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"A study of Financial Crises, and their Relation to the Oil and Gas Industry"

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Executive Summary

This thesis investigates the relationship between the main oil indicators and the probability of a financial crisis. The main oil indicators include oil consumption, oil production and oil price. The financial probability is based on Carmen Reinhart's BCDI+ index, which is a financial turbulence index, and Robert Barro's definition of crises based on a cumulative decline in GDP and 'Consumption'.

The methodology used in order to establish a quantitative relationship between the main oil indicators and the probability of a financial crisis is: Poisson regression and Logistic regression. As to the current knowledge, this methodology has not been used before.

The first section is a qualitative analysis of the issue, starting with an introduction of financial crises over the last century and the history of the oil and gas industry, subsequently moving on to James Hamilton's (1983) analysis of its relation to the economy. The section continues with an introduction to Carmen Reinhart's theory and data from the book 'This Times is Different: Eight Centuries of Financial Folly' where the BCDI+ index is explained. The section ends with an examination of Robert Barro's working paper 'Macroeconomic Crises since 1870' where he uses a cumulative decline in 'Consumption' and GDP to identify crises.

The second section uses a quantitative approach to further analyze and justify the issue in concern. This section starts with an overview of data and methodology, where some basic descriptive statistics, in addition to a contingency table, are included for each variable. The aim of including this part was to assess the data's reliability and validity and get a basic indication of whether or not the data point out any crises. After this, a correlation analysis of the variables is performed. The final and most important part of the quantitative analyses includes various logistic regressions and Poisson regressions.

The thesis ends with a conclusion which presents the findings from the quantitative analyses, performed to reveal the relationship between the probability of a financial crisis and the main oil indicators. Oil consumption and oil production were excluded from the regressions because of inadequate data. The analysis gave some ambiguous results in how an increase in the oil price increases the probability of a financial crisis. Three possible explanations for these ambiguous results are the volatility of the oil price, the behavior of the oil price during the crises defined with a binary variable equal to 'one' in the regressions, and the position of oil price in the global economy.

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Preface

This thesis is written as the final part of my masters after two years of studying within economics and business administration, with a specialization in applied finance. My topic for the thesis is: "A Study of Financial Crises, and their Relation to the Oil and Gas Industry."

In a previous class 'Investments', I studied the global crisis of 2007 and the different impact it had on Ireland and Norway. We found out that the crisis was managed very differently by the two countries and thus affecting them in very diverse manners. Norway was able to protect itself by channeling the returns generated by oil and gas into a Sovereign Fund (Oljefond), which was utilized to keep the economy stable.

I am currently working for Subsea7, which is a global oil service company. From the experience gathered, I was able to observe firsthand how the most recent global financial crisis affected the global oil and gas industry. This prompted me to choose a thesis topic that investigates the relationship between financial crises and the oil and gas industry. After discussing with my supervisor Loran Grady Chollete, we agreed on the topic "A Study of Financial Crises and their Relation to the Oil and Gas Industry."

In another previous class, I have used data from Carmen M. Reinhart. She has, together with Kenneth S. Rogoff, written the book 'This Times is Different: Eight Centuries of Financial Folly', which was a comprehensive study of financial crises. This made me interested in reading further on it and using extracts for my thesis.

In addition to this, my supervisor Loran Grady Chollete recommended Robert Barro's working paper 'Macroeconomic Crises since 1870'. Robert Barro uses an approach different to that of Carmen Reinhart to identify crises. We therefore decided that my basis for the thesis should consist of Carmen Reinhart's and Robert Barro's data in addition to different oil indicators. To our knowledge, this relationship had not been analysed before.

The process has at times been time-consuming and stressful, but overall an exciting and informative experience. I would like to thank my supervisor Loran Grady Chollete for helpful and constructive guidance. I would also like to thank Stina Kommedal and Hemalee Wanigasuriya for being two good fellow students during the studies. The last thanks go to Subsea7 for their support, especially my line manager Roar Saurdal which has given me the time off from work so that I was able to accomplish this degree.

1.0 Introduction

During the last century, the world has experienced a number of financial crises. Financial crises are nothing new; they have occurred since the development of money and financial markets. Even though financial crises have been experienced before, they usually take us by surprise and create fervor in the field of finance and economy. It appears that the most recent financial crises have been more comprehensive, affecting a significant number of economies. This can be due to increased globalization of the financial markets. Globalization of the financial markets have encouraged increased import, export, trading, borrowing and lending across borders which again have led to increased capital flow between countries. Benefits such as optimization of international resources, international risk sharing, reduced macroeconomic volatility and economic growth (International Monetary Fund [IMF], 2007) can be observed. However, it has also brought disadvantages when it comes to risk and financial contagion effects. Since the financial crisis of 2007 affected a large number of countries, it has attracted a lot of attention from financial analysts and the media.

After the second industrial revolution, the world experienced a new era in the fields of technology and commercial industries, which in turn created an increasing demand for crude oil. Not only did it become important for the commercial industries, but the availability of crude oil became an important resource during the two world wars. More and more countries have during the last decades transformed into modern industrialized economies, where oil has become a central determining factor in the standard of living. From the 1970s 'the black gold' has played a significant role in the global economy and there are many markets analyses based on oil and its relation to financial crises.

1.1 Approach to the problem

"A Study of Financial Crises, and their Relation to the Oil and Gas Industry" is a broad topic which can be analyzed or defined by different approaches. Therefore, it is important to identify a specific approach to the problem.

Robert Barro and Carmen Reinhart are two of many economists who have studied the probability of a financial crisis based on national accounts and a number of financial instruments. Several well-known economists, such as James D. Hamilton (1983), have followed the oil price and its relation to the macro economy. However, the relationship

between main indicators of the oil and gas industry and the probability of a financial crisis has not been fully discovered. Therefore, this thesis is an attempt to combine two main components: The probability of a financial crisis and the main indicators of the oil and gas industry.

A suitable approach to be addressed in this thesis therefore became:

"How do the main oil indicators affect the probability of a financial crisis?"

In order to discuss and answer the above question, the thesis uses three main sources of data. The first source of data is the BCDI+ index introduced by Carmen M. Reinhart and Kenneth S. Rogoff, in their book 'This Times is Different: Eight Centuries of Financial Folly'. The BCDI+ index is a financial turbulence index composited of **B**anking crises, **C**urrency crises, **D**ebt crises (internal and external), **I**nflation crises and to stock market crashes (+). The index summarizes the number of crises experienced each year for a specific country.

The second source of data is Robert Barro's data for 'Consumption' and 'Gross Domestic Product' introduced in the working paper 'Macroeconomic Crises since 1870'. 'Consumption' is measured in real capita personal consumer expenditure and GDP is based on national account data. The authors define a crisis as a cumulative decline of 10 percent or more in respectively 'Consumption' and GDP.

The last source of data is the oil related factors or indicators of the oil and gas industry: oil consumption, oil production and oil price.

To be able to address the question and quantify the relationship between the main oil indicators and the probability of a financial crisis, a quantitative approach is adopted. Two basic relationships will be analyzed using the approach:

- The relationship between Carmen Reinhart's BCDI+ index and Robert Barro's data for 'Consumption' and GDP
- The relationship between Carmen Reinhart and Robert's Barro's data and the oil related data

Before any quantitative analyzes are carried out, it is beneficial to get a proper overview of the history and theory behind the quantitative data. The first section in the thesis therefore contains an introduction to the historical footprint of financial crises, an overview of the

history of oil and its relation to the macro economy, and an introduction to Carmen M. Reinhart's and Robert Barro's theory and data.

The second section is an attempt to give a quantitative basis for the relationship under discussion. It starts with some basic descriptive statistics to give the reader a better visual understanding of the data. Then the dependence between the data is examined in the form of a correlation analysis. Finally, the section ends with the main analysis of data using a logistic regression and a Poisson regression. The results are then presented in the conclusion as an attempt to answer the question which was addressed above.

1.2 Limitations

The thesis is based on secondary data composited by Carmen M. Reinhart and Robert Barro. The data has therefore been directly implemented in the thesis using the same assumptions as the authors. In addition to this, the availability of data has sometimes been inadequate which has curtailed the number of the variables. Because the thesis has being written within the last six months, obviously the time limit will reduce the number of analyses as well.

2.0 Financial Crises from 1900 to 2012

In order to get a better understanding of financial crises, their extent and their outcome, the next section gives a brief overview of the most familiar financial crises over the last century.

2.1 Panic of 1907

In 1907, the United States entered an economic recession, later named 'The Panic of 1907'. During the beginning of the 1900s, a major number of trust funds were established as an attempt to consolidate numerous businesses in the United States. One of these schemes included F. Augustus Heinze and Charles W. Morse's attempt to corner the stock of the United Copper Company. While Heinze and Morse were buying shares in the copper business, they discovered that the market was dealing in more shares than they assumed which caused the scheme to fail. In October 1907, The Bank of Commerce announced that they would no longer accept checks form Knickerbocker Trust, which had financed 'the Heinze and Morse scheme', and soon after Knickerbocker Trust, the U.S. second-largest trust company, declared bankrupt (Gordon, 2011). The United States' economy was already fragile; the stock market was falling, the gold supply from England varied, the dollar deflated and the supply of credit was low, which again led to rising interest rates. During the next weeks, the panic spread to the rest of the financial markets; commodity prices had fallen with 21 percent, the dollar volume of bankruptcy had spiked by 47 percent and unemployment had risen from 2.8 to 8 percent (Bruner & Carr, 2007, p. 141-142). The panic of 1907 was now a fact.

2.2 World War I

The assassination of Austria's archduke in Sarajevo on June 28th 1914 is said to be the trigger of World War I. Before the assassination, there had been high tension between the Balkan states, especially between Serbia and Austria-Hungary.

Since Russia was a part of the 'Triple Entente' with France and Great Britain and supported the Balkan states, Austria-Hungary consulted with Germany before they took any action against Serbia. Germany saw this as an opportunity to get more influence in Europe, and as Austria- Hungary introduced a set of terms that was unacceptable for Serbia, Austria-Hungary declared war. Because Russia supported Serbia, the war turned out to a battle between the 'Triple Entente' composed of Russia, France and Great Britain and the 'Triple Alliance'

composed of Germany, Austria-Hungary and Italy. However, it turned out Italy did not trust Austria-Hungary and made a secret treaty with France. The war turned out to be a composition of alliances as Germany, France and Great Britain all had colonies on the African continent and invaded several other European countries. Australia, Canada and New Zealand had already offered their assistance to Great Britain. A world war had started. The United States had stated that they did not want to enter the war as it had not affected them to a great extent. However, in 1917 after Germany had promised Mexico land in the United States, the United States declared war against Germany. Many soldiers were killed and the countries lost a substantial amount of human and physical capital. In addition to these losses, the countries had financed a great amount of the war with debt. All these factors resulted in huge economic deficits. During 1918, the countries started to be tired of the wars, and Russia was one of the first countries to resign. In November 1918, an agreement of armistice was agreed upon and finally after some months, the Versailles Treaty (a peace treaty) was signed and the war ended. (Rosenberg, n.d.; British Broadcasting Corporation [BCC], n.d.)

2.3 Hyperinflation

Even though World War I was officially over in 1918, the biggest contributors to World War I struggled into the beginning of the 1920s. One of these countries was Germany which entered a period of hyperinflation.

The Cambridge Dictionary Online (n.d) defines hyperinflation as:

"A condition where the price of everything in a national economy goes out of control and increases very quickly"

The hyperinflation in the 1920s had its root from World War I. Inflation in Germany increased significantly during the war and the German mark was depreciated. The German government were confident that they would win the war, and their intention was that the losers of the war would pay the cost associated with it. In addition to this, Germany had before World War I stopped the right to convert the mark into gold and suspended the gold standard which had been a stable target for the currency. The result was that the German Government literally borrowed money to themselves and printed new banknotes, instead of financing the war with for example increased taxes which never went above 35% (The Economist, 1999). The result was that the German mark fell rapidly against other currencies; in fact in 1918 the mark had fallen with more than 50% against the dollar (The Economist,

1999). At the same time, the cost of import caused soaring prices and government expenses, and the mark fell even more. This vicious cycle of printing money as an attempt to save the German economy continued, and at the end the German mark was virtually worthless. Germany found themselves in a situation of "hyperinflation". This lasted until the mid 1925, when the government introduced a new currency named the 'Rentenmark'. (Salemi, n.d.; The Economist, 1999).

2.4 The Great Depression

After a period of broad economic expansion in the U.S economy 'The Great Depression' started Tuesday, October 29th 1929, later known as 'Black Tuesday'. As from figure 1 (I. Federal Reserve Bank of St. Louis, n.d.) on 'Black Tuesday' the Dow Jones Industrial Average fell almost 23 percent and the market lost between $8 billion and $9 billion in value (Taylor, n.d.).

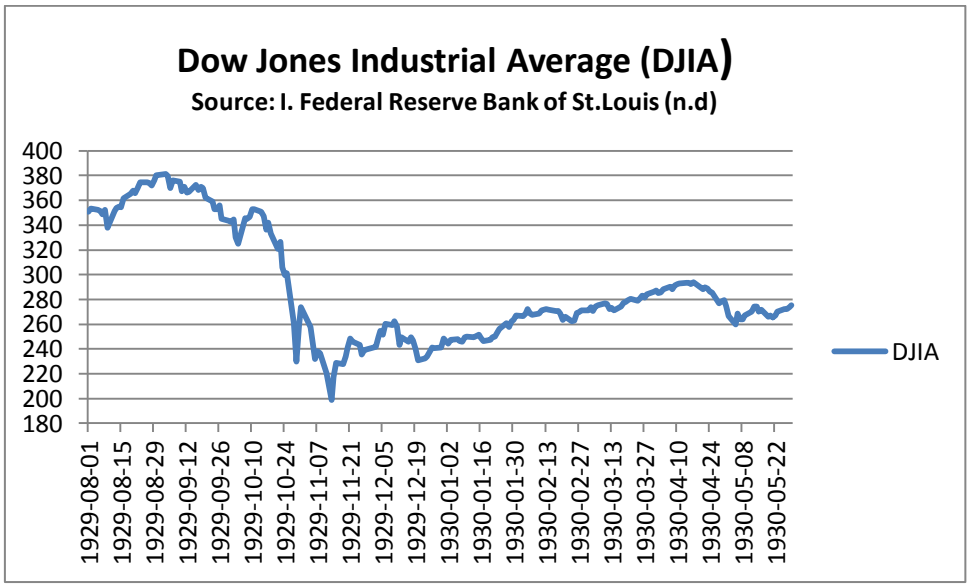

Figure 1 - Dow Jones Industrial Average

'Black Tuesday' was the beginning of one of the longest and most rigid financial crisis experienced in the industrialized Western world. The crisis led to a dreadful cycle: the stock market continued to fall, unemployment rose, banks and other business failed and as a consequence of this, spending and demand on goods fell rapidly. Even though 'The Great

Depression' started in the United States, it quickly spread to the rest of the world. After the earlier world wars, the United States had lent money to the countries who were hit hardest by debt of war; mainly Great Britain and Germany. When the United States economy experienced an economic recession, the country was no longer able to supply credit for investments to these European countries. In addition to a suffering economy from the earlier war, Great Britain and other countries had adopted the gold standard. When the United States entered 'The Great Depression' the gold from other countries started to flow towards the United States. As a consequence of this, several European countries had to deflate along with the United States and increased the interest rates. The contagion effect was a fact; many countries in the industrialized Western world experienced default of banks and an unstable financial market. 'The Great depression' lasted until the late 1920s and for some countries until the beginning of 1930s. (Taylor, n.d.; Nelson, n.d.)

2.5 World War II

After World War I and 'The Great Depression' a lot of countries were facing problems with regards to the economy. Germany still struggled from the hyperinflation and, together with other European countries, the high levels of external debt. Japan had also experienced several episodes of banking, inflation and exchange rate crises resulting in external debt during this period. World War II started September 1st 1939, when Germany decided to invade Poland as an attempt to win back the country. The fear that Germany under Adolf Hitler's Nazi Regime would invade Europe prompted Great Britain and France to declare war against Germany. During the spring in 1940, Germany continued to expand by invading Denmark and Norway, followed by the 'Blitzkrieg' (also known as the lightning-war) against Belgium, the Netherlands and France. They continued fighting against Great Britain and in 1941 Germany invaded Russia. The Untied States had in the beginning of the war claimed neutrality. However, in the mid 1941, Japan attacked the United States' navy base at Perl Harbour, Hawaii. Japan, which was in an alliance with Germany, invaded the Philippines, Burma and Hong Kong. From this day on the war escalated as Japan and Germany invaded even more Asian and European countries. The war continued until Russia managed to win the battle in Berlin on April 21st 1945. The Germans surrendered May 7th 1945, and one day later the war ended. The war took a tremendous number of lives, the countries infrastructures were destroyed and the economy had collapsed. The countries experienced an incredible amount of

debt which caused a new era of taxes and economic restrictions. (Robinson, 2011; The New York Times, n.d.).

2.6 The Oil Shock

The oil shock in 1973-1974 is said to be a result of the Yom Kippur War between Israel and a collaboration of Arab countries led by Syria and Egypt. The United States and several Western countries supported Israel during the war. Even though the war was the main triggering factor of the oil shock, the decision regarding a suspension of the convertibility of the American dollar into gold made by the president of the United States, Richard Nixon, in 1971 was another triggering factor. As the oil price was denominated in American dollars, the oil exporting nations experienced a negative economic effect, and the members of the Organization of Petroleum Exporting Countries (OPEC) wanted to price the oil in terms of gold. The combination of the war and the conversion of the U.S. dollar, made the Arab members of Organization of Petroleum Exporting Countries (OPEC) to impose an embargo for exporting crude oil to the allies with Israel. In addition to this, they also increased the oil price with about 70 percent. Even though the war ended, the Arab members of OPEC continued to reduce the oil production and increased the oil price. Figure 2 shows the monthly spot oil price of the West Texas Intermediate (WTI) (II. Federal Reserve Bank of St.Louis, n.d.). The result was that the oil price almost quadrupled up in 1974.

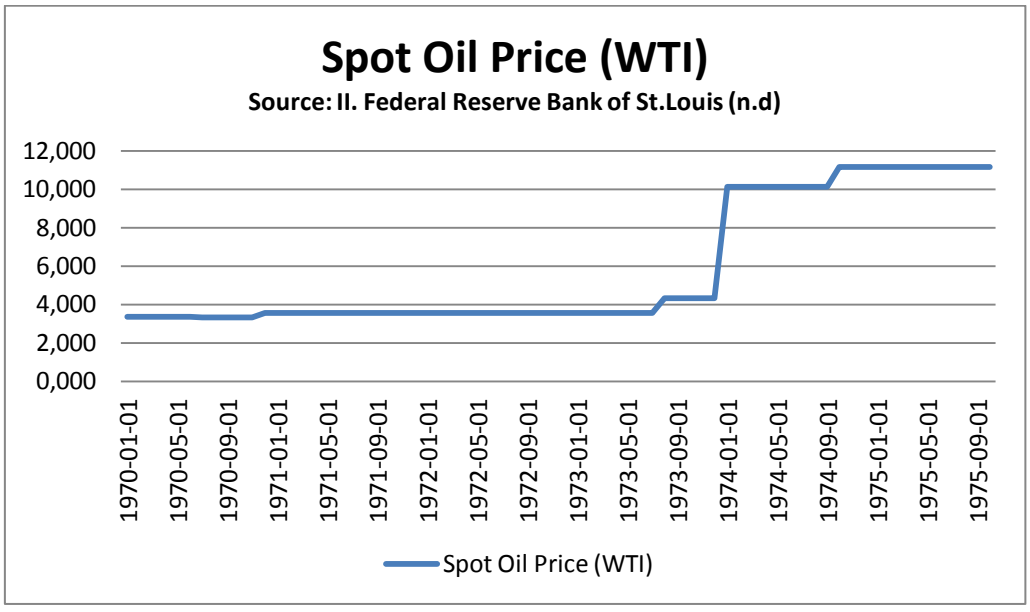

Figure 2 - Spot Oil Price (WTI)

The demand for oil from the United States and other Western countries had increased to a great extent due to increased industrialization. Because of the high oil price and the lack of access for oil the countries experienced a reduction in economic growth and increased inflation (The Regents of the University of California, n.d.).

2.7 The Latin American Debt Crisis

The Latin American debt crisis began early in the 1980s but actually has its roots from the late 70s. It all started when developing countries in the Latin America continent borrowed a serve amount of money from other countries which received a hug deposits from the oil productions countries, especially the United States. At the beginning, the loans were issued as a part of the 'Bretton Woods System'. The Bretton Woods Institutions consists of the World Bank and the International Monetary Fund (IMF), and was established as an attempt to create an international economic cooperation. The institution was supposed to provide financial assistance and create a stable international trading environment (Bretton Woods Project, n.d.).

However, in the end of the 1960s the Bretton Woods System started to disintegrate; the purchasing power decreased and there was lack of control of the currencies exchange rates. At the same time countries with wealthier economies, such as the United States, wanted to invest more abroad and issued commercial loans to the Latin American countries. The loan had low but floating interest rates, which made the loans very attractive. The funds from the loan were rapidly utilized on consumption as an attempt to develop the countries. The oil price started to increase steadily after the oil crisis in 1973, and the Latin American countries borrowed even more money to be able to pay for the oil they needed to finance the growth. As the oil price was increasing, the United States decided to increase the interest rate in 1981. Because of the increasing interest rates, the Latin American countries began to struggling in terms of paying their loans. In 1982, Mexico announced that they were not able to pay their financial obligations. Shortly after, the Latin American debt crisis became a reality as other Latin American nations such as Argentina, Brazil and Bolivia announced the same (Miller, 2002; Devlin & Ffrench-Davis, 1995)

2.8 The Asian Financial Crisis

During the previous decades before 'the Asian crisis', most of the East Asian countries experienced an economic boom. The East Asian countries, known as the 'Asian Tigers', had

high investment rates, high savings and a relatively stable currency and interest rate. The countries were characterized with a high amount of capital inflow. As the interest rate for domestic loans were higher than the interest rate for foreign loans, the high amount of investment was financed by debt in foreign currencies, such as U.S. dollars. This way of financing seemed to be greatly beneficial for the Asian countries. However, as from figure 3 (III. Federal Reserve Bank of St.Louis, n.d.), in the mid 1990s Thailand's currency, the Thai Baht, started to lose its value against the U.S. dollar and the borrowing cost increased rapidly.

