Stockholm School of Economics
Master Thesis in Finance

The Impact of Oil Price Fluctuations on Stock Prices
-
Evidence from three Asian Countries

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ABSTRACT

This paper examines the relationship between oil price changes and the stock market and tests whether changes in the oil price can forecast stock returns. In order to investigate this query a regression-based approach is employed using the stock indices of three Asian emerging markets, namely Indonesia, India and China for the period January 1993 – April 2006. These countries have all experienced a rapidly growing oil demand during the investigated time period. Being the most populous countries in the world, excluding the U.S., this will have a hefty impact on global oil consumption. Also, as oil prices during the last few years have been at their highest levels since the oil crisis in the seventies, this study assesses if different levels of the oil price affect this factor's liaison with stock returns. Our results indicate of the presence of an oil effect in the case of the Indian stock index, whereas no such effect can be identified for the Indonesian or the Shanghai index. Nor do we find significant evidence of an altered oil effect at different oil price levels.

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1 Introduction

On April 13th 2006, the WTI oil price once again exceeded USD 70 per barrel, its highest price in eight months. On that occasion it was hurricane Katrina that caused the rise. Currently, the world is anxious about the risk of a military invasion in Iran, the fourth largest oil producer in the world. Simultaneously, disturbances in Nigeria, Africa's largest producer of crude oil and an important supplier of high quality oil that is most suitable for making petrol, cause analysts to bite their nails. The oil price is currently hovering around USD 70 per barrel and we are currently facing stagnation in the extraction of this resource. In that perspective, the fact that rapidly growing countries like China, Indonesia and India are experiencing an increasing demand for energy, it does not seem too drastic to imagine a scenario when oil prices go beyond USD 100 per barrel. Then one might ask what implications such a scenario would have for stock markets?

The relationship between the oil price and economic activity is quite well documented and has been found to be negative in many studies. One of the most frequently quoted researchers within the field, Hamilton (1983), argues that all recessions in the post-World War II period, at least to some extent, can be explained by increases in the oil price. Having a documented negative relationship between oil price movements and economic output, it is intuitive to draw similar conclusions about the linkage between the oil price and financial markets. If higher oil prices affect economic output negatively, they should also affect stock prices through the means of lowered expected earnings. However, the amount of research made on this connection is rather limited. Furthermore, most of the research done has been concentrated on developed economies and the periods examined have not included the last years of peaking oil prices.

The purpose of this thesis is to investigate the relationship between oil price movements and stock prices. Previous research has suggested that investors underreact to news announcements under certain circumstances, contradicting with the Efficient Market Hypothesis. By employing a regression-based approach using stock market indices in China, India and Indonesia, we will examine the oil price's ability to forecast stock returns. China and India, the two most populous countries in the world, are today experiencing rapid economic growth and consequently so are also their demands for energy, yet maybe not for the same underlying reasons.[1] Finally we have Indonesia, a member of OPEC,[2] which, at least historically, has been a net exporter of oil and should therefore react differently from oil price movements than the other two countries. Moreover we will construct three different regimes of oil prices to test if the impact and/or prediction ability varies with different oil

[1] Due to their diverse GDP drivers, their required quantities of oil are not at the same level and consequently India only consumes a third of the oil that China does on a daily basis. Source: Nation Master web page.
[2] Organization of Petroleum Exporting Countries.

price levels. While previous research has examined data from periods before 2003 this study covers the period January 1993-April 2006.

The thesis is organized as follows. Section 2 summarizes the theoretical framework for the study. In Section 3 the hypotheses investigated are specified. Section 4 and 5 provide a discussion of the methodology used for the study and a description of the data. In section 6 we present the empirical results and findings which in turn are analyzed in section 7. Finally, section 8 concludes the results.

2 Theory

In this section essential background and concepts are presented. Provided is previous research followed by an overview of the markets investigated as well as the oil price development. A discussion on economic theories finalizes the section.

2.1 Background

Crude oil is the most actively traded commodity in the world.[3] As briefly mentioned in the introduction, the relationship between oil and the macroeconomy has been explored by many researchers. In a paper by the IMF (2000) five channels through which a higher oil price affects the global economy are pointed out. In short these are; 1) a transfer of income from oil consumers to oil producers, 2) a rise in the cost of production of goods and services, putting pressure on profit margins, 3) an impact on the price level and on inflation (the magnitude varies with monetary policy), 4) both direct and indirect impact on financial markets, 5) a change in relative prices, creating incentives for energy suppliers to boost investments and production and for oil consumers to economize. By running simulations of a USD 5 per barrel increase they estimate the level of global output to reduce by 0.25 percent over a period of four years. The IMF is not alone about documenting a relationship between oil prices and economic output. However, there is no common agreement amongst previous research concerning the precise effect of changes in the oil price (Driesprong et al., 2005). Also, more interesting for the purpose of this paper, the discussion on the oil price and its effect on stock markets is limited and the conclusions various.

Jones and Kaul (1996), in one of the most comprehensive studies in this field, test if reactions in stock prices due to oil price shocks are justified by considering changes in real cash flows. While reactions in the U.S. and the Canadian stock markets can be validated, this is not the case of the U.K. and Japan. Sadorsky (1999) who uses a different model, a vector autoregression model on monthly data, shows that both oil prices and oil price volatility do have important roles in affecting real stock returns. He also concludes that oil price volatility shocks have an asymmetric effect on the economy,

[3] NYMEX webpage.

in that decreases in the oil price have a much weaker, if any, effect on real stock returns while increases have a clear negative effect.

In contrast to the two previously mentioned authors' conclusions, Huang et al. (1996), using data from 1979 to 1990, do not find any evidence of a significant relationship between oil futures prices and aggregate stock returns. Neither do Chen et al (1986) find any evidence suggesting that oil constitutes an economic pricing factor in their sample of U.S. equities. Kaneko and Lee (1995) investigate the effect of oil price shocks in the U.S. and Japanese stock markets and do indeed find that oil prices play an important role for the Japanese- but not for the U.S. stock market.

More recent work includes a study by Hammoudeh and Li from 2005, which focuses on two stock indices, the main Mexican and the main Norwegian, in addition to two industry sectors from each of those countries, a transport index and an oil industry index. Even though their study shows that the oil price has an effect on both nations' indices as well as on the industry sectors, it also shows that the systematic risk from the world market index is of greater importance than the oil effect. In another study by Hammoudeh and Aleisa (2004) five members of GCC[4] are investigated. Using daily data they only find the oil price to have significant impact on the stock index in Saudi Arabia.

One of few studies that relates oil to stock returns in a prediction setting is the one by Driesprong et al (2005), which also in many ways has inspired the work of this thesis. Controlling for other more widely accepted predictors, they find that oil price changes significantly predict stock market returns and that investors underreact to rises in the oil price. Even though emerging markets are included in their investigation,[5] most attention is paid to the developed countries' stock markets. As the authors conclude that the prediction ability of oil is stronger in countries with high oil consumption per capita their findings regarding India are counterintuitive. The Indian consumption per capita ranks as low as 163rd on a world wide ranking list,[6] which opens for further investigation. In this study we focus on three emerging countries that do not have very high oil consumptions per capita, nevertheless are experiencing a rapidly growing overall oil demand.

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[4] Gulf Corporation Council Saudi Arabia was a prime mover in setting up the Gulf Cooperation Council in 1981. Other members are Bahrain, Kuwait, Oman, Qatar and the United Arab Emirates (UAE).
[5] Serving as an out of sample test.
[6] Nation Master website.

Table I
Summary of Previous Research including Results

Study	Purpose	Method and sample data	Conclusion(s)
Hamilton 1983	To test the effect of oil price changes on the U.S economy.	VAR-method using quarterly data on GNP growth, inflation and unemployment rate.	Oil price shocks are related to recessions in the U.S. economy.
Jones and Kaul 1986	To test if reactions in stock prices due to oil price shocks are justified considering changes in real cash flows.	Using excess returns and monthly data. Model includes changes in industrial production, term spread, risk premium and dividend yields.	In the U.S. and the Canadian stock markets such reactions can be justified, but not the U.K. and Japan.
Chen et al. 1986	To test whether innovations in macroeconomic variables are risks that are rewarded by the stock market.	Using multi-factor asset pricing model on U.S. equities.	Find no evidence that the oil price constitutes as a pricing factor.
Huang et al. 1996	To test oil futures prices' relationship to aggregate stock returns.	Use VAR-approach to test on the S&P Index.	Do not find any significant relationship between those factors.
Sadorsky 1999	To test oil prices' and their volatilities' impact on real stock returns.	VAR- approach using 3-month T-bill rate, Industrial Production and real stock returns.	Both oil prices and volatility have significant impact on stock returns.
Hammoudeh and Alesia 2004	To study the relationship between oil and the stock markets in GCC countries.	With daily data they investigate a bi-directional relationship.	Find that oil price only affects the stock market in one of the five members.
Driesprong et al. 2005	To test if oil prices can forecast stock returns.	Using a thirty-year sample of monthly data for thirty developed stock markets and a shorter time period for some emerging markets.	Oil prices predict stock market returns. Investors underreact to information in the oil price.

2.2 What are the driving forces behind oil price movements and what is the link to stock markets?

In this section we will describe the linkage between oil and stock prices on a general and intuitive level. The approach is similar to the one used in previous work by Huang et al (1996).

To value a company and hence to price its stock, expected cash flows are discounted by using a discount rate (e.g. average cost of capital). From this follows that movements in either the expected cash flows or the discount rate will affect the stock return and the stock price. Oil prices can affect both these two parameters in different ways and for different reasons. As oil is an essential input to the production of many goods, changes in the price of oil certainly should have impact on the costs for many companies. This could be compared to other input variables such as labor or capital. Whether the effect of the changes in the oil price on stock prices is positive or negative is consequently determined by the character the company. While a producer of oil would expect higher earnings if oil prices increased consumers would expect lower earnings. This argument holds on a microeconomic level as well as for an international level.[7]

Oil prices can also, at least indirectly, influence stock prices via the discount rate. The reasoning behind this is that the expected discount rate is an amalgamation of the expected inflation rate and the expected real interest rate, which can both affect the oil price. Considering a net oil importing country, higher oil prices would affect the trade balance negatively, which in turn would depress the foreign exchange rate and put an upward pressure on the domestic inflation rate. Consequently, a higher expected inflation rate is positively related to the discount rate and hence negatively related to stock returns. Taking the argumentation one step further one could use the oil price as a proxy for the inflation rate, since oil is a commodity. Also the real interest rate is closely linked to the oil price. As oil is one of the major resources in the world wide economy, a higher oil price by itself can put upward pressure on the real interest rate (Huang et al., 1996).

The correlation between oil price changes and stock indices is however more complex and cannot only been explained by higher cost for oil consuming economies and higher revenues for oil producing ones. Increases in oil prices occur for many different reasons and do not necessarily affect the economy in the same way every time. On the one hand, an increase in the demand for oil, which is driven by growth but assumed not to be offset by an increase in supply, will lead to higher oil prices. In that scenario, the increased demand is accompanied by a strong and growing economy. Hence it is also likely that companies are performing well and thus intuitive to expect a positive correlation between the oil price and stock performance. Another way for the demand to increase is driven by speculation. For example motorists, distributors and other intermediaries may fill up their reserves if they believe that oil is becoming a more scarce resource for which the cost is lower today than it will be in the future (Lemieux, 2005). On the other hand, the oil price can fluctuate due to changes in the supply, as a response to e.g., hurricanes and conflicts in oil producing countries. In this case the correlation between the oil price and stock performance depends only on companies' costs and revenues, which in turn are altered by oil price changes.

Considering the discussion above it is not completely straightforward to expect to find any direct impacts on broadly-inclusive stock indices caused by oil price changes. Oil prices relate to so many macroeconomic factors that we should consider any isolated significant effects quite surprising.

