing and using renewable energy resources and therefore less sensitive. The bivariate results does not show a pattern of negative correlations for Sweden between GDP growth and real oil price increases, however the U.S.A showed to be more sensitive to oil price increases.

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1 Introduction

The conference “Oil Price Volatility, Economic Impacts, and Financial Management: Risk-Management Experience, Best Practice, and Outlook”-Washington D.C. March 10 - 11, 2008 started like this:

“Oil prices aren't just rising, but the volatility is also worsening-fluctuations are more pronounced than they were in the 1990s, creating unpredictable consequences."

Oil represents one of the most important macroeconomic factors in the world economy and the crude oil market is the largest commodity market in the world. What makes oil price changes even more interesting is not only their direct impact on economic activity, but also the changes in oil prices might reflect or even forecast changes in the intercontinental stability.

As a difference from other commodities oil is probably one of the few or the only production input that can affect both positively and negatively economic growth, to an extent that it might even lead to a recession. Oil price volatility dampens growth through different channels, from an increase in production cost to inflation expectations.

According to the Energy Information Administration (EIA) Global economic performance remains highly correlated with oil prices. Overall, an oil-price increase leads to a transfer of wealth from importing to exporting countries through a shift in the terms of trade. The magnitude of the direct effect of a given price increase depends on the share of the cost of oil in national income, the degree of dependence on imported oil and the ability of end-user to reduce their consumption and switch away from oil (IEA, 2006).

The oil-GDP relationship became a popular research topic in 1980s. Hamilton, J.D (1982) at U.C. Berkeley, found a negative correlation between oil prices and GDP growth, which proved that recessions in the U.S.A economy and the oil shock during the sample period. In 1973 Alice Rivlin, a highly regarded economist, found that the US Congressional Budget Office estimated that the 1973 increase cost the US economy $350 billion. (Hamilton, 1982)

The empirical evidence from a growing body of academic literature and reports from government institutions clearly suggests that oil price increases dull macroeconomic growth by increasing inflation and unemployment and depressing the value of financial and other assets, at least in oil importing nations (Awerbuch, 2003).

For most developing countries oil accounts for a large proportion of gross domestic product expenditures in energy production. According to the IEA, oil accounted for 40% of the global energy needed in 2000. Significant increases in energy prices will lead to a considerable rise in production and transportation cost for many industries and hence drives wages and inflation upwards, which at the same time will dampen economic growth (O’Neill, Penm & Terrell,2008).

According to Hamilton & Herrera (2003) inexpensive oil is crucial for the world’s demand for energy but its availability is scarce, therefore volatility in supply will have substantial economic impact. That volatility in supply can be translated into “Peak oil”. With the ever growing demand of oil OPEC´s production capacity in the 2000´s was not enough to satisfy the world demand so the price of oil skyrocketed from 11$ a barrel in 1999 to all time high in history 147$ a barrel in august 2008.

Taking into consideration the events of the year 2008 and the amount in the price change mentioned in the paragraph above, one can understand the current importance of oil volatility and how motivating this research topic might be for economist and governmental energy agencies.

Up till today oil price and GDP relationship is investigated from many different points of view by many researches .In general they agree that oil prices and its supply is vital to economy and oil price increases, more importantly volatility dampens growth. For example researches made by IEA shows recent estimations that 10$ oil price increase would lop 0.5 per cent off global GDP, creating $225 billion losses over several years. (Awerbuch, 2003).

We chose two countries U.S.A and Sweden. The reason is that the U.S.A is the biggest economy in the world and consumes 25 per cent of the world's oil production and is the most price sensitive among all developed countries. Although since the first oil crisis of 1973,the U.S.A has reduced its use of petroleum as a share of its economy, there is a growing dependence on imported oil as its production drops and reserves depleting. In 1973, net imports of petroleum made up 35 percent of petroleum product supplied (consumption). For 2000, this share has risen to over 50 percent and is expected to reach 64 percent by 2020 (IEA, 2006).

Sweden on the contrary energy efficient and consumes relatively less oil per capita than many developed countries. We expect to see oil price volatility affect the U.S.A more than Sweden since its share of oil in national income is much larger.

1.1 Research Problem

The negative relationship between oil price and GDP is proven by many scholars as it can be seen from the literature review section of this paper. However energy efficiency policies of last decade and tendency in the world to greener technology decreased oil consumption. Therefore the authors have chosen to investigate the plausible affects of recent oil shocks in short run GDP growth of two different countries. The developed countries were chosen because they dependency and oil share in energy consumption is dramatically different, so there exposure to oil price fluctuations is different

Questions:

- Is there a correlation between oil price fluctuations and short run GDP growth?
- Is the change in GDP growth the same for price increases as for price decreases?

1.2 Purpose

The purpose is to investigate the plausible short run effects of oil price volatility in GDP growth.

1.3 Outline

The first section provides an introduction to the topic of oil-GDP relationship. The second section gives background of the oil demand and supply history. This is followed by the presentation of the theoretical framework with emphasis in important concepts, definitions and the theories used when the variable of energy is included as an input to production. The following section provides the empirical testing results and analysis originated from the bivariate regression model. Following are the conclusion then the references list and to finalise the Appendixes.

1.4 Method

The linear regression model by Mork & Olson (1994) was selected because the model focuses on the bivariate correlation between oil prices and GDP growth. In addition it provides recommendations to establish a number of lags because the effects of an oil shock are not immediate. Their model is extended to the countries of Sweden and the U.S.A during a sample period that starts from the last year their model took into consideration which is 1993 to the third quarter of the year 2008. The data for the regression was gathered primarily from Statistics Sweden and the U.S.A C.I.A.

2 Background

The following section presents brief oil supply and demand history. They are main determinants of price dynamics in the long run. To have a better picture of the problem this section is helpful.

2.1 Oil demand and supply history

Demand. In the early years of the 20th century the introduction of the internal combustion engine (engine of cars) provided a demand for petroleum products that has largely sustained the industry to this day. Since then over the 20th century scientist discovered many different products and industry inputs from oil that are important to almost all industries and manufacturers now. They range from power generators and cars to simple medicine tablets and pens. There are few industries and services left that directly or indirectly do not use oil and oil products. Not surprisingly crude oil market is the largest commodity market in the world. Throughout the last and present eras of industrialization, in different parts of the world, demand for oil never stopped to increase. In fact at the present time it is seen as impossible to stop increasing demand. A first indicator of the economic growth is considered rapidly increasing oil demand or consumption.

Demand for oil comes mostly from developed and fast growing developing countries such as USA, EU countries, Japan, China and India. As countries develop, industry, rapid urbanization and higher living standards drive up energy use, most often of oil.

Between 1950 and 1973 the world oil industry grew nine fold, a rate of increase of 10% per year, sustained over a period of 20 years. During that time period, the world produced over 2.5 billion new motor vehicles, half of which in the United States. (Wright, 2006)

In 1950s the world´s demand for oil was 11 million barrels per day. This number has multiplied to 57 million barrels per day (mb/d) in 1970s and to a little more than 80 mb/d in our times. The U.S.A consumes 20.7 mb/d (Figure 3), which is the more than any nation and equals the consumption of the next five largest national consumers (China, Japan, Germany, Russia and India). (Wright, 2006)

World demand has recently grown faster than ever as the economies of China (6.5 mb/d) and India (2.3 mb/d) have developed and growth with the 10 per cent annually, but the United States remains the largest consumer.

China has seen oil consumption growth by eight per cent yearly since 2002, doubling from 1996-2006 (Figure 3). India's oil imports are expected to more than triple from 2005 levels by 2020, rising to 5 million barrels per day. (IEA, 2006)

Along with the demand growth speed and volume, the structure of the oil consumption of the country is important. Because sensitivity to the oil price volatility depends on how fast and cheap the economy can move to alternative energy source.

The U.S.A's consumption is comprised of four major sectors: transportation, industrial, electricity generation and residential/commercial. Transportation accounts for almost 70 per cent of all US oil consumption, of which two thirds is motor gasoline. Country's population accustomed to cheap and plentiful gasoline and has structured cities and lifestyles around this fact. (Wright, 2006).