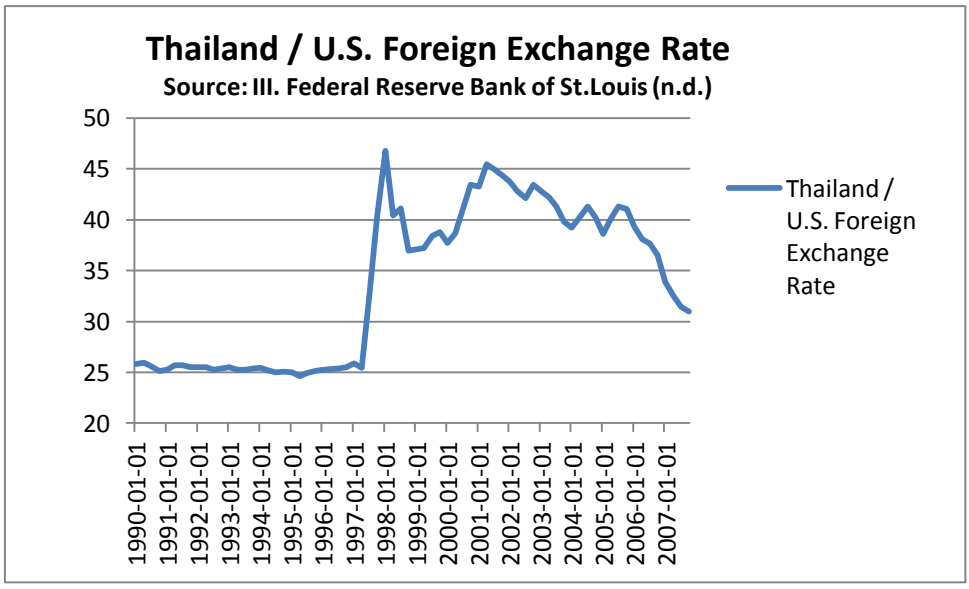

Figure 3 - Thailand/U.S. Foreign Exchange Rate

At the same time, the stock market had already begun to fall. In 1997, several businesses in Thailand announced that they were not able to pay their debt obligations. Soon afterwards Thailand found themselves in a financial crisis, with their currency worth virtually nothing. The currency meltdown spread quickly to other Asian countries such as Singapore, Malaysia, Indonesia, Korea and Japan. The countries got financial help from organizations such as the International Monetary Fund (IMF). However, the countries struggled for a long period as they had to increase taxes, cut investments and keep a high interest rate (Hill, n.d)

2.9 Financial Crisis of 2007 – 'The Great Recession'

The latest global financial crisis started in the United States in 2007. However, the crisis had its roots a decade earlier.

In the late 1990s and the beginning of 2000, the global economy experienced a strong growth. During the beginning of 2000, the United Sates had increasing house prices, low interest rates and increased consumption due to an expansive monetary policy. With interest rates kept low, risky assets were earning higher returns. This in turn induced investors to take on more risk. As a part of the expansive monetary policy, the United States started to purchase goods from the rest of the world, such as China. China became a key player in the global export market and started to invest heavily in American government bonds. As China and other countries experienced a high amount of export, the United States continued to spend money within the country. The result was that the United States ended up with a deficit on the balance of trade and from an international view there was a significant unbalance on the international balance of trade. In addition to the negative trading balance, the United States had involved themselves in two expensive wars: the invasion of Afghanistan and the invasion of Iraq (Henriksen & Windheim, 2008).

As a part of economic liberalisation, the financial institutions increased their activity. Agents readily offered loans so that the borrowers could buy houses, and the thought was that the rise in the house prices was going to secure the risk. The agents got the commission, and if the loan defaulted, the bank claimed the house. The bank trusted the agents, and did not evaluate the credit quality of the borrowers themselves. This resulted in subprime loans. These loans refer to the credit quality of the borrowers who have weakened credit history and therefore carry a greater risk of loan default (Federal Reserve Bank of New York, n.d.). According to The Economist (2007) "*a fifth of all new mortgages in 2006 were subprime*".

The loans was securitized and sold as obligations in the market. The Oxford Dictionaries (n.d) define securitization as:

"*Converting (an asset, especially loans) into marketable securities, typically for the purpose of raising cash by selling them to other investors"*

By securitization of the loans the banks were able to convey the loans off their balance sheet to trusts which then issued units of interests or "securities" to investors. This process made it

possible for the banks to release capital to obtain more loans and assets (American Bar Association, 2009).

The credit rating agencies, which was assigned to range the credit quality of the issuers of certain types of debt obligations as well as the debt instruments themselves, did a poor job. They have been accused for underestimating the risk involved with the subprime loans. In addition to this, the rating was usually requested from the issuers of the securities which gave the credit rating agencies an incentive to give high ratings. The financial institutions bought the obligations, but because these obligations did not have any real value, they had trouble in fulfilling their obligations in the end. When the financial institutions do not need to report total exposure of these obligations, the banks have no control of the total risk.

As shown in the graph in figure 4 (IV. Federal Reserve Bank of St.Louis, n.d.), the interest rate was kept low for about a five year period. In fact in 2003, the interest rate was a low as 1 %. However, in 2006 the interest rate had increased tremendously ending up at 5, 25 %.

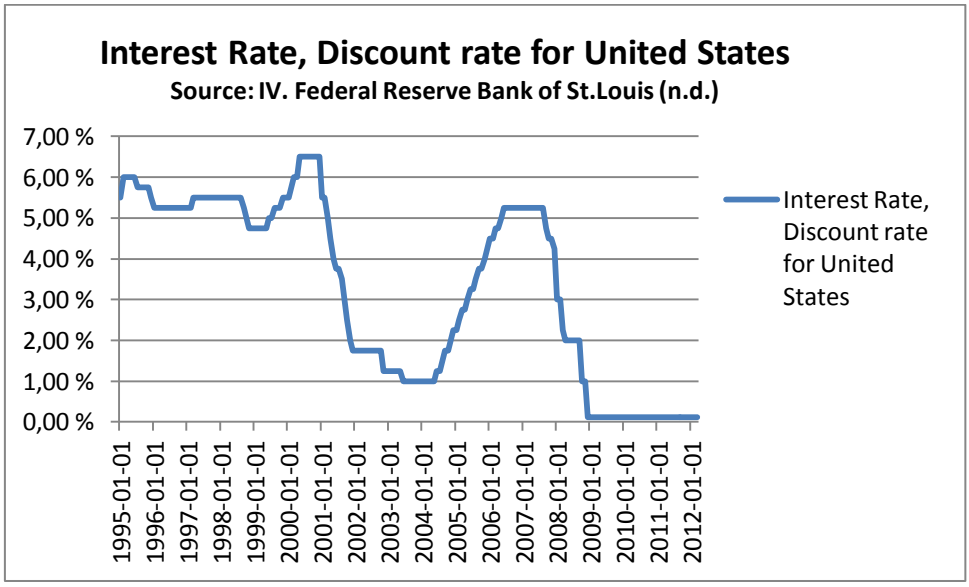

Figure 4 - Interest Rate, Discount rate for United States

The rationale behind this was to partly decrease the demand for houses and partly to control inflation.

With such a serve increase in the interest rate, householders with subprime loans began to struggle with their debt payments and the Americans were afraid of buying new houses. The

result was that the banks were left with houses that no one would buy, the houses was virtually worthless.

The American banks and financial institutions experienced huge losses, and in March 2008 Bear Stearns (one of the world largest investment bank) announced that they were having liquidity problems, but was saved and bought by another investment bank J.P. Morgan. During the months that followed, several other financial institutions announced that they were having financial problems and the American government decided to take control over these institutions. However, in September 2008 when Lehman Brothers (yet another investment bank) announced that they were having liquidity problems, the American government did nothing. The collapse of Lehman Brothers sent a panic throughout the financial market, and soon after even more financial institutions collapsed. The United States found themselves in a dreadful spiral where commodity prices fell, companies were bankrupt and unemployment rose.

As the financial market has become more and more globalized it did not take much time until the crisis spread to the rest of the world. The United States has for a long time played an important role in the international economy when it comes to lending, import and investment. Even though the financial crisis started to slow down in 2009, several countries in the industrialized world are still struggling.

3.0 Oil, Macro economy and Financial Crises

Oil factors and their relation to the macro economy have attracted more and more attention from economists and other analysts over the last decades, especially from the beginning of the 1970s when the oil price experienced a period with high volatility and several oil shocks hit the economy. Before moving into the theory of oil and gas and their relation to the global economy, the next section will give a short overview of oil and gas history.

3.1 The Black Gold

It all started in Pennsylvania in 1859 when Colonel Edwin Drake drilled the world's first successful oil well. The oil was typically sold for commercial use, and it is likely to believe that Drake did not know to what extent the oil would influence the future. Drake stored and transported the oil in wooden barrels which became the fundamental measurement of oil.

However, in 1882 Thomas Alva Edison presented the light bulb powered from electricity which made the world move their eyes away from the oil. In the beginning of the 1900s Ford Motors Company and General Motors Corporation started the development of vehicles with gasoline motors and the demand for fuel increased steadily with the demand of vehicles. This was the beginning of the second industrial revolution with new inventions such as the telephone, the telegraph and motor driven vehicles such as cars, ships and trains.

When World War I started in 1914, the demand for oil became a part of political and military strategies as it was needed for logistics and transportation. The war had shown that the oil had become important, with the United States as the global leader of oil production accounting for almost 70 percent of global output in 1919 (Maugeri, 2006, p. 25). In fact, worldwide consumption of oil products had risen by 50 percent between 1914 and 1918 (Maugeri, 2006, p. 25).

The exploration for oil continued all over the world and during the first three decades of 1900 Mexico and Venezuela found 'the black gold'. By the eve of World War II, the United States was still the leader of crude oil production accounting for more than 60 percent of the global output (Maugeri, 2006, p. 51). But in line with the increased production, the demand for petroleum products increased rapidly and caused the oil price to increase by 80 percent from 1945 to 1947 (British Petroleum Company [BP], n.d.)

The shortage of oil made the United States, Great Britain and Russia, among others, to continuously look for concessions for oil abroad even though the countries did not believe that there was much of oil to be discovered in the Arab countries or the Persian Gulf.

In the mid 1940s, the American geologist Everett DeGolyer claimed that the Persian Gulf had noteworthy oil reserves and the world powers turned their attention to these countries. This was the beginning of the tremendous oil production in the Middle East and the start of the golden age of oil. Global proven oil reserves jumped from nearly 70 billion barrels in 1948 to 667 billion barrels in 1973, where 355 billion barrels was concentrated in the Middle East with Saudi Arabia, Iran, Kuwait, Iraq and the Arab Emirates as the leaders (Maugeri, 2006, p. 80). During this period the oil became important in terms of politics and strategy.

In 1960, Iran, Iraq, Kuwait, Saudi Arabia and Venezuela established the Organization of Petroleum Exporting Countries (OPEC) with a goal of increasing bargaining strength and self-defense.

During the post-war period, the oil supply had increased significantly and the price of oil was kept relatively low. In 1971, the president of the United States announced that the U.S. dollar was no longer going to be linked to the gold standard as an attempt to control the overvaluation of the currency. This led to economic losses for the Middle East countries as all oil transaction was made in U.S. dollars and the currency experienced devaluation. As a result from the Yom Kippur war between the Arab members of OPEC and Israel, the Arab members of OPEC imposed an oil embargo against Israel and their allies. The combination of the conversion of the dollar and the oil embargo is said to be the trigger of the first oil shock in 1973 described in section 2.6.

The oil price continued to increase slowly and the OPEC countries still controlled the majority of oil production. The United States tried to implement schemes that were supposed to reduce the dependence of oil abroad.

The second oil shock started in the end of the 1970s with the Iranian Islamic revolution which was Iran's attempt to transform into a modern, industrialized country. Iran had over the last years played an important role with regards to oil production. The revolution caused a worldwide panic as oil production was curtailed and exports were cut. The turbulence spread to several countries in the Middle East and in 1980 Iraq invaded Iran. The reduction of

production caused the oil price increase with approximately 150 percent and thus creating a second oil shock affecting the world.

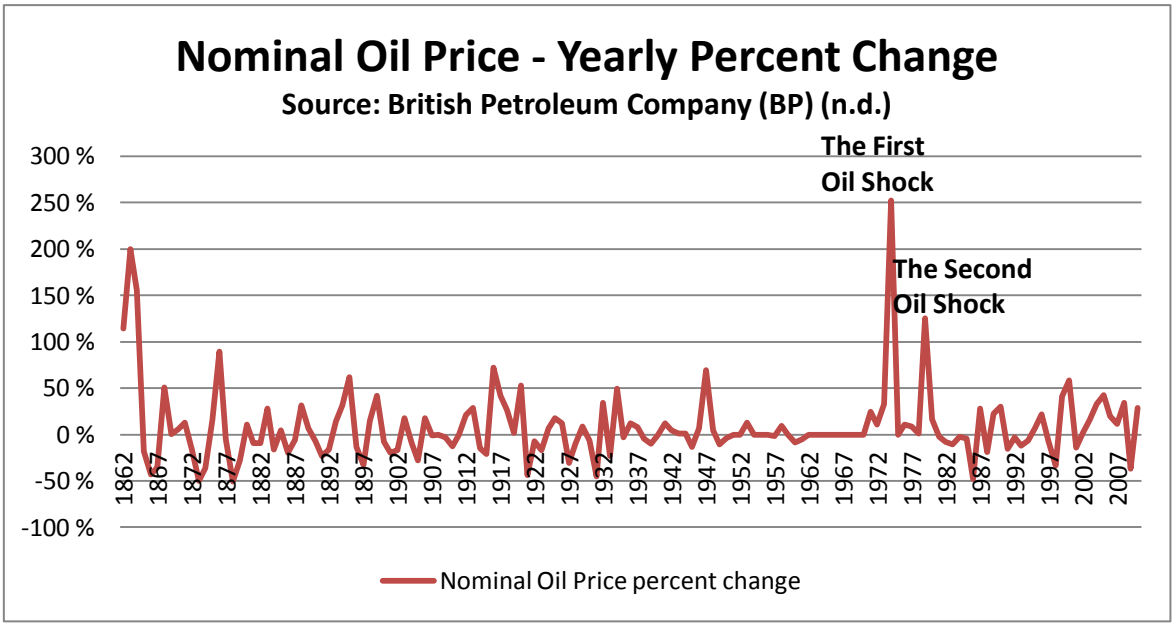

Figure 5 - Nominal Oil Price – Yearly Percent Change

The second oil shock was followed by the 1980s oil glut. Over the last years, oil had been discovered in new areas of the world such as the field of the Netherlands and the North Sea causing a reduced demand of oil from non-OPEC countries. In addition to this, the war between Iran and Iraq continued causing low oil production. The OPEC countries tried to reduce the production as an attempt to keep up the high oil price, but failed. The oil price started to decline, and from 1980 to 1986 the price had fallen with more than 50 percent in nominal terms (BP, n.d.).

In the 1990s the world experienced the first Persian Gulf War and the East Asian Crisis. However, from 1987 to 1999 oil prices fluctuated at around a modest $18 per barrel in nominal terms (Maugeri, 2006 p.145). OPEC still continued with several failed attempt to control the oil price by changing the level of production.

Because of economic growth during the beginning of 2000, the oil price started to increase again with an exception of 2001, when the United States became a victim of the terrorist attack destroying the New York's World Trade Center. More and more countries have transformed into modern industrialized economies, where oil has become a central factor in the standard of living. This has strongly increased the demand for oil, which in turn has

caused the oil price to increase significantly. The financial crisis that started in 2007 caused the oil price to drop in the end of 2008. However, it has since the beginning of 2009 increased.

3.2 'Oil and the Macro economy since World War II"

One of the economists that have followed the oil and gas market and its relation to the macro economy is James D. Hamilton. In 1983, he published the paper 'Oil and the Macroeconomy since World War II'. His starting point for the paper is based on the poor performance of the United States economy since 1973. His comparison of the oil price and the United States recessions shows that whenever the oil price has increased notably a recession has followed, with a single exception of the recession of 1960 to 1961. Figure 6 is picked up from Hamilton (1983, p.229) article 'Oil and the Macroeconomy since World War II' and displays changes in crude oil prices and the United States recessions.

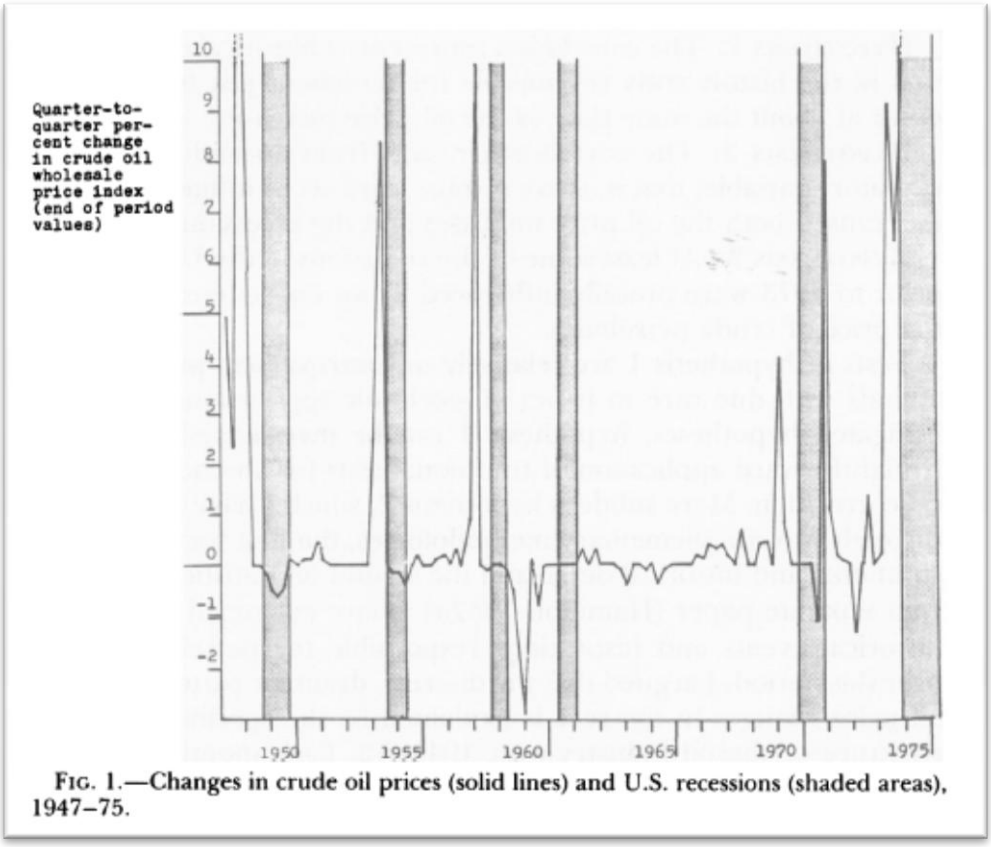

FIG. 1.—Changes in crude oil prices (solid lines) and U.S. recessions (shaded areas), 1947–75.

Figure 6 - Changes in crude Oil Price and U.S. recessions

Hamilton found that not only has there been a secular correlation between energy and output over the last decade, there has been a cyclical correlation as well (Hamilton, 1983 p.229). He describes three possible explanations for the correlation (Hamilton,1983, p. 230):

Hypothesis 1: "*The correlation represents a historical coincidence; that is, the factors truly responsible for recessions just happen to occur at about the same time as the oil price increases."*

Hypothesis 2: "*The correlations results from an endogenous explanatory variable; that is, there is some third set of influences that in fact caused both the oil price increases and the recessions."*

Hypothesis 3: "*At least some of the recessions in the United States prior to 1973 were causally influenced by an exogenous increase in the price of crude petroleum*."

Hamilton uses various quantitative methods for testing the hypotheses. In his conclusion he finds few grounds for claiming that the correlation between oil prices and output is just a statistical coincidence. He also find little proof for hypothesis number two; that some third set of influences was responsible for both the increase in oil price and the recessions. Hamilton argues that because the first two hypotheses do not get much support, it strengthens the case with regard to the third hypothesis. Hamilton (1983, p.245) conclude that the timing, magnitude, and/or duration of at least some of the recessions prior to 1973 would have been different had the oil price increases or attendant energy shortages not occurred. However, he states that oil price increases are neither a necessary nor a sufficient condition for post-war recession.

4.0 'Two Approaches to Studying Crises and Disasters'

In the book, 'This Time is Different: Eight Centuries of Financial Folly' from 2009, Carmen M. Reinhart has together with Kenneth S. Rogoff studied eight centuries of financial crises. The book aims to provide an expansive, systematic and quantitative history of financial crises, with a study of sixty-six countries over the last eight centuries (Reinhart & Rogoff, 2009). The authors want to highlight the fact that even though financial crises take us with surprise and no matter how different they are from time to time, they have usually remarkable similarities from earlier crises. They describe the essence of the "this-time-is different" syndrome as;

"It is rooted in the firmly held belief that financial crises are things that happen to other people in other countries at other times; crises do not happen to us, here and now. We are doing things better, we are smarter, we have learned from past mistakes." (Reinhart & Rogoff, 2009, part I p.1)

4.1 BCDI Index

As a part of the book 'This Time is Different: Eight Centuries of Financial Folly' the authors have collected and structured financial data for sixty-six countries from 1800 up to 2010. The data sets can be found under Carmen M. Reinhart's webpage: http://www.carmenreinhart.com/data/browse-by-topic/topics/7/.

Based on these data, the authors introduce a composite country financial turbulence index, the BDCI index [**B**anking (systemic episodes only), **C**urrency, **D**ebt (domestic and external), and **I**nflation crisis index]. The index contains five varieties of crisis:

Crises	Description
Currency crises	1. Currency crashes: An annual depreciation versus the US dollar (or the relevant anchor currency – historical the UK pound, the French franc, or the German DM and presently the euro) of 15 percent or more. 2. Currency debasement Type I: A reduction of the metallic content coins in circulation of 5 percent or more. 3. Currency debasement Type II: A currency reform where a new currency replaces a much depreciated earlier currency in circulation. (Reinhart & Rogoff, 2009, Chap.1 p.7)
Inflation crises	An annual inflation rate of 20 percent or higher. The authors also examine separately the incidence of more extreme cases where inflation exceeds 40 percent per annum. (Reinhart & Rogoff, 2009, Chap.1 p.7)
Banking crisis	We mark a banking crisis by two types of events: 1. Bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions. 2. If there are no runs, the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions), that makes the start of a string of similar outcomes for other financial institutions. (Reinhart & Rogoff, 2009, Chap.1 p.11)
Sovereign debt crisis external	A sovereign default is defined as the failure of a government to meet a principal or interest payment on the due date (or within the specified grace period). The episodes also include instances in which rescheduled debt is ultimately extinguished in terms less favourable than the original obligation. (Reinhart & Rogoff, 2009, Chap.1 p.11)
Sovereign debt crisis domestic	The definition given above for an external debt crisis applies. In addition, domestic debt crises have involved the freezing of bank deposits and/or forcible conversion of such deposits from dollar to local currency. (Reinhart & Rogoff, 2009, Chap.1 p.11)

Table 1 - Varieties of Crises in the BCDI index

The index basically sums up the numbers of crises that a specific country experience each year. This means, if a country experiences no crises the given year, the turbulence index will be zero. If the country experiences all the named crises listed in table 1 for the given year, the turbulence index will be five. It is important to note that a country can experience more than one crisis of the same category each year (have a BCDI index greater than five) and that the index is based on binary variables.