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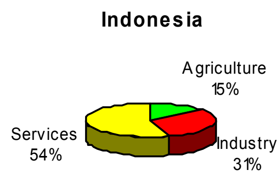
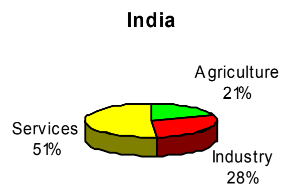
[7] Compare for example an oil producing company to a transport company and a country such as Saudi-Arabia to China.

2.3 The importance of oil in three Asian countries





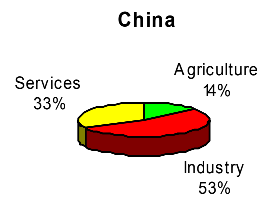


Figure I. GDP composition by sector.
Source: www.cia.gov

Having discussed the link between oil and the financial market it is natural to study the investigated markets' sources of income, consumption- and production patterns. The figure above depicts the GDP composition by sector in each country. Comparing them, China stands out as greatly dependent on the industry sector while for the other two have the largest part of their GDP comes from the service sector. For this reason it is interesting to see whether the effect of oil price fluctuations differs between the markets.

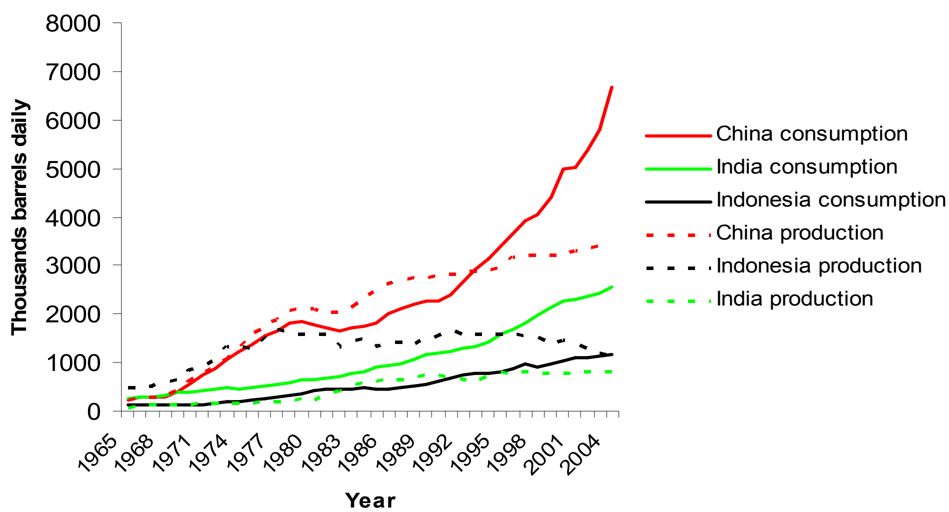


Figure II. Oil consumption and production in China, India and Indonesia for the period 1965-2004.
Source: BP Statistical Review of World Energy, April 2006 (www.bp.com)

The figure above shows the oil consumption as well as the oil production for the three countries between 1965 and 2004. Looking at China it is clearly the case that consumption has been shooting up relatively the production. In fact, in the recent years it has become the fourth largest net importer of oil globally (Garner, 2005). Indonesia, too, shows an upward trend in consumption while the production has decreased since the beginning of the nineties. For India it can be noted that consumption has increased significantly over the last years while production has been fairly stable. Figure III below shows the oil consumption for different geographical regions. Also here it can be seen that the Asia-Pacific region has experienced a boom in oil consumption while other regions have had a moderate growth.

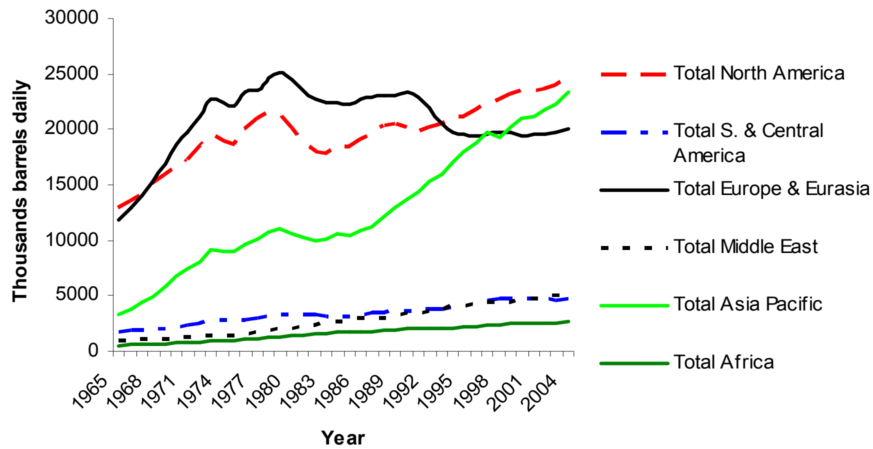


Figure III. **Daily consumption in thousands barrels by region.**
Source: BP Statistical Review of World Energy, April 2006 (www.bp.com)

If adhering to energy analysts' projections about the future oil consumption, the above shown trends will continue for a long time yet to come. In the market outlook in IEO2005 emerging economies' energy demand are expected to exceed that of the mature markets by 9 percent in 2025.[8] In China and India the demand is predicted to more than double over the forecast period. This makes it highly interesting to investigate these two countries to see what affect a changing oil price will have on their financial markets. Especially China is expected to be hurt by oil price increases as that economy very much depends on heavy industrialized sectors which directly suffer from higher energy prices. To also get a view from the investor perspective we interviewed Gustav Rehnman at Asia Growth Investors, an investment fund manager of a mutual equity fund mainly investing in East Asia. Rehnman shares the view of a growing oil demand for the region and that oil is crucial for the development of these economies. However, he does not consider the oil price to be among the most critical factors when making decisions about future investments.

Indonesia differs from the other two countries in more than one way and therefore deserves separate introduction. First of all, Indonesia is member of OPEC and traditionally has had the role of an energy exporter. Therefore it should react, according to the economic theory presented above, positively to higher oil prices. However, Indonesia has today become a net importer as the domestic demand for energy is increasing while simultaneously the exploration activity has not been reinvigorated. What even more complicates the situation is that the government has been and still is subsidizing petroleum products (24 % of the government's expenditure 2005), which deteriorates the

[8] Source: Energy Information Administration.

economy's export capabilities (Credit Suisse Equity Research, 2005). Furthermore, subsidies are planned to gradually be removed which will have important implications for the population as well as for foreign investors. Thus, there is a large uncertainty regarding the effect of oil price changes in Indonesia, a view which also is supported by Gustav Rhenman at Asian Growth Investors. Possibly we could expect a positive impact from higher oil prices from the earlier part of the sample period while less pronounced or even negative during the last years.

2.4 Variability in oil prices

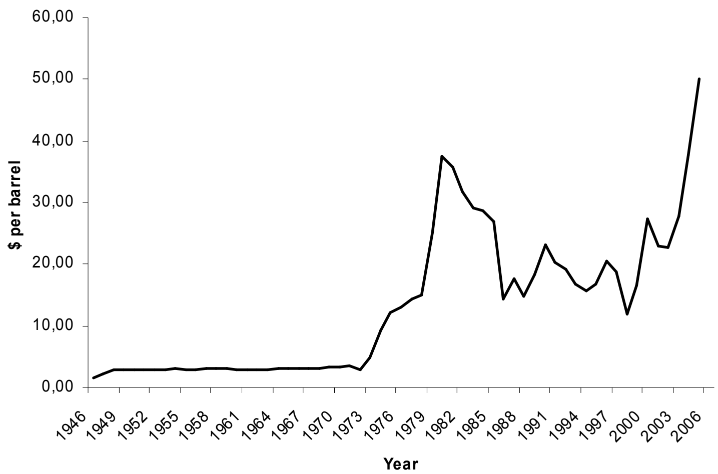


Figure IV. Nominal average annual crude oil prices since 1946 in USD per barrel.
Source: www.inflationdata.com

The figure above depicts the oil price movements since 1946. Before the Yom Kippur War and the OPEC-crisis in the seventies, fluctuations in the oil price had been limited. This can be one reason why previous research on oil price fluctuations and their relations to the financial market is rather limited. Even though oil prices today, as mentioned in the introduction, are at very high levels, prices adjusted for inflation are yet not as high as the prices around 1980. So what qualified guesses can be made about future oil prices? While energy analysts seem to agree that lower oil prices are to be expected, some groups of geologists claim that the world is running out of oil which will eventually cause an economic disaster (The Economist, 2006). What we all, however, can agree on is that oil and oil prices are subject for a very topical debate among experts as well as laymen. If oil prices are watched very carefully it seems unlikely that changes should be incorporated into stock prices with a delay. Thus we could expect reactions to oil price changes today to differ from those of earlier time periods. For this reason our investigation, including the last years' oil price rally, could contribute with valuable information.

In order to take this fact into account when conducting a study of oil price changes and their effects on stock indices, one approach could be to break up the oil price into different levels that each represents a different regime. At the lowest price regime, it would be reasonable to expect that the effects of the price of oil are taken into account and discounted with a certain delay, whereas at higher prices, the market would be prepared to pay more attention to changes in this important input factor in many industries and discount it immediately. In other words, each of the regimes contains different conditions possibly affecting the relationship between stock returns and oil price returns.

2.5 What would economic theory suggest?

One of the most central propositions in finance is the Efficient Market Hypothesis (EMH), which in its classic configuration was defined as a financial market place in which security prices always fully reflect all available information (Shleifer, 2000). Even though the EMH (see for example Malkiel, 2003) is not unanimously accepted among researchers and other observers, it is often referred to in the literature. According to it there should not be any delayed reactions in stock returns due to changes in the oil price, as oil prices are public information and readily available for all observers. Thus news, such as a rise in the price of fuel today, should not make stock prices go down tomorrow. All information is quickly observed and should therefore be incorporated in prices right away. Extensive research has also shown that this indeed is the case. For example, stock prices react within ten minutes to earnings announcements (Jones et al., 2003). The EMH does, besides the concept of absorbing news, also state that the response to news announcements should be of the correct magnitude, meaning that the market will neither underreact nor overreact to new information. Regarding this, however, there is less evidence from empirical research. Thus, it might be that the stock market reacts to changes in oil prices, but that the reaction could be too weak or too strong. In contrast to the EMH, Grossman and Stiglitz (1980) argue that such efficiency (in its strong form)[9] is not plausible. The reason is that arbitrageurs, who collect costly information, need to be compensated with trading profits, otherwise no one would have incentive to gather such information. Thus prices only reflect information partially. Also, contrary to the EMH, more recent research argues that there indeed are factors that can forecast stock returns (Cochrane, 2001). However the oil price as such a factor has, to our knowledge, received little attention.

Hong and Stein (1999) develop a model featuring two different types of agents who are both rationally bounded, namely newswatchers[10] and momentum traders[11]. They argue that if each newswatcher observes a certain piece of information, but has difficulties in deciphering how other newswatchers' use their private knowledge concerning that same information in order to arrive at their evaluation of it, then information diffuses gradually across the population. Consequently, an

[9] Meaning that prices reflect all relevant information, also including private information.

[10] Newswatchers make forecasts based on signals that they privately observe about future fundamentals. They do not condition on current or past prices.