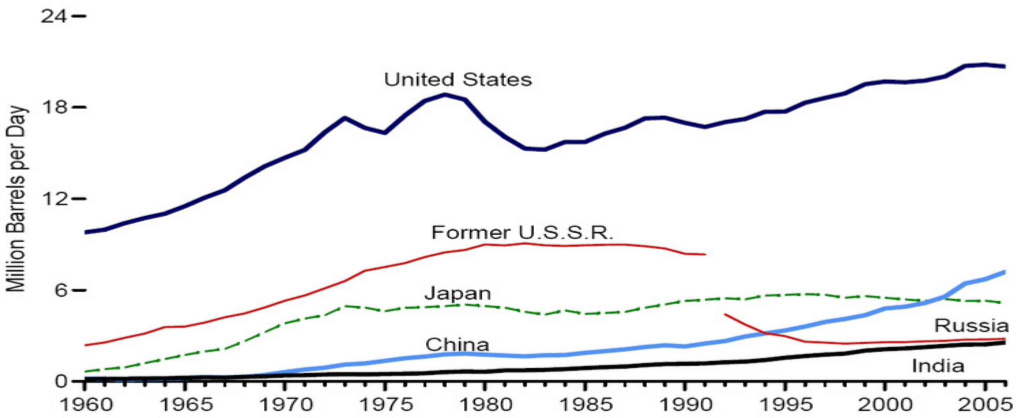

Figure 1. Biggest consumers demand growth.
Source: US DOE, Energy Information Administration, Annual Energy Review 2005

When it comes to overall world crude oil demand, it grew an average of 1.76% per year from 1994 to 2006, with a high of 3.4% in 2003-2004 and is projected to increase 37% over 2006 levels by 2030 (118 million barrels per day from 86 million barrels), the largest part of increase in demand will come from the transportation sector. (IEA, 2006)

Supply. Supply of oil is very important, taken into account its crucial role in world's everyday life. Since petroleum usage in industrial scale originated in Europe and USA, first oil wells were drilled in Europe, Russia and USA. But European countries never were big oil producers until hydrocarbon reserves were discovered in North Sea 1970s.

Initially kerosene was the driver of the petroleum industry, but a big production need became apparent after Fords method of automobile production made it possible to buy cars for many ordinary people, not only elite.

In 1948, the United States became a net importer of oil. Together with other industrialized countries USA's economic growth became very dependent on foreign oil supply. Although the U.S.A is one of the largest producer at 8.5 million barrels per day, it consumes 20.5 million barrels per day and the majority of the consumption is imported. (EIA, 2006)

There have been three supply shocks in the recent history.

In 1973 Arab oil embargo: the Yom Kippur War, or the Arab-Israeli Conflict, sparked a series of political and economic crises. In response to Western support of Israel, the Arab countries of OPEC placed an embargo on oil supplies to the United States on October 16th, 1973. (Wright, 2006)

In 1979 Iranian revolution: Khomeini, the religious leader came to the power after protesters overthrow Shah, the monarch of Iran. At that time Iran was producing 6 million barrels per day, which decreased to almost half.

In 1991 Gulf war and Soviet Union collapse: Saddam Hussein invades Kuwait, both big oil producers, created crisis of supply but for a shorter time than in previous crises. Soviet Union was one of the biggest producer collapsed, decreased supply as well at that time.

Below, figure 4 illustrates that every shocks caused significant drop in supply and were reason of big disturbances in the market. From the first supply shock industrialized nations understood that cheap oil was history and since then energy efficiency and oil supply became national security issues.

During the first half of the past century the industry as a hole and supply, which means price determination, was concentrated in the hands of the so called "Seven Sisters"[1], but later it passed to OPEC.

The biggest five American companies successfully created an oligopoly in union with the 3 European firms. Smaller companies entered the market during the course of history, but never rivaled the scope of the pioneer companies. The oligopoly proceeded to make up business and legal systems for extracting oil and controlling supply. But this situation did not last long, big profits, undermining the interests of reserve owner countries started to create a lot of unrest among population and nationalization progressed.

In response to the growing industry and rising profits, the producing countries began to push back against the oil industry and formed the Organization of Petroleum Exporting Countries (OPEC)[2]. (Wright, 2006)

The aim of the creating OPEC was to change decision making centers from west to resource owner's territory.

Today there is no real country or organization that effectively influences or controls supply as used to have "Seven Sisters".

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[1] "Seven Sisters" is the term given to the fist seven pioneer companies of the industry that grow to multinational level and dominated the industry. They are American – Exxon, Texaco, Mobil, Gulf and Chevron – one French (Total S.A), one Dutch (Shell) and one British (British Petroleum)

[2] OPEC was created in 1960 by Iran, Iraq, Kuwait, Saudi Arabia and Venezuela. Eight other countries later joined OPEC: Qatar (1961); Indonesia (1962) but 2008 stopped membership; Libya (1962); United Arab Emirates (1967); Algeria (1969); Nigeria (1971); Ecuador (1973) and Gabon (1975).

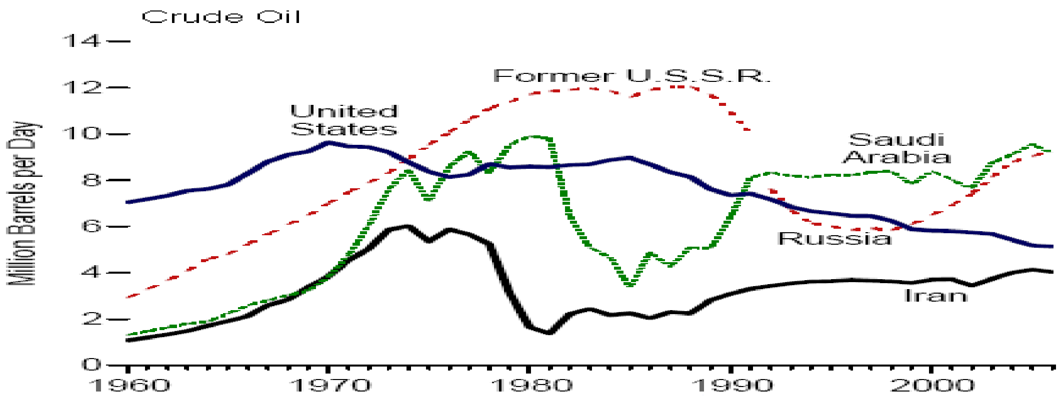

Figure 2. Top oil producing countries 1960-2006.
Source: US DOE, Energy Information Administration, Annual Energy Review 2006

As can be seen from the figure 4 supply was stable before 1970s. Big disruptions in supply starts form 1973 and never stabilized to perfect since then.

Today production is more stable than before but many new different risks appeared which affects price to be volatile.

2.2 What explains oil price volatility?

Most experts say that increased crude oil markets and price volatility can be due to unanticipated economic developments. Chinese and Indian unforeseen heave energy demand and the declining weighted value of the U.S dollar can be recent examples. From the figure below it is obvious that first oil shock was the beginning of the era of the price instability that made world economic growth slower.

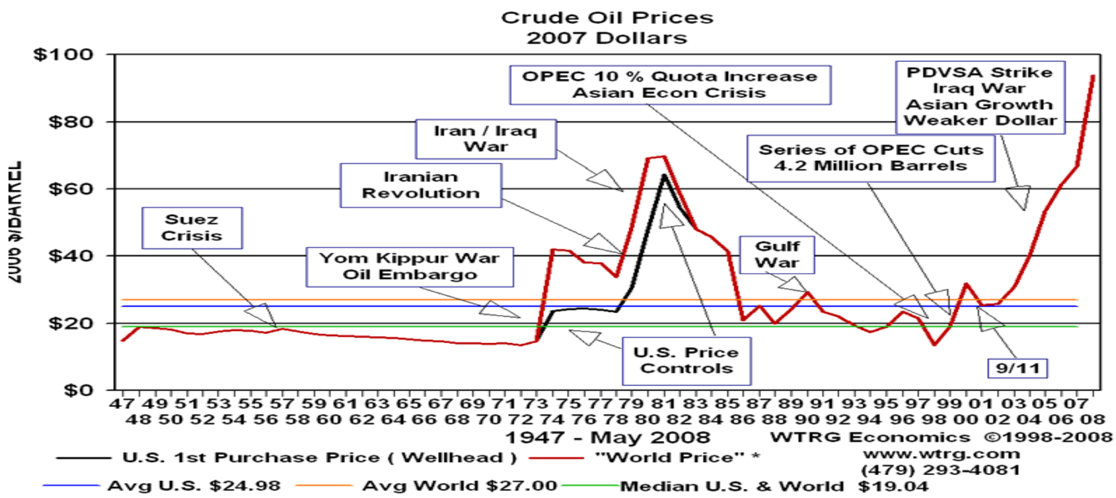

Figure 3. Crude Oil Prices 2007. **Source: www.wtrg.com**

Throughout the history many factors caused price instability but recent frequent volatility is some thing that world never experienced (figure 5). We can say that there are two kinds, economic and noneconomic reasons of increased oil price volatility. Some of the economic causes are economic growth followed by high growth of demand for oil in developing countries was not offset by sufficient supply, under investment to new prospective projects caused by resource nationalism, recent skyrocketed price of exploration technology, maturing old oil wells, depreciation of dollar value against world currencies.