"A binary variable is a variable that is either zero or one "(Stock & Watson, 2007 p.775). The fact that the variables are binary implies that the index does not say anything about the degree of the crises or the contagion effect they potentially have. However, the authors refer to the rating agency Standard & Poor's (S&P) which lists a country as either in default or not in default. Because the presence of default is such a special case, the S&P rating has proven to be very useful. An occurrence of a crisis, based on the criteria for the varieties given above, will also be a special case and the index will most likely give a good picture of the countries state.

Historically, stock market crashes have turned out to play a significant part in earlier financial crises, such as in 'The Great Depression' in 1929. The BCDI index does not originally include stock market crashes. Data on stock market crashes has been hard to collect for the countries. However, the authors use Barro and Ursúa's benchmark, a cumulative decline in real equity prices of 25 percent or more, to define asset price collapses (Barro & Ursúa, 2009). This data is added to the BCDI index to composite the BCDI+ index. The BCDI+ index will therefore contain six varieties of crises.

The authors mention two other important dimensions of default which is not included in the index, namely household debt and corporate defaults. In the latest financial crisis in 2008, household debt was pointed out as one of the main causes and has as a consequence of this attracted a lot of attention. Unfortunately, reliable data on household debt is hard to find, even for countries with advanced economies. However, the authors point out that household debt is likely to be captured in the banking crises variable because whenever the banks issues the loan to the borrower it will most likely be reflected in the bank's balance sheet.

High degrees of corporate default have been experienced in several financial crises such as 'The Great Recession' in 2007, but as for household debt the problem related to lack of reliable data also applies for corporate default. However, the authors point out that corporate

defaults and banking crises are highly correlated and we can again assume that corporate defaults are incorporated indirectly in the BCDI+ index.

4.2 'Macroeconomic Crisis sine 1870'

Robert Barro has together with José F. Ursúa written the working paper 'Macroeconomic Crises since 1870'. The authors use an approach different than Carmen Reinhart and Kenneth Rogoff to identify crises. The paper focuses on the probability of disasters and their average duration. To support this working paper from 2008, Barro and Ursúa have constructed a dataset (which can be found under http://rbarro.com/data-sets/) that contains gross domestic product (GDP) and real capita personal consumer expenditure ('Consumption') on a yearly basis for forty-two countries.

Bureau of Economic Analysis (2010) gives three ways to measure GDP:

"(1) the sum of goods and services sold to final users, (2) the sum of income payments and other costs incurred in the production of goods and services, (3) the sum of the value added at each stage of production" (Chap. 2, p. 7)

Bureau of Economic Analysis (2012) defines Personal Consumption Expenditures as:

"the goods and services purchased by "persons" – that is, by households and by nonprofit institutions serving households"

Barro has in his earlier studies used Angus Maddison's dataset from 2003, for long-term international GDP data. However, the authors claim that Maddison's data have some shortcomings when it comes to his assumptions of filling in missing data. As a solution, Barro and Ursúa have tried to estimating long-term GDP for several countries. This was also done due to the fact that after 2003 there has become more data available on long-term national accounts. When it comes to the issue regarding missing data during the greatest crises such as during wars, Barro and Ursúa are in the opinion of that the missing periods almost surely contain a crisis and have therefore tried to estimate the data as precisely as possible.

Even though the datasets have values from before 1870 for some countries, Barro and Ursúa start the analyses from 1870 or later. Countries with no data before 1914 are excluded in the analyses.

Barro and Ursúa find that GDP and Consumption do not always pair up and show the same results with regard to occurrence of crises. Their explanation to this is whether the shocks hit the investment demand or the desired saving. One example given in the paper refers to the United Kingdom during the two world wars. During the world wars, military spending made the GDP increase, while 'Consumption' fell rapidly. A separate analysis of one of the variables alone may therefore give the wrong picture of a crisis.

When the working paper was issued in 2006, Barro and Ursúa used a "peak-to-through" method to identify economic crises based on a cumulative decline in gross domestic product (GDP) and 'Consumption' of 15 percent or more for samples that started in 1870. In the working paper from 2008, Barro and Ursúa have broaden this limit to 10 percent, which is used for the analyses in this thesis. The authors find that the difference between 10 and 15 percent display more events, but have only moderate implications.

As mentioned above, the dataset constructed to support the working paper, contains data for forty-two countries. However, due to insufficient data the authors analyze twenty-two countries when it comes to 'Consumption' and 35 countries when it comes to GDP. The analyses are divided between OECD-countries and Non-OECD countries. Egypt, Ireland and Russia are all omitted from their analyses, most likely caused by insufficient data after 1914. In addition to this, China is included in the dataset online but has not been commented in the article.

Table 1 in the working paper lists the countries and gives an overview of the data's starting dates and their missing values. The table also gives an overview of which countries that are excluded from their analyses. These countries, in addition to China, are also excluded from the thesis. Appendix 1 gives an overview of what countries that are excluded.

5.0 Data and Methods

Before analyzing any data, it is important to identify the necessary data, where or if it is available and how the data should be applied. To get an overview, it can be helpful to identify which research design to use. The research design gives a description of how the researcher has put together a research study in order to answer a specific question. The three most well-known research designs are: Exploratory research design, descriptive research design and causal research design. The design used in this thesis is descriptive research design.

Descriptive research design is a research method where the researcher has a fundamental knowledge of the problem and wants to describe the situation of the problem. The researcher should not only try to describe the isolated relation between the variables, but also describe the possible correlation between the variables. The design is characterized by a planned and structured process and usually contains hypothesis testing. As opposed to exploratory research design, descriptive research design is often linked to quantitative analyses (Griprus, Olsson & Silkoset, 2006).

5.1 Quantitative versus Qualitative research

Quantitative data is a type of information that can be counted or expressed numerically and measured. Quantitative research is for that reason built on quantitative data which is organized systematically and used in for example statistical or mathematical calculations. Qualitative data, on the other hand, is a type of information that is observed, but not expressed in numbers and are therefore hard to measure. Qualitative research is for that reason built on experience and interpretations. Even though the two methods of research are two different methods, they are often linked together. The data used in this thesis is mostly quantitative data. However a qualitative approach can be used to interpret the results (Johannessen, Kristoffersen & Tufte, 2004).

5.2 Primary vs. Secondary Data

A quantitative research method needs structured data. There are two main sources of data: primary data and secondary data.

Primary data is data collected directly by the researcher himself. Primary data are often used because of lack of secondary data. The collection process can be done by interviews,

observations and questionnaires. Collecting primary data can be time consuming but will be an advantage as the researcher is in charge and can design the process to fit his purpose. However, it is important that the researcher is critical to the collected data and make sure that it is reliable and valid.

Secondary data are data that already exist and are not collected for the researcher's particularly problem. Secondary data are usually less time consuming than primary data. However, the researcher still needs to evaluate if the data are fit for the purpose and that it is reliable and valid. The data used in this thesis are secondary data based on historical observations and interpretations.

5.3 Reliability and Validity

When searching for data to be used for statistical and mathematical analyzes, it is important to identify the quality of the data. In relation to this, the researcher should have a closer look into the data's reliability and validity.

5.3.1 Validity

The purpose of validity is to examine the data or the research trustworthiness. This is done by revealing the quality of the data measure that the researcher wishes to measure. For the data to be valid it has to be reliable. When examine the validity of the data the most important aspect is to interpret the data, not which method to use. There are several types of validity such as content validity, face validity, criterion-related validity and construct validity (Gripsrund, Olsson & Silkoset, 2006)

5.3.2 Reliability

Reliability is used to measure the data's accuracy and trustworthiness or more specific, the accuracy and trustworthiness of the results from the data. In other words, to what extend will the data indicate the same results on repeated trials? If the trials give more or less the same result, the data most likely have high reliability. This is of course under the assumption that the terms are the same, the selection area is the same and that the analyses are done in the same way. It is worth mentioning that high-quality of reliability does not necessarily indicate high quality of validity (Gripsrund, Olsson & Silkoset, 2006).

5.4 Data categorization

In order to implement the theory of data and methods, the next sections introduce the data used in the regressions presented in section 6. The aim is to give the reader an overview of the data by using a critical and objective approach with regards to the reliability and the validity of the data. The section starts with a general introduction of some common factors for the data. Appendix 1 includes an overview of the categorization of the data. All the variables are divided into three categories:

Category	Description
OECD: Organization of Economic Co-Operation and Development	The organization was established after World War II as an attempt to ensure peace by a co-operation between European countries. The co-operation was a success and as the United States and Canada joined the organization in 1960, the organization took a step into a global co-operation (Organization for Economic Co-Operation (OECD), n.d.)
OPEC: Organization of the Petroleum Exporting Countries	The organization was established in 1960s with an objective to co-ordinate and to unify petroleum policies to be able to secure fair and stable prices for petroleum producers (OPEC, n.d.)
Non-OECD/OPEC	Countries that are not members of the Organization for Economic Co-operation and Development (OECD) and/or Organization of the Petroleum Exporting Countries (OPEC).

Table 2 - Categorization of Countries

The category 'Non-OECD/OPEC' is a composition of countries from different continents and with potentially different economies which can make them hard to compare. The pie chart in figure 7 shows the proportion of continents in this category.

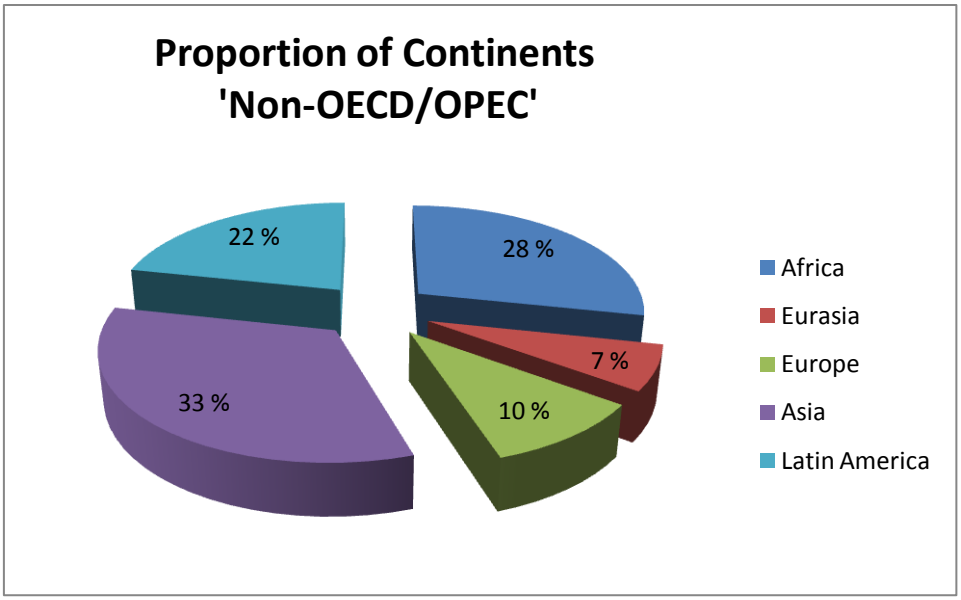

Figure 7 - Proportion of Continents – 'Non-OECD/OPEC'

Even though the countries in this category may have several different aspects when it comes to economy and political control, most of the countries are categorized as 'emerging and developing economics'.

International Monetary Fund (2012) uses the following definition to classify advanced economies versus developing economies in the World Economic Outlook:

'*The main criteria used by the WEO to classify the world into advanced and emerging economies are (1) per capita income level, (2) export diversification — so oil exporters that have high per capita GDP would not make the advanced classification because around 70% of its exports are oil, and (3) degree of integration into the global financial system.'*

Section 5.5 to 5.8 will go through each variable introduced in section 1.1, which will be used for further analyzes. For each of the variables a table with basic descriptive statistics is given. The tables display the sampling period, the mean, the standard deviation, number of observations and the frequencies of the observations. The mean is the arithmetic mean where the calculations are based on the total value from the data, divided by number of events. The standard deviation is a measure of the spread of the distribution around its mean (Stock & Watson, 2007 p.781).

5.5 BCDI+ Index

As mentioned earlier, the data used to composite the BCDI+ index is found under Carmen M. Reinhart webpage: http://www.carmenreinhart.com/data/browse-by-topic/topics/7/.

In the book, 'This Time is Different: Eight Centuries of Financial Folly' the authors study sixty-six countries. However, the data available on Carmen M. Reinhart's webpage contains data for seventy countries. As the book was published in 2009, it is likely to assume that the data for the five additional countries (Ghana, Iceland, Ireland, Sri Lanka and Switzerland) were collected at a later stage or have not been sufficient enough to be included at that point. Hong Kong is included as one of the sixty-six countries studied in the book, but is not included in the dataset online. The data are structured in a table format for each of the seventy countries and reported on a yearly basis from 1800 to 2010. The datasets include the five varieties listed in table 1: banking crises, currency crises, inflation crises and sovereign debt crises internal and external. Stock market crashes are included for some countries, depending on the availability of the data. In addition to this, there is also included a column with binary variables to indicate when the specific country was independent. The data is structured in four excel files as followed:

Varieties Part I: Algeria, Angola, Argentina, Australia, Austria, Belgium, Bolivia, Brazil, Canada, Central African Republic, Chile, China, Colombia, Costa Rica, Cote D'Ivoire, Denmark, Dominican Republic, Ecuador, Egypt, and El Salvador.

Varieties Part II: Finland, France, Germany, Ghana**,** Greece, Guatemala, Honduras, Hungary, Iceland, India, Indonesia, Ireland, Italy, Japan, Kenya, Korea, Malaysia, Mauritius, Mexico, and Morocco.

Varieties Part III: Myanmar, Netherlands, New Zealand, Nicaragua, Nigeria, Norway, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Russia, Singapore, South Africa, Spain, Sri Lanka, Sweden, and Switzerland.

Varieties Part VI: Taiwan, Thailand, Tunisia, Turkey, United Kingdom, United States, Uruguay, Venezuela, Zambia, and Zimbabwe.

When the data was downloaded from the webpage, it turned out that varieties part III (M-S) was not available. However, the analyses are based on the data that were available at this point as it would most likely show the trends with regards to financial crises.

The implementation of the data is based on an annual average with the exception of the Poisson regression. The annual average is the total numbers of financial crises experienced by each category each year, divided on the total number of countries. The original dataset included observations from 1800 up to 2010. However, the dataset used for further analyses are from the period 1870 to 2010 to make it more consistent with regards to the other data included in the regressions. When it comes to the quality of the data, Carmen M. Reinhart has already identified possible weaknesses introduced in section 4.1.

BCDI+	Numbers of Years With at Least One Crisis	Numbers of Years Without any Crisis	Total
OECD	139	2	141
OPEC	128	13	141
Non-OECD/OPEC	141	0	141

Table 3 - Contingency Table BCDI+ Index

The contingency table displays the frequency distribution of the BCDI+ index from 1870 to 2010 for each category. By structuring the data in such way, it can help the reader to analyze the relationship between the two types of events: occurrence of crises and no occurrence of crises. The contingency table indicates that, based on the BCDI+ index, a crisis is likely to appear almost each year, which might take the reader by a surprise. Recall that the BCDI+ index is based on binary variables. This means even though the BCDI+ index reveal a crisis for a specific year, it does not say anything about the degree of the crisis or to what extent it has influenced the economy.

BCDI+ Index - Annual Average					
Region	Sample Period	Mean	Standard Deviation	No. Of Observations	Frequency Of Observations
OECD	1870 - 2010	0,60	0,40	141	Yearly
OPEC	1870 - 2010	0,68	0,80	141	Yearly
Non-OECD/OPEC	1870 - 2010	0,53	0,44	141	Yearly

Table 4 - BCDI+ Index – Annual Average

Table 4 includes an overview of basic descriptive statistics for the BCDI+ index which will be useful for the logistic regressions. A comparison of the three categories indicates that on average 'OPEC' experience more crises than the two other categories.

To get a better visually overview and to be able to identify where the BCDI+ index exceeds its standard deviations, figure 8 includes a graph with the annual average BCDI+ index and its mean and standard deviations. The intention is to get a better perception of whether or not the most well-known crises would lie above the standard deviations.

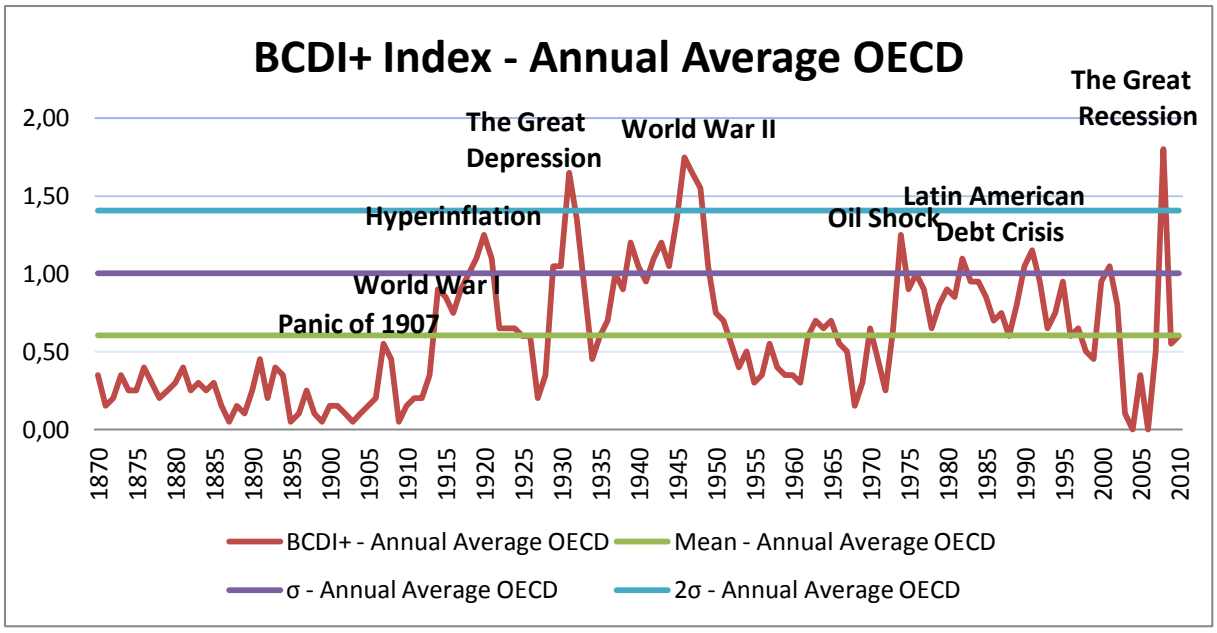

Figure 8 - BCDI+ Index – Annual Average 'OECD'

The crises that have an annual average BCDI+ index above its two standard deviations are 'The Great Depression', 'World War II' and 'The Great Recession'. 'World War I', 'Hyperinflation', 'The Oil Shock' and 'The Latin American Crisis' all have a BCDI+ index

above one standard deviation. In section 2, the history of the most well-known financial crises during the last century was introduced, and the European countries central roles in the two world wars and how they struggled in the period after were explained. As the majority of the 'OECD' members are European countries, it was no surprise that the two world wars and the 'Hyperinflation' are identified in the graph. 'The Great Depression' and 'The Great Recession' both had its roots in the United States which has been an important trading partner to the European countries, which has resulted in a high BCDI+ index for the 'OECD' countries.

'The Oil Shock' and 'The Latin American Crisis' did not have their roots in the United States nor the European Countries. However, in the 1970s the Western industrialized countries dependence of crude oil had exploded and they were influenced by the rapid increase in the oil price in 1973 that caused 'The Oil Shock'.

Mexico and Chile are relatively recent members of 'OECD' and are also categorized as Latin American countries. Mexico and Chile were hit hard by the 'Latin American Debt Crisis' which explains the high BCDI+ index.

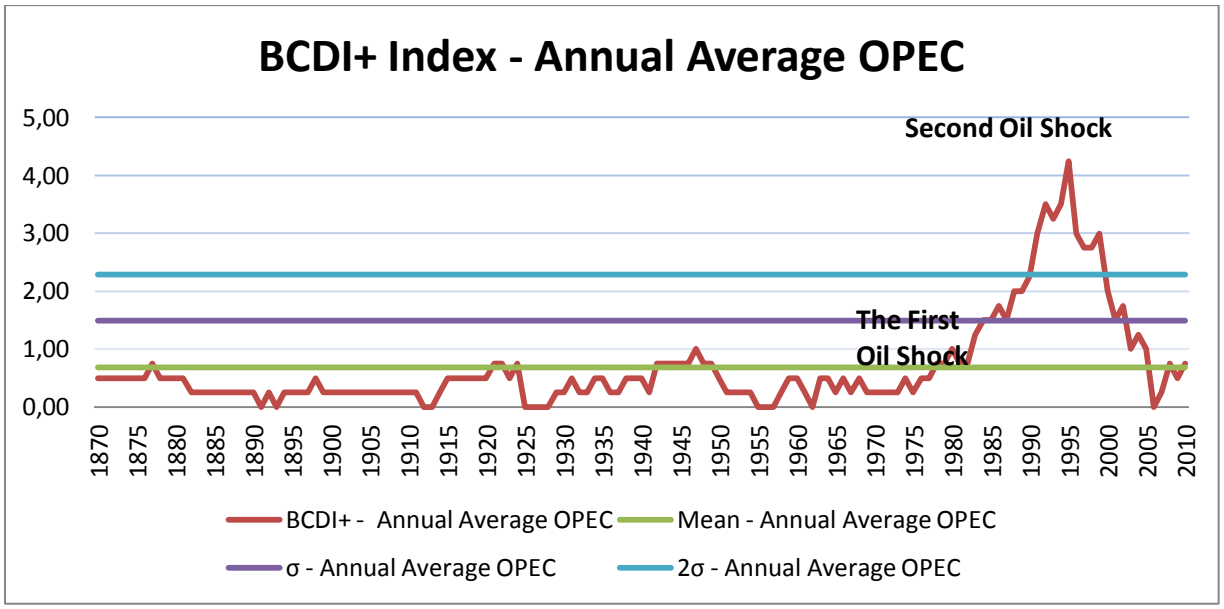

Figure 9 - BCDI+ Index – Annual Average 'OPEC'

The section 'Oil, Macro economy and Financial Crises' described the 'OPEC' countries' close relationship to the oil and gas industry, especially the relation to the oil price. The graph

in figure 9 shows that the BCDI+ index starts to increase rapidly from 1973, when the first oil shock hit the global economy. The BCDI+ index continues to increase during the 1980s as a result from the second oil shock that hit the global economy. From the beginning of the 1970 to the 1990s, the members of OPEC have done several attempts to control the oil price and the supply of oil. However, the attempts have not been successful and 'OPEC' has experienced an unstable economy during this period.