[11] Traders that make judgments based on historical prices. They can find arbitrage opportunities in the difference between the true value of a stock and its prevailing market value, caused by the underreaction on behalf of the newswatchers. However, their forecasts are limited to be simple (univariate) functions of past prices.

underreaction in stock prices occurs in the short run. Even though their study mainly relates to private information, the model also holds for public information under certain conditions. Such circumstances may take place when the available public information is difficult to convert into a judgment concerning the value of the stock, i.e. it requires additional, private, information. Thus it might still be the case that the market underreacts to news, even though is public and available to all observers at the same time. Hence, Hong and Stein (1999) conclude that the market's response to publicly accessible news involves an aggregation of private signals. Strong evidence for this hypothesis is found by Hong, Tourus and Valkanov (2004) who further argue that, because of limited information-processing capacity, investors cannot possibly pay attention simultaneously to asset prices in markets, in which they are not specialized. Also argued is that information travels slowly, since valuable information that starts off in one market reaches investors in other markets with a delay. In their paper "Do Industries Lead Stock Markets?" they find the petroleum industry, amongst others, to predict stock market movements by one month.

Not only do Hong and Stein (1999) argue that there exists an underreaction in stock prices to news in the short run but they also claim that there follows an overreaction in the long run. The reason behind this is that momentum traders, limited to simple strategies, who are trying to extract profit from the mentioned underreaction will eventually set off an overreaction in the market. Different models and theories on under- and overreaction to news announcements that attempt to forecast stock returns have been developed by numerous researchers. Shleifer (2000) gives an excellent overview of this discussion and also introduces a model founded in experimental psychological evidence on failures of individual judgment under the pressure of uncertainty, which however is beyond the scope of this study and is therefore not presented here.

The argumentation above has important implications for the purpose of this study. We know from previous research that changes in oil prices do have an impact on economic activity. We also know that the Efficient Market Hypothesis is quite questionable. Furthermore, investors may have difficulties in evaluating the precise effect of oil price changes and/or may pay attention to the information at different points in time. Thus, we do have reasons to believe that investors may underreact as well as overreact to new information about the oil price.

3 Hypotheses

There is vast research that documents the impact of oil price changes on economic activity, which argues that higher oil prices have a negative effect on the overall economy. The effect on stock markets is, however, less explored, neither is it found to be the same among researchers. Assuming that observers actually do have difficulties in assessing the impact of oil price changes on stock returns and may react to oil price changes at different times, we expect higher oil prices to predict lower stock returns. Consequently we expect declining oil prices to predict higher stock returns.

A less documented, but equally interesting, effect is the one of inconsistent conditions related to different levels of the oil price. One could argue that at low oil price levels or regimes as denoted above, investors would not be as observant of oil price changes, which suggests a slight delay in their reactions to this factor. Following that argument, at higher prices, one would expect oil price changes to be taken into account immediately. Accordingly, our hypotheses are the following:

Hypothesis 1: A rising oil price predicts lower stock returns.

Hypothesis 2: A declining oil price predicts higher stock returns.

Hypothesis 3: The impact varies in different price regimes.

4 Data

Building a model that attempts to explain or predict asset prices is indeed not a simple task. Many times researchers "go fishing" for explanatory variables that make their models successful, meaning that the models cannot be rejected as capable of pricing assets. However, there is no consensus concerning what right-hand side variables are to be included in a regression analysis. Models like the CAPM and the APT are perhaps the most well-known models in asset pricing, nonetheless they are hardly accepted as the perfect measurement tools. In order to avoid "fishing", Cochrane (2001) recommends that regressors be robust out of sample and across different markets and also to have some relation to macroeconomic fundamentals. In addition to our investigated oil factor, which at least fulfills the latter condition, we have included more commonly used predictors of stock returns such as lagged returns, interest rates, industrial production, and inflation. By including these variables, we attempt to protect our findings from being inflated by time varying risk (Hong et al., 2004). Below we discuss the different data used to perform this study and the reasoning behind our selections. An overview of the data sample characteristics finalizes the section.

4.1 Sample selection and reliability of data

For the purpose of this study all data used was gathered from Datastream through Thomson Financial. Thomson Financial is a globally leading supplier of financial information and can therefore be considered a reliable source. The study is performed for the period January 1993-April 2006, the longest dataset available that holds for the variables for the different countries. In total the sample consists of 160 observations of monthly data. We chose a monthly frequency as we expected the effect of oil price changes to show up in the longer perspective. Nevertheless we have performed all tests also on a weekly as well as on a daily basis, however, with less significant results. One might reason that the oil price is public information that is announced on a daily basis and should therefore give an effect on daily data. However, it seems as if examining changes in such a short time perspective is not the most sensible approach. One reason for this is that even if the oil price increases strongly one day, it could very well decrease again the day after and therefore it would not be sound for investors to base their investment decisions on the daily fluctuations of the oil price. Yet, the levels of oil prices in a longer time perspective are highly relevant, as they are indicators of the prevailing and future price levels that have an important impact on the macroeconomy.

4.2 Explanatory variables

Oil

The crude oil market comprises of various types and qualities aimed for different purposes. As there are so many types of crude oil one usually quotes prices of three types, which serve as benchmarks. These are West Texas Intermediate (WTI, U.S.), Brent (Europe) and Dubai which is the benchmark for Middle East oil flowing to the Asia-Pacific region. One might argue that the most proper oil reference to be used for our investigated markets is Minas (Indonesia). However, as long data sets for Minas were not available, we chose to use Dubai. This should, however, not have any severe implications as the oil prices fluctuate rather closely even if the Dubai oil tends to trade at slightly lower prices than e.g. WTI. As stated in the hypotheses, we expect the oil variable to move in the opposite direction to the dependent stock indices and hence the sign of the coefficient should be negative.

Lagged endogenous stock indices

Using lagged values of the dependent variable among the explanatory variables is called an autoregressive model. Controlling for those lagged stock returns we may capture important dynamic structure in the dependent variable that might be caused of other factors (Brooks, 2002).

S&P 500, Hong Kong Stock Exchange and Nikkei

Even though the magnitude of influence from the U.S economy differs among our selected markets, they do all rely on exports to U.S. to some extent. China in particular is very much dependent on the U.S. purchasing power, while Indonesia is the least affected country. We have chosen to include the S & P 500 as a proxy for the overall state of the U.S. economy. Furthermore, in our preliminary regression model we have included the Hong Kong Stock Exchange as well as the Japanese stock index Nikkei. We expect these variables to have a positive relationship with all investigated markets.

Interest rates

Comparing macro variables in emerging markets like China, India and Indonesia is not straightforward and has to be done with some caution. In this study we have tried to find one short- and one long-term interest rates for each country. However, how these are defined can sometimes differ quite a lot between the investigated countries. For example, a ten-year treasury bond serves as the long interest rate in India while the same in Indonesia is the one-year rate. In Appendix A a detailed description including type of rate, names and times to maturity for the different rates is found. Interest rates can affect stock returns for different underlying reasons. Firstly, increased interest rates will cause debt to become more expensive which consequently will compress margins and profitability for companies. The amount of cash flow available to reinvest in growth diminishes which in turn lowers the stock price of the company. Secondly, higher interest rates make the choice of investing in bonds more attractive relative to equities. Finally, interest rates affect the consumption behavior in a population. Higher rates make mortgages more expensive and fewer people can afford them. This lowers the disposable income and consumption will go down, slowing the economy down and stock prices fall. Thus we expect the interest rates' coefficients to have negative signs.

Term spread

To capture the influence of the shape of the term structure we define another variable; term spread, which is the long bond yield less the short bond yield for each country respectively. Thinking of stock dividends as bond coupons plus risk, we should expect any bond premium to be reflected in stock returns. A larger positive difference between the long and short term yield is commonly seen as a sign of a good state of the economy. The reason is that investors require a higher yield on long term assets. A rising short term yield signals that the government is concerned about inflation. Falling long term yields indicate investors' concern about the inflation and the level of economic activity. Thus a narrower gap between the rates is likely to slow down the growth of an economy. Consequently we expect the term spread to be positively correlated with stock returns.

Industrial Production

The industrial production is measured using each country's reported industrial production index not seasonally adjusted on a monthly basis. Theoretically, an increase in industrial production should have a positive effect on the economy. If this is true, companies earn higher profits and dividends, which consequently should raise stock prices. On the other hand, a strongly growing economy implies higher interest rates which can, as mentioned in the previous section, dampen or at least accommodate stock returns. However, we believe the first effect to be stronger and hence we expect the industrial production to show a positive sign. As the reporting of this variable is done on a monthly basis, on the 15^{th} of every month to be more exact, it would seem reasonable to use lagged values for it in a regression model so that it is last month's value that is expected to affect this month's index returns. However, we believe, in the case of this particular variable, that the effect of the increased production will have a direct affect on the economy and thereby the stock markets, even though the actual Industry Production figure has yet to be announced.

Inflation

The relationship between inflation and stock returns has been investigated in by numerous researchers. Empirical evidence can be found for a positive- as well as for a negative relationship.[12] To be consistent with the Fisher Hypothesis[13] we should not expect the inflation to have any real impact on stock returns. Earnings should, according to that theory, be consistent with the inflation rate and consequently real stock returns should remain unaffected. As our study uses nominal stock returns we expect the coefficient for inflation to show a positive sign. However it is important to remember, before drawing any conclusions, that higher oil prices lead to higher inflation and that we might therefore just be picking up the same effect.

Table II

Explanatory Variables and Expected Signs on the Coefficients of the Regression:

Variable	Description	Expected Sign
CPI_t^i	Consumer Price Index	+
IP_t^i	Industrial Production Index	+
$Bond_t^{Short}$	Yield on short-term bond	-
$Bond_t^{Long}$	Yield on long-term bond	-
r_t^{spread}	Term Spread	+
r_{t-j}^i	Return on lagged stock index	+
$r_t^{S\&P}$	Return on S&P 500	+
r_t^{HK}	Return on Hong Kong Stock Exchange	+
r_t^{NIK}	Return on Nikkei 500	+
r_t^{oil}	Return on oil price (Dubai)	-

4.3 Omitted variables

An omitted variable is defined as, in a regression, an excluded independent variable that might have influence on the dependent variable. As long as this variable is uncorrelated with the included explanatory variables this is not a severe problem and estimates are still unbiased. However, in case of having an omitted variable that is correlated with some of the other independent variables, OLS regression generally produces biased and inconsistent variables (Brooks, 2002). In this study we have strived to include all available explanatory variables based on their economical and statistical relevance. Even though some of the most frequently used control variables, in regressions that attempt to forecast stock returns, are included, others are left out. The reasons for this vary. In some cases we did not have access to appropriate data (e.g. dividend yields) while other factors such as

[12] See for example Firth and Gultekin for a documented positive relationship or Fama (1981) for a negative relationship.
[13] The Fisher hypothesis is the proposition by Irving Fisher that the real interest rate is independent of monetary measures, especially the nominal interest rate. Thus, real interest rate is the nominal interest rate minus inflation.

season anomalies are not very well documented and appear in different ways in the different markets.[14]

4.4 Sample Characteristics

All regressions have been carried out on a monthly- as well as on a weekly basis. Here we report the characteristics for the monthly data as it gave most significant results. The way of using the economic variables to explain or predict stock returns differs widely in the literature. In order to choose between different lags we have run a regression for each explanatory variable separately for the individual countries. The version of each variable, still theoretically motivated, that was most significant has then been included in the larger model. Below we first show all significant variables across all countries and then statistics for each country individually.

Table III

Descriptive Statistics

This table presents the descriptive statistics for those variables that are relevant across all three countries. The sample covers the period January 1993 – April 2006 and contains monthly data. The total number of months in the observation period is 160. All descriptive statistics are denoted in percent.

Variable	Min.	Max.	Mean	σ
r_t^{Dubai}	-36.547	33.872	0.837	8.799
$r_t^{S\&P}$	-15.759	9.232	0.685	4.103
r_t^{HK}	-34.413	28.376	0.489	8.030
r_t^{NIK}	-16.483	14.673	0.250	6.334

A few observations can be made from Table III. The returns on the Dubai oil price are positive for this whole period, which is in line with expectations, since the oil price has increased quite significantly during that same period, seen clearly in Figure V below. We can also note that the volatility in the oil price has been rather high during this period as compared to that of the major stock markets, Dow Jones and Nasdaq. One should bear in mind that the volatility of those two markets can be assumed to be greater than otherwise, however due to the terrorist attacks on September 11th 2001.