Short term big price fluctuations are mainly affected by news of US economic performance and petroleum and gasoline inventory data.

Long term volatility is affected by more fundamental demand and supply forecasts and long term world economic performance.

Noneconomic factors are mostly politically motivated. For example countries with big oil reserves do not reveal real oil data for investors, so they could be sure of profitability of there investment projects. Countries manipulate oil data for the benefit of their political influence and consider it national security matter. This uncertainty keeps most of the investors reluctant from investing in big perspective projects, which could secure steady supply. The accountability of the countries problem is connected to the so called "Peak oil" theory. The theory says that the maximum rate of global extraction will be reached in some point in time, after which the rate of production will decline.

Instability in the regions of oil producing countries caused by wars for resource control and week protection of investor's rights in resource abundant countries caused by different political uncertainties also noneconomic reasons.

Political games were so intensive last decades that investments to new projects, which provides steady supply, were totally ignored and as a result so called "spare capacity"[3] of oil producers disappeared.

International Energy Agency, Europe's energy agency, was created to protect western importers interests, accuse OPEC for not pumping enough oil to meet the demand, which causes price volatility. But OPEC mainly brings problem of not enough refinery capacity of the world and says that it can increase production any time but it will not calm down the instability in the markets.

There are many reasons for price instability but in the long run, more than one year period, price is affected by estimations of world economic performance. As historical data shows that in recessions period price of oil drops and vice versa. For example during the last quarter of 2008 we witnessed remarkable drop in oil price from highest 147$ per barrel to lowest 45$ a barrel in world markets, mainly due to global economic crisis and forecasts of very low demand for 2009.

This creates another dangerous circumstances as low prices can make investment in new oil projects not profitable as prices fell below the marginal cost of production. Later when world will recover from crisis, there can be less supply than demanded again and it can contribute for future high price volatility again.

2.3 Oil intensity of the U.S.A and Sweden.

Oil price volatility and oil GDP relationship are important only, when "oil intensity"[4] of economy is increasing or already big enough to threaten the stability of economic growth. In the beginning of the 1070's the U.S.A and Sweden had similar energy dependence on fossil fuel. But since first oil shock two countries succeeded differently in decreasing fossil intensity. In this section reader can get some insight to the chosen countries petroleum dependence.

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[3] Spare capacity is the possibility of oil producing countries to have extra capacity that is not used at the moment but in case of demand can be used and increase supply to stabilize the market.

[4] Oil intensity is defined as the number of barrels of oil required to generate $1000 of GDP.

The U.S.A

The U.S.A's oil consumption is approximately 21 million barrels per day (mb/d), yet the domestic production is only 8.5 mb/d. The import cost of oil is approximately $630 billion dollars a year (at $115/barrel). While it costs the Arabian Peninsula just one U.S. dollar to extract a barrel of oil, the cost on the world market has varied up to $147/barrel in 2008. (Wright, 2006)

Although the U.S.A has about 22 billion barrels of oil reserves, it is really small if compared to annual consumption level, which is about 7.6 billion barrels per year in 2006, with the usage increase of 2 % per year. (EIA, 2006)

If we look at the total population and the amount of oil consumption things get clearer. Americans constitute less than 5% of the world's population (around 305 million), but consume 26% of the world's energy to produce 26% of the world's industrial output. From the worlds total about 25% of the world's petroleum consumption goes to the U.S.A., while it produces only 6% of the world's annual petroleum supply and having only 3% of the world's known oil reserves.(CIA, 2007)

The 1973 oil crisis forced policy makers and companies to focus on oil efficiency and to take steps towards energy conservation. Even though oil dependence of US economy since then did not grow with the same path as prior to crisis, among developed nations US is the most oil inefficient and remains as a biggest consumer (per capita) country.

The trend in the figure below shows relative success of the policy of energy conservation that policy makers of the U.S.A implemented, but at the same time the statistics of the present situation with oil dependence proves that country most oil intensive in the world.

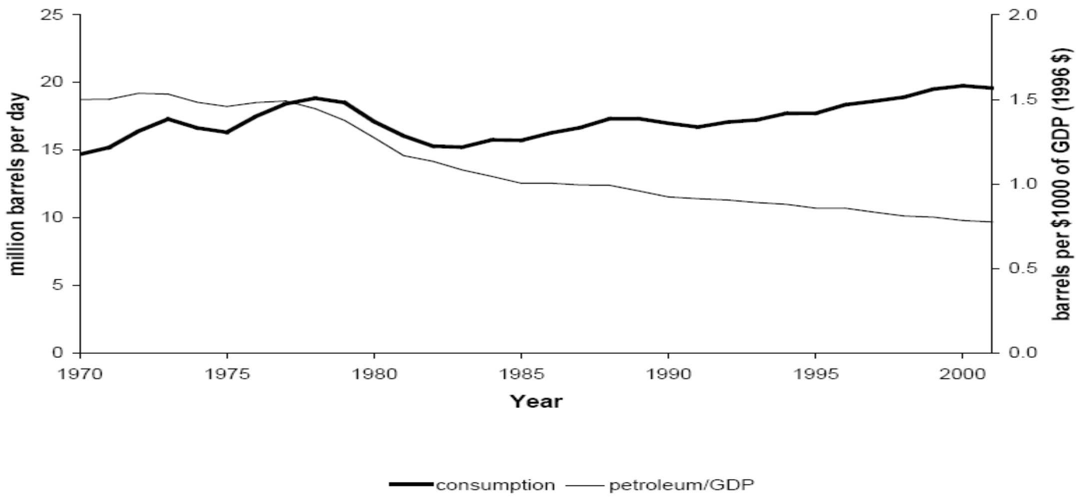

Figure 4. US trends in petroleum consumption. Source: EIA 2002

Now the U.S.A is facing problems related to oil supply like increasing world and domestic petroleum products demand, unstable oil prices, declining domestic production (peak oil), dependence on unsteady imported foreign oil, and deteriorating infrastructure, like refineries and the pipeline in Alaska.

Sweden.

At the moment when first oil shock hit the world many countries were enjoying cheap oil. Sweden was one of them. Together with many countries Sweden made decision to change it and as can be seen from the figure 5, it succeeded.

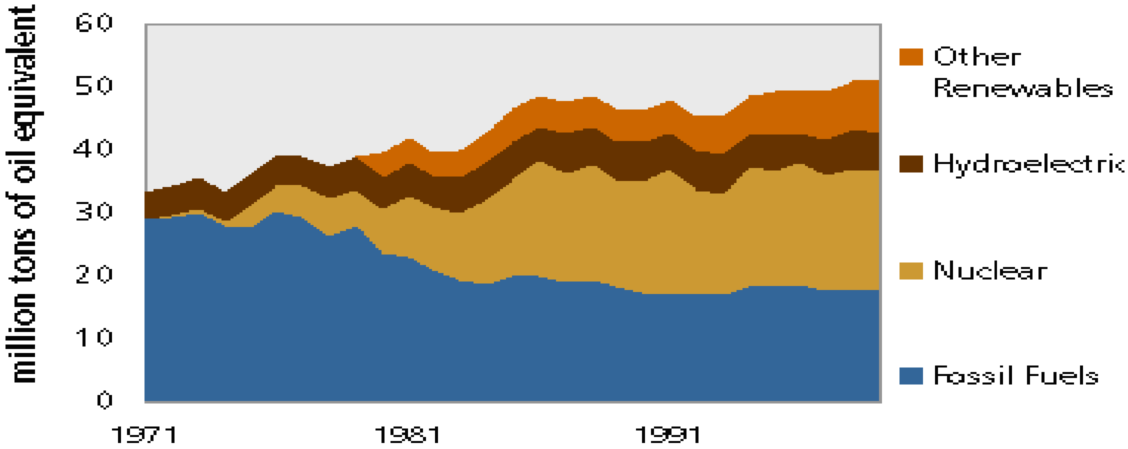

Figure 5. Energy Consumption by Source, 1971-1999, Sweden.
Source: World Research Institute website (Sweden country profile).