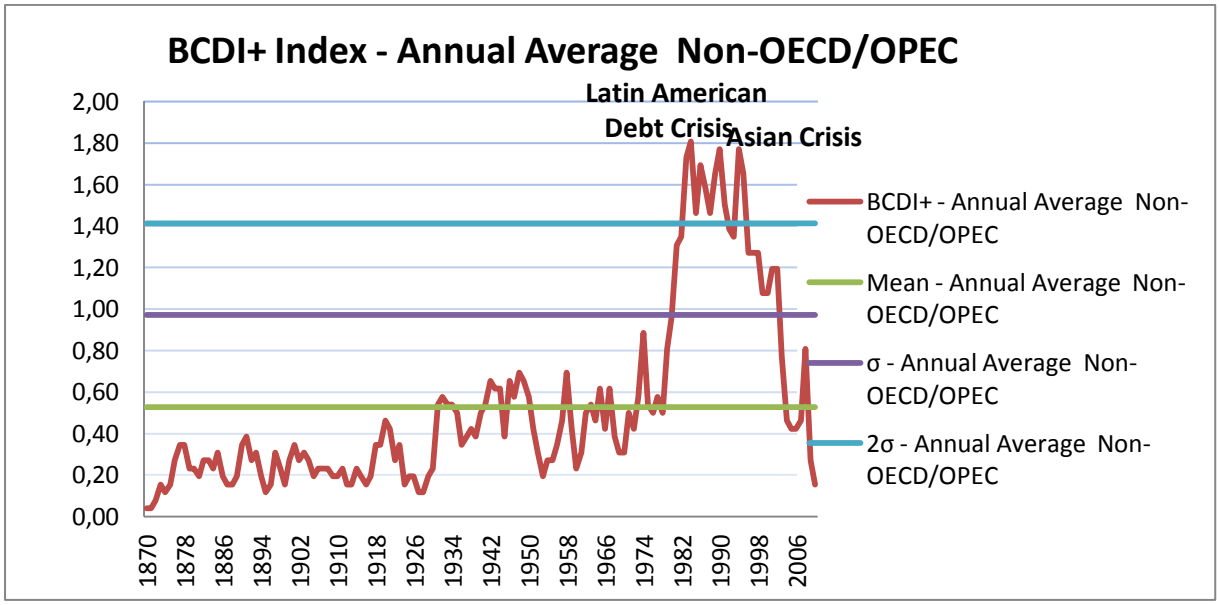

Figure 10 - BCDI+ Index – Annual Average 'Non-OECD/OPEC'

The BCDI+ index for 'Non-OECD/OPEC' countries starts to increase in the end of the 1970s, ending up above two standard deviations from its mean which indicates 'The Latin American Debt Crisis' and 'The Asian Crisis'. Even though the Latin American countries only represent 22 percent of the 'Non-OECD/OPEC' category (figure 7), 'The Latin American Debt crisis' was an immense crisis which lasted for a long period for a number of countries. Some of the Latin American countries, such as Argentina and Uruguay, experienced a crisis in all the varieties explained in table 1 which caused a high BCDI+ index.

'The Asian Crisis' was also a harsh crisis that made the Asian countries struggle for a long period. The Asian countries (including countries in Eurasia) represent 40 percent of the 'Non-OECD/OPEC' category and it is no surprise that the BCDI+ index reveal 'The Asian Crisis'.

5.6 Gross Domestic Product and Consumption

As mentioned in section 4.2, Barro and Ursúa have divided their analyzes between 'OECD' and 'Non-OECD' countries, where recent 'OECD' members such as Chile, Mexico, South Korea and Turkey are included as 'Non-OECD' countries. The analyses in this thesis include these countries in the category 'OECD' to make them more comparable to the other variables. China is included from the dataset.

The working paper 'Macroeconomic Crises since 1870' from 2008, have used data where the indexes for 'Consumption' and GDP are set to 100 in 2000. The dataset online, which is the basis for this thesis, has set the index to 100 in 2006.

The data for Gross Domestic Product (GDP) and 'Consumption' are based on Robert Barro's dataset explained in chapter 4.2. The working paper from 2008 discusses the quality on the data and whether or not it is reliable enough to be included in the analyses. The authors' assumptions of which countries that should be excluded are implemented in this thesis where an overview can be found in appendix 1. The datasets contain annual data for both GDP and 'Consumption', which made it possible to calculate the yearly percent change. The first attempt to identify crises based on Barro's and Ursúa's target, was done by summarizing the total percent change for each category and following dividing it on total numbers of countries for the specific category. Unfortunately, the result did not give much meaning because if one country had a decrease in 10 percent, and another country had an increase in 10 percent, the total change became zero. The solution became to count the number of countries which had a cumulative decline of 10 percent or more for each year and dividing it on the total number of countries. This revealed the probability of a crisis and is the basis for further analyzes with the exception of the Poisson regression where the number of counts is included.

Consumption	Numbers of Years With at Least One Crisis	Numbers of Years Without any Crisis	Total
OECD	34	106	140
OPEC	N/A	N/A	N/A
Non-OECD/OPEC	33	107	140

Table 5 - Contingency Table Consumption

The contingency table for 'Consumption' is based on numbers of years with a decline in 'Consumption' of 10 percent or more. The table shows the frequency distribution of crises from 1870 to 2009. As opposed to the contingency table for the BCDI+ index, table 5 for 'Consumption' displays that there are more years with no crisis than years with a crisis. This is most likely due to the fact that Reinhart and Barro use two different approaches for defining a crisis.

GDP	Numbers of Years With at Least One Crisis	Numbers of Years Without any Crisis	Total
OECD	36	104	140
OPEC*	8	132	140
Non-OECD/OPEC	30	110	140

Table 6 - Contingency Table GDP

The contingency table 6 is based on the number of years with a decline in GDP of 10 percent or more, and base the frequency distribution from 1870 to 2009. Table 6 indicates that there are more years with no crises than years with a crisis. This is again the opposite from the contingency table 3 which is based on the BCDI+ index.

Table 7 and 8 give an overview of the basic descriptive statistics for GDP and 'Consumption'. It is worth mentioning that for these two variables 'OPEC' consists of Venezuela only. This should be kept in mind for further analysis as there may not be enough data to give any reliable results.

Gross Domestic Product - Probabilty of a cumulative decline of 10% or more					
Region	**Sample Period**	**Mean**	**Standard Deviation**	**No. Of Observations**	**Frequency Of Observations**
OECD	1870 - 2009	2,38 %	5,36 %	140	Yearly
OPEC*	1884 - 2009	6,35 %	24,48 %	140	Yearly
Non-OECD/OPEC	1870 - 2009	3,41 %	7,22 %	140	Yearly

*Venezuela only

Table 7 - Gross Domestic Product

Consumption - Probabilty of a cumulative decline of 10% or more					
Region	**Sample Period**	**Mean**	**Standard Deviation**	**No. Of Observations**	**Frequency Of Observations**
OECD	1870 - 2009	2,34 %	5,18 %	140	Yearly
OPEC	1870 - 2009	N/A	N/A	140	Yearly
Non-OECD/OPEC	1876 - 2009	4,85 %	13,87 %	140	Yearly

Table 8 - Consumption

Appendix 1 shows that Barro and Ursúa have excluded 'Consumption' for Venezuela in their analyses, due to lack of reliable data. As Venezuela is the only country in the category 'OPEC', there is no information for 'Consumption' for this group.

To get a better visual understanding of the descriptive statistics a graph for each category is shown below. The graph for 'OPEC' is not included with regards to GDP because it did not give much meaning as Venezuela was the only contributor.

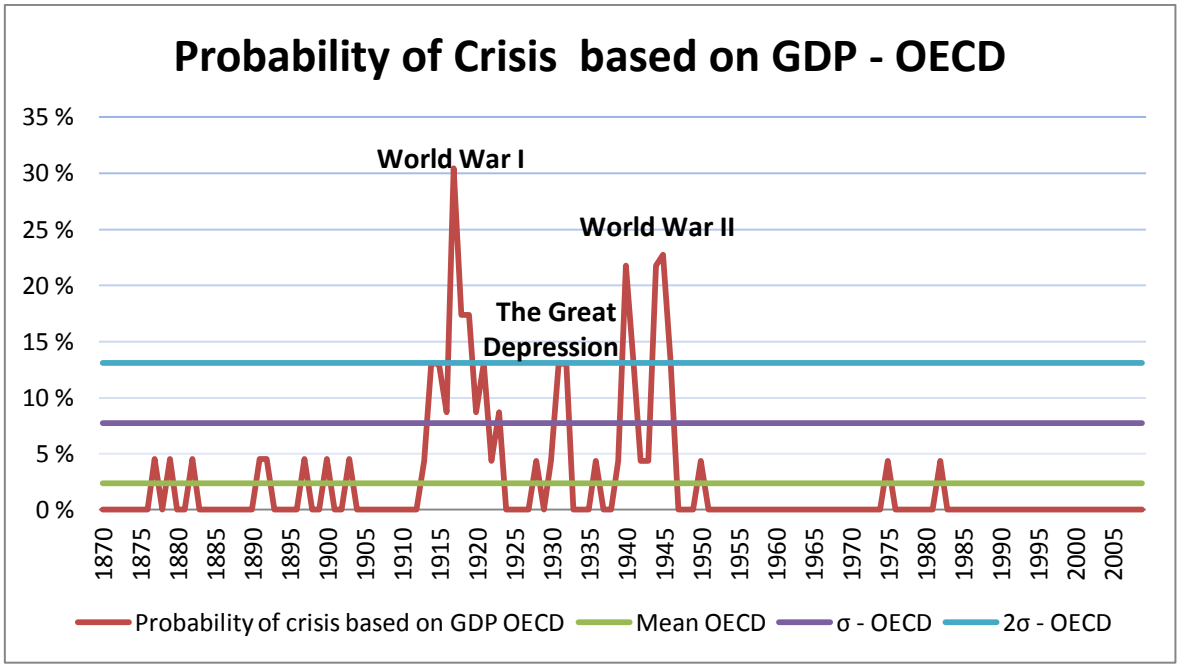

Figure 11 - Probability of Crises based on GDP – 'OECD'

Figure 11 shows that 'World War I', 'The Great Depression' and 'World War II' are displayed on the basis of GDP. As from section 5.5, the two world wars and 'The Great Depression' included the United Sates in addition to several European countries which are members of 'OECD'. An important aspect to notify is that the graph does not reveal any major findings with regards to 'The Great Recession' that happened in 2007 where the United Sates and several European countries were hit the hardest.

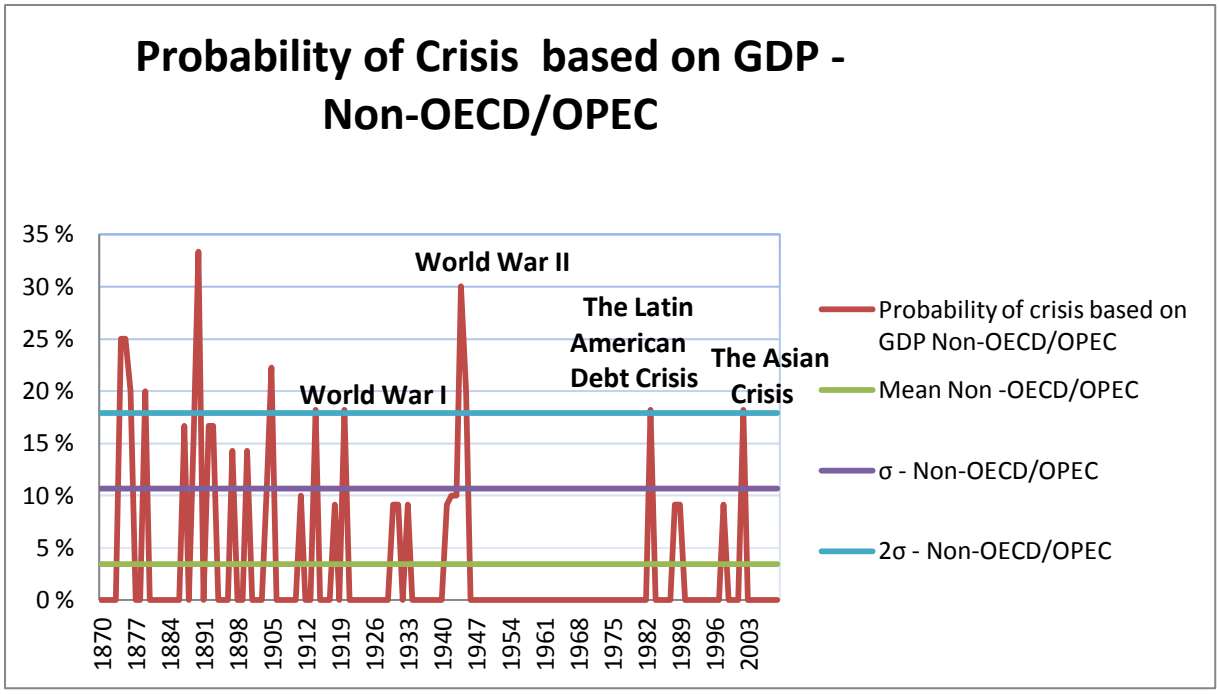

Figure 12 - Probability of Crisis based on GDP - 'Non-OECD/OPEC'

In addition to the two world wars, the graph in figure 12 shows that the 'Latin American Debt Crisis' and 'The Asian Crisis' both exceed two standard deviations from the mean. This is not a surprise as several Latin American countries are represented in this category and was hit hard by the debt crisis. In addition, the Asian countries represent the majority of this category and suffered from 'The Asian Crisis' over a long period. The main difference from the BCDI+ index for this category is that the probability of a crisis based on GDP reveals World War I. A closer look at the data for each country shows that the main contributors to this crisis are Uruguay and Argentina, where Uruguay supported the Allies as they were a trading partner with the United States. Even though Argentina claimed neutrality during the war, the economy was influenced because of the decreased international flow of goods.

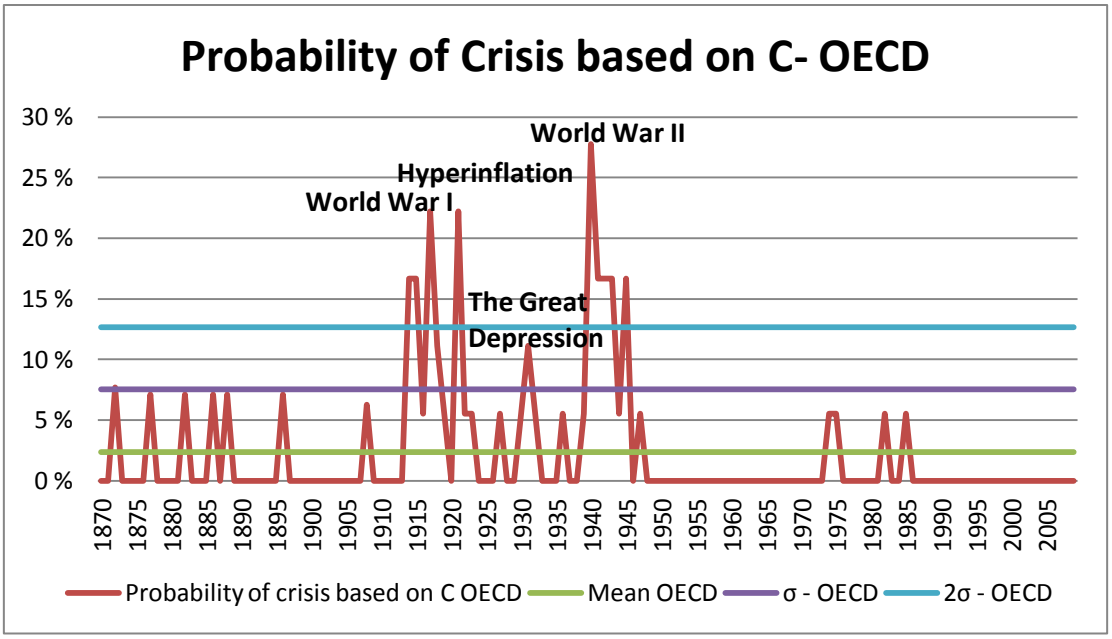

Figure 13 - Probability of Crisis based on C – 'OECD'

The graph in figure 13 shows more or less the same crises as the graph based on GDP for 'OECD' in figure 11. Also in this case, the graph does reveal much information of the most recent crises such as 'The Great Recession'.

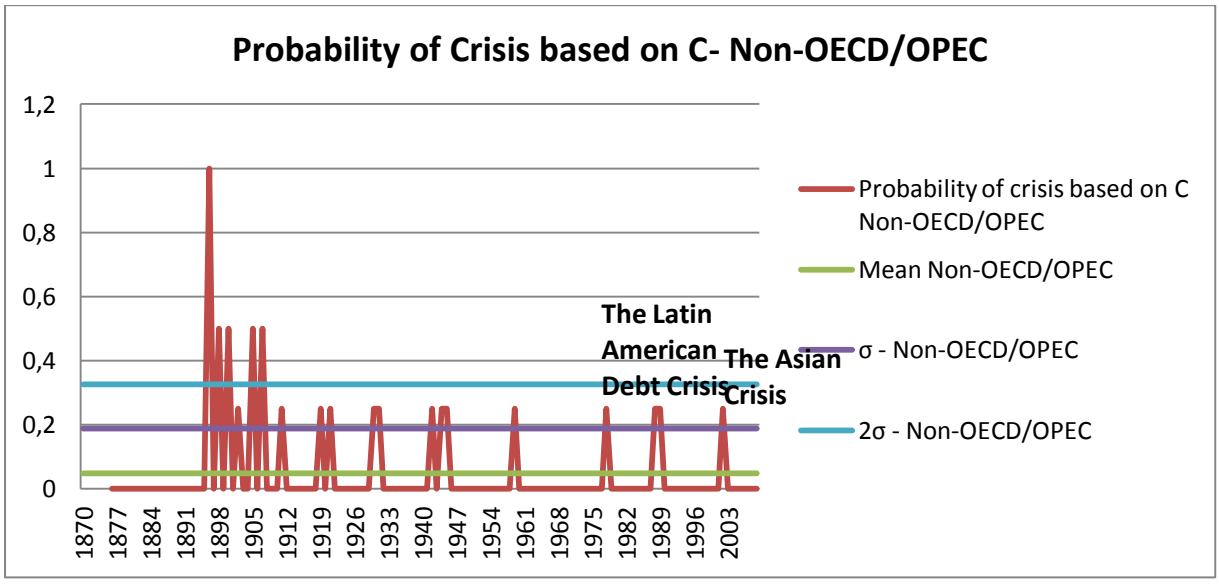

Figure 14 - Probability of Crisis based on C - 'Non-OECD/OPEC'

The probability of a crisis based on 'Consumption' indicates more or less the same crises as it did for GDP, but to a lower extent. Yet again, the probability does not reveal any information with regards to latest financial crisis in 2007.

5.7 Oil Consumption and Oil Production

The datasets 'Oil consumption' and 'Oil Production' do not start before 1965, which can become a problem for further analyzes as it is a relatively short period. The original datasets, picked up from the British Petroleum Company's (BP) webpage (BP, n.d.), include oil consumption and oil production on a yearly basis, calculated with the basis of thousand barrels per day. To make it easier to interpret the data and to get a better visual overview of possible changes during crises, the variables are converted into yearly percent change.

The data are given for more or less all countries in the world. However, some countries are assembled into one group such as 'Other European Countries'. This means that there may be some countries which should have been included as 'OECD' or 'OPEC' countries, but have been included as 'Non-OPEC/OECD' countries because of the lack of knowledge of these assembles groups. However, it is likely to assume that these countries are relatively minor contributors to oil consumption and oil production and would therefore not have significantly importance. Table 9 and 10 gives the basic descriptive statistics for oil consumption and oil production.

Oil Consumption - Percent change					
Region	**Sample Period**	**Mean**	**Standard Deviation**	**No. Of Observations**	**Frequency Of Observations**
OECD	1965 - 2010	1,64 %	3,82 %	45	Yearly
OPEC	1965 - 2010	4,77 %	3,32 %	45	Yearly
Non-OECD/OPEC	1965 - 2010	3,64 %	3,16 %	45	Yearly

Table 9 - Oil Consumption

Oil Production - Percent change					
Region	**Sample Period**	**Mean**	**Standard Deviation**	**No. Of Observations**	**Frequency Of Observations**
OECD	1965 - 2010	1,27 %	3,12 %	45	Yearly
OPEC	1965 - 2010	2,31 %	7,81 %	45	Yearly
Non-OECD/OPEC	1965 - 2010	3,28 %	3,75 %	45	Yearly

Table 10 - Oil Production

Appendix 2 and 3 includes the graphs for oil consumption and oil production, where the mean and the standard deviations are included in the graphs. To get an indication which category is responsible for most oil consumption and oil production, see graphs in figure 15 and 16 below.

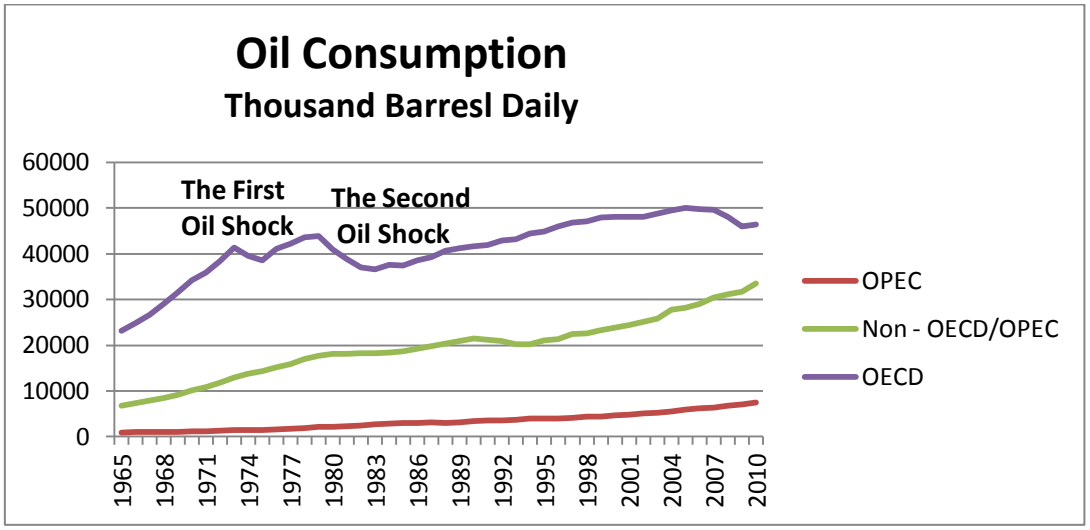

Figure 15 - Oil Consumption

The graph in figure 15 shows that the countries that are members of 'OECD' contributes the most to oil consumption, whereas the members of 'OPEC' contributes less. The two oil shocks are represented in a fall in oil consumption for 'OECD'.