[14] For example, the fiscal year in China ends in January while it in India ends in March.

Table IV

Descriptive Statistics

This table presents the descriptive statistics for those variables that are relevant for Indonesia only. The sample covers the period January 1993 – April 2006 and contains monthly data. The total number of months in the observation period is 160. All descriptive statistics are denoted in percent.

Variable	Min.	Max.	Mean	σ
$r_t^{Indonesia}$	-52.274	43.404	0.022	14.324
$CPI_t^{Indonesia}$	-1.057	12.005	1.024	1.686
$IP_t^{Indonesia}$	-31.923	27.687	0.062	9.699
$Bond_t^{Short}$	-38.566	57.941	-0.367	9.269
$Bond_t^{Long}$	-32.850	54.972	-0.407	7.852
r_t^{spread}	-41.689	27.763	-0.040	6.516

In Table IV above, there are some things that need to be noted. Firstly, the return on the index has during this period been positive, which is in accordance with theory as Indonesia has until today been a net exporter of oil. However, the market has been rather volatile during this period, indicating that the positive return has been associated with quite some risk. It should be noted that the values for both Industrial Production (IP) and Consumer Price Index (CPI) are quoted in terms of return, not in actual levels. It can be seen that, in the case of Indonesia, CPI has increased, for the most part, gradually the last five years. Concerning the return on IP the mean is near zero, yet there has been a lot of volatility in this variable. Please note that the bonds are much more volatile than in more developed countries, indicating some of the instability that is inherent in this economy.

Table V

Descriptive Statistics

This table presents the descriptive statistics for those variables that are relevant for India only. The sample covers the period January 1993– April 2006 and contains monthly data. The total number of months in the observation period is 160. All descriptive statistics are denoted in percent.

Variable	Min.	Max.	Mean	σ
r_t^{India}	-25.393	19.904	0.687	8.410
CPI_t^{India}	-2.182	3.149	0.524	0.863
IP_t^{India}	-22.423	15.439	0.514	5.291
$Bond_t^{Short}$	-35.667	76.214	-0.246	10.666
$Bond_t^{Long}$	-11.310	17.869	-0.337	-3.784
r_t^{spread}	-58.345	30.877	-0.011	9.623

From the above table we see that the Indian stock market as well as the Indonesian one has a positive mean and exhibits quite high volatility. CPI is more stable for this country than for the latter, as is IP. Concerning both of the bonds, the Indian economy shows more volatility than what would be expected for a more developed economy. The positive trend in the Indian stock market is contrary the theory that higher oil prices lower stock returns.

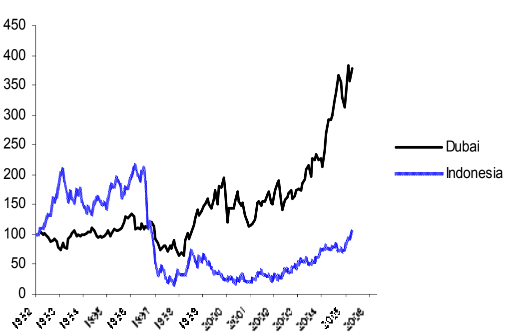
Table VI

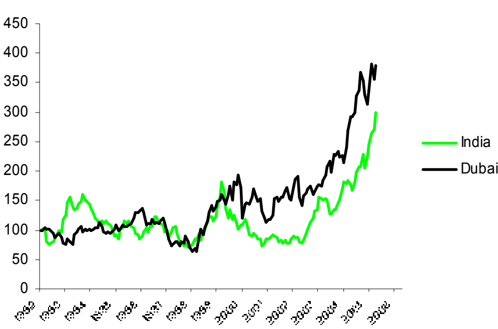
Descriptive Statistics

This table presents the descriptive statistics for those variables that are relevant for China only. The sample covers the period January 1993– April 2006 and contains monthly data. The total number of months in the observation period is 160. All descriptive statistics are denoted in percent.

Variable	Min.	Max.	Mean	σ
$r_t^{Shanghai}$	-48.477	86.228	0.116	12.940
$CPI_t^{Shanghai}$	-1.903	1.944	-0.048	0.738
$IP_t^{Shanghai}$	-42.453	32.649	1.117	12.857
$Bond_t^{Short}$	-37.807	31.508	-0.678	5.691
$Bond_t^{Long}$	-44.629	25.490	-0.785	6.001
r_t^{spread}	-21.187	25.489	-0.108	4.035

In the case of the return on the Shanghai index in China, this sample period has had, as previous countries, positive returns. Again this would be in opposition with our initial hypothesis that when the oil price increases, that should have a negative effect on the stock market. However if looking at the last years peaking oil price, we can observe a decline in the Chinese stock index. The bond market demonstrates a low negative return which is in line with economic theory as the stock market has increased. The rate for the IP has increased rather strongly during this period. This factor is as volatile as for Indonesia.





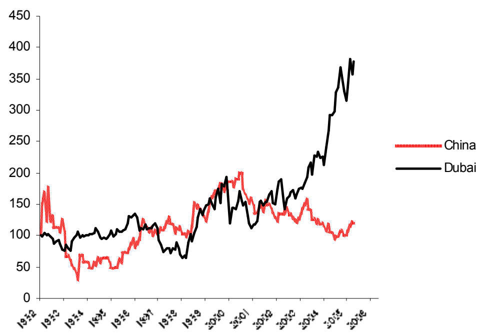


Figure V. The relative stock index development contra the oil price using 1993 as base year for the different countries.

5 Method

In this section the methodology used for the study is described and discussed. The different steps leading to the final models are described as well as our constructed oil price regimes. Also provided is the transformation of our raw data. All regressions and statistical tests have been carried out using the software package Intercooled Stata 9.1.

5.1 Methodology

The subjects for this study are the stock markets in China, India and Indonesia for the period January 1993-April 2006.[15] In order to measure the impact of oil price fluctuations we conduct a separate regression-based model, for each of the different countries, on the major stock indices for each market. Choosing what variables to include in a regression-based model that aims at explaining or predicting variations in stock returns is not a simple task. Previous research provides evidence for that certain variables have forecasting power, however there is no consensus among researchers on one appropriate combination of factors (Cremers, 2002). The motivations for including each of the variables in our model were described in the data section. Testing for an oil effect we started by including, apart from some more widely used variables, lagged oil prices up to sixth months, in accordance with Driesprong et al (2005).

5.2 Transforming the data

When attempting to establish a relationship between the oil effects and stock returns all variables were transformed into returns rather than prices as we are more concerned with the effect of changes in the return on the oil price on the return on stock indices, as opposed to examining the relationship between the oil price and the stock index price. Therefore, the first step was to transform all variables that were quoted in prices into returns, as is shown below for the stock index variable.

$$r_t^{index} = 100 * (\ln P_t^{index} - \ln P_{t-1}^{index}) \quad (1)$$

[15] This was the longest period for which we could find appropriate data from Datastream.

When it comes to the variables Industrial Production and the Consumer Price Index variables we also transformed them into “returns”, even though their original values were not in prices, but rather in index values. (This was done in order to enable comparison of variables of the same nature, so that all variables could be interpreted as percentage changes in a final model.)

5.3 Oil regimes

When converting all data into returns, some important information is lost concerning the actual levels of the oil price. Thus, to take into account and test for the fact that the oil price has been at some of its highest levels ever in the last few years, a method of using so-called oil regimes was employed. This in essence means that the oil price was divided into three different levels that indicate whether the oil price is Low (below USD 20), Medium (between USD 20 and USD 34) or High (above USD 34). They were set in such a way that each regime should capture a meaningful spectrum of oil price levels, including enough observations for valid tests to be conducted. Dummy variables were used to distinguish between each of the regimes. The objective was thereafter to include regime dummies in the final model discussed in section 5.6 below. With that model, we could test if different levels of oil price could add any information to the full-period model. In the figure below, the Dubai oil price is shown including the three oil price regimes.

Table VII

Descriptive Statistics for Oil Price Regimes

This table presents the different price levels that divide the Dubai oil price into different regimes. The sample covers the period January 1993– April 2006 and contains monthly data. The total number of months in the observation period is 160. All figures are in USD.

Regime	Min.	Max.	Mean	σ
All levels	10.17	60.83	23.35	11.18
Low	10.17	19.82	15.60	2.33
Medium	20.48	33.19	25.34	3.06
High	34.01	60.83	46.69	9.36

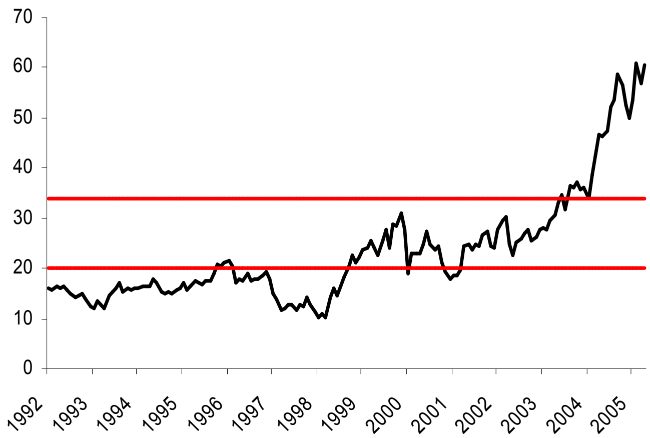


Figure VI. **Crude Oil-Arab Gulf Dubai USD/BBL with constructed price regimes.**
Source: Datastream

5.4 Testing for an Oil effect

To see at an early stage if an oil effect could be established two different tests were conducted. The first was to, in accordance with Driesprong et al. (2005), simply incorporate one lag of the oil return in a regression with the index return for each of the countries.[16]

$$r_t^i = \alpha^i + \beta^i r_{r-1}^{oil} + \varepsilon_t^i \qquad (2)$$

where α^i is the constant term estimated by the regression and ε_t^i is the error term, the superscript *i* indicating each of the countries. With a standard t-test it was then tested if the coefficients estimated for β^i significantly differed form zero. Should the null hypothesis be rejected, it could be claimed at this early stage that there is evidence of an oil effect.

5.5 Inclusion of control variables

The next step in determining if an oil effect is present amongst the determinants for stock prices is to put together a model containing all of the relevant regressors discussed in the data section above. To determine which lags of the variables that were most significant for forecasting stock returns, each of the variables was regressed, including lags zero through six of that same variable on each of the three stock indices. The lag that gave the most significant results was selected to be included in a first-draft model (exclusive of the oil regressors), which is referred to as the ***restricted model.*** An example of the restricted model and unrestricted (for India) model is shown below:

[16] Also tested were later lags as well the unlagged version of the oil variable. However, as we considered the one month lagged oil price to be most economically motivated, we chose not to present these equations here. This expectation also showed to hold when running the different regressions.

$$r_t = \alpha + \beta_1 r_{t-1} + \beta_2 CPI_{t-1} + \beta_3 IP_{t-1} + \beta_4 Bond_t^{Long} + \beta_6 r_t^{S\&P} + \beta_7 r_t^{HK} + \beta_8 r_t^{NIK} + \varepsilon_t \quad (3)$$

To that model we then added all the lags of oil to arrive at the ***unrestricted model***.

$$r_t = \alpha + \beta_1 r_{t-1} + \beta_2 r_t^{oil} + \beta_3 r_{t-1}^{oil} + ... + \beta_8 r_{t-6}^{oil} + \beta_9 CPI_{t-1} + \beta_{10} IP_{t-1} + \beta_{11} Bond_t^{Long} + \beta_{12} r_t^{S\&P} + \beta_{13} r_t^{HK} + \beta_{14} r_t^{NIK} + \varepsilon_t \quad (4)$$

Each of these will be run on the three countries of interest. Then they are to be compared with an F-test to see if the oil lags are significantly different from zero, in which case we can conclude that there is evidence of an oil effect. The F-test statistic is calculated as follows:

$F = \frac{(RSS_R - RSS_{UR})/m}{RSS_{UR}/(n-k)}$ which is F distributed with m and n-k degrees of freedom.