From modern energy means Sweden is well endowed mostly with hydro potential, which it uses to very considerable extend. Most of the electricity comes from hydro and nuclear power plants. Heating and most industrial production is on the electricity. Oil consumption mainly comes from transportation and infrastructure projects (asphalt roads).

As of 2008, 43% of the Swedish primary energy supply comes from renewable sources, which is the largest share in any European Union country. (Marckert, 2008)

If we look at comparative per capita oil consumption of two countries Sweden again more successful. According to British Petroleum's annual world energy outlook the U.S.A consumes 25.13 barrels per person and Sweden 14.64 per person.

Although Sweden is less dependent on fossil fuel, 20 % is seen as dangerous amount by the government. Sweden was first in the world that came with the policy of what is called "oil phase-out in Sweden" until 2020. Although it was not proposed to end the use of oil entirely, purpose was independence from exposure to oil supply disturbances risks with developing more alternative, renewable sources available.

Oil price fluctuations affect directly or indirectly all countries. In figure 6 upward trend is the cost to economy from recent oil price increase for Sweden. The topic of our paper becomes even more interesting when we see that no countries are free from effect of energy supply and price instability.

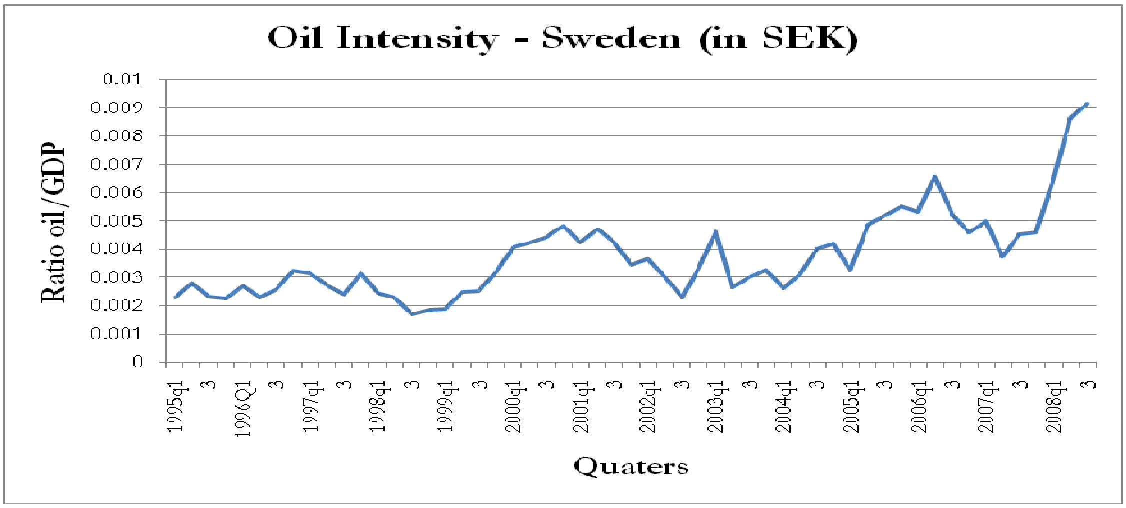

Figure 6. Oil intensity of Sweden.
Source: Figure made by authors using data obtained from Swedish statistics bureau.

2.4 Oil and GDP relationship.

Since petroleum became very important commodity in world's life and economy, the relationship between oil and macroeconomics is mostly investigated through oil prices.

The existence of a negative relationship between oil prices and macroeconomic activity has became widely accepted since Hamilton's (1983) work indicating that oil prices increases reduced US output growth between 1948-1980. Hamilton's results have been confirmed and extended by a number of other researchers. (Awerbush, 2003).

The most energy economists came to the conclusion that the majority U.S. post World War 2 recessions, as well as 2001 recession, were caused by sharp increase in oil prices.

One conventional explanation is that oil price increases lower GDP growth by raising production costs. Alternatively and complementarily, large oil price changes, either increase or decrease, may affect aggregate output adversely because they delay business investment by raising uncertainty or costly sectoral resource reallocation, for example, from more adversely influenced sector to less adversely influenced sector, and such reallocation is costly.(H. Gou and K.L.Kliesen 2005)

This makes clear that crude prices increase affect negatively on output and employment, because the increase act as a tax on consumption. Moreover, firms facing higher cost, increase prices for their products, which means increase in inflation.

If output growth slowed because of uncertainty delays investment in capital goods, this brings another result, since employment growth tends to be highly dependent on output growth, price volatility decreases employment growth and increases unemployment rate.

Price volatility influences financial markets both directly and indirectly. Actual as well as anticipated changes in economic activity, corporate earnings, inflation, and monetary policy following the oil price increases will affect equity and bond valuations, and currency exchange rates. (FT, 2008)

2.5 Literature review.

It has not been accepted as an empirical fact the negative correlation between oil prices and real output. Hamilton (1983) reported a robust link between the "oil crisis" of the 1970s and the U.S recession. Mork (1989) confirms Hamilton results finding a strong negative correlation between oil price increases and the growth, the relation based on oil price increases persist in a sample extended beyond the 1985-1986 oil price decline.

It is necessary to mention another perspective on this matter in the earlier 1980´s before Hamilton's result were published whereas several authors proposed alternative hypothesis that focus on major events occurring roughly coincidentally. Some of this alternative hypothesis points the final breakdown of pegged exchange rates in 1973 and the widespread adoption of price controls in the U.S in 1971. Such controls may have caused understatement of the GNP deflator compared to true values. In 1973-1975 when controls were relaxed real income fell back to its real values giving an illusion of a deeper recession. Michael R. Darby (1981)

Research suggests that there is a significant effect of energy supply disruptions on economic activity. A notable relation between energy prices and aggregate measures of output and employment have been reported [5]. Other authors successfully predicted the U.S recession of 2001 from a multivariate analysis in which energy prices featured prominently.[6] It has also been demonstrated that oil shocks are a major force driving changes in international trade and has been attributed to the transfer of wealth between oil importers and oil exporters Backus and Crucini (2000).Nevertheless another author Mark Hooker (1996) demonstrated that neither Hamilton nor Mork (1989) linear relation between oil prices and output is consistent with observed economic performance between 1986 and 1996. As Hamilton stated "*Hooker´s evidence is overwhelming and his conclusion in unassailable*". Oil price changes are clearly an unreliable instrument for macroeconomic analysis of data subsequent to 1986 Hamilton(1996).

The belief that energy price shocks increases contributes to economic slowdowns remains controversial, partly because of Hooker findings of the unstable relationship over time between oil prices and GDP growth. Nevertheless a number of authors in the field have attributed such instability of empirical relationship to misspecification of the functional form Loungani (1986), Hamilton (1996) and Cuñado and Perez de Gracia (2000) among others mentioned on the paper by Hamilton (2003).

To conclude this section, Hamilton's third claim in his paper of 1988 is that :

"Large fluctuations in output can be generated by small disruptions in the supply of primary commodities such as energy. The benefits of a price decline on crude oil price would be smaller than the damages caused by an increase in price of similar size"(Hamilton,1988)

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[5] Hamilton, J.D (2003) mentions Rashe and Tatom (1977,1981), Burbidge and Harrison(1984), Santini (1985), B.C Daniel (1997) and Carruth et al (1998), among others.

[6] Muelbauer and Nunziata (2001) are mentioned in Hamilton.J.D (2003) literature review.

3 Theoretical Framework

This section describes RBC Real Business Cycles theory which was selected to explain how external shocks to the economy like oil shocks have a short run effect in capital and labor which in turn reflects in GDP growth. Following the model by Kim & Loungani (1992) shows how the variable of energy is included in their RBC model. To end this section the cost components when oil exporter countries decide to raise oil prices are presented as well as an explanation of why the effect on growth from price increases is different from price decreases.

3.1 RBC Theory or Real Business Cycles

RBC Theory or Real Business Cycles sustains that business cycle fluctuations to a large extent are subject to real shocks which affect market dynamics. They consider that economic crisis and fluctuations are a consequence from an external shock, such as technology shocks. Previous research found out that many cyclical events cannot be explained by a model driven only by technology shocks. This lead to models where additional disturbances are included such periods of bad weather, natural disasters, oil shocks, stricter environmental and safety policies, etc (W.S., George 1994)

According to George, W.S (1994) another way to classify RBC models is through differentiating the strongest impulses driving the cycle: Do they arise from a demand shock or a supply shock in the economy? Some economist attributes the latest oil shock to OPEC supply constraints and some other to demand by Asian economies.