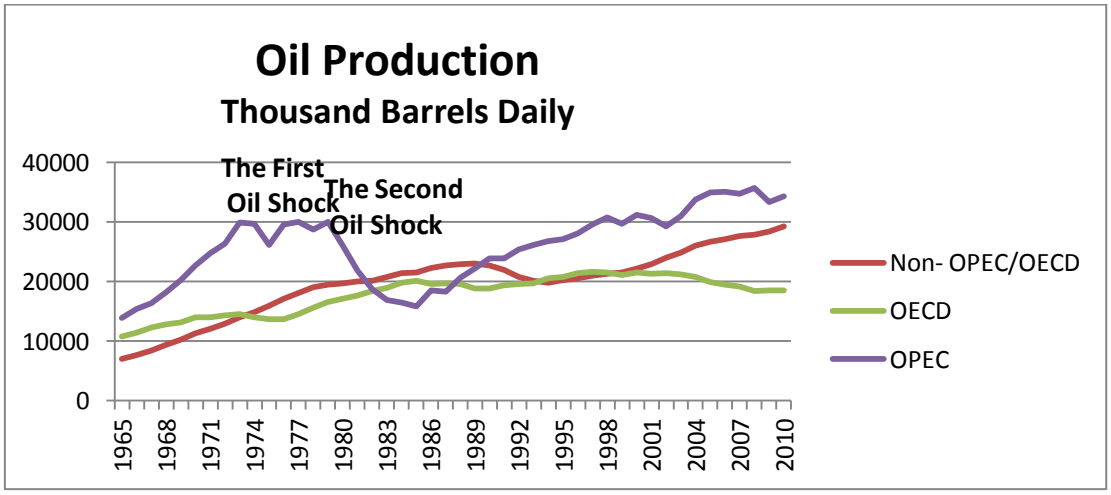

Figure 16 - Oil Production

The graph in figure 16 shows that 'OPEC' contributes the most to the oil production. However, during the beginning of 1970 and during the 1980s the oil production declines. As from chapter 3.1, these two declines can be explained by the two oil shocks that hit the global economy, especially 'OPEC' during the 1970s and the 1980s. The decline was a "controlled" decline as most of the 'OPEC members tried to reduce the production as an attempt to keep a high oil price.

5.8 Oil Price

The datasets (BP, n.d) for oil price starts as early as 1861 and consists of two 'types' of oil prices namely nominal oil price and real oil price. The nominal oil price is simply the price paid for crude oil at the time it was traded. The real oil price is corrected for inflation and usually expresses which year the correction for inflation is done. In this case, the real oil price is expressed in 2010 prices. The oil price used for the analyses in this thesis is based on yearly data. The oil price originally varies on a daily basis. By using yearly data, large fluctuations in the oil price during for example a day or a month may not be reflected. The reason for choosing the oil price on a yearly basis was to make it more comparable to the other variables used in the regressions.

Oil Price	Sample Period	Mean	Standard Deviation	No. Of Observations	Frequency Of Observations
Nominal Oil Price - percent change	1861 - 2010	8,60 %	39,59 %	149	Yearly
Real Oil Price (2010 prices) - percent change	1861 - 2010	5,41 %	33,88 %	149	Yearly
Nominal Oil Price - in terms of U.S. dollars	1861 - 2010	8,61	16,02	150	Yearly
Real Oil Price (2010 prices) - in terms of U.S. dollars	1861 - 2010	29,44	21,50	150	Yearly

Table 11 - Oil Price

Table 11 gives an overview of the basic descriptive statistics for the different terms of the oil price. The oil is traded in U.S. dollars and the oil price is therefore given in terms of U.S. dollars per barrels. The analyses include both the actual oil price and the percent change from one year to the other. Another important dimension related to the statistics is the oil price's volatility. For some years the oil price changes tremendously. One example is the change between 1973 and 1974 where the oil price increased with 252% based on yearly nominal prices. Such extreme values can contribute to higher key statistics and some analysts may exclude these case. The analyses in this thesis include the extreme values because they have

been accused for being one of the main triggers in previous crises. Even though these extreme values are included, they still have to be kept in mind.

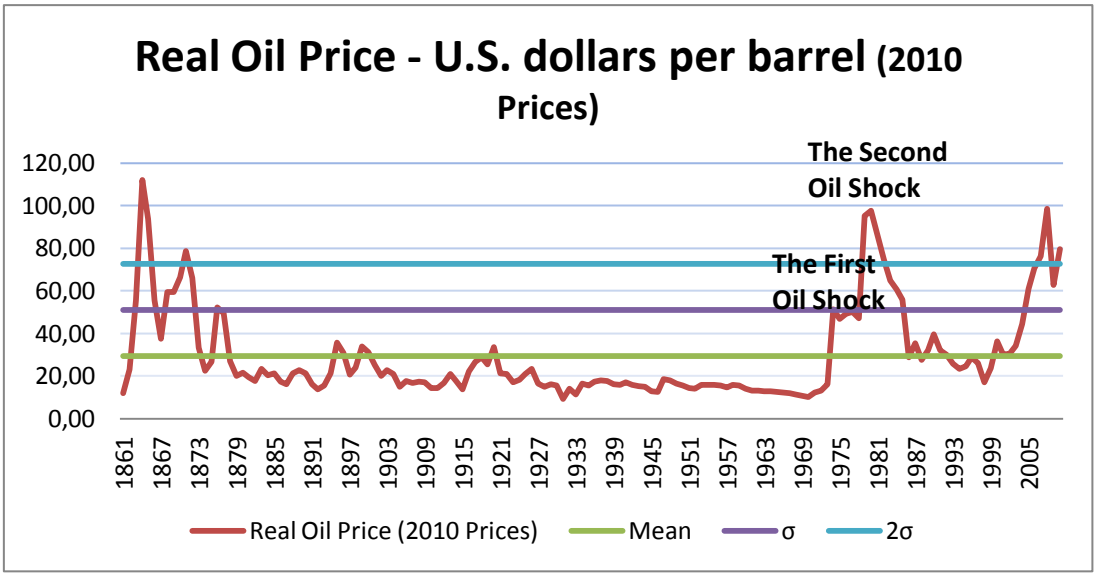

Figure 17 - Real Oil Price (2010 Price – U.S. Dollars)

Figure 17 shows the real oil price from 1861 to 2010. The two oil shocks made the oil price exceed its standard deviations. Appendix 4 gives one graph for each type of oil price.

6.0 Data Analysis

In order to give a quantitative approach to the question address in section 1.1:

"How do the oil factors affect the probability of a financial crisis?"

section 6 is composed of a correlation analysis, a logistic regression and a Poisson regression, where each of the three analyses are done for each category 'OECD', 'OPEC' and 'Non-OECD/OPEC'. The regressions revealed the same results in with regards to the relationship between the oil price and the probability of a financial crisis. The analyses showed some ambiguous results in order of how an increase in the oil price affected the probability. However, even though a concrete result was difficult to be achieved, a significant relationship between oil price fluctuations and a probability of financial crisis can be seen.

6.1 Correlation

Before doing a regression, it can be beneficial to carry out a correlation analysis of the variables that are intended to be included in the regression. One of the reason do to this is to be able to eliminate variables that can possibly create multicollinearity. Multicollinearity arises when one of the regressors is a perfect linear combination of the other regressors (Stock & Watson 2007, p. 206). That means that multicollinearity arises when one or more variables or strongly correlated which indicates that they show too much of the same information. The correlation between a variable X and a variable Y can be calculated by the equation:

$$Corr(X,Y) = \frac{Cov(X,Y)}{\sqrt{var\ (X)var(Y)}} = \frac{\sigma_{XY}}{\sigma_X \sigma_Y}$$

Equation 1 - Correlation

The variables are not dependent of each other if the correlation is zero. If it is equal to one, they are perfectly correlated to each other and move in the same direction, and if it is minus one, they are perfectly negatively dependent on each other and move in the opposite direction. According to this interpretation the correlation is always between minus one and one;

$$-1 \leq Corr(X,Y) \geq 1$$

The tables below shows the correlation between the variables used for further analyzes. There is one table with correlation for each category 'OECD', 'OPEC' and 'Non-OECD/OPEC'.

6.1.1 Correlation 'OECD'

Corr. OECD	BCDI+	C	GDP	Nom.Oil Price	Nom. Oil Price %	Real Oil Price	Real Oil Price %	Oil Cons. %	Oil Prod. %
BCDI+	1,00								
C	0,35	1,00							
GDP	0,41	0,75	1,00						
Nom.Oil Price	0,18	-0,17	-0,19	1,00					
Nom. Oil Price %	0,15	-0,04	-0,04	0,15	1,00				
Real Oil Price	0,10	-0,11	-0,16	0,76	0,28	1,00			
Real Oil Price %	0,09	-0,07	-0,07	0,13	0,99	0,26	1,00		
Oil Cons.%	-0,44	-0,39	-0,31	-0,58	-0,18	-0,73	-0,16	1,00	
Oil Prod. %	0,00	-0,12	-0,02	-0,40	-0,18	-0,12	-0,20	0,33	1,00

Table 12 - Correlation 'OECD'

The correlation of the variables in the 'OECD' category shows that the nominal oil price is strongly correlated with the real oil price, both in terms of U.S. dollars and percent change. In addition to this, Consumption and GDP are relatively strongly correlated with a correlation coefficient of 0.75.

6.1.2 Correlation 'OPEC'

Corr. OPEC	BCDI+	GDP	Nom.Oil Price	Nom. Oil Price %	Real Oil Price	Real Oil Price %	Oil Cons. %	Oil Prod. %
BCDI+	1,00							
GDP	-0,06	1,00						
Nom.Oil Price	0,32	-0,09	1,00					
Nom. Oil Price %	0,00	-0,13	0,15	1,00				
Real Oil Price	0,16	-0,10	0,76	0,28	1,00			
Real Oil Price %	-0,03	-0,12	0,13	0,99	0,26	1,00		
Oil Cons. %	-0,31	0,05	0,10	0,21	0,27	0,20	1,00	
Oil Prod. %	0,02	-0,13	-0,33	0,00	-0,59	0,02	0,01	1,00

Table 13 - Correlation 'OPEC'

The correlation between the nominal oil price and real oil price obviously give the same result as described in the correlation of the 'OECD' category as the oil price is a general variable for all the three categories. Except from this strong correlation, the rest of the variables do not indicate any strong correlations to each other. Note that 'Consumption' is not included in this correlation because of Barro and Ursúa's exclusion of this variable.

6.1.3 Correlation 'Non-OECD/OPEC'

Corr.Non-OECD/OPEC	BCDI+	C	GDP	Nom.Oil Price	Nom. Oil Price %	Real Oil Price	Real Oil Price %	Oil Cons. %	Oil Prod. %
BCDI+	1,00								
C	-0,09	1,00							
GDP	-0,06	0,23	1,00						
Nom.Oil Price	0,40	-0,11	-0,14	1,00					
Nom. Oil Price %	0,04	-0,16	-0,12	0,15	1,00				
Real Oil Price	0,27	-0,06	-0,10	0,76	0,28	1,00			
Real Oil Price %	0,00	-0,16	-0,11	0,13	0,99	0,26	1,00		
Oil Cons. %	-0,68	0,03	-0,20	-0,32	0,21	-0,34	0,21	1,00	
Oil Prod. %	-0,64	-0,05	-0,06	-0,40	0,12	-0,33	0,12	0,87	1,00

Table 14 - Correlation 'Non-OECD/OPEC'

The last table with correlations concerns the countries that are not a part of 'OCED' or 'OPEC'. The correlation between oil consumption and oil production is 0.87 which indicates that the variables are strongly correlated. Apart from this, the only correlation worth mentioning is, yet again, the correlation between the nominal oil price and the real oil price.

6.2 Logistic Regression

A logistic regression (also called logit regression) is a nonlinear regression which is designed to fit binary dependent variables. As from earlier, a binary variable is a variable that is either 0 or 1 (Stock & Watson, 2007, p. 775). The logistic regression is supposed to reveal the probability of the dependent variable to be 1, that means that the value revealed by the regression has to lie in between 0 and 1. By doing a "normal" regression such as a linear regression, it is likely to end up with numbers that are above one or negative. A logistic regression is therefore designed to adopt a nonlinear approach that forces the distribution to fall in between 0 and 1. The logistic cumulative distribution function has a specific functional form (Stock and Watson 2007, p.394):

The population logit model of the binary dependent variable Y with multiple regressors is:

$$\Pr(Y = 1|X_1, X_2, \ldots\ldots, X_n) = F(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + e)$$
$$= \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + e)}}$$

Equation 2 - Logistic Regression Function

'e' is the error term that includes all possible factors that are not included as regressors, but may contribute to the determination of the dependent variable. In this case, there may be other variables such as proved oil reserves or corporate default that contributes to the level of the probability of a financial crisis.

The coefficients of the logit model are estimated by maximum likelihood. The maximum likelihood method chooses the coefficients so that the observed values for the dependent variable are those which are most likely to occur. The maximum likelihood estimator is consistent and normally distributed in large samples, so that t-statistics and confidence intervals of the coefficients can be constructed in the usual way (Stock & Watson 2007, p. 394).

The case of a financial crisis is binary in nature where the two options are whether there is a crisis or not. The logistic estimation method will therefore suit the data well. The statistical analysis program Statistical Package for the Social Sciences (SPSS) is used in order to carry out the logistic estimations. The next section will give a description of the logistic regression output from SPSS and how it should be interpreted.

6.2.1 Logistic Regression – SPSS Output

The SPSS output starts with a general overview of what data that is included, such as how many cases are included in the regression.

The output is divided into two sections. 'Block 0: Beginning Block' and 'Block 1: Method = Enter'. 'Block 0' is based on the dependent variable and the constant and is called the null model, while 'Block 1' is based on the full model containing the independent variables in addition to the dependent variable and the constant.

The first table to analyze from the output is "Omnibus Tests of the Model Coefficients", where the Chi-Square for the model is given.

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	59.622	3	.000
	Block	59.622	3	.000
	Model	59.622	3	.000

Figure 18 - 'Omnibus Test of Model Coefficients'

The Chi-Square is linked to the -2 Log Likelihood (-2LL) in figure 19. The Chi-Square shows the difference between the -2LL from the 'block 0'-model to the 'block 1'-model where the

last column in the table shows if this drop is statistically significant. If the Chi-Square is statistically significant, it indicates that the full model is a better model than the null model and that the joint null-hypothesis can be rejected (H_0: all of the coefficients in the regression in the full model are zero). When 'step', 'block' and 'model' have the same values it is because there is not used a stepwise regression or any blocking of variables.

In order to measure the fit of the model the output includes the table 'Model Summary'.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	98.405[a]	.345	.512

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than ,001.

Figure 19 - 'Model Summary'

The Cox & Snell R square and the Nagelkerke R Square are the pseudo R-squares. The pseudo-R^2 uses the likelihood function to measure the fit of the model. As for the R^2 in OLS regression, the pseudo-R^2 is a poor measure of fit due to the fact that R^2 increases whenever a regressor is added.

The next output from SPSS is the "Classification Table".

Classification Table[a]

Observed			Predicted		
			GDP		
			0	1	Percentage Correct
Step 1	GDP	0	100	6	94.3
		1	14	21	60.0
	Overall Percentage				85.8

a. The cut value is ,500

Figure 20 - 'Classification Table'

The 'Classification Table' shows the numbers of zeros and 'ones' that are observed in the dependent variable and how many cases that are correctly and not correctly classified.

The last table included in the SPSS output is the "Variables in the Equation".

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	BCDIAnnualAverage	1.074	.649	2.740	1	.098	2.928
	OilPrice$2010	-.030	.017	3.124	1	.077	.970
	Consumption	40.655	8.803	21.329	1	.000	4.533E17
	Constant	-1.993	.612	10.612	1	.001	.136

a. Variable(s) entered on step 1: BCDIAnnualAverage, OilPrice$2010, Consumption.

Figure 21 - 'Variable in the Equation'

The first column named "B" examines the coefficients that are used for the calculation of the logistic regression when predicting the dependent variable from the independent variables. Whether the coefficient is reducing or increasing the probability of the dependent variable is revealed by the respectively negative or positive value. The 'Wald' statistic is the Chi-Square for each coefficient and has a separate column for the two tailed p-value linked to it (Sig.). As from above, if the p-value is statistically significant, the null hypothesis, which says that the coefficient is zero, is rejected. One important thing to notice is that if the coefficient has an unrealistically high value, the 'Wald' statistic is not reliable because the calculation of the standard error is wrong. The final column 'Exp(B)', is simply the exponential coefficient, and can be used to examine the 'odds' and' log odds'.

6.2.2 Logistic Regression

As mentioned earlier, the case of a financial crisis can be treated as a binary variable where the two options are whether there is a crisis or not. The aim for doing a logistic regression was to investigate whether or not the BCDI+ index, GDP, 'Consumption' and the main oil indicators could have any effect on the probability of a financial crisis.

In order to define a dependent variable for the logistic regression, the decision was to run one regression including the BCDI+ index as the dependent variable and two separate regressions where Robert Barro's data (GDP and C) were the dependent variables. One separate regression for each of the three categories 'OECD', 'OPEC' and 'Non-OECD/OPEC' was carried out.

In addition to the BCDI+ index and Robert Barro's data for GDP and 'Consumption' the original starting point included data for oil consumption, oil production and the four terms of oil prices. However, it turned out that the data available for oil consumption and oil production were not sufficient because the data series did not start before 1965. These data were therefore excluded and the regressions were done by the different types of oil price, the BCDI+ index, GDP and 'Consumption'.

Another important aspect to remember is how 'GDP' and 'C' are calculated. The data reflect the probability of a crisis based on numbers of countries with a cumulative decline of 10 percent or more in both, GDP and 'Consumption'. Therefore, before analyzing the regressions and with no mathematical or statistical arguments, when GDP or 'Consumption' are included as independent variables an increase in the variable will hopefully increase the probability of a crisis.

The logistic regression output has been tested against a 95% (*) and 90% (**) confidence level where the SPSS output is in included in appendix 5, 6 and 7.

6.2.3 Logistic Regression 'OECD'

The first sets of logistic regressions were carried out for the category 'OECD'.

Logistic Regression 'OECD' – Dependent Variable: BCDI+

The first regression carried out for 'OECD' included the BCDI+ index as the dependent variable. As the BCDI+ index was based on an annual average it had to be converted into binary variables with value equal to one or zero. The transformation was based on the mean and the standard deviation of the dataset. The mean for the BCDI+ index was calculated to be 0.6 with a respectively standard deviation of 0.4. Years with an annual average equal or above one were changed to 'one' and the years with an annual average below 'one' were changed to zero. The regression was run with various combinations of the independent variables.

The correlation in section 6.1.1 pointed out the strong correlation between GDP and 'Consumption', which caused the problem of multicollinearity. The combination of the two variables therefore gave insignificant results, and the variables were tested separately with the four terms of oil price.

The combination of GDP and the nominal oil price in percent turned out to be the only statistically significant regression. The overall test of the model had a statistically significant

Chi-square with a p-value below 0.05. GDP was statistically significant at a 95% level, while the nominal oil price in percent was statistically significant at a 90% level. However, notify that the coefficient for GDP is relatively large, which indicates that the Wald Chi-Square and the p-value are not reliable.

With GDP as 0.07 and a change in nominal oil price of 20 percent, the logistic regression can be calculated as:

$$\Pr(Crisis|GDP, NomOilPrice\%) = F(-2{,}130 + 17{,}155GDP + 1{,}035NomOilPrice\%)$$

$$= \frac{1}{1 + e^{-(-2{,}130 + 17{,}155*0{,}05 + 1{,}035*0{,}20)}}$$

$$\Pr(Crisis|GDP, NomOilPrice\%) = 0{,}3262$$

Equation 3 - Logistic Regression Function OECD DV: BCDI+

Equation 3 shows that if GDP increases or/and if the percent change of the nominal oil price increases the probability of a crisis increases.

Logistic Regression 'OECD' – Dependent Variable: 'Consumption'

The second regression for 'OECD' included 'Consumption' as the dependent variable. Also in this case the dataset needed to be transformed into binary variables. The data for 'Consumption' are calculated and interpreted in a different way than the BCDI+ index. Therefore, the attempt to transform the data into binary variables based on the mean and the respectively standard deviation failed because the dataset revealed too few 'ones'. As mentioned earlier, the data for 'Consumption' gives the probability of a crisis based on a cumulative decline of 10 percent or more. For that reason, it is likely to assume that the data already indicates when there is a crisis or not. The years which had a probability of a crisis greater than zero therefore got the value one. This also matched when it was examined against previous crises during the 1900s.

The regression was carried out with different combination of independent variables. The only regression with statistically significant results combined the BCDI+ index and the nominal oil price as the independent variables. The Chi-square for this regression was statistically significant with a p-value less than 0.05., and both the BCDI+ index and the nominal oil price coefficients were statistically significant on a 95% level.

With an annual average BCDI+ index of 0.6 and a nominal oil price of 20, the logistic regression can be calculated as:

$$\Pr(Crisis|BCDI+, NomOilPrice) = F(-2{,}457 + 2{,}612BCDI + -0{,}077NomOilPrice)$$

$$= \frac{1}{1 + e^{-(-2{,}457 + 2{,}612*0{,}6 - 0{,}077*20)}}$$

$$\Pr(Crisis|BCDI+, NomOilPrice) = 0{,}088$$

Equation 4 - Logistic Regression Function 'OECD' DV: C

According to equation 4, an increase in the annual average BCDI+ index increases the probability of a crisis, while an increase in the nominal oil price decreases the probability of a crisis. In terms of how the oil price affects the probability of a crisis, the logistic regression including the BCDI+ index as the dependent variable showed the opposite effect.

Logistic Regression 'OECD' – Dependent Variable: GDP

The last logistic regression for 'OECD' included GDP as the dependent variable. The transformation of the dataset into binary variables was done in the same was as for 'Consumption': years with a probability greater than zero got the value 'one'.

All the four terms of oil price in the combination with the BCDI+ index gave statistically significant results, where the real oil price and the nominal oil price had a p-values less than 0.05 and the real oil price and the nominal oil price, both in terms of percent, had a p-value less than 0.1. The four models had all statistically significant Chi-Squares on a 95% level (Appendix 5).

With an annual average BCDI+ index of 0.6 and a nominal oil price of 20, the logistic regression can be calculated as:

$$\Pr(Crisis|BCDI+, NomOilPrice) = F(-2{,}157 + 2{,}632BCDI + -0{,}135NomOilPrice)$$

$$= \frac{1}{1 + e^{-(-2{,}157 + 2{,}632*0{,}6 - 0{,}135*20)}}$$

$$\Pr(Crisis|BCDI+, NomOilPrice) = 0{,}038$$

Equation 5 - Logistic Regression Function 'OECD' DV: GDP

Equation 5 displays that an increase in the BCDI+ index increases the probability of a crisis, while an increase in the oil price reduces the probability of a crisis. Because the two separate regressions including the BCDI+ index and 'Consumption' as the dependent variable gave inconsistent results of how the oil price affected the probability of crisis, it is worth notifying that the three other statistically significant regressions with GDP as dependent variable revealed the same effect of an increase in the oil price as the regression in equation 5.

6.2.4 Logistic Regression 'OPEC'

The original starting point for the logistic regressions for 'OPEC' included with one regression with the BCDI+ index as the dependent variable and two separate regressions with GDP and 'Consumption' as dependent variables. However, recall that the only country belonging to 'OPEC' for the variables GDP and 'Consumption' was Venezuela. Robert Barro excluded Venezuela in his analysis of 'Consumption' due to insufficient data, which is complied in this regression analysis.