The corresponding hypotheses for each country are the following:

$H_0: \beta_1 = \beta_9 = \beta_{10} = \beta_{12} = \beta_{13} = \beta_{14} = 0$

$H_1: \beta_1, \beta_9, \beta_{10}, \beta_{11}, \beta_{12}, \beta_{13}$ and/or $\beta_{14} \neq 0$

5.6 Final models

In order to finally end up with a model that takes into account as many significant variables as possible, without including too many, we strived at finding a model for each of the three countries, which maximizes the predictive power for the stock index returns. As R^2 is a non-decreasing function of the number of regressors in a model, we decided to use adjusted R^2 instead, which is corrected for the number of degrees of freedom in a regression model (Gujarati, 2003). Thus, maximizing that goodness of fit measure aids in finding a regression model that predicts as much of the index fluctuations as possible, without losing degrees of freedom by including excessive variables. The approach taken was to start off with a model that included all the economically justifiable variables that could contribute in explaining the returns on the three indices, and then reduce that regression model. By eliminating the least significant variables, one at a time, with the aim of maximizing the adjusted R^2, we finally ended up with three different models, which are presented in section 6.3. The starting point was thus to estimate Regression 4[17] (also denoted as the unrestricted model above) for each month *t* for all of the countries. In other words, a model that was found reasonable was deliberately over-fitted and then, in the described top-down approach, reduced until a meaningful result was obtained. One might ponder over the risks of constructing a spurious model when

[17] Please note that this is the regression for relevant for India. The corresponding regressions for Indonesia and China are presented in Appendix C.

attempting this approach. A spurious relationship is one that is nonsensical, yet has a very high explanatory value, R^2. It is common that non-stationary variables regressed on each other exhibit statistically significant correlations, without there actually being any correlation between them whatsoever (Gujarati, 2003). Therefore, we tested all variables for a unit root process, which was rejected at the ten percent level in favor of the alternative hypothesis of stationarity.[18]

5.7 Testing the oil regimes

When the final models for each of the countries had been acquired, these were used to investigate whether there are any significant differences between the oil price regimes. In order to do this we re-estimated the final models, this time splitting them up into three separate parts by using dummy multipliers for each oil price regime. Using the estimated coefficients from the combined regression we test, with an F-test as in section 5.5, if the variables multiplied by the regime dummies are significantly different from zero. If that is the case, the null hypothesis, which states that the oil regimes do not contain any supplementary information with respect to the information obtained from the combined model, can be rejected. A simplified version of this may look as follows:

$$Y = aL + bL \cdot X + cL \cdot Z + dM + eM \cdot X + fM \cdot Z + gH + hH \cdot X + iH \cdot Z + m \qquad (5)$$

For Regime Low:	For Regime Medium:	For Regime High:
$H_0: \ a = b = c = 0$	$H_0: \ d = e = f = 0$	$H_0: \ g = h = i = 0$
$H_1: a, b$ and/or $c \neq 0$	$H_1: d, e$ and/or $f \neq 0$	$H_1: g, h$ and/or $i \neq 0$

6 Empirical Results

6.1 Testing for an Oil effect

One first approach to examine the predictive effect of oil price changes for stock returns is to run simple regressions including only oil, in different forms, as explanatory variable. In this first assessment, we chose to test if the return on oil from one month prior to today, had any significant explanatory value for the current month's stock return.[19] Table VIII summarizes the results from our regression with one lag of the oil price for each of the stock markets.

[18] Please see Appendix B for more details.

[19] As also mentioned in footnote 16 in section 5.4, regressions were also made on the oil variable in all different forms. Again, as these did not show any significant results, we have chosen to only present the result for the one month lagged oil price.

Table VIII

Initial Oil Effect Test

This table shows the relation between lagged oil return and return on market indices for the three markets. The following regression is estimate using OLS regression: $r_t^i = \alpha^i + \beta^i r_{r-1}^{oil} + \varepsilon_t^i$. The values in parentheses are t-values. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Market	Constant	r_{r-1}^{oil}	$Adj.R^2$	*N*
Indonesia	0.052 (0.40)	-0.016 (-1.01)	-0.005	158
India	0.808 (0.23)	-0.155** (-2.05)	0.020	158
Shanghai	-0.130 (-0.13)	-0.015 (-0.14)	-0.006	158

For China and Indonesia we cannot reject the null hypothesis that the oil coefficient is significantly different from zero, i.e. there are no indications of an oil effect for these countries. For India, however, we do find a significant relationship between the oil price and the Indian stock index. The negative estimated coefficient for r_{r-1}^{oil} of –0.155 can be interpreted to mean that if last month's oil price return increased by one percent, then this month's stock return would decrease by 0.155 percent. Or, given that the surrounding conditions remain constant, this would imply that if the current month's oil price return is positive that predicts the stock returns in the next month to be negative. This result is statistically significant at the five percent level.

Interpreting the results is not straightforward. According to our hypotheses not only the Indian stock market should exhibit a negative significant relationship, but also the Chinese index. From Indonesian stocks, on the other hand, oil price movements were expected to predict stock returns in the same direction, i.e. that oil price increases should predict increases in the share index as well. That these two countries do not show any significant results does not necessarily mean that there is no effect on stock returns from oil price fluctuations, but could be the result of not having enough of data. Before taking the analysis further or drawing any conclusions from this evidence, the models for each country are expanded with various widely-used predictors below.

6.2 Subsequent test including control variables

Having no unison conclusions from the first regression with only oil as explanatory variables, the model is extended by including a number of well-known predictors of stock returns as described under section 5.5 above. Moreover, several lags of oil are included, namely those ranging from today's oil return to the oil return with a time lag of six periods. The reasoning behind the inclusion of all of these is that such an approach allows for the detection of delayed oil effects, in addition to those that occur in a short time perspective. Table IX below contains the results for each market from testing the unrestricted model against the restricted one.

Table IX

Subsequent Oil Effects Test

These tables show the result from testing whether the unrestricted model, inclusive of oil lags, adds significant explanatory value in addition to the explanatory value provided by the restricted model. The estimates result from the regression tests under section 5.5 above.

Market	Number of Parameters, m	Degrees of Freedom, n-k	Unrestricted $Adj.R^2$	Restricted $Adj.R^2$	F(m,(n-k))	Prob > F
Indonesia	7	124	0.36	0.37	0.74	0.638
India	7	116	0.33	0.28	2.30	0.031
Shanghai	7	140	0.03	0.06	0.52	0.819

The results presented in Table IX above are in line with those found by the initial test for oil effects. In other words, in the case of both Indonesia and China there is no evidence of that the oil variables have contributed with any supplementary information through their incorporation in the unrestricted model. This can be confirmed by the fact that adjusted R^2 for the restricted model is higher than for the unrestricted models, clearly indicating that the oil lags do not add enough explanatory value to compensate for the loss of degrees of freedom that their inclusion results in.[20]

However, turning to the case of the Indian stock exchange's dependency of oil, also this test gives evidence for there being an oil price effect. Here, the addition of the seven oil variables have contributed enough to the unrestricted model for the difference between it and the restricted one to be statistically significant. Again, this is further shown by the fact that the adjusted R^2 for the unrestricted model is higher than for restricted model.

6.3 Final models

From the regression inclusive of all variables discussed in section 4.2 the model has been reduced by eliminating the least significant variables, one at a time, and striving to maximize adjusted R^2 to finally end up with one final model for each country. Please also note in the case of Indonesian and Indian regression models, we have included lagged variables of the regressands in order to correct for autocorrelation.[21] Tables X-XII contains the results from the final estimations for the different countries.

[20] Please see Appendix C for further details.

[21] Please see Appendix B for further details.

Table X

Final Model

Indonesia

This table shows the relation between the stock index and all those explanatory variables that were necessary when maximizing adjusted R^2. The following regression are estimated using standard OLS:

$$r_t^{Indonesia} = \alpha^{Indonesia} + \beta_1 r_{t-1}^{Indonesia} + \beta_2 r_{t-2}^{Indonesia} + \beta_3 r_{t-4}^{Indonesia} + \beta_4 r_{t-4}^{oil} + \beta_5 r_{t-5}^{oil} + \beta_6 IP_{t-5} + \beta_7 Bond_{t-4}^{Short} + \beta_8 Bond_t^{Long} + \beta_9 r_{t-4}^{spread} + \beta_{10} r_t^{HK} + \beta_{11} r_t^{NIK} + \varepsilon_t$$

The values in parentheses are t-values. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Constant	$r_{t-1}^{Indonesia}$	$r_{t-2}^{Indonesia}$	$r_{t-4}^{Indonesia}$	r_{t-4}^{oil}	r_{t-5}^{oil}	$IP_{t-5}^{Indonesia}$
-0.344* (-0.37)	0.209*** (3.03)	-0.216*** (-3.29)	0.214*** (3.21)	0.179* (1.71)	-0.115 (-1.11)	-0.290*** (-2.89)

$Bond_{t-4}^{Short}$	$Bond_t^{Long}$	r_{t-4}^{spread}	r_t^{HK}	r_t^{NIK}	$Adj. R^2$	N
0.245** (2.04)	-0.338*** (-2.61)	0.751*** (4.16)	0.733*** (5.54)	0.280 (1.63)	0.48	141

As we can see from the estimated coefficients that result from the final model for Indonesia, only two lags of oil regressors are left after reducing the regression into a model that explains the returns in the Indonesian index in the most satisfactory way, given the set of data acquired. This model's adjusted R^2 is 0.48, meaning that it is capable of explaining 48 percent of the returns in the stock index. Even though it could be higher, we consider this explanatory power to be satisfactory, as the determinants for stock return in this country are also heavily dependant on such factors as political climate and other country specific risk factors which have a large impact on investors' willingness to trade in these stocks. When taking a closer look at some of the estimated coefficients, we can note that all three lagged variants of the dependant variable are significant at the one percent level, giving the model some autoregressive characteristics. Of the two oil lags remaining in the model, only lag four is significant at the ten percent level. That particular lag has a positive estimated coefficient, which goes along with our above stated expectations. The interpretation of its estimated coefficient would be that a positive return on the oil price at time t would predict a positive return on the stock index at time $t+4$, given that all other variables are held constant. However, as the subsequent oil lag, lag 5, is negative, we cannot draw any too strong conclusions from these estimated coefficients.

Some of the other important explanatory variables for the Indonesian stock index are the long bond and the term spread. These are both significant at the one percent level and have coefficients that are aligned with expectations. Estimated coefficients show that the Hong Kong stock index return also has a strong influence on the returns on the Indonesian one which, again, is expected since the prior market is much more strongly integrated in the global stock market than the latter. The coefficients that have turned out to go against our expectations are the industrial production and the short bond, which both have negative coefficients and are significant. Perhaps these variables go against expectations because they are lagged four and five periods, respectively. It is reasonable to think that certain relationships and effects are altered in a longer time perspective.