The basic idea that lies in RBC theory is that if and an external shock occurs that directly changes the effectiveness of capital and/or labor. This in turn has an effect on workers and firms decisions, which in turn change their consumption and production patterns and thus eventually affect output in a negative way. (Finn, E.K., 1982)

This theory has some implication in the results in a sense that it supports that a prominent oil shock will affect growth. Business cycles vary tremendously in magnitude and duration therefore cycles does not appear to be alike. The magnitude of the price changes in the last oil shocks and the duration of it differ from the current oil shock being analyzed. The results in this thesis exhibit less correlation which can be explained by changes in economic fundamental that will be discussed in the conclusion.

3.2 Modeling GDP growth treating energy as a variable in RBC

According to the RBC theory provided we can consider that economic output fluctuations can arise from an oil shock.

In order to find a model that allows to include the variable of energy represented by oil into a GDP growth model, The Prescott & Kidland (1982) model served as an starting point since they show that the neoclassical growth model Solow (1956) is capable of replicating many of the features of modern business cycles.

The real business cycle (RBC) model of Prescott & Kidland (1982) has been manipulated including different variables targeting several directions according to the authors as displayed in table 1.

Table 1. Extension of the RBC model

Author	Contribution or variable included
Hansen (1985)	Labor indivisibilities
Benhabib, Rogerson, and Wright (1990)	Home production
Benzivinga(1988)	Preference shocks
Kim & Loungani (1992)	Role of energy price shocks

Source: Mork & Olson (1994)

Whether the state of technology affects GDP or not does not concern the authors of the present thesis. However the extension by Kim & Loungani in their paper *Energy in real business cycle models* considers in particular the role of energy price shocks. In the model the business cycles or representation of short run GDP are generated by exogenous oil price shocks as well as productivity shocks or constraints of supply. This model serves as reference to establish the reduced form of macro-economic model used later by Mork & Olson (1994) which will be extended in this paper by the authors from 1993 until the third quarter of 2008.

3.3 Cost components

When oil exporter countries decide to raise oil prices above the competitive market level, oil importing countries face three types of cost categorized by Greene, D.L. (2000) as:

1. Production output decreases for the reason that a key factor of production has become more expensive.
2. Unexpected changes in oil prices drive unemployment up, which in turn reduce economic output
3. A part of the wealth of oil consuming nations is transfer to foreign oil producers nations.

Whether the high oil prices during 2008 are a consequence of OPECS initiative is not the primary focus, nevertheless the cost components that come with an increase in oil price could be an explanatory reason of why the U.S.A and Sweden shows a decrease in growth when oil prices increase

3.3.1 Loss of potential GDP

When the price of oil is raised, the increased price of oil warns the economy that a basic resource has all of a sudden happen to be scarcer. *The loss of potential GDP* is the denomination given to the contraction of GDP when a primary resource in the economy becomes scarcer. Even if all resources are fully employed in their optimum use, the potential to produce is reduced because in economic terms oil is scarcer. As a result, economic output falls below its full potential. Since such *economic adjustment costs* result from the economy's inability to respond quickly, they are temporary and are believed to dissipate over a time frame of three to five years. (Greene, 2000)

This loss is expected to be larger for the U.S.A. The data suggest that Americans are more dependent in oil as a source of energy than Swedes. Sweden can rely on nuclear and electric sources of energy to keep production at a similar phase but the U.S.A might be forced to reduce output.

3.3.2 Macroeconomic adjustment cost

"*The adjustment costs triggered by Macroeconomic adjustment are the most complex of the three cost components because they depend not only on the price shock itself, but on policy responses (e.g., contraction or expansion of the money supply) and on expectations about the length of the price increase*" (Lee, K..S., & Ratti, R.A. ,1995)

Despite of the efforts that each country undertakes, a rise in production cost will follow up by an increase in wages to cover increases in living cost expenses. This boost in costs raises the economy's aggregate price level. The effectiveness of contractions or expansion in the money supply will depend on each country's economic department and policies. In the absence of an expansion of the money supply in terms of real money, the money supply adjusted for the price level, decline. Interest rates go up, hampering investment, and through the multiplier effect, output and with an stagnation in output there is no growth.(Greene, 2000)

I has been found that oil price shocks caused much greater job destruction than sources of labor, the study also found that the most energy intensive sectors suffered more than twice the employment losses than the least energy intensive industries. A country with a large energy intensive sector in which oil is a primary resource will feel the oil shock more and probably for a longer time. (Greene, 2000)

3.3.3 The Transfer of Wealth

The last of the cost component is a *transfer of wealth* from oil consuming to oil producing countries. The phenomenon definitely worsens the terms of trade, and it reflects the fact that consuming nations have to trade more resources for the same quantity of oil due to the exercise of monopoly power by the oil producers. The transfer of wealth is not seeing as a loss of the worlds economic output since resources lost by consuming nations is kept by producing nations. It is, however, a real economic loss to the consuming countries. As it can be seen from figure 7 since 2001 until 2007 the transfer from oil consuming nations has rocketed and climbed up to $3 trillion. (Greene, 2000)

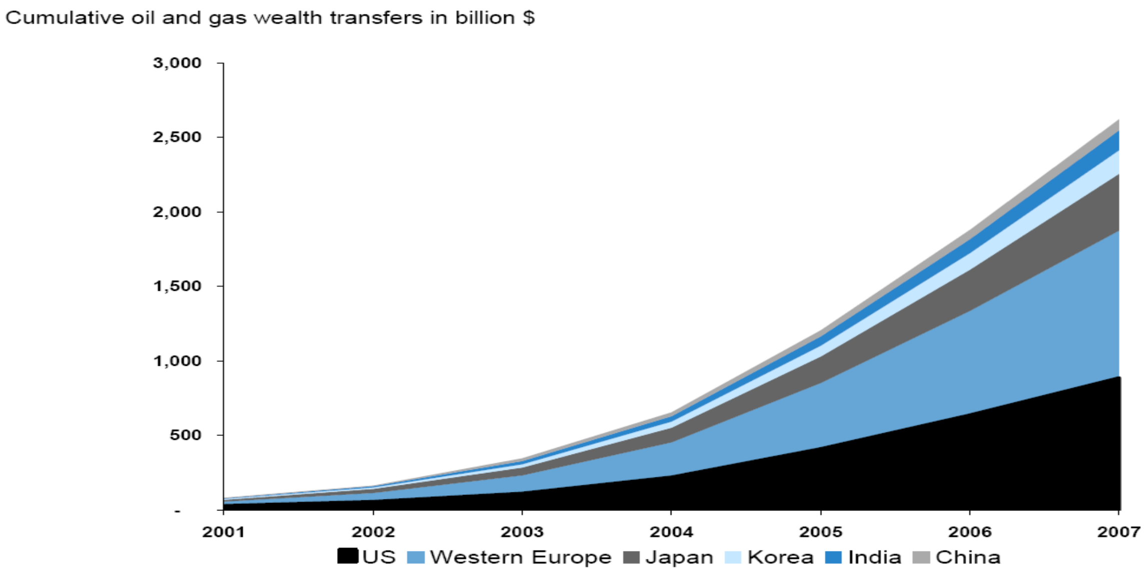

Figure 7. The Transfer of Wealth
Source: International Energy Agency IEA and Goldman Sachs Research Database.

3.4 Price increase differs from a price decrease

Supporting Hamilton's findings that the benefits of a price decline on crude oil price would be smaller than the damages caused by an increase in price of similar size. In his paper "*Macroeconomic Responses to oil price increases and decreases in seven OECD countries"* Mork & Olson (1994) show how a distinction can be made between the effects when the price fluctuate.

In general the effects on GDP for a price increase and a price decrease are expected to be different. For an oil price increase is likely to be negative unless the energy producing sector accounts for a large portion of the country economy which is the case of most oil exporter's countries. In a multi sector model with more friction for resources it is possible that the loss of output due to reallocation of resources could offset the gains from an oil-price decrease, even if the country imports all its oil. (Mork & Olson 1994)

3.5 Hypothesis

In earlier research Hamilton reported a statistically significant correlation between oil price shocks and economic recessions in the postwar period in America (Hamilton1983) .The findings have been corroborated by many authors even though the analysis vary in approach. Such evidence makes the variable of energy qualify as shock to GDP in business cycles and reject the idea of historical coincidence.

It is important to mention that the share of energy in total GDP in money terms is the variable that makes the shock differ from country to country. Energy can be treated as an input to production .One of the justifications of the authors to treat oil as energy is that crude actually accounts for 40% of the global energy needed According to the (IEA, 2006).