Logistic Regression 'OPEC' – Dependent Variable: BCDI+

To transform the BCDI+ index into binary variables, a mean of 0.68 with a standard deviation of 0.80 were found. The years with an index equal or greater than 1.48 got the value 'one' and the years with an index less than 1.48 got the value zero. When the regression was carried out, it turned out that the independent variable GDP did not give any meaning and the results was strongly statistically insignificant. This can be explained by the inadequate data for GDP. As a possible solution, the actual value for GDP, in addition to the yearly percent change, for Venezuela was included as independent variables. The result was disappointing as it did not improve the regression. Nevertheless, the regression was continued with the BCDI+ index and the oil indicators. It turned out that the only statistically significant results included the nominal oil price as the independent variable, where both the overall Chi-Square and the coefficient were statistically significant at a 95 % level. With a nominal oil price of 20, the regression can be calculated as:

$$\Pr(Crisis|NomOilPrice) = F(-2{,}263 + 0{,}033 NomOilPrice)$$

$$= \frac{1}{1 + e^{-(-2{,}263 + 0{,}033 * 20)}}$$

$$\Pr(Crisis|NomOilPrice) = 0{,}2013$$

Equation 6 - Logistic Regression Function 'OPEC' DV: BCDI+

Equation 6 shows that whenever the oil price increases, the probability of a crisis increases. Yet again the regression gives ambiguous results when it comes to how the oil price affects the probability of a crisis.

Logistic Regression 'OPEC' – Dependent Variable: GDP

The logistic regression including GDP as dependent variable did not reveal any statistically significant result. In fact, it was not possible to run the regression trough SPSS as there were not enough crises (defined with 'one') as a result of too little information with regards to GDP for this category.

6.2.5 Logistic Regression 'Non-OECD/OPEC'

The final set of logistic regressions included the category 'Non-OECD/OPEC'. The data was implemented as it was for the two other categories, 'OECD' and OPEC'.

Logistic Regression 'Non-OECD/OPEC' – Dependent Variable: BCDI+ Index

The first logistic regression had the BCDI+ index as the dependent variable. The mean for the index was calculated to be 0.53 with a respectively standard deviation of 0.44. Years with a BCDI+ index equal or greater than 0.97 got the value 'one' and the years with BCDI+ index less than 0.97 got the value zero. When the regression was carried out, both GDP and 'Consumption' were insignificant no matter what combinations there were included in. However, both the nominal oil price and the real oil price were significant at a 95% level. With a nominal oil price of 20, the regression can be calculated as:

$$\Pr(Crisis|NomOilPrice) = F(-2{,}191 + 0{,}042 NomOilPrice)$$

$$= \frac{1}{1 + e^{-(-2{,}191 + 0{,}042 * 20)}}$$

$$\Pr(Crisis|NomOilPrice) = 0{,}2590$$

Equation 7 - Logistic Regression Function 'Non-OECD/OPEC' DV: BCDI+

The calculation in equation 7 shows that an increase in the nominal oil price increases the probability of a crisis. For the regression including the real oil price, the coefficient revealed the same effect on the probability of a crisis as in equation 7.

Logistic Regression 'Non-OECD/OPEC' – Dependent Variable: GDP

The logistic regression which included GDP as the dependent variable did not reveal any findings with regard to the four terms of oil price, but gave statistically significant when 'Consumption' was included as the only independent variable. This regression has not been analyzed due to the fact that it does not say anything about the relationship between the probability of a crisis and the oil and gas industry.

Logistic Regression 'Non-OECD/OPEC' – Dependent Variable: C

The last logistic regression had 'Consumption' as the dependent variable. The regression including the real oil price in percent change and GDP was statistically at a 95% level, while the regression including the nominal oil price in terms of percent was statistically significant at a 90% level. The coefficients for GDP were relatively high in both the regressions, which can indicate that the p-values are not reliable. Therefore, appendix 7 includes two regressions where GDP has been excluded. With GDP equal to 0.07 and a change in the nominal oil price of 20 percent, the logistic regression can be calculated as:

$$\Pr(Crisis|GDP, RealOilPrice\%) = F(-2{,}753 + 7{,}734GDP + -2{,}692RealOilPrice\%)$$

$$= \frac{1}{1 + e^{-(-2{,}753 + 7{,}734*0{,}07 - 02{,}692*0{,}20)}}$$

$$\Pr(Crisis|GDP, RealOilPrice\%) = 0{,}064$$

Equation 8 - Logistic Regression Function 'Non-OECD/OPEC' DV: C

The interpretation of the result in figure 8 is: whenever GDP increases the probability of a crisis increases and whenever the oil price increases the probability of a crisis decreases.

6.2.6 Summary Logistic Regression

As a number of regressions were done, this section is supposed to give a brief overview of the findings. Whenever the BCDI+ index, GDP or 'Consumption' were included as independent variables, an increase in the variables contributed to an increase in the probability of a crisis.

The oil price did in turn reveal some ambiguous results in terms of how an increase in the oil price affected the probability of a financial crisis. However, even though the results are ambiguous, the oil price at least has some effect of the probability of a crisis. Three possible explanations for the ambiguous results have been discussed below.

As mentioned before, the oil price has revealed some extreme values such as the significant increase in the oil price during the first oil shock. Would the regressions revealed more consistent results if these extreme values were eliminated? This thesis has not included any regressions where the extreme values are excluded because these values have been accused to be an important cause of previous crises.

Another important aspect is whether a high oil price indentifies a crisis or a boom? Or put in another way: If an increase in the oil price indicates a financial crisis, will a decrease in the oil price denote a boom or at least no crisis? During the 1970s, when the first oil shock hit the global economy, the oil price increased rapidly. In the logistic regressions, the dependent variable then takes the binary value 'one' for these years, which indicates a crisis. For some of the crises, especially 'The Hyperinflation', 'World War II' and 'The Asian Crisis' the change in the oil price is negative. That means that during these crises, which also have the binary variable 'one' in the dependent variable, the oil price decreases. This again implies that the negative or positive change in the oil price differs for the crises which are denoted by the value 'one' in the dependent variable and will again affect the maximum likelihood method used in the logistic regression. The maximum likelihood method chooses the coefficients so that the observed values for the dependent variable are those which are most likely to occur, and the oil price will therefore gives some ambiguous results.

The last possible explanation for the results can be the role played by oil price in the overall economy. Over the last decades the global economy has changed into a more comprehensive economy where crude oil has become a "common" commodity and plays a different role than it did before. The oil price should therefore, as any other commodity, be analyzed in connection with the demand. A rapid increase in the oil price has usually been interpreted as an economic recession. However, the International Monetary Fund (IMF) has published the working paper 'Oil Shocks in a Global Perspective: Are they Really that Bad?' (Rasmussen & Roitman, 2011). The authors find that: "the oil prices tend to be surprisingly closely associated with good times for the global economy" (p.16). They claim that the negative impact from oil shocks for oil-importing countries is partly offset by the corresponding

increases in exports and other income flow. These flows occur because high commodity prices are being associated with good times for the world economy, in addition to the recycling of petrodollars by oil-exporting economies, and therefore the impact of the oil price should been viewed in a global perspective.

They also find that with the exception of the United States, increased oil prices have generally caused increased import and export, which again had led to a smaller reduction in GDP. Even though the impact of the increase in the oil price is small, it should not be ignored. They found that some countries have without a doubt been negatively affected by the increase.

The working paper explain that the cross-country differences in the relationship between oil prices and the macro economy can in large parts be explained by the differences in relative size in oil imports. A closer look at the logistic regressions above shows that when the oil price increases it increases the probability of a financial crisis for the 'OPEC' countries, while for the two other categories, 'OECD' and 'Non-OECD/OPEC', the regressions gives ambiguous results. A closer look at the graphs for oil consumption and oil production in section 5.7 shows that 'OECD' is the main contributor to oil consumption, while the main contributor to oil production is 'OPEC'. The output from the logistic regression and the analyses of the graphs in section 5.7 therefore matches the findings of the cross-country differences explained in the working paper.

6.3 Poisson Regression

Because the logistic regressions revealed some ambiguous results in terms of how the oil price affected the probability of a financial crisis and in order to investigate whether or not the results had been different in another form of regression, a Poisson regression was carried out.

Poisson regression is categorized as a generalized linear model (GLM). Generalized linear models allow for modeling of responses that have another distribution than a normal distribution, such as a probability distribution.

Poisson regression has, as the logistic regression, different mathematics and underlying probability distribution than ordinary least squares (OLS) regressions. The Poisson distribution is a discrete distribution which is a distribution of random variables with finite numbers of values. The distribution counts the data of for example a particular event. The Poisson probability mass function can be expressed by (Dunteman & Ho, 2006):

$$f(y|\lambda) = \frac{\lambda^y e^{-\lambda}}{y!}$$

Equation 9 - Poisson Probability Mass Function

Where 'e' is the base of the natural logarithm which is approximately 2.7183 and $y! = y(y-1)(y-2)\cdot \ldots \cdot 1$. (for example $3! = 3 \times 2 \times 1$). λ is the intensity or rate parameter which is the mean of the numbers of events (X) which again its equal to the variance of the numbers of events (figure 10)

$$\lambda = E(X) = Var\ (X)$$

Equation 10 - Poisson regression - Mean and Variance

The Poisson regression is often used to model rare events. Poisson regressions aim to model counts of observations or events, in this case, the number of financial crises. It is important to note that the responses are independent. The Poisson regression models the log of the expected count. Because the regression is based on the natural logarithm scale, there will be no negative integer values. According to Cameron & Trivedi (2005, p.668): "the regression is derived from the Poisson distribution by parameterizing the relation between the mean

parameter λ and covariates (regressors) x." The Poisson regression standard link function is revealed in equation 11, where the lnλ is a function of the linear model:

$$Ln(Y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n$$

$$Y = \left(e^{\beta_0}\right) * \left(e^{\beta_1 X_1}\right) * \left(e^{\beta_2 X_2}\right) * \ldots * \left(e^{\beta_n X_n}\right)$$

Equation 11 - Poisson Standard Link Function

As for the logistic regression in chapter 6.2, the statistical analysis program Statistical Package for the Social Sciences (SPSS) is used in order to carry out the Poisson regressions.

6.3.1 Poisson Regression - SPSS output

The SPSS output begins with a basic description of the regression, such as how many cases are included, which model is run etc. The first output table from SPSS is 'Continuous Variable Information'.

Continuous Variable Information

		N	Minimum	Maximum
Dependent Variable	Numbers of decline of more or equal to 10% gdp	141	0	7
Covariate	BCDI+ Index total	141	.000000	36.000000
	NominalOilPrice	141	.5600	97.2560
	Numbers of decline of more or equal to 10% consumption	141	0	5

Continuous Variable Information

		Mean	Std. Deviation
Dependent Variable	Numbers of decline of more or equal to 10% gdp	.54	1.222
Covariate	BCDI+ Index total	12.07092199	8.036208585
	NominalOilPrice	8.926899	16.4646922
	Numbers of decline of more or equal to 10% consumption	.40	.918

Figure 22 - 'Continuous Variable Information'

The output in figure 22 gives an overview of the basic descriptive statistics for the variables included in the regression. This can be used to check how the mean is compared to the minimum and maximum level or how it is compared to the variance.

The next output is the 'Goodness of fit' table included in figure 23.

Goodness of Fit[b]

	Value	df	Value/df
Deviance	101.192	137	.739
Scaled Deviance	101.192	137	
Pearson Chi-Square	126.310	137	.922
Scaled Pearson Chi-Square	126.310	137	
Log Likelihood[a]	-94.378		
Akaike's Information Criterion (AIC)	196.757		
Finite Sample Corrected AIC (AICC)	197.051		
Bayesian Information Criterion (BIC)	208.552		
Consistent AIC (CAIC)	212.552		

Dependent Variable: Numbers of decline of more or equal to 10% gdp
Model: (Intercept), BCDIIndextotal, NominalOilPrice, Numbersofdeclineofmoreorequalto10consumption

a. The full log likelihood function is displayed and used in computing information criteria.

b. Information criteria are in small-is-better form.

Figure 23 - 'Goodness of Fit'

This table compares the current regression to other models. The table is used to test if the Poisson regression fit the data well, or if other models could be more appropriate. Other models can for example be another type of model or another Poisson model where the comparison is done between a reduced model and a full model. The 'Deviance', which is a test of the model form, should be evaluated. The deviance values divided on numbers of degrees of freedom (value/df) says something about the fit of the model. Due to the fact that the mean of the Poisson Regression its equal to is variance, the 'value/df' should be approximately 1. If it is less than 1, the regression is said to have underdispersion and if it is above 1 it is said to have overdispersion. In the case of under- or overdispersion, the

requirements (mean equal variance) of the Poisson distribution are violated. Overdispersion is more common than underdispersion. If the distribution has overdispersion it means that the count data with regards to the dependent variable are more volatile than expected for the Poisson distribution. An alternative model to use can be the negative binominal distribution. Under- or overdispersion does not affect the estimation of the parameters in the regression, however it will affect the estimation of the standard errors for the coefficients in the regression (Dunteman & Ho, 2006).

The 'Omnibus Test' in figure 24 tests whether or not the overall model is statistically significant. As from the logistic regression output, it tests whether or not the full model is a better model than the null model. If the p-value is less than 0.05 the joint null-hypothesis can be rejected (H_0: all of the coefficients in the regression in the full model are zero) on a 95% level.

Omnibus Test[a]

Likelihood Ratio Chi-Square	df	Sig.
144.914	3	.000

Dependent Variable: Numbers of decline of more or equal to 10% gdp
Model: (Intercept), BCDIIndextotal, NominalOilPrice, Numbersofdeclineofmoreorequalto10consumption

a. Compares the fitted model against the intercept-only model.

Figure 24 - 'Omnibus Test'

One of the tables that should be properly analyzed is the 'Parameter Estimates'.

Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval	
			Lower	Upper
(Intercept)	-1.931	.3134	-2.545	-1.317
BCDIIndextotal	.073	.0147	.045	.102
NominalOilPrice	-.098	.0377	-.172	-.025
Numbersofdeclineofmoreorequalto10consumption	.510	.0717	.369	.651
(Scale)	1[a]			

Dependent Variable: Numbers of decline of more or equal to 10% gdp
Model: (Intercept), BCDIIndextotal, NominalOilPrice, Numbersofdeclineofmoreorequalto10consumption

a. Fixed at the displayed value.

Parameter Estimates

Parameter	Hypothesis Test			Exp(B)
	Wald Chi-Square	df	Sig.	
(Intercept)	37.976	1	.000	.145
BCDIIndextotal	24.838	1	.000	1.076
NominalOilPrice	6.826	1	.009	.906
Numbersofdeclineofmoreorequalto10consumption	50.539	1	.000	1.665
(Scale)				

Dependent Variable: Numbers of decline of more or equal to 10% gdp
Model: (Intercept), BCDIIndextotal, NominalOilPrice, Numbersofdeclineofmoreorequalto10consumption

Figure 25 - 'Parameter Estimates'

The first column 'B' displays the coefficients (β) for the relevant variables included in the regression. If β is zero, then $e^{\beta} = e^{0} = 1$, and the coefficient (β) will not affect the change in the independent variable (X) from equation 11. If $\beta < 0$, the independent variable (X) will have a negative effect on the dependent variable (Y), and last if $\beta > 0$ the independent variable (X) will have a positive effect on the dependent variable (Y). The next column 'Std. Error' is the variables standard errors. The next column of interest is the 'Sig' which reveal the p-value for each variable. As from earlier, if the p-value is below 0.05 the null-hypothesis, which says that the coefficient is zero, is rejected and the coefficient is statistically significant. The last column 'Exp(B)' is simply showing the exponential coefficient.

6.3.2 Poisson Regression 'OECD'

The Poisson regression for 'OECD' was done with the same variables as for the logistic regression. However, to make the data more appropriate for the Poisson regression some of the variables were structured different than for the logistic regression. The BCDI+ index consisted of the total number of crises experienced each year. The lowest number of crises experienced for one year was zero and the highest number was thirty-six. For GDP and 'Consumption', the data included the total numbers of decline of 10 percent or more for each year. The lowest number of experienced crises for GDP was zero and the highest was seven. For 'Consumption' the lowest value was zero, and the highest value 5. The four terms of the oil price were included as they were for the logistic regressions.

Poisson Regression 'OECD' – Dependent Variable: BCDI+

The regressions for 'OECD' started with the BCDI+ index as the dependent variable. One separate regression for each aspect of oil price in the combination of GDP and 'Consumption' were carried out. Appendix 8 includes the most important output from SPSS for each of the regressions. The fours regressions all had statistically significant coefficients and Chi-Square on a 95% level. However, 'Deviance/df' was about 4.5 for all the regressions. In section 6.3.1 overdispersion was introduced and all the four regressions suffer from this, which again indicate that another type of distribution may give better results. As attempt to get better results, GDP and 'Consumption' was included as the probability of a crisis based on cumulative decline of 10 percent instead of counts of occurrence of crises. The result was disappointing as this regression turned out to be statistically insignificant.

The four original regressions all had positive coefficients and therefore affected the dependent variable in the same way. If GDP is 2, 'Consumption' 3 and the nominal oil price is 20, the calculation of the Poisson standard link function become:

$$Ln\,(BCDI+) = \beta_0 + \beta_1 GDP + \beta_2 C + \beta_3 NomOilPrice$$

$$Ln(BCDI+) = 2{,}258 + 0{,}139GDP + 0{,}087C + 0{,}009NomOilPrice$$

$$BCDI+ = e^{2{,}258} * e^{0{,}139GDP} * e^{0{,}087C} * e^{0{,}009NomOilPrice}$$

$$BCDI+ = e^{2{,}258} * e^{0{,}139*2} * e^{0{,}087*3} * e^{0{,}009*20}$$

$$BCDI+ = 19{,}63$$

Equation 12 - Poisson Standard Link Function 'OECD' - DV: BCDI+

The number of crises based on the BCDI+ index will therefore be 19.63.

Poisson Regression 'OECD' – Dependent Variable: 'Consumption'

The regression with 'Consumption' as the dependent variable obviously included the BCDI+ index, GDP and the four terms of oil prices as the independent variables. There was only one regression that revealed statistically significant results, namely the combination of the BCDI+ index, GDP and the nominal oil price as independent variables. The 'Deviance Value/df' was 0.678. Because it was below one, it indicates that there is a case of underdispersion. However, the Chi-Square was together with GDP and the BCDI+ index, statistically significant at a 95% level. The nominal oil price was statistically significant at a 90% level. With a GDP of 2, a BCDI+ index of 3 and a nominal oil price of 20, the Poisson standard link function become:

$$Ln\,(C) = \beta_0 + \beta_1 GDP + \beta_2 BCDI + \beta_3 NomOilPrice$$

$$Ln(C) = -2{,}055 + 0{,}424 GDP + 0{,}051 BCDI - 0{,}045 NomOilPrice$$

$$C = e^{-2{,}055} * e^{0{,}424 GDP} * e^{0{,}051 BCDI} * e^{-0{,}045 NomOilPrice}$$

$$C = e^{-2{,}055} * e^{0{,}424*2} * e^{0{,}051*3} * e^{-0{,}045*20}$$

$$C = 0{,}14$$

Equation 13 - Poisson Standard Link Function 'OECD' - DV: C

According to Equation 13, an increase in the oil price decreases the number of financial crises, which is the opposite effect from the regression with the BCDI+ index as the dependent variable.

Poisson Regression 'OECD' – Dependent Variable: GDP

The last regression for 'OECD' included GDP as the dependent variable. The combination of the BCDI+ index and the nominal oil price as independent variables turned out to have statistically significant Chi-Square and coefficients on a 95% level. The regression including the real oil price and the BCDI+ index also had a p-value for the Chi-Square below 0.05, but the coefficient for the real oil price was statistically significant at a 90% level. Both the regression's 'Deviance/df' had a value approximately equal to one. The calculation of the regression in equation 14 is based on 'Model 1' in appendix 8 where 'Consumption' is set to 2, the BCDI+ index has a value of 3 and the oil price is 20.

$$Ln\,(GDP) = \beta_0 + \beta_1 C + \beta_2 BCDI + \beta_3 NomOilPrice$$

$$Ln(GDP) = -1{,}931 + 0{,}510 C + 0{,}073 BCDI - 0{,}098 NomOilPrice$$

$$GDP = e^{-1,931} * e^{0,510C} * e^{0,073BCDI} * e^{-0,098NomOilPrice}$$

$$GDP = e^{-1,931} * e^{0,510*2} * e^{0,073*3} * e^{-0,098*20}$$

$$GDP = 0,07$$

Equation 14 - Poisson Standard Link Function 'OECD' - DV: GDP

As from equation 14, an increase in the nominal oil price decreases the number of financial crises. If the BCDI+ index and/or 'Consumption' increase, the numbers of financial crises increases.

6.3.3 Poisson Regression 'OPEC'

The variables for the category 'OPEC' were included in the same way as it for 'OECD', where the highest value for the BCDI+ index was 17 and the lowest was zero.

Because Venezuela is the only country in this category, the highest value of numbers of decline of 10 percent or more per year was one, and the lowest value was zero. Yet again, 'Consumption' is not included due to insufficient data. The original starting point included one regression with the BCDI+ index as the dependent variable and one regression with GDP as the dependent variable. However, as experienced in the logistic regressions, whenever a regression included GDP as a variable, the regressions failed. Therefore, the regression with the BCDI+ index as the dependent variable was the only regression that was carried out.

Poisson Regression 'OPEC' – Dependent Variable: BCDI+ Index

Appendix 9 shows the two regressions that were statistically significant, one with the nominal oil price included as independent variable and one with the real oil price included as the independent variable. In fact, both the regressions were statistically significant at a 95% level. The two regressions had a 'Deviance/df' around 2.5 which gives an indication of overdispersion. The calculation of 'Model 1' (appendix 9) with an oil price of 20 can be written as followed:

$$Ln\,(BCDI+) = \beta_0 + \beta_1 NomOilPrice$$

$$Ln(BCDI+) = 0,827 + 0,015NomOilPrice$$

$$BCDI+ = e^{0,0827} * e^{0,015NomOilPrice}$$

$$BCDI+ = e^{0,0827} * e^{0,015*20}$$

$$BCDI+ = 3{,}086$$

Equation 15 - Poisson Standard Link Function 'OPEC' DV: BCDI+

Equation 15 shows that an increase in the nominal oil price will increase the number of financial crises, which was also the case in the regression including the real oil price as the independent variable. Again, the regressions give ambiguous results of how the oil price is affecting the counts of financial crises.

6.3.4 Poisson Regression' Non-OECD/OPEC'

The regressions for 'Non-OECD/OPEC' were built up in the same way as for the two other categories. The highest value for the BCDI+ index was forty-seven and the lowest was 'one'. For GDP the highest amount of crises experienced was three and the lowest amount was zero, and the highest amount of crises experienced in 'Consumption' was five with the lowest amount of zero. Also for this category, one regression for each dependent variable GDP, 'Consumption' and the BCDI+ index was carried out.