Table XI

Final Model

India

This table shows the relation between the stock index and all those explanatory variables that were necessary when maximizing adjusted R^2. We estimate the following regression using standard OLS:

$$r_t^{India} = \alpha + \beta_1 r_{t-1}^{India} + \beta_2 r_{t-3}^{India} + \beta_3 r_{t-1}^{oil} + \beta_4 r_{t-4}^{oil} + \beta_5 r_{t-5}^{oil} + \beta_6 r_{t-6}^{oil} + \beta_7 CPI_t^{India} + \beta_8 Bond_t^{Long} + \beta_9 r_t^{NIK} + \beta_{10} r_t^{HK} + \varepsilon_t$$

The values in parentheses are t-values. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Constant	r_{t-1}^{India}	r_{t-3}^{India}	r_{t-1}^{oil}	r_{t-4}^{oil}	r_{t-5}^{oil}	r_{t-6}^{oil}
0.795 (1.15)	-0.066 (-0.88)	-0.144* (-1.91)	-0.110* (-1.66)	0.125* (1.90)	0.097 (1.48)	0.148** (2.28)

CPI_t^{India}	$Bond_t^{Long}$	r_t^{HK}	r_t^{NIK}	$Adj.R^2$	N
-1.771** (-2.60)	-0.622*** (-3.92)	0.120 (1.47)	0.506*** (4.88)	0.36	133

In the case of the Indian stock index four lags of oil return remain in the final model. The first of these is negative, as expected, and significant at the ten percent level. It indicates that a positive oil return at the present time, time t, predicts negative stock returns at time $t+1$, or, that negative oil returns predict positive stock returns, with the same time perspective. However as inflation, contrary to expectations, also shows a negative relationship, it makes it harder to draw any strong conclusions regarding the isolated effect from an oil price change. Subsequent oil return lags are all positive. The fourth and sixth are significant at the ten and five percent levels, respectively, while the fifth is not. As well as for Indonesian market's model, this one contains lagged versions of the dependant variable. Here, the third lag is significant at the ten percent level and has a negative sign. The other two most significant explanatory variables are the return on the long bond and the return on the Japanese stock index, Nikkei. Both of these variables' estimated coefficients are of expected signs. Concerning the adjusted R^2 for this model, it is a bit lower than for that of the Indonesian market. However, we still consider it quite satisfactory, particularly in the light of the fact that the country's economy, like many other developing countries' economies, has changed drastically during the sample period, which makes it hard to find a model that captures enough of the dimensions that affect stock returns in this index.

Table XII

Final Model

China

This table shows the relation between the stock index and all those explanatory variables that were necessary when maximizing adjusted R^2. We estimate the following regression using standard OLS: Please note that this regression was estimated using Huber-White sandwich estimators[22] of variance in place of ordinary ditto, thus no adjusted R^2 values can be presented, why R^2 values are given. $r_t^{Shanghai} = \alpha + \beta_1 r_{t-1}^{Shanghai} + \beta_2 r_t^{oil} + \beta_3 r_{t-4}^{oil} + \beta_4 CPI_{t-5}^{China} + \beta_5 Bond_t^{Long} + \beta_6 r_{t-2}^{NIK} + \varepsilon_t$

The values in parentheses are t-values. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Constant	$r_{t-1}^{Shanghai}$	r_t^{oil}	r_{t-4}^{oil}	CPI_{t-5}^{China}	$Bond_t^{Long}$	r_{t-2}^{NIK}	R^2	N
-0.435 (-0.51)	-0.102 (-0.75)	-0.112 (-1.01)	0.126 (0.92)	-2.848** (-2.10)	-0.302* (-1.84)	0.254 (1.41)	0.10	154

For the Chinese stock index, the final regression model is not nearly as good in terms of explanatory value as for the two previous countries.[23] It is only able to explain ten percent of the index returns for this market. The model still includes two oil variables, one for the current time and one for four months prior to today's date, none of which is statistically significantly different from zero. The two variables that are indeed significant are the lagged consumer price index and the long-term bond. CPI, which is a measurement of inflation, does not have the sign we expected. Rather than being positively correlated with the stock index, it is quite negatively correlated with the index. The other variable that is significant, this time at the ten percent level, is the long-term bond, which has a negative estimated coefficient along with expectations. Perhaps it should be remarked upon the fact that, rather contrary to expectations, the Hong Kong stock index return did not make it to the final model as major explanatory model. This, along with the fact that the explanatory value is so low, forces us to be prudent when drawing any conclusions from the Chinese model.

6.4 Testing the oil regimes

The approach of testing if different price levels of oil affect the predictive property of oil return on stock index returns is applied to each of the countries' final models. Since each stock index has a proprietary model, each model will be presented together with the results that are shown for one country at a time. The regression models are the same as the final models above, yet they are split up by the oil regimes Low, Medium and High. Each regression is estimated and tested in three separate groupings to see if the set of coefficients adhering to the same regime are different from zero. In the case of Indonesia, the full model for this estimation is the following:

[22] Huber/White/sandwich estimators give heteroskedasticity-consistent estimates. Source: Stata web page

[23] As there was a need to correct for some issues with model diagnostics to obtain the more significance levels for each estimated coefficients, adjusted R^2 is no longer a relevant measure. Thus, we comment on the R^2 value instead, which is rather low.

Regression 6, for Indonesia:

$$
\begin{aligned}
r_t^{Indonesia} &= R_L(\alpha_L + \beta_{L1} r_{t-1}^{Indonesia} + \beta_{L2} r_{t-2}^{Indonesia} + \beta_{L3} r_{t-4}^{Indonesia} + \beta_{L4} r_{t-4}^{oil} + \beta_{L5} r_{t-5}^{oil} \\
&\beta_{L6} IP_{t-5}^{Indonesia} + \beta_{L7} Bond_{t-4}^{Short} + \beta_{L8} Bond_t^{Long} + \beta_{L9} r_{t-4}^{spread} + \beta_{L10} r_t^{HK} + \beta_{L11} r_t^{NIK}) \\
&+ R_M(\alpha_M + \beta_{M1} r_{t-1}^{Indonesia} + \beta_{M2} r_{t-2}^{Indonesia} + \beta_{M3} r_{t-4}^{Indonesia} + \beta_{M4} r_{t-4}^{oil} + \beta_{M5} r_{t-5}^{oil} \\
&\beta_{M6} IP_{t-5}^{Indonesia} + \beta_{M7} Bond_{t-4}^{Short} + \beta_{M8} Bond_t^{Long} + \beta_{M9} r_{t-4}^{spread} + \beta_{M10} r_t^{HK} + \beta_{M11} r_t^{NIK}) \\
&+ R_H(\alpha_H + \beta_{H1} r_{t-1}^{Indonesia} + \beta_{H2} r_{t-2}^{Indonesia} + \beta_{H3} r_{t-4}^{Indonesia} + \beta_{H4} r_{t-4}^{oil} + \beta_{H5} r_{t-5}^{oil} \\
&\beta_{H6} IP_{t-5}^{Indonesia} + \beta_{H7} Bond_{t-4}^{Short} + \beta_{H8} Bond_t^{Long} + \beta_{H9} r_{t-4}^{spread} + \beta_{H10} r_t^{HK} + \beta_{H11} r_t^{NIK}) + \varepsilon_t
\end{aligned}
$$

Table XIII

Oil Regime Effects – Indonesia Index

These tables show the result from testing whether the regimes significantly differ from each other with respect to the each country's full model. The estimates result from the Regression 6 and the tests correspond to the hypotheses listed above. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Regime	Number of Parameters, m	Degrees of Freedom, n-k	F(m,(n-k))	Prob > F
High	11	106	0.61	0.813
Medium	11	106	2.90***	0.002
Low	12	106	9.92***	0.000

The way to interpret the above results is that the regimes that are significant add information that differs from the remaining part of the regression. Thus, for the Indonesian stock index, this implies that in the Low regime the regression estimated differs from the remaining two periods that it is compared to in with the F-test. The same applies to the Medium regime. The tests indicate that, at such price levels of oil, there is some difference in the relationships between the explanatory variables and the dependant variable.

To see which of the coefficients that actually are significantly different between the oil price regimes, we also tested the pair of corresponding coefficients across the regimes to see if they differed significantly from each other. The only estimated coefficients that were statistically different from zero were the below presented ones.

Table XIV

Differing Coefficients – Indonesian Index

This table shows the coefficients obtained from Regression 6 that significantly differs in a pair wise comparison across the regimes for the Indonesian stock index. Please note that this comparison test was carried out for all variables in the model, but that only the significant ones are presented here. The values in parentheses are t-values. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Regimes	Variable	Est. Coefficient Low	Est. Coefficient Medium	F(m,(n-k))	Prob > F
Low –Medium	$r_{t-1}^{Indonesia}$	0.321*** (3.42)	0.013 (0.10)	3.80*	0.054
Low-Medium	$r_{t-2}^{Indonesia}$	-0.342*** (-3.85)	-0.058 (-0.48)	3.57*	0.062

In this case we see that the coefficients that differed between the regimes were the lags of the dependant variable, the stock index returns. For both of these lags, the coefficients have changed from being significant explanatory variables at the low price levels of oil to insignificant ones. Their signs have remained the same, however. The lags of oil have not turned out as variables that obtain significantly diverse estimated coefficients depending on the level of the oil price. Thus, it does not seem as if the oil price in the case of Indonesia has a stronger or weaker effect on the stock index returns if the price per barrel of oil is high or low.

Regression 7, for India:

$$\begin{aligned}
r_t^{India} &= R_L(\alpha_L + \beta_{L1} r_{t-1}^{India} + \beta_{L2} r_{t-3}^{India} + \beta_{L3} r_{t-1}^{oil} + \beta_{L4} r_{t-4}^{oil} + \beta_{L5} r_{t-5}^{oil} + \beta_{L6} r_{t-6}^{oil} \\
&+ \beta_{L7} CPI_t^{India} + \beta_{L8} Bond_t^{Long} + \beta_{L9} r_t^{HK} + \beta_{L10} r_t^{NIK}) \\
&R_M(\alpha_M + \beta_{M1} r_{t-1}^{India} + \beta_{M2} r_{t-3}^{India} + \beta_{M3} r_{t-1}^{oil} + \beta_{M4} r_{t-4}^{oil} + \beta_{M5} r_{t-5}^{oil} + \beta_{M6} r_{t-6}^{oil} \\
&+ \beta_{M7} CPI_t^{India} + \beta_{M8} Bond_t^{Long} + \beta_{M9} r_t^{HK} + \beta_{M10} r_t^{NIK}) \\
&R_H(\alpha_H + \beta_{H1}^{a} r_{t-1}^{India} + \beta_{H2} r_{t-3}^{India} + \beta_{H3} r_{t-1}^{oil} + \beta_{H4}^{a} r_{t-4}^{oil} + \beta_{H5} r_{t-5}^{oil} + \beta_{H6} r_{t-6}^{oil} \\
&+ \beta_{H7} CPI_t^{India} + \beta_{H8} Bond_t^{Long} + \beta_{H9} r_t^{HK} + \beta_{H10} r_t^{NIK}) + \varepsilon_t
\end{aligned}$$

Table XV

Oil Regime Effects – India Index

These tables show the results from testing whether the regimes significantly differ from each other with respect to the India's full model. The estimates result from the Regression 7 and the tests correspond to the hypotheses listed above. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Regime	Number of Parameters, m	Degrees of Freedom, n-k	F(m,(n-k))	Prob > F
High	10	100	1.76*	0.078
Medium	11	100	5.30***	0.000
Low	11	100	3.51***	0.000

For India, all of the oil price regimes are significantly different from the two remaining ones to which they are compared. This indicates that the estimated sub-regression for each oil price level has a different impact on the index than the other two do when they are combined. Therefore each regime of oil is characterized by diverse conditions. The question is then to see which of the variables that differ on an individual base when compared pair wise.