Motivated by previous findings, in the present paper we investigate this correlation in a different sample period from 1993-2008. And the hypothesis to test is the following:

1. Oil price increases have no effect on real GDP growth during the sample period.
2. Oil price decreases have no effect on real GDP growth during the sample period.

The hypothesis testing that oil prices can dampen economic growth through different channels in short business cycles should be reflected by a simple regression that will be presented in the following section.

4 Data and estimation models

A model that is consistent with different approaches while allowing us to test the hypothesis this paper is interested in is applied. The relevance of the theoretical section and the preceding chapter lies in its suggestions regarding hypothesis to test and variables to include. Following we analyze the bivariate correlation between oil-price fluctuations and GDP growth.

Mork & Olson (1994) did it similar to Granger Causality, that is by estimating a regression equation with the GDP growth on the left and lagged values of GDP and oil price changes on the right. First they enter real oil prices increases and decreases as separate variables. In addition they state that preliminary investigations suggest a lags of five quarters.

The regression estimated is from 1993 to the third quarter of the year 2008 and the data is pooled for the regression, these years were chosen because of available data for all the variables and they were divided into quarter to simulate short term business cycles.

4.1 Estimation Model

The literature suggests a number of ways to model macroeconomic data in addition to the procedures in the last section. In order to model the time series data of GDP growth, the equation by Mork & Olson (1994) provides a convenient starting place for testing for the negative correlation between oil prices and GDP growth, in this paper is taken into consideration lags of five quarters for the price of oil as they did and a reduced form GDP growth model.

$$Ln\ \text{QUOTE} = \beta_0 + \sum_{j=1}^{5} \beta_j \mathbf{y}_{t+j} + \sum_{j=1}^{5} \beta_j \mathbf{p}^{+}{}_{t+j} + \sum_{j=1}^{5} \beta_j \mathbf{p}^{-}{}_{t+j} + \mathbf{u} \qquad \textbf{(1)}$$

Where the dependent variable is $\hat{Y}_t$

$\hat{Y}_t$ is the growth rate in real GDP

y_t is the growth rate in real GDP

p_t^{+} equals growth rate in the real price of oil when the rate in positive and otherwise 0.

p_t^{-} growth rate in the real price of oil when the rate in negative and otherwise 0.

Where $Ln\hat{Y}_t$ is the dependent variable and y_t , p_t^{+} , p_t^{-} are the independent variables and *u* is the error term. The regression coefficients are β
From equation (1) it is expected a negative correlation whereas when p_t^{+} goes up then $Ln\hat{Y}_t$ decreases by less than p_t^{+} and the opposite should apply when there is a price decrease.

We can carry out the following two null hypotheses concerning this paper.

1. Oil price increases have no short run effect on real GDP growth: $H_0 : \beta_2 = 0$

$H_A : \beta_2 \neq 0$

2. Oil price decreases have no short run effect on real GDP growth: $H_0 : \beta_3 = 0$

$H_A : \beta_3 \neq 0$

4.2 Descriptive Statistics

GDP growth a normally distributed variable

Table 1A and table 1B in the second section of the appendix display the summary statistics of quarterly GDP growth for Sweden and the U.S.A from 1993 to the third quarter of 2008.

There are two ways of evaluating normality; Histogram and Jarque-Bera Normality test. Paying attention to the descriptive statistics of Sweden presented in table 1A of the GDP growth "descriptive statistics" it can be seen that the skewness is negative at -0.129, which reflects that the observed distribution has a longer "tail" to the left compared to the Normal distribution. The kurtosis is at 2.486 which is less than 3, and assuming that at 3 the distribution has a higher peak than the Normal distribution in the case of GDP growth it can be said the distribution follows a normal pattern. (Gujarati 2000)

For the U.S.A the observed distribution has a longer tail to the right and its skewness is positive. The Kurtosis is also less than 3 units and lies at 2.564 meaning that it does not has a higher peak that the normal distribution, reefer to table 1.A and 1.B in appendix for results.(Gujarati 2000)

5 Results and analysis

The results will be presented in a way that after each result an analysis will be displayed. This was chosen in order to make the paper more clear. To see the complete results of the regressions results refer to the second section in the appendix.

5.1.1 Results for the first regression model

Table 2. Results of regression of equation (4) for Sweden and the U.SA, 1993-2008.

		Sweden			**U.S.A**		
Price increases	Lag	Coefficient	t-value	P-value	Coefficient	t-value	P-value
	1	-0,00674	-0.592473	0.5573	-0,002867	-0.157174	0.8760
	2	-0,011831	-1.031463	0.3094	-0,000256	-0.014238	0.9887
	3	0,002161	0.200513	0.8422	-0,000183	-0.010499	0.9917
	4	0,003264	0.320950	0.7502	0,02041	1.300603	0.2014
	5	-0,010242	-0.911489	0.3683	**-0,042892**	**-2.340310**	**0.0248**
Price decreases	Lag	Coefficient	t-value	P-value	Coefficient	t-value	P-value
	1	-0,019443	-1.262376	0.2152	-0,004704	-0.173294	0.8634
	2	-0,012126	-0.656842	0.5156	-0,034424	-1.391141	0.1725
	3	-0,009435	-0.585253	0.5621	**0,048025**	**1.738566**	**0.0904**
	4	-0,005349	-0.270109	0.7887	-0,012712	-0.483837	0.6314
	5	-0,018101	-1.163468	0.2525	0,032479	1.162330	0.2525

With this model it can be appreciated that the p-values of each t-statistics are not significant for the country of Sweden under a 5% significance level, which is not in line with the hypothesis. However for the U.S.A they are at a significance level of 0.024 in the fifth lagged when the price of oil increases. It can be observed that the third lagged shows significance when price decreases if establishing a borderline significance level of 10%.

At 5 % level of significance, the null hypotheses cannot be rejected for Sweden, meaning that according to the model and the sample period oil price fluctuations have no effect on Swedish GDP growth. The results do not show a pattern of negative correlations for Sweden GDP.

For the United Stated it would be the opposite, a negative correlations arise from a price increase while a price decrease has as consequence a positive impact. According to the model and the sample period studied the U.S.A is more sensitive to oil fluctuations. A price increase will eventually have a negative effect on output and a price decrease a positive effect.

As we can observe from table 5.1 the more dependent country on oil which is the USA presents a coefficient of -0, 042 and a p-value of 0.024 in the fifth lagged variable when there is a real price increase for a price decrease the coefficient is 0,048 in the third lag and the p-value is less significant at 0.090.

5.1.2 Results for the regression model excluding $\hat{Y}_t$

In equation (2) the variable $\hat{Y}_t$ which represents the growth rate in real GDP is excluded. The aim is finding a model that fits the data better and focuses primarily on price fluctuations and verifies if the initial oil shock in the fifth quarter repeats again.

$$Ln\hat{Y}_t = \beta_0 + \sum_{j=1}^{5} \beta_j p_{t-j}^{+} + \sum_{j=1}^{5} \beta_j p_{t-j}^{-} + u \qquad (2)$$

Table 3. Represents the correlation between GDP growth and oil price increases and decreases excluding the variable of GDP growth.

Table 3. Results of regression of equation (2) for Sweden and the U.SA, 1993-2008.

		Sweden			**U.S.A**		
Price increases	Lag	Coefficient	t-value	P-value	Coefficient	t-value	P-value
	1	0.001844	0.165391	0.8694	-0.010896	-0.671529	0.5054
	2	**-0.021483**	1.896825	**0.0647**	0.006576	0.403703	0.6884
	3	0.000448	0.040891	0.9676	0.001285	0.078747	0.9376
	4	0.003859	0.370922	0.7126	0.014773	0.985480	0.3298
	5	**-0.018820**	1.838920	**0.0730**	**-0.028461**	-1.872165	**0.0678**
Price decreases	Lag	Coefficient	t-value	P-value	Coefficient	t-value	P-value
	1	-0.016138	1.079683	0.2864	-0.008454	-0.352577	0.7261
	2	-0.019440	1.150233	0.2566	-0.038440	-1.774924	0.0828
	3	-0.024169	1.569889	0.1239	**0.050297**	2.009663	**0.0506**
	4	0.006856	0.387220	0.7005	-0.012258	-0.544305	0.5890
	5	**-0.034580**	2.262521	**0.0289**	0.038822	1.566710	0.1243

Once excluded the growth rate variable, the result show that the initial oil shock affects the Swedish GDP in the third quarter and in the fifth, however the significance is weak. For a price increase in the third quarter the correlation is negative as expected and significance of 0.064 and for the fifth quarter the correlation is negative again and a significance of 0.073 when there is an increase in price. Price decrease seems to have a negative impact on Swedish GDP which is not in line with our hypothesis but will be discussed further on.