Poisson Regression 'Non-OECD/OPEC' – Dependent Variable: BCDI+

The two regressions that were statistically significant were the combinations of GDP, 'Consumption' and respectively the nominal oil price and real oil price. Both the regression had a relatively high 'Deviance/df' (indication of overdispersion) but statistically significant coefficients and Chi-square at a 95% level. Equation 16 gives the calculation of 'Model 1' in appendix 10, where the GDP is 2, 'Consumption' is 3 and the nominal oil price is 20.

$$Ln\,(BCDI+) = \beta_0 + \beta_1 GDP + \beta_2 C + \beta_3 NomOilPrice$$

$$Ln(BCDI+) = 2{,}453 + 0{,}115GDP - 0{,}07C + 0{,}014NomOilPrice$$

$$BCDI+ = e^{2{,}453} * e^{0{,}115GDP} * e^{-0{,}07C} * e^{0{,}014NomOilPrice}$$

$$BCDI+ = e^{2{,}453} * e^{0{,}115*2} * e^{-0{,}07*3} * e^{0{,}014*20}$$

$$BCDI+ = 2{,}1234$$

Equation 16 - Poisson Standard Link Function 'Non-OECD/OPEC' DV: BCDI+

According to equation 16, an increase in the nominal oil price increases the numbers of financial crises. 'Consumption' behaves differently from the previous regressions as an

increase in consumption decreases the numbers of financial crises. The real oil price and 'Consumption' affected the numbers of financial crisis in the same way as the regression in equation 16.

Poisson Regression 'Non-OECD/OPEC' – Dependent Variable: GDP

The regression with GDP as the dependent variable gave no statistically significant results even with different combinations of the independent variables.

Poisson Regression 'Non-OECD/OPEC' – Dependent Variable: 'Consumption'

The final Poisson regression included 'Consumption' as the dependent variable. It turned out that whenever the BCDI+ index was included as an independent variable the regressions gave statistically insignificant results. As a matter of fact, the combination of GDP and the nominal oil price was the only regression which gave significant coefficients and Chi-Square. The 'Deviance/df' was close to one, which indicates that the Poisson regression is appropriate regression for this distribution. The regression including GDP as 2 and the nominal oil price as 20, was calculated as followed:

$$Ln\,(C) = \beta_0 + \beta_1 GDP + \beta_3 NomOilPrice$$

$$Ln(C) = -0{,}870 + 0{,}614 GDP - 0{,}065 NomOilPrice$$

$$C = e^{-0{,}870} * e^{0{,}614 GDP} * e^{-0{,}065 NomOilPrice}$$

$$C = e^{-0{,}870} * e^{0{,}614*2} * e^{-0{,}065*20}$$

$$C = 0{,}3898$$

Equation 17 - Poisson Standard Link Function 'Non-OECD/OPEC' DV: GDP

Yet again, equation 17 reveals that an increase in the oil price decreases the numbers of financial crises.

6.3.5 Summary Poisson Regression

The purpose of this section is to give a brief synopsis of the findings of the Poisson regressions. Whenever the BCDI+ index, GDP or 'Consumption' were included as independent variables an increase in the variables contributed to an increase in the number of financial crises. The only exception was the regression for 'Non-OECD/OPEC' with the BCDI+ index as dependent variable, where an increase in 'Consumption' decreased the number of financial crises.

With regards to the oil price, it had the same effect on the dependent variable as it had for the logistic regressions. It gave ambiguous results of how it affected the number of financial crises. In fact, if the exact same regression is compared for the two types of regressions (i.e. 'OECD' with dependent variable as BCDI+ for logistic regression and Poisson regression), they revealed the same results with regards to how the dependent variable was affected. In section 6.2.6, where the findings from the logistic regressions were summarized, three possible explanations for the ambiguous oil price results were introduced. The three explanations discussed the extreme values in the oil price, the behavior of the oil price with regard to the estimation method in the regression and finally the oil price's role in the economy.

While the logistic regression uses the maximum likelihood method to predict the probability of the dependent variable, the Poisson regressions aim to model counts of observations or events. More specifically, according to Cameron & Trivedi (2005, p.668): "the regression is derived from the Poisson distribution by parameterizing the relation between the mean parameter λ and covariates (regressors) x." The oil price's different behavior during crises discussed in section 6.2.6, will therefore also apply for the Poisson regression.

The two other possible explanations have been interpreted in section 6.2.6 and will therefore not be explained in this section.

7.0 Conclusion

The aim of this thesis was to investigate whether or not the main indicators in the oil and gas industry affected the probability of a financial crisis. The methodology used in order to establish a quantitative relationship between the main oil indicators and the probability of a financial crisis was: Poisson regression and Logistic regression. As to the current knowledge, this methodology has not been used before.

This conclusion will discuss the findings from the quantitative analyses and the most important interpretation from the results. Recall, two main relationships was investigated:

- The relationship between Carmen Reinhart's BCDI+ index and Robert Barro's data for 'Consumption' and GDP
- The relationship between Carmen Reinhart and Robert's Barro's data and the oil related data

The quantitative analysis is based on the categories 'OECD', 'OPEC' and 'Non-OECD/OPEC'.

The BCDI+ Index is a financial turbulence index, introduced by Carmen Reinhart, composited of **B**anking crises, **C**urrency crises, **D**ebt crises (internal and external), **I**nflation crises and stock market crashes (+). The index summarizes the number of crises experienced each year for a specific country. 'Consumption' and 'Gross Domestic Product' are based on Robert Barro definition of a financial crisis, which is measured by a cumulative decline of 10 percent or more in the respectively variables. The main oil indicators used in the quantitative analysis were oil consumption, oil production and the four terms of oil prices: nominal oil price and real oil price both in actual value, and the nominal oil and real oil price both in yearly percent change.

In order to quantify the relationship between the main oil indicators and the probability of a financial crisis, the two regressions 'Logistic' and 'Poisson' were carried out in addition to a correlation analysis. The correlation analyses were supposed to identify any dependence between the variables. Not surprisingly, the nominal oil price was strongly correlated with the real oil price, both in terms of actual prices and the yearly percent change. For 'OECD', GDP and 'Consumption' were also strongly correlated, while for 'Non-OECD/OPEC' oil consumption and oil production were strongly correlated.

A logistic regression, which estimates the probability of a financial crisis, was done for each of the three categories. In fact, for each category, there was one regression with the BCDI+ index as the dependent variable and two separate regressions with respectively GDP and 'Consumption' as the dependent variable. When the regressions were done, it turned out that oil consumption and oil production had to be excluded due to inadequate data. However, whenever the BCDI+ index, GDP and 'Consumption' were included as independent variables, an increase in these variables all increased the probability of a financial crisis. The oil price on the other hand, gave some ambiguous results in how it affected the probability of a financial crisis. More specifically, the effect from the oil price gave ambiguous results for 'OECD' and 'Non-OECD/OPEC', while for 'OPEC', an increase in the oil price increased the probability of a financial crisis. Possible explanations for theses ambiguous results will be explained further down.

The final quantitative analysis was based on a Poisson regression. The Poisson regression models the number of counts for the dependent variable. This regression used the same dependent variables as above, which are GDP, 'Consumption' and the BCDI+ Index. With regard to the oil price, the Poisson regression revealed the exact same results of how an increase in the oil price affected the number of counts of the dependent variable.

The oil price ambiguous effect on the dependent variable in the regressions was discussed in section 6.2.6 where three possible explanations were discussed. The first possible explanation is the volatility of the oil price. The oil price has revealed some extreme values such as the significant increase in the oil price during the first oil shock. Would the regressions revealed more consistent results if these extreme values were eliminated? This thesis has no regressions where the extreme values are excluded because the rapid increases are considered as one of the main contributing factors in previous crises such as the two oil shocks.

The second possible solution discussed the oil price's "behavior" during crises. During the first oil shock, the oil price increased rapidly. In the logistic regressions, the dependent variable then takes the binary value 'one' for these years, which indicates a crisis. On the other hand, for some crises that also took on the binary value 'one', such as 'The Asian Crisis', the oil price decreased. That being said, whether the oil price increases or decrease differs for the crises which are denoted by the value 'one' in the dependent variable and will again affect the maximum likelihood method used in the logistic regression. Because the Poisson regression models counts of observations by parameterizing the relation between the

mean-parameter and the regressors, the different behavior of the oil price will be interpreted in the same way as it was for the logistic regression.

The final possible explanation for the ambiguous results can be the role played by the oil price in the overall economy. During the last decades the global economy has changed into a more comprehensive economy where crude oil has become a "common" commodity. A rapid increase in the oil price has usually been interpreted as an economic recession. However, section 6.2.6 introduced the IMF working paper 'Oil Shocks in a Global Perspective: Are they Really that Bad?' where the authors claimed that the oil price tend to be closely associated with good times for the global economy. This is because they found that the negative economic impact is partly balanced by the corresponding increase in exports and other income flow. The authors state that even though the impact of the increase in the oil price is small, it should not be ignored as some countries, especially countries with a low level of oil-import, have been negatively affected by the increase. The two types of regressions showed that when the oil price increases it increases the probability of a financial crisis for the 'OPEC' countries, while for the two other categories, 'OECD' and 'Non-OECD/OPEC', the regressions gives ambiguous results. The output from the regressions therefore matched the findings in the working paper with regards to the cross-country differences as the graphs for oil consumption and oil production in section 5.7 shows that 'OECD' is the main contributor to oil consumption, while the main contributor to oil production is 'OPEC'.

Even though a concrete solution was difficult to be obtained, a significant relationship between oil price fluctuations and the probability of a financial crisis can be seen.

7.1 Possible Extensions

Section 1.3 introduced the limitations for this thesis. Recall that due to the limit of time the number of analyzes is minimized. This section aim to give some possible extensions that can be carried out if the reader wishes to continue the investigation of the relationship between the main oil indicators and the probability of a financial crisis.

When the Poisson regression was carried out, it turned out that some of the regressions suffered from the occurrence of overdispersion. Overdispersion indicates that another distribution than the Poisson distribution may be a better fit. As a consequence of this, the negative binominal regression was suggested, which includes dispersion, in addition to the mean, as a parameter.

As the oil price revealed some ambiguous with regards to whether or not the oil price increases or decreases during crises, this should be investigated to a greater extent. One suggestion is to have a separate look at the decrease in oil prices during crisis, not just the relation of crises and an increase in the oil price. Another aspect to be analyzed is the oil price role in the global economy: Is an increase always that bad?

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Appendix

Appendix 1 - Data Overview

OECD Countries	BCDI+ Index	GDP	Consumption	Oil Consumption	Oil Production
Australia	x	x	x	x	x
Austria	x	x	x*	x	
Belgium	x	x	x	x	
Canada	x	x	x	x	x
Chile	x	x	x	x	
Czech Republic				x	
Denmark	x	x	x	x	x
Estonia					
Finland	x	x	x	x	
France	x	x	x	x	
Greece	x	x	x*	x	
Germany	x	x	x	x	
Hungary	x			x	
Iceland	x	x	x*		
Ireland	x			x	
Israel				x	
Italy	x	x	x	x	x
Japan	x	x	x	x	
Korea	x	x	x*	x	
Luxembourg				x**	
Mexico	x	x*	x*	x	x
Netherlands		x	x	x	
New Zealand		x	x*	x	
Norway		x	x	x	x
Poland				x	
Portugal		x	x	x	
Slovak Republic				x	
Slovenia					
Spain		x	x	x	
Sweden		x	x	x	
Switzerland		x	x	x	
Turkey	x	x*	x*	x	
United Kingdom	x	x	x	x	x
United States	x	x	x	x	x

* Excluded from analyses because of insufficient coverage

** Belgium and Luxembourg included as one

OPEC Countries	BCDI+ Index	GDP	Consumption	Oil Consumption	Oil Production
Algeria	x			x	x
Angola	x				x
Ecuador	x			x	x
Iran				x	x
Iraq					x
Kuwait				x	x
Libya					x
Nigeria					x
Qatar				x	x
Saudi Arabia				x	x
United Arab Emirates				x	x
Venezuela	x	x	x*	x	x

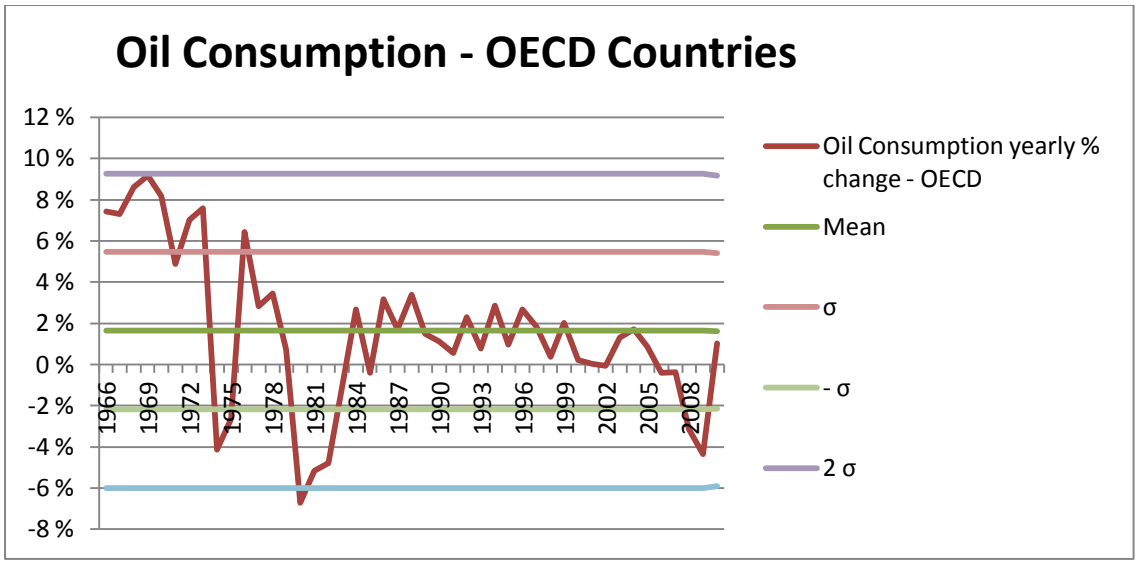
* Excluded from analyses because of insufficient coverage

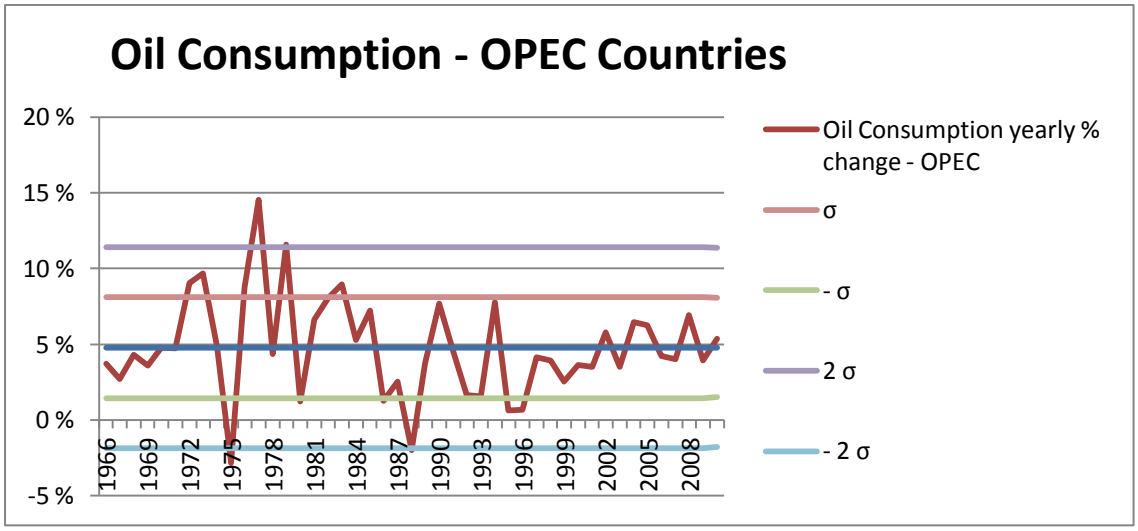
Non-OECD/OPEC Countries	BCDI+ Index	GDP	Consumption	Oil Consumption	Oil Production
Argentina	x	x	x	x	x
Azerbaijan				x	x
Bangladesh				x	
Belarus				x	
Bolivia	x				
Brazil	x	x	x	x	x
Brunei					x
Bulgaria				x	
Central African Republic	x				
Chad					x
China	x	x*	x*	x	x
Columbia	x	x	x*	x	x
Costa Rica	x				
Cote D'Ivoire	x				
Dominican Republic	x				
Egypt	x	x*	x*	x	x
El Salvador	x				
Equatorial Guinea					x
Gabon					
Ghana	x				
Guatemala	x				
Honduras	x				
Hong Kong SAR				x	
India	x	x	x*	x	x
Indonesia	x	x	x*	x	x
Kazakhstan				x	x

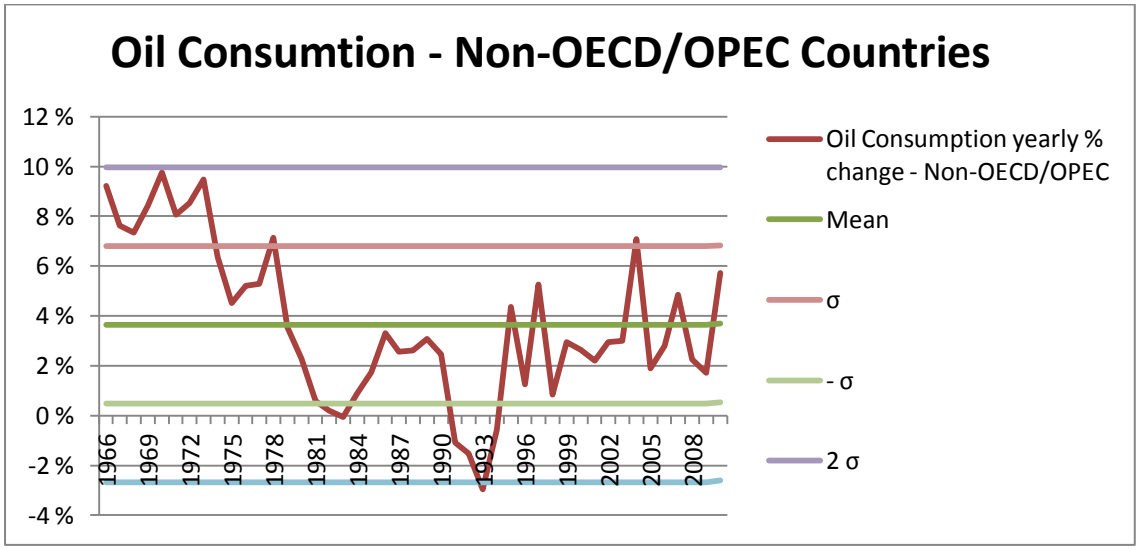
Lithuania				x	
Kenya	x				
Malaysia	x	x*	x*	x	x
Mauritius	x				
Morocco	x				
Oman					x
Other Africa				x	x
Other Asia Pacific				x	x
Other Europe and Eurasia				x	x
Other Middle East				x	x
Other South and Central America				x	x
Pakistan				x	
Peru		x	x	x	x
Philippines		x	x*	x	
Republic of Congo					x
Romania				x	x
Russia		x*	x*	x	x
Singapore		x*	x*	x	
South Africa		x	x*	x	
Sri Lanka		x	x*		
Sudan					x
Syria					x
Taiwan	x	x	x	x	
Thailand	x			x	x
Trinidad & Tobago				x	x
Tunisia	x				x
Turkmenistan				x	x
Ukraine				x	
Uruguay	x	x	x*		
Uzbekistan				x	x
Vietnam				x	x
Yemen					x
Zambia	x				
Zimbabwe	x				