Table XVI

Differing Coefficients – India Index

This table shows the coefficients obtained from Regression 7 that significantly differs in a pair wise comparison across the regimes for the Indian stock index. Please note that this comparison test was carried out for all variables in the model, but that only the significant one is presented here. The values in parentheses are t-values. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Regimes	Variable	Est. Coefficient Low	Est. Coefficient High	F(m,(n-k))	Prob > F
Low –High	r_t^{HK}	0.007 (0.07)	1.350* (1.88)	3.44*	0.066

Somewhat contrary to expectations, we find that the only variable differing strongly between the regimes is the return on the Hong Kong stock index. It changes from being an insignificant independent variable for the low period to being a significant variable with a positive estimated coefficient in the high oil price regime. The fact that only one variable was found to differ between the regimes on this individual basis when the jointly tested regime coefficients seem to contain different information, could be for one of several reasons. Firstly, it could be that each estimated coefficient has changed only slightly, which is not enough to be captured by the individual test carried out above, but their added effect is substantial enough for each period to contribute with a different set of information than the other ones. Secondly, most observations in each regime often follow each other chronologically, meaning that the low oil price regime contains mostly observations from the first years of the times series and the high oil price regime contains observations from the latter end of the dataset. This results in that several factors will be captured in the regimes that are related to economic conditions in general, which would have a greater impact on the returns on each stock index than can be captured by a simple regression model.

Regression 8, for Shanghai:

$$r_t^{Shanghai} = R_L(\alpha_L + \beta_{L1} r_{t-1}^{Shanghai} + \beta_{L2} r_t^{oil} + \beta_{L3} r_{t-4}^{oil} + \beta_{L4} CPI_{t-5}^{China} + \beta_{L5} Bond_t^{Long} + \beta_{L6} r_{t-2}^{NIK})$$
$$R_M(\alpha_M + \beta_{M1} r_{t-1}^{Shanghai} + \beta_{M2} r_t^{oil} + \beta_{M3} r_{t-4}^{oil} + \beta_{M4} CPI_{t-5}^{China} + \beta_{M5} Bond_t^{Long} + \beta_{M6} r_{t-2}^{NIK})$$
$$R_H(\alpha_H + \beta_{H1} r_{t-1}^{Shanghai} + \beta_{H2} r_t^{oil} + \beta_{H3} r_{t-4}^{oil} + \beta_{H4} CPI_{t-5}^{China} + \beta_{H5} Bond_t^{Long} + \beta_{H6} r_{t-2}^{NIK}) + \varepsilon_t$$

Table XVII

Oil Regime Effects – Shanghai Index

These tables show the result from testing whether the regimes significantly differ from each other with respect to the each country's full model. The estimates result from the Regression 8 and the tests correspond to the hypotheses listed above. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Regime	Number of Parameters, m	Degrees of Freedom, n-k	F(m,(n-k))	Prob > F
High	7	134	15.0***	0.000
Medium	5	134	1.33	0.257
Low	7	134	1.61	0.137

As seen from Table XVII above, the high oil price regime is the only one that is significant for the estimated regression for the Chinese stock index. This implies that, since the Dubai oil price reached and exceeded USD 34 per barrel, some economic condition that affects the predictive characteristics of the explanatory variables changed, as compared to the two other oil price periods. These differences will be further investigated by comparing the coefficients across the regime levels. Since we see that the F statistics are rather similar for regimes Low and Medium, we would not expect them to have any coefficients that differ when compared pair wise, however we would expect there to be differences when comparing either one of those regimes with the High oil price regime.

Table XVIII

Differing Coefficients – Shanghai Index

These tables show the coefficients obtained form Regression 8 that significantly differ in a pair wise comparison across the regimes for the Shanghai stock index. Please note that this comparison test was carried out for all variables in the model, but that only the significant ones are presented here. The values in parentheses are t-values. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Regimes	Variable	Est. Coefficient Low	Est. Coefficient High	F(m,(n-k))	Prob > F
Low –High	r_t^{oil}	-0.248 (-1.20)	0.240 (1.22)	2.92*	0.090
Low –High	r_{t-4}^{oil}	0.402 (1.33)	-0.403** (-2.39)	5.40**	0.022
Low –High	CPI_{t-5}^{China}	-4.807** (-2.48)	2.476** (2.16)	10.44***	0.002

Regimes	Variable	Est. Coefficient Medium	Est. Coefficient High	F(m,(n-k))	Prob > F
Medium –High	r_{t-4}^{oil}	-0.082 (0.279)	-0.403** (-2.39)	3.04*	0.084
Medium –High	r_{t-2}^{NIK}	0.174 (1.46)	-0.210 (-1.16)	3.14*	0.079

In the tables above our expectations are confirmed, in that there are a number of coefficients that differ when comparing across the regimes. In addition, all of these involve the High oil price regime. First of all, when comparing the Low and High regimes, between which it is reasonable to expect to find the greatest differences, two oil variables have contrasting estimated coefficients, namely the current time, time t_0's oil return and the oil return corresponding to four months prior to the index return, time $t-4$. For both variables the estimated coefficients have almost turned out to be the opposite in the High oil price regime as compared to the Low regime. In the Low oil regime the coefficient for r_t^{oil} was negative, indicating that a current high oil price should be associated with a high return in the index today. Whereas, the coefficient for the same regime, but for the lagged oil variable, is positive and thus indicates that a positive return on the oil price today speaks for a positive index return at time $t+4$. The opposite seems to be true for the High regime, in which the current oil price coefficient is positive and the lagged one is negative. The other factor that has changed a lot between the High and Low regimes is CPI. It has gone from significantly negative in the low price regime to significantly positive in the high one. Our expectations on this variable was for it to be positively correlated with the index returns, however there is a certain disagreement in the literature, as mentioned in section 4.2, that suggests that this variable could have either a positive or a negative correlation with stock performance. Certainly, the influence of inflation has changed, but exactly what those changes have been are beyond the scope of this paper.

In the Medium and High regime comparison the oil lag again shows up as a variable that, in the regressions, receives a different estimated coefficient depending on which oil price level one focuses on. In the Medium oil regime, the lagged oil return's estimated value is very weekly negative and insignificantly different from zero, while in the High price level, as discussed above, it is more negative and a significant estimator at the five percent level. The other variable that has a significant difference in its estimated value in the Medium to the High price regime is the lagged return on the Nikkei stock index. Neither one of its estimated coefficients is significant at the ten percent level. However, since it goes from being a positive estimator for the Medium price regime, to a negative estimator in the High price regime, it is captured by this test as a variable that varies with different periods of oil price levels.

6.5 Robustness

Since we found, in the regime tests above, that the estimated coefficients either differed individually or in terms of their joint effect, it could be appropriate to carry out a complementary assessment to check if the regression models are robust over time. Therefore the dataset was divided into two equal-sized periods and the regressions re-estimated, however, this time including a variable that indicates the second time period. Finally, we tested if the second time period's coefficients added any information to the full period regression.[24]

[24] For stated regressions and corresponding hypotheses, please see Appendix C.

Table XIX

Robustness over Time

This table presents the results from testing whether the regression model for each county is robust over time with an F test. The first period cover the period January 1993 through July 1999. The second period runs from August 1999 to April 2006. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Market	Number of Parameters, m	Degrees of Freedom, n-k	F(m,(n-k))	Prob > F
Indonesia	12	117	1.92**	0.039
India	11	111	2.02**	0.033
Shanghai	7	140	1.29	0.261

To a certain extent the results obtained in this robustness test mirror the results from the regime tests. Given that the oil price regimes for Medium and High oil prices collectively correspond rather well to the second period of the robustness test, it is likely that the results obtained from the tests are quite similar to those for the Low regime. In other words, it is expected that robustness over time is likely to be rejected for India and Indonesia, but not for Shanghai. In the case of the latter stock market, it seems as if the first two regimes are rather similar, while the last one differs substantially from the two prior ones. In the robustness test this difference within period two cannot be captured, instead that whole period's estimated coefficients will be some type of average of the Medium and High regimes, why the differences will be less pronounced than in the robustness test above.

7 Analysis

7.1 The impact and predictive power of oil price changes

This study was carried out with an expectation for there to be a significant predictive quality in oil returns on at least the Chinese and Indonesian stock indices. However, the results obtained have shown that the impact of oil price returns is minor in those two countries, while it does have predictive power in the case of the Indian stock index. This was identified already in the initial and subsequent oil effect tests, as the one month lagged oil price return had a significant effect on that stock index. Also, the comparison of the unrestricted and the restricted model showed that oil variables contributed with significant information. At first glance, these results might sound too counter-intuitive to be true. China, which is thoroughly dependant on oil as an input for its massive manufacturing industry, ought to be more affected by oil price changes than India. Indonesia, which is an oil producer that nowadays is becoming a net oil importer, also relies heavily on oil. In contrast, India has a low oil production and consumption on a per capita basis.[25] Its industries are mostly

[25] Source: Nation Master. In an oil consumption per capita ranking list comprised of 207 countries, China ranked 136th with 0.049 bbls/day per 10 people, Indonesia ranked 137th with 0.048 bbls/day per 10 people and India ranked 163rd with 0.021 bbls/day for 10 people.

software and IT services related, why its energy demand is relatively lower than for the global heavy-industry hub, China. Then one might ask oneself why the Indian stock exchange shows a significant relationship with the oil return variables.

Considering that, in these two oil dependant countries, much greater attention is paid by investors to the changes in the oil price since it is such a vital input factor. This then relates to the Efficient Market Hypothesis in that the oil price is public information that is readily accessible to all investors. Therefore, that factor should be discounted momentarily. Hence, there should not be any predictive power by the oil price on stock indices, especially for those indices that are located in countries in which this input factor is an important one, like in China or Indonesia. However, in the case of India, a different situation could set the standards. Investors in that region may not view the oil price as a factor that must be carefully considered and observed. That could be why more predictive power resides in the oil price movements in the case of that index.

When including other, more established, predictors for stock market fluctuations in each of the final models, in addition to several lags of the oil price returns, oil seems to have somewhat more explanatory value. In all of the final models at least two oil variables have subsisted after the elimination of redundant variables. These are not always individually significant by measure of t-statistics, but they still contribute to the predictive capability of the model. An explanation for this could be that all the factors that cause stock price changes are so complexly intertwined that some of the generally accepted variables need to be present for the oil price effects to be able to be addressed.

In the case of the Indonesian model one of the two oil variables is significant at the ten percent level. It is the four-month lagged oil price return, r_{t-4}^{oil}, that gives evidence of a positive correlation with the index returns. As mentioned before, we expected a positive correlation between the Indonesian index and oil regressors. By that token, this result could one the one hand be seen as pleasing. It may very well be interpreted to indicate that oil has a predictive effect on the Indonesian index, which in this instance entails that if the oil price return is positive at time t_0 that should foretell a positive oil return in four months time. On the other hand, the other lag of oil that is present in that very same model, namely lag five of the oil return, r_{t-5}^{oil}, which is insignificant at the ten percent level, has a negative estimated coefficient. Therefore, this evidence cannot be viewed upon as being reliable enough for any conclusions to be drawn. Instead, it is more sensible and correct to say, that in the case of Indonesia, there is some relationship, although weak, between oil- and stock returns. From this sample and investigation approach it appears as if the connection between the two factors is positive or neutral, but that is as far as it would be prudent to draw conclusions.

In the Indian model there is more evidence of there indeed being an oil effect that influences future returns on the stock index. In that regression, three of the four oil variables are significant at the five or ten percent level. Here, the estimated coefficient for the first significant oil regressor, r_{t-1}^{oil}, is negative and significant. It can therefore be interpreted as is done under section 6.3, that a positive oil price return at time t_0 is likely to result in a negative return on the index at time $t+1$. The coefficients for the regressors r_{t-2}^{oil} and r_{t-3}^{oil} are not significantly different from zero. But subsequently following are the lagged oil returns for lags four, five and six, of which all have positive estimated coefficients. In this pattern of first negative returns followed by positive returns one could possibly identify an under- and overreaction behavior on behalf of the investors. As described under section 2.6 Hong and Stein (1999) discuss how newswatchers and momentum traders together create a market place that, as a united entity, frequently first underreacts to information in the market, to later overreact to the same news in the long run. If investors that focus on the Indian stock market are not primarily concerned with the oil price as a key factor in their decision-making processes or if they have difficulties in assessing the impact on stock prices, it is likely that they would underreact to changing oil prices. In other words that means that in response to an increase in the oil price at time t_0, the market does not react with the correct magnitude at time t_0 by adjusting the stock price up if oil prices have decreased or down in oil prices have increased.