The results for the U.S.A are in line with the hypothesis. The initial oil shock in the United Sates for a price increase starts in the fifth quarter and it has significance of 0.067. For a price decrease the correlation is positive and has significance of 0.050 .Both countries seem to be affected by an oil shock during the fifth quarter, these results match previous research which motivates the authors to isolate the fifth lagged. (Mork & Olson 1994)

5.1.3 Results for the fifth lagged in the regression model excluding $\hat{Y}_t$

In order to strengthen the results the fifth lagged is isolated in equation 6.

$$Ln\hat{Y}_t = \beta_0 + \sum_{j=5}^{5} \beta_j p_{t-j}^{+} + \sum_{j=5}^{5} \beta_j p_{t-j}^{-} + u \qquad (3)$$

Table 4. Bivariate correlation between GDP Growth and oil price increases and decreases for the fifth lagged.

		Sweden			U.S.A		
Price increases	**Lag**	Coefficient	t-value	P-value	Coefficient	t-value	P-value
	5	**-0.018286**	-1.917	**0.0609**	**-0.026248**	-1.785553	**0.0800**
Price decreases		Coefficient	t-value	P-value	Coefficient	t-value	P-value
	5	**-0.028695**	-2.085	**0.0421**	0.024516	1.032776	0.3065

On the basis on the sample evidence we cannot accept the hypothesis that oil price increases that oil price increases have no effect on real GDP growth under a 10% borderline significance level. Swede seems to have a negative correlation and significance of 0.060 and the U.S.A showed significance of 0.080 it is important to mention that the results match previous findings as it can be seen from table 5.

Oil price decreases have a negative correlation for Sweden at a significance level of 0.042 where surprisingly the coefficient is -0.028. It can be said that oil price decreases have a negative effect on the real GDP growth of Sweden. For the U.S.A a decrease in the price of oil showed no significant results when isolating the fifth lagged.

Table 5. Approximate Historic GDP Decreases After a 10% Oil Price Increase for U.S

Authors	**Period Studied**	**%GDP Growth Decrease**	**Quarters after initial price shock**
Hooker	1948-1972	0.6	3-4
Hamilton(2000)	1948-1980	1.4	4
Rotemberg and W.	1948-1980	2.5	5-7
Source: Awerbuch, 2003 IEA Research Paper			
Present paper	1993-2008	0.2	5

If comparing the latest findings on U.S.A data the present paper performs quite well when the focus is restricted on an oil price increase. A table providing results for Sweden was not available. One drawback of this paper is the number of observations considering that initial shocks effects are expected to come five quarters after the prominent price increase.

6 Conclusion

Oil price fluctuation have a retarded effect on output, the magnitude of an oil shock will depend on the share that oil has on the overall energy production, and the initial oil shock might initiate in at different times on different countries. The result we have here confirmed previous research, however they might not be relevant due to few degrees of freedom but in comparison with other periods studied it can be said that growth is explained in lesser degree by oil price volatility, this can be due to governments attention on energy efficiency in the economy and the development of alternative energy sources and fuels. Figures 4 and 5 in the background section, relative oil to GDP ratios of the U.S.A and energy consumption per million GDP of Sweden can be observed. Both countries have considerable reduce their dependence in the last decade.

Economic fundamentals have developed since the 70´s, better performance of the global economy in 2000s and the lower oil-intensity of global production in the 2000s can explain the decrease in the oil price GDP correlation. (Steven, 2008)

As presented in the literature review of this paper, studies carried on before indicate that higher oil prices have a potential effect on the global economy through a variety of channels, including transfer of wealth from oil consumers to oil producers, an increase in the cost of production of goods, and impact on inflation, consumer confidence, policy adjustments and financial markets. The Swedish economy as we expected showed far more less dependence in oil price and GDP growth, it even showed a negative relationship between GDP growth and decreases in the price of crude which can be explained by the large share of nuclear, electric and hydraulic energy and the fact that during times of cheap oil nations give e preference to oil production and not to alternative energy sources. America on the contrary showed larger relationship which is in line with the expectations of the authors, a negative correlation when prices go up and a positive correlation when prices go down.While higher oil prices adversely affect stock market returns in the U.S.A, the United Kingdom and France, the effects are positive in other countries such as Canada and Australia as these countries are significant exporters of energy resources. This argument might hold for Sweden (O'Neill, Penm & Terrell,2008)

It is important to mention the limitations of the simple model since growth is affected by many other variables not taken into consideration therefore it is suggested for further research to expand the number of independent variable, expand the sample period and test both linear and nonlinear relationships as Hooker (1996) suggested. Another interesting case study would be that of how African developing economies get hurt by dramatic oil shocks such as the ones in 2008. And the last suggestion would be to analyse if there is a link between security market of crude as a commodity and its effects on real stock returns since it is a common believe that price volatility creates uncertainty in investments and contributes to relocation of resources in labour markets.

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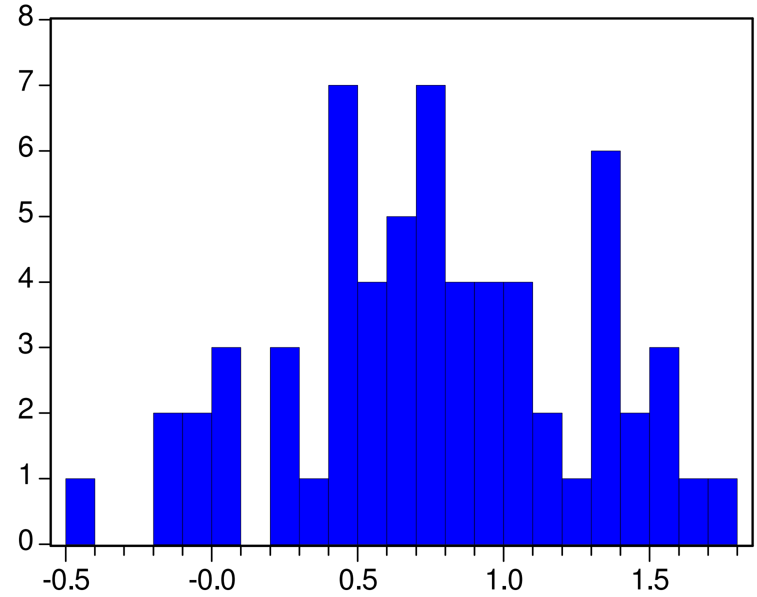
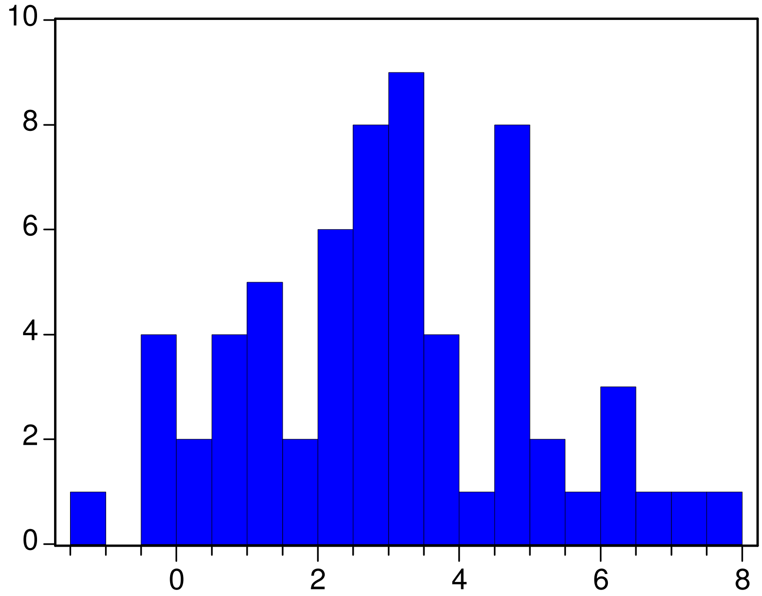
Appendix.