* Excluded from analyses because of insufficient coverage

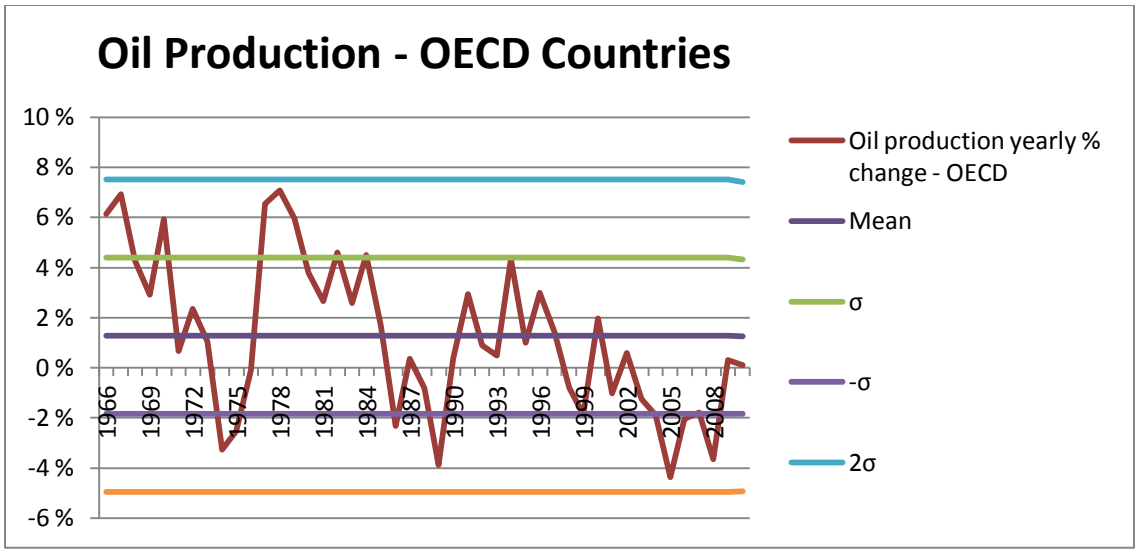
Appendix 2 - Oil Consumption

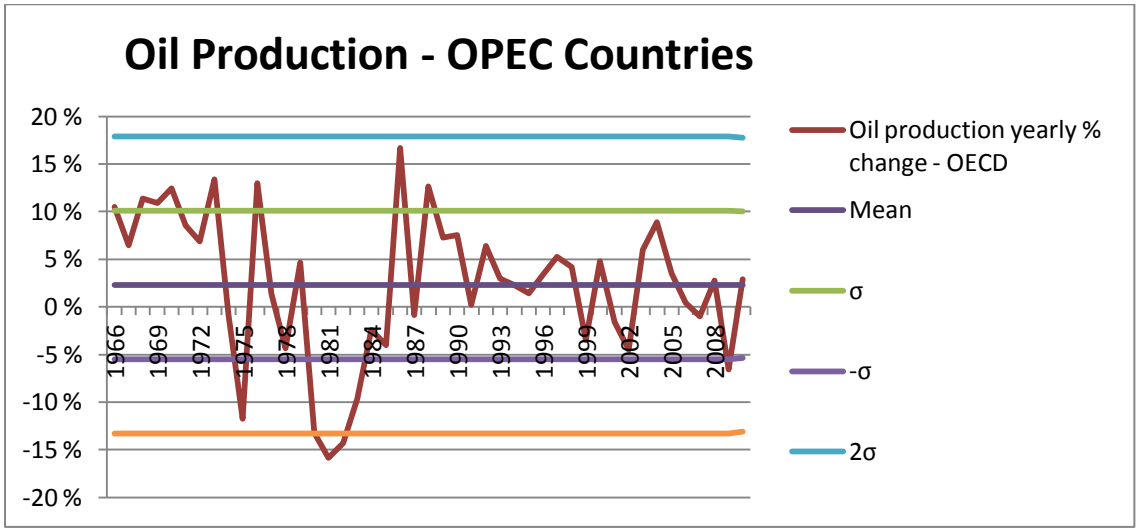


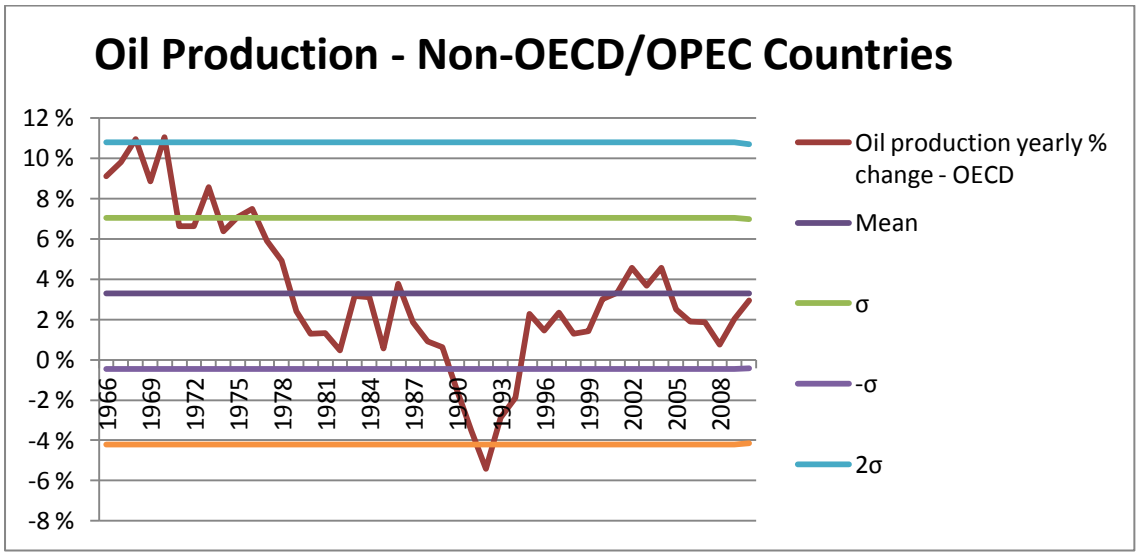




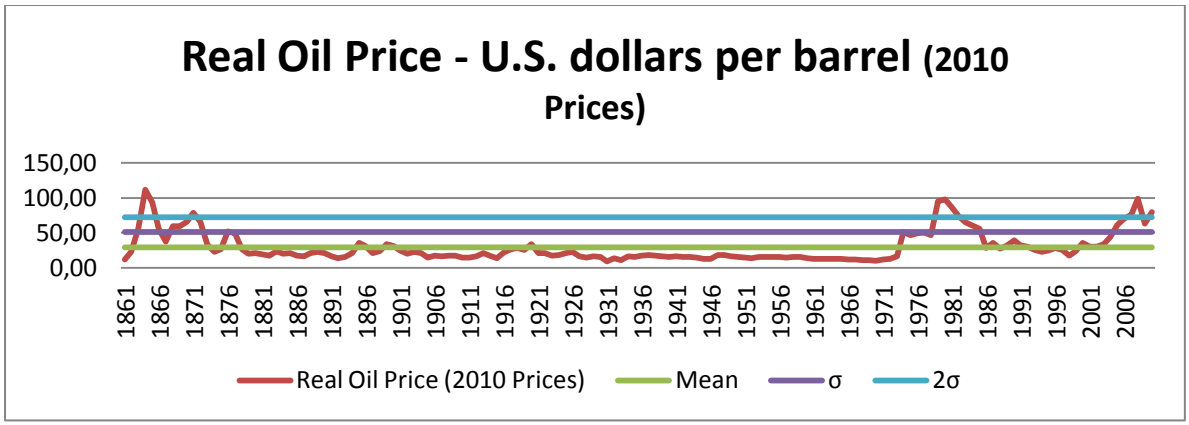
Appendix 3 - Oil Production

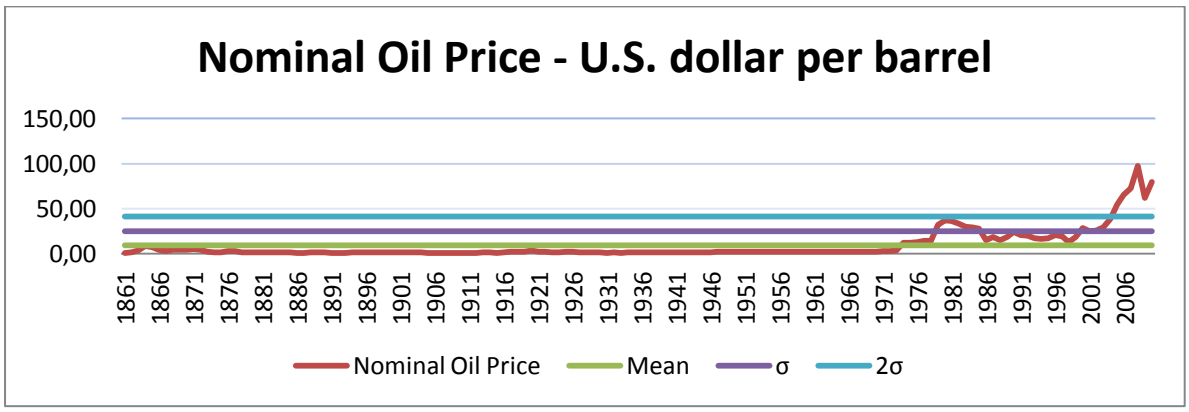


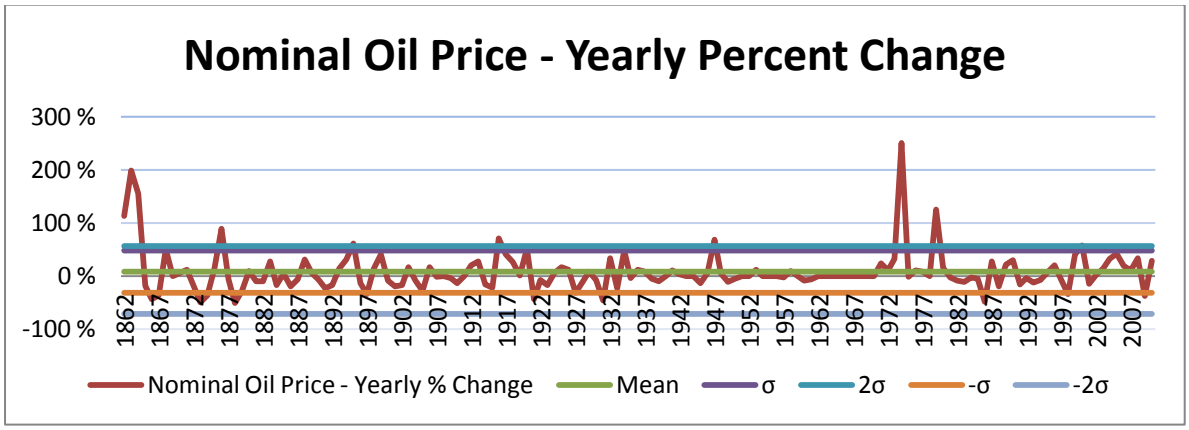


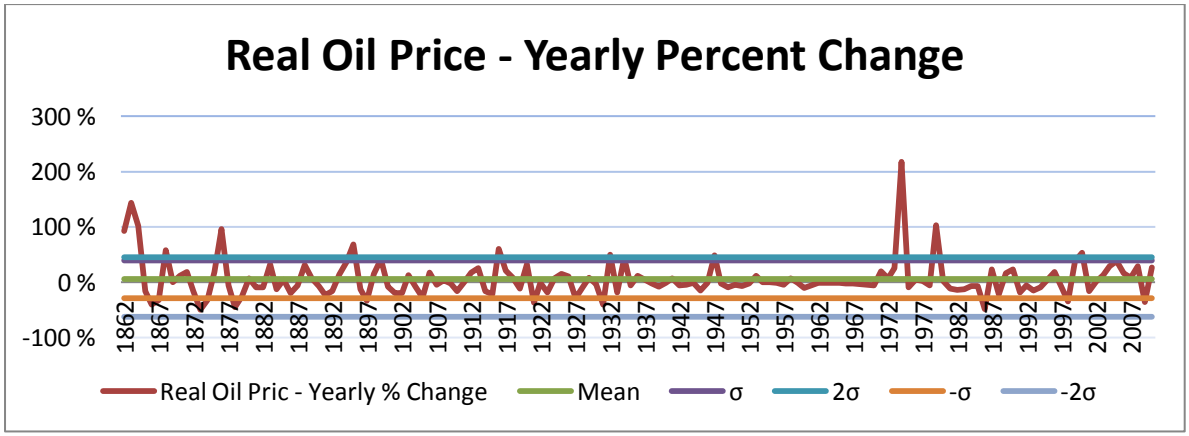


Appendix 4 – Oil Price









Appendix 5 - Logistic Regression Output SPSS OECD

Dependent Variable: BCDI+	Model 1		
	β	S.E.	Sig.
Constant	-2,13	0,297	0,000*
GDP[1]	17,155	4,319	0,000*
Consumption	-	-	-
Nominal Oil Price	-	-	-
Nominal Oil Price %	1,035	0,606	0,088**
Real Oil Price (2010 Prices)	-	-	-
Real Oil Price % (2010 Prices)	-	-	-
Numbers of Observation	140		
Chi- Square	22,296		0,000*
-2Log Likelihood	112,090		

[1] GDP has a relatively high constant which may indicate that the S.E. is not statistically significant

* Confidence Interval 95%, P-value < 0.05. ** Confidence Interval 90%, P-value < 0.10.

Dependent Variable: Consumption	Model 1		
	β	S.E.	Sig.
Constant	-2,457	0,475	0,000*
BCDI+	2,612	0,618	0,000*
GDP	-	-	-
Nominal Oil Price	-0,077	0,031	0,011*
Nominal Oil Price %	-	-	-
Real Oil Price (2010 Prices)	-	-	-
Real Oil Price % (2010 Prices)	-	-	-
Numbers of Observation	141		
Chi- Square	28,921		0,000*
-2Log Likelihood	124,52		

* Confidence Interval 95%, P-value < 0.05. ** Confidence Interval 90%, P-value < 0.10.

Dependent Variable: GDP	Model 1			Model 2			Model 3			Model 4		
	β	S.E.	Sig.	β	S.E.	Sig.	β	S.E.	Sig.	β	S.E.	Sig.
Constant	-1,655	0,513	0,001*	-2,157	0,454	0,000*	-2,435	0,445	0,000*	-2,34	0,443	0,000*
BCDI+	2,106	0,564	0,000*	2,632	0,622	0,000*	2,001	0,542	0,000*	2,057	0,548	0,000*
Consumption	-	-	-	-	-	-	-	-	-	-	-	-
Nominal Oil Price	-	-	-	-0,135	0,046	0,003*	-	-	-	-1,534	0,870	0,078**
Nominal Oil Price %	-	-	-	-	-	-	-	-	-	-	-	-
Real Oil Price (2010 Prices)	-0,034	0,015	0,020*	-	-	-	-	-	-	-	-	-
Real Oil Price % (2010 Prices)	-	-	-	-	-	-	-1,744	0,962	0,070**	-	-	-
Numbers of Observation	141			141			141			141		
Chi- Square	21,346		0,000*	35,941		0,000*	18,509		0,000*	18,298		0,000*
-2Log Likelihood	136,681			122,086			139,518			139,729		

* Confidence Interval 95%, P-value < 0.05. ** Confidence Interval 90%, P-value < 0.10.

Appendix 6 - Logistic Regression Output SPSS OPEC

Dependent Variable: BCDI+	Model 1		
	β	S.E.	Sig.
Constant	-2,263	0,309	0,000*
GDP	-	-	-
Consumption	-	-	-
Nominal Oil Price	0,033	0,012	0,005*
Nominal Oil Price %	-	-	-
Real Oil Price (2010 Prices)	-	-	-
Real Oil Price % (2010 Prices)	-	-	-
Numbers of Observation	141		
Chi- Square	7,634		0,006*
-2Log Likelihood	103,847		

* Confidence Interval 95%, P-value < 0.05. ** Confidence Interval 90%, P-value < 0.10.

Appendix 7 - Logistic Regression Output SPSS Non-OECD/OPEC

Dependent Variable: BCDI+	Model 1			Model 2		
	β	S.E.	Sig.	β	S.E.	Sig.
Constant	-2,191	0,301	0,000*	-2,459	0,415	0,000*
GDP	-	-	-	-	-	-
Consumption	-	-	-	-	-	-
Nominal Oil Price	0,042	0,013	0,001*	-	-	-
Nominal Oil Price %	-	-	-	-	-	-
Real Oil Price (2010 Prices)	-	-	-	0,025	0,010	0,013*
Real Oil Price % (2010 Prices)	-	-	-	-	-	-
Numbers of Observation	141			141		
Chi- Square	12,263		0,000*	5,829		0,016*
-2Log Likelihood	109,850			116,284		

* Confidence Interval 95%, P-value < 0.05. ** Confidence Interval 90%, P-value < 0.10.

Dependent Variable: GDP	Model 1			Model 2		
	β	S.E.	Sig.	β	S.E.	Sig.
Constant	-2,191	0,301	0,000*	-2,459	0,415	0,000*
BCDI+	-	-	-	-	-	-
Consumption	3,589	1,479	0,015*	-	-	-
Nominal Oil Price	-	-	-	-	-	-
Nominal Oil Price %	-	-	-	-	-	-
Real Oil Price (2010 Prices)	-	-	-	0,025	0,010	0,013*
Real Oil Price % (2010 Prices)	-	-	-	-	-	-
Numbers of Observation	141			141		
Chi- Square	6,710		0,010*	5,829		0,016*
-2Log Likelihood	109,850			116,284		

* Confidence Interval 95%, P-value < 0.05. ** Confidence Interval 90%, P-value < 0.10.

Dependent Variable: Consumption	Model 1			Model 2			Model 3			Model 4		
	β	S.E.	Sig.	β	S.E.	Sig.	β	S.E.	Sig.	β	S.E.	Sig.
Constant	-1,960	0,274	0,000*	-1,885	0,262	0,000*	-2,735	0,334	0,000*	-2,263	0,324	0,000*
BCDI+	-	-	-	-	-	-	-	-	-	-	-	-
GDP[1]	-	-	-	-	-	-	7,734	2,865	0,007*	7,660	2,857	0,007*
Nominal Oil Price	-	-	-	-	-	-	-	-	-	-	-	-
Nominal Oil Price %	-	-	-	-2,692	1,213	0,027*	-	-	-	-2,279	1,221	0,062**
Real Oil Price (2010 Prices)	-	-	-	-	-	-	-	-	-	-	-	-
Real Oil Price % (2010 Prices)	-3,120	1,349	0,021*	-	-	-	-2,735	1,369	0,046*	-	-	-
Numbers of Observation	141			141			141			141		
Chi- Square	6,615		0,010*	5,971		0,015*	13,607		0,001*	12,866		0,002*
-2Log Likelihood	104,866			105,510			97,873			98,614		

[1] In Model 4, GDP has a relatively high coefficient and the S.E. may therefore be statistically insignificant

* Confidence Interval 95%, P-value < 0.05. ** Confidence Interval 90%, P-value < 0.10.

Appendix 8 - Poisson Regression Output SPSS OECD

Dependent Variable: BCDI+	Model 1					Model 2				
	β	S.E.	Sig.	Mean	S.D	β	S.E.	Sig.	Mean	S.D
Constant	2,258	0,033	0,000*	-	-	2,197	0,047	0,000*	-	-
GDP	0,139	0,026	0,000*	0,540	1,222	0,135	0,258	0,000*	0,540	1,222
Consumption	0,087	0,035	0,014*	0,400	0,918	0,079	0,035	0,026*	0,400	0,918
Nominal Oil Price	0,009	0,001	0,000*	8,927	16,465	-	-	-	-	-
Nominal Oil Price %	-	-	-	-	-	-	-	-	-	-
Real Oil Price (2010 Prices)	-	-	-	-	-	0,006	0,001	0,000*	27,717	19,643
Real Oil Price % (2010 Prices)	-	-	-	-	-	-	-	-	-	-
Numbers of Observation	141					141				
Deviance Value/df [1]	4,554					4,744				
Likelihood Ratio Chi-Square	155,014		0,000*			129,011		0,000*		

[1] 'Deviance Value/df' is relatively high which may indicate overdispersion.

* Confidence Interval 95%, P-value < 0.05. ** Confidence Interval 90%, P-value < 0.10.

Dependent Variable: BCDI+	Model 3					Model 4				
	β	S.E.	Sig.	Mean	S.D	β	S.E.	Sig.	Mean	S.D
Constant	2,346	0,029	0,000*	-	-	2,355	0,028	0,000*	-	-
GDP	0,120	0,025	0,000*	0,540	1,222	0,123	0,026	0,000*	0,540	1,222
Consumption	0,081	0,035	0,021*	0,400	0,918	0,080	0,035	0,022*	0,400	0,918
Nominal Oil Price	-	-	-	-	-	-	-	-	-	-
Nominal Oil Price %	0,275	0,062	0,000*	0,061	0,332	-	-	-	-	-
Real Oil Price (2010 Prices)	-	-	-	-	-	-	-	-	-	-
Real Oil Price % (2010 Prices)	-	-	-	-	-	0,238	0,073	0,001*	0,035	0,301
Numbers of Observation	141					141				
Deviance Value/df [1]	4,773					4,828				
Likelihood Ratio Chi-Square	124,970		0,000*			117,421		0,000*		

[1] 'Deviance Value/df' is relatively high which may indicate overdispersion.

* Confidence Interval 95%, P-value < 0.05. ** Confidence Interval 90%, P-value < 0.10.

Dependent Variable: Consumption	Model 1				
	β	S.E.	Sig.	Mean	S.D
Constant	-2,055	0,336	0,000*	-	-
BCDI+	0,051	0,017	0,003*	12,071	8,036
GDP	0,424	0,065	0,000*	0,540	1,222
Nominal Oil Price	-0,045	0,025	0,079**	8,927	16,465
Nominal Oil Price %	-	-	-	-	-
Real Oil Price (2010 Prices)	-	-	-	-	-
Real Oil Price % (2010 Prices)	-	-	-	-	-
Numbers of Observation	141				
Deviance Value/df [1]	0,678				
Likelihood Ratio Chi-Square	93,719		0,000*		

[1] 'Deviance Value/df' is less than 1, which may indicate underdispersion.

* Confidence Interval 95%, P-value < 0.05. ** Confidence Interval 90%, P-value < 0.10.

Dependent Variable: GDP	Model 1					Model 2				
	β	S.E.	Sig.	Mean	S.D	β	S.E.	Sig.	Mean	S.D
Constant	-1,931	0,313	0,000*	-	-	-1,851	0,398	0,000*	-	-
BCDI+	0,073	0,015	0,000*	12,071	8,036	0,067	0,156	0,000*	12,071	8,036
Consumption	0,510	0,072	0,000*	0,400	0,918	0,578	0,070	0,000*	0,400	0,918
Nominal Oil Price	-0,098	0,038	0,009*	8,927	16,465	-	-	-	-	-
Nominal Oil Price %	-	-	-	-	-	-	-	-	-	-
Real Oil Price (2010 Prices)	-	-	-	-	-	-0,018	0,010	0,067**	27,717	19,643
Real Oil Price % (2010 Prices)	-	-	-	-	-	-	-	-	-	-
Numbers of Observation	141					141				
Deviance Value/df	0,739					0,835				
Likelihood Ratio Chi-Square	144,914		0,000*			131,657		0,000*		

[1] 'Deviance Value/df' is less than 1, which may indicate some underdispersion.

* Confidence Interval 95%, P-value < 0.05. ** Confidence Interval 90%, P-value < 0.10.

Appendix 9 - Poisson Regression Output SPSS OPEC

Dependent Variable: BCDI+	Model 1					Model 2				
	β	S.E.	Sig.	Mean	S.D	β	S.E.	Sig.	Mean	S.D
Constant	0,827	0,060	0,000*	-	-	0,765	0,087	0,000*	-	-
GDP	-	-	-	-	-	-	-	-	-	-
Consumption	-	-	-	-	-	-	-	-	-	-
Nominal Oil Price	0,015	0,002	0,000*	8,927	16,465	-	-	-	-	-
Nominal Oil Price %	-	-	-	-	-	-	-	-	-	-
Real Oil Price (2010 Prices)	-	-	-	-	-	0,008	0,002	0,000*	27,717	19,643
Real Oil Price % (2010 Prices)	-	-	-	-	-	-	-	-	-	-
Numbers of Observation	141					141				
Deviance Value/df [1]	2,479					2,690				
Likelihood Ratio Chi-Square	41,435		0,000*			12,140		0,000*		

[1] 'Deviance Value/df' is more than one, which may indicate overdispersion.

* Confidence Interval 95%, P-value < 0.05. ** Confidence Interval 90%, P-value < 0.10.

Appendix 10 - Poisson Regression Output SPSS Non-OECD/OPEC

Dependent Variable: BCDI+	Model 1					Model 2				
	β	S.E.	Sig.	Mean	S.D	β	S.E.	Sig.	Mean	S.D
Constant	2,453	0,031	0,000*	-	-	2,340	0,043	0,000*	-	-
GDP	0,115	0,039	0,004*	0,280	0,587	0,110	0,040	0,006*	0,280	0,587
Consumption	-0,070	0,030	0,018*	0,400	0,918	-0,098	0,030	0,001*	0,400	0,918
Nominal Oil Price	0,014	0,001	0,000*	8,927	16,465	-	-	-	-	-
Nominal Oil Price %	-	-	-	-	-	-	-	-	-	-
Real Oil Price (2010 Prices)	-	-	-	-	-	0,010	0,001	0,000*	27,717	19,643
Real Oil Price % (2010 Prices)	-	-	-	-	-	-	-	-	-	-
Numbers of Observation	141					141				
Deviance Value/df [1]	6,926					7,480				
Likelihood Ratio Chi-Square	178,598		0,000*			102,694		0,000*		

[1] 'Deviance Value/df' is more than one, which may indicate overdispersion.

* Confidence Interval 95%, P-value < 0.05. ** Confidence Interval 90%, P-value < 0.10.

Dependent Variable: Consumption	Model 1				
	β	S.E.	Sig.	Mean	S.D
Constant	-0,870	0,180	0,000*	-	-
BCDI+	-	-	-	-	-
GDP	0,614	0,154	0,000*	0,280	0,587
Nominal Oil Price	-0,065	0,025	0,010*	8,927	16,465
Nominal Oil Price %	-	-	-	-	-
Real Oil Price (2010 Prices)	-	-	-	-	-
Real Oil Price % (2010 Prices)	-	-	-	-	-
Numbers of Observation	141				
Deviance Value/df	1,144				
Likelihood Ratio Chi-Square	28,707		0,000*		

* Confidence Interval 95%, P-value < 0.05. ** Confidence Interval 90%, P-value < 0.10.