Table 1A. Descriptive Statistics for Sweden



Series: GROWTH	
Sample 1993Q1 2008Q4	
Observations 63	
Mean	0.715873
Median	0.700000
Maximum	1.700000
Minimum	-0.500000
Std. Dev.	0.500711
Skewness	-0.129573
Kurtosis	2.486840
Jarque-Bera	0.867537
Probability	0.648062

Table 2A. Descriptive Statistics for U.S.A



Series: GROWTH	
Sample 1993Q1 2008Q4	
Observations 63	
Mean	2.939683
Median	2.900000
Maximum	7.500000
Minimum	-1.400000
Std. Dev.	2.032838
Skewness	0.155398
Kurtosis	2.564944
Jarque-Bera	0.750402
Probability	0.687151

Section 2 .Regressions for Sweden and the U.S.A
Price equals the coefficient for a price increase. P equals the coefficient for a price decrease

Sweden .Table 5.1
Dependent Variable: LOG(GROWTH)

Method: Least Squares

Date: 01/16/09 Time: 14:40

Sample (adjusted): 1993Q2 2007Q2

Included observations: 53 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.267540	0.359718	-0.743749	0.4620
GROWTH(1)	0.257139	0.231617	1.110189	0.2745
GROWTH(2)	0.343920	0.186606	1.843025	**0.0738**
GROWTH(3)	0.250080	0.195617	1.278418	0.2095
GROWTH(4)	0.534507	0.208482	-2.563799	**0.0148**
GROWTH(5)	0.124375	0.251492	0.494548	0.6240
PRICE	0.001687	0.012158	-0.138785	0.8904
PRICE(1)	0.006740	0.011376	-0.592473	0.5573
PRICE(2)	0.011831	0.011470	-1.031463	0.3094
PRICE(3)	0.002161	0.010779	0.200513	0.8422
PRICE(4)	0.003264	0.010171	0.320950	0.7502
PRICE(5)	0.010242	0.011237	-0.911489	0.3683
P	0.011460	0.017637	-0.649781	0.5201
P(1)	0.019443	0.015402	-1.262376	0.2152
P(2)	0.012126	0.018461	-0.656842	0.5156
P(3)	0.009435	0.016122	-0.585253	0.5621
P(4)	0.005349	0.019804	-0.270109	0.7887
P(5)	0.018101	0.015558	-1.163468	0.2525

R-squared	0.440438	Mean dependent var	-0.281398
Adjusted R-squared	0.168650	S.D. dependent var	0.541875
S.E. of regression	0.494073	Akaike info criterion	1.692035
Sum squared resid	8.543793	Schwarz criterion	2.361191
Log likelihood	-26.83894	F-statistic	1.620523
Durbin-Watson stat	1.772358	Prob(F-statistic)	**0.111459**

Sweden. Table 5.2.

Dependent Variable: LOG(GROWTH)
Method: Least Squares
Date: 02/05/09 Time: 12:58
Sample (adjusted): 1993Q2 2007Q2
Included observations: 53 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.218670	0.280899	0.778465	0.4407
PRICE(1)	0.001844	0.011152	0.165391	0.8694
PRICE(2)	-0.021483	0.011326	-1.896825	0.0647
PRICE(3)	0.000448	0.010947	0.040891	0.9676
PRICE(4)	0.003859	0.010403	0.370922	0.7126
PRICE(5)	-0.018820	0.010234	-1.838920	0.0730
P(1)	-0.016138	0.014947	-1.079683	0.2864
P(2)	-0.019440	0.016901	-1.150233	0.2566
P(3)	-0.024169	0.015396	-1.569889	0.1239
P(4)	0.006856	0.017705	0.387220	0.7005
P(5)	-0.034580	0.015284	-2.262521	0.0289

R-squared	0.229819	Mean dependent var	-0.281398
Adjusted R-squared	0.046442	S.D. dependent var	0.541875
S.E. of regression	0.529143	Akaike info criterion	1.747356
Sum squared resid	11.75967	Schwarz criterion	2.156284
Log likelihood	-35.30493	F-statistic	1.253261
Durbin-Watson stat	1.794987	Prob(F-statistic)	0.287306

Sweden. Table 5.3

Dependent Variable: LOG(GROWTH)
Method: Least Squares
Date: 02/09/09 Time: 12:15
Sample (adjusted): 1993Q2 2007Q2
Included observations: 53 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.065431	0.117852	-0.555193	0.5812
PRICE(5)	-0.018286	0.009538	-1.917192	0.0609
P(5)	-0.028695	0.013758	-2.085657	0.0421

R-squared	0.100612	Mean dependent var	-0.281398
Adjusted R-squared	0.064636	S.D. dependent var	0.541875
S.E. of regression	0.524071	Akaike info criterion	1.600558
Sum squared resid	13.73250	Schwarz criterion	1.712084
Log likelihood	-39.41479	F-statistic	2.796668
Durbin-Watson stat	1.707334	Prob(F-statistic)	0.070580

Table 5.1 for the U.S.A

Dependent Variable: LOG(GROWTH)

Method: Least Squares

Date: 01/16/09 Time: 14:42

Sample (adjusted): 1993Q1 2007Q2

Included observations: 55 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.412788	0.518885	0.795528	0.4314
GROWTH(1)	0.005156	0.064441	0.080010	0.9367
GROWTH(2)	-0.005166	0.067699	-0.076305	0.9396
GROWTH(3)	-0.022922	0.067357	-0.340304	0.7356
GROWTH(4)	0.078825	0.067692	1.164465	0.2517
GROWTH(5)	0.050703	0.065572	0.773249	0.4443
PRICE	0.027829	0.017175	1.620319	0.1137
PRICE(1)	-0.002867	0.018242	-0.157174	0.8760
PRICE(2)	-0.000256	0.017968	-0.014238	0.9887
PRICE(3)	-0.000183	0.017457	-0.010499	0.9917
PRICE(4)	0.020410	0.015693	1.300603	0.2014
PRICE(5)	-0.042892	0.018328	-2.340310	**0.0248**
P	0.051992	0.028184	1.844763	**0.0731**
P(1)	-0.004704	0.027145	-0.173294	0.8634
P(2)	-0.034424	0.024745	-1.391141	0.1725
P(3)	0.048025	0.027623	1.738566	**0.0904**
P(4)	-0.012712	0.026274	-0.483837	0.6314
P(5)	0.032479	0.027943	1.162330	0.2525

R-squared	0.401267	Mean dependent var	0.949571
Adjusted R-squared	0.126173	S.D. dependent var	0.834403
S.E. of regression	0.779989	Akaike info criterion	2.599056
Sum squared resid	22.51016	Schwarz criterion	3.256002
Log likelihood	-53.47405	F-statistic	1.458656
Durbin-Watson stat	1.380781	Prob(F-statistic)	0.165402

Table 5.2 for the U.S.A

Dependent Variable: LOG(GROWTH)
Method: Least Squares
Date: 02/05/09 Time: 13:01
Sample (adjusted): 1993Q1 2007Q2
Included observations: 55 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.006170	0.406289	2.476486	0.0172
PRICE(1)	-0.010896	0.016226	-0.671529	0.5054
PRICE(2)	0.006576	0.016289	0.403703	0.6884
PRICE(3)	0.001285	0.016319	0.078747	0.9376
PRICE(4)	0.014773	0.014991	0.985480	0.3298
PRICE(5)	-0.028461	0.015202	-1.872165	**0.0678**
P(1)	-0.008454	0.023979	-0.352577	0.7261
P(2)	-0.038440	0.021657	-1.774924	0.0828
P(3)	0.050297	0.025027	2.009663	**0.0506**
P(4)	-0.012258	0.022521	-0.544305	0.5890
P(5)	0.038822	0.024779	1.566710	0.1243

R-squared	0.297233	Mean dependent var	0.949571
Adjusted R-squared	0.137513	S.D. dependent var	0.834403
S.E. of regression	0.774911	Akaike info criterion	2.504720
Sum squared resid	26.42146	Schwarz criterion	2.906187
Log likelihood	-57.87981	F-statistic	1.860966
Durbin-Watson stat	1.442544	Prob(F-statistic)	0.077516

Table 5.3 for the U.S.A

Dependent Variable: LOG(GROWTH)
Method: Least Squares
Date: 02/05/09 Time: 13:02
Sample (adjusted): 1993Q1 2007Q2
Included observations: 55 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.077668	0.178922	6.023119	0.0000
PRICE(5)	-0.026248	0.014700	-1.785553	**0.0800**
P(5)	0.024516	0.023738	1.032776	**0.3065**

R-squared	0.123482	Mean dependent var	0.949571
Adjusted R-squared	0.089770	S.D. dependent var	0.834403
S.E. of regression	0.796070	Akaike info criterion	2.434743
Sum squared resid	32.95386	Schwarz criterion	2.544234
Log likelihood	-63.95544	F-statistic	3.662821
Durbin-Watson stat	1.708127	Prob(F-statistic)	0.032493