What is seen in the case of the Indian stock index is that, rather than there being a reaction at the time of the oil price change, it is delayed. The market most likely observes the change in the oil price, but either it does not know how to interpret it, or it does not dare to discount that piece of information harshly enough. This can possibly explain why we see a negative reaction at lag $t-1$. The two following lags are not significantly different from zero. At that point the market seems to be in some type of recovery state under which returns neither improve nor worsen. In the thereafter subsequent lags there again is a positive reaction which could then be interpreted as an overreaction. This whole reasoning is based on the assumption that there is some stickiness in the market that makes reactions come slowly at first, after which all investors react simultaneously resulting in the overreaction.

For the Chinese model and its estimated coefficients, we see a similar pattern as noted for the Indian index in that the first oil price return variable is negative and the lagged variable is positive. In this case it is the current time, t_0's oil return that is negative, whereas for India it was the one time-period lagged variable. That fact has different implications, meaning that the Chinese market reacts immediately to changes in the oil price. One plausible explanation may be that the Efficient Market Hypothesis holds in that traders involved in this market have experience with oil price fluctuations and enjoy the right tools to discount the changing oil price more efficiently than in other markets.

Since oil is an economically important factor for this country, it is also possible that investors have learnt not only how to discount the public information in the market, but they might also have built an understanding as to how other investors are likely to react to the flow of news. That makes the market more swift at reacting to information and doing so with a closer to correct magnitude, rather than under- and overreacting interchangeably until efficiency has been achieved. However, as this model shows rather unsatisfactory explanatory capability, in addition to the fact that neither of the oil coefficients is significant, we will not attempt to draw any more extensive conclusions from that model.

7.2 Implications of oil price levels

The interpretation of the above discussed results is rather intricate as they differ across the countries investigated. This also goes for the results from the regimes that were utilized in order to detect any disparities in the correspondence between oil price returns and stock returns at different levels of the oil price. The reasoning behind this was that at higher prices we would expect the oil price to be a more crucial factor in the eyes of shareholders than when oil prices remain more stable at lower levels. Hence, first tests were carried out to see if any of the regimes differed significantly from the combined two other regimes, to which it was compared. Then, in order to understand which factors were the main stimulators of this difference, a pair wise comparison of each of the factors' coefficients was carried out. The results obtained were somewhat unsatisfactory in that they did not correspond to expectations. We would have expected the highest regime to differ from the two others rather distinctively, since it represents a period during which oil prices practically skyrocketed.

Concerning the results obtained for Indonesia, the Low and Medium regimes differed significantly in comparison to the others and the only pair wise compared variables that were different across the regimes were two lagged versions of the dependant variable. Thus, it cannot be claimed that the existence of oil effects could be supported by this finding.

The results obtained from the same tests on the estimated regression for India were also somewhat unexpected. Here, all regimes differed from the other two, meaning that each and every one of them had contrasting explanatory conditions. However, on an individual basis, the estimated oil coefficients failed to differ when compared across oil price regimes. Thus, one cannot assert that there be evidence of an oil effect that differs in conjunction with the levels of the oil price, even though each regime can be said to be characterized by separate economic conditions.

The only stock market that gave the results that were aspired for was the Shanghai stock index. Here the High oil regime was significantly different from the other two. It thus seemed to carry information that could not be extracted from the relationship between the oil and stock returns at lower oil prices. Also, when inspecting which of the coefficients that differed between the High regime and the two other regimes, it was found that oil return in its current time variant, r_t^{oil}, and in its four period lagged variant, r_{t-4}^{oil} , were significant. However, with respect to the actual estimated coefficients, the results were not exactly in line with expectations. The only statistically significant variable was r_{t-4}^{oil} and its estimated value was rather strongly negative. In addition, it was early on in this thesis concluded that the model estimated for Shanghai was not of such quality that it could be used for any extensive conclusion drawing. Then, you might wonder, why we present its results in the paper.

One reason for why we decided to persist with this country's stock index was that we have made note of that China has been excluded from some previous research of which we have taken part in the preparation for this thesis (see for example Driesprong et al., 2005). We therefore were curious to find out what type of results it would give.

7.3 Other explanations for our findings

To round off this analysis it should be mentioned that what has been shown in this study is in support of the previous research that claims that oil has a limited direct effect on stock returns. Also, the countries explored here are developing ones that have gone through rather radical development changes during the sample period. This can be confirmed by the robustness test performed which shows that neither the Indonesian nor Indian stock markets could be claimed to be robust over the sample period. In the case of Shanghai stock market, robustness cannot be rejected by the equally-split sample test, but it is probable that it would not be robust over time if a different split up of the sample period were utilized.

Some other reasons why the effect of oil price changes appear so limited in this study is that they have been related to changes in the major stock indices for each country. One should then keep in mind that these indices are comprised of stocks from many different industries that are affected in diverse ways by oil price changes. Some of which can be assumed to be positively correlated with oil return, some negatively and others not at all. Therefore, their combined effects may be cancelling each other out, resulting in that no effect is shown. It is feasible to assume that investors that hold stocks in a particular country aim at having a certain weight of for example Indian shares in their portfolio. They might therefore reallocate their capital within that country's stock market as a response to oil price changes, resulting in a zero net effect in the index.

8 Conclusions

The purpose of this thesis was to examine the relationship between oil price movements and the stock market and test if changes in the oil price can forecast stock returns. More specifically three Asian emerging economies were examined, which are expected to consume an increasing share of the world's oil reserves in the future. Our hypotheses that rising oil prices predict lower stock returns and declining oil prices predict higher stock returns were tested on aggregated data for the period January 1993-April 2006. Furthermore, we tested if this effect varied with different oil price levels.

While the findings for India suggest a relationship and that oil price changes do predict stock returns in accordance with our hypotheses, the results for Indonesia and China give too weak evidence of an oil effect for any conclusions to be drawn with respect to oil's influence on stock returns. The results for India contradict the theory of true market efficiency as we find that there is a delayed response to oil price changes. However, the fact that India is identified as a country with an oil effect, while the other two countries investigated are not, is supported by previous findings by for example Driesprong et al. (2005). Concerning the utilized oil price regimes we found no strong evidence suggesting that these altered the relationship between oil- and stock returns.

As discussed in the opening theoretical paragraphs of this paper, previous research does not give one, cohesive message as to whether stock returns can be predicted by oil price changes. Some research concludes that so is the case, while others, like Chen et al. (1986) and Huang et al. (1996), find no evidence for any such relationship. Therefore, the conclusions arrived at in this paper are supported by that latter group of researchers.

As a final remark, we should point out the fact that the models and techniques used in this thesis are non-exhaustive. Thus, even though we find little evidence of an oil effect by the means of this study, we will not go so far as to claim that an oil effect is an inconceivable influence on stock returns.

9 Suggestions for further research

After having summarized the results obtained in this study, we can conclude that the findings do not give much satisfactory indications concerning there to be important impacts of oil price changes on stock indices. Hoping for oil to show up as a predictor of stock returns in the enormous noise of different factors affecting financial markets is perhaps not evident. However, using different methods or approaches, we still believe that there is more evidence to find in this area. For example, it would be interesting to perform an event study considering shocks in the oil price, defined as certain percentage change. Furthermore, it could be interesting to examine different sectors of companies, which also has been done for other markets in previous research. Finally, as these emerging economies provide relatively limited data sets, future research might be able to find more information on the impact of oil prices on stock returns.

10 References

Literature

Brooks, C., 2002, Introductory Econometrics for Finance, Cambridge: University press.

Chen, N.F., Roll, R., and S.A. Ross, 1986, Economic Forces and the Stock Market, *Journal of Business* 59, pp. 383-403.

Credit Suisse First Boston, 2005, Indonesia Energy Outlook, Boom or Bust? Credit Suisse Equity Research, Sector Review, 25 Nov 2005.

Cremers, K.J. Martijn, 2002, Stock Return Predictability: A Bayesian Model Selection Perspective, *The Review of Financial Studies*, 15(4), pp. 1225-1226.

Chocrane, J.H., 2001, Asset Pricing, Princeton University, Princeton and Oxford.

Driesprong, G., Jacobsen, B., and B. Maat, 2005, Stock Markets and Oil Prices, Rotterdam School of Management.

The Economist, 2006, Why the World is Not to Run Out About Oil, April 20th.

Fama, E.F., 1981, Stock Returns, Real Activity, Inflation and Money, *American Economic Review*, pp. 1346-1355.

Firth, M., 1979, The Relationship between Stock Market Returns and Rates of Inflation, *Journal of Finance*, pp. 743-749.

Garner, J., 2005, The Rise of the Chinese Consumer, Credit Suisse First Boston (Europe) Limited, John Wiley & Sons Ltd, West Sussex, England.

Grossman, J.S. and J.E. Stiglitz, 1980, On the Impossibility on Informationally Efficient Markets, *The American Economic Review*, Vol. 70, No. 3, pp. 393-408.

Gujarati, D.N., 2003, Basic Econometrics (4th ed.), New York: McGraw-Hill.

Gultekin, N.B, 1983, Stock Market Returns and Inflation: Evidence from other Countries, *Journal of Finance*, pp. 49-65.

Hamilton, J.D., 1983, Oil and the Macroeconomy since World War II, *The Journal of Political Economy*, Vol. 91, No. 2, pp. 228-248.

Hammoudeh, S. and E. Aleisa, 2004, Dynamic Relationships among GCC Stock Markets and NYMEX Oil Futures. *Contemporary Economic Policy,* Vol. 22, No. 2, 250-269.

Hammoudeh, S. and H. Li, 2005, Oil Sensitivity and Systematic Risk in Oil Sensitive Stock Indices, *Journal of Economics and Business*, Vol. 57, No. 1, pp. 1-21.

Hong, H., Tourus, W., and Rossen Valkanov, 2004, Do Industries Lead Stock Markets?, Working Paper, Princeton, UCLA.

Hong, H., and J. Stein, 1999, A Unified Theory of Underreaction, Momentum Trading and Overreaction in Assets Markets, *The Journal of Finance*, Vol.54 No. 6, pp. 2143-2148.

Huang, R.D., Masulis, R.W. and H.R. Stoll, 1996, Energy shocks and financial markets, *Journal of Futures Markets*, Vol. 16, No. 1, 1-27.

International Monetary Found, 2000, The Impact of Higher Oil Prices on the Global Economy, Prepared by the Research Department.

Jones, L.S, and Jeffry M. Netter, 2003, Efficient Capital Markets, *The Concise Encyclopedia of Economics.*

Lemieux, P., 2005, The Oil Price Mirage, Department of Management Sciences of the Université du Québec in Outaouais, *Financial Post* (Toronto), August 19.

Malkiel, B.G., 2003, The Efficient Market Hypothesis and Its Critics, Princeton University, CEPS Working Paper No. 91.

Sadorsky, P., 1999, Oil Price Shocks and Stock Market Activity, *Energy Economics*, 21, pp. 449-469.

Shleifer, A., Inefficient Markets, An Introduction to Behavioural Finance, Oxford University, New York, USA.

Web Pages

Energy Information Administration:
http://www.eia.doe.gov/oiaf/ieo/world.html, May 3rd, 2006.

Nation Master:
http://www.nationmaster.com/graph-T/ene_oil_con_percap May 14th, 2006.

NYMEX:
http://www.nymex.com/lsco_pre_agree.aspx, April 28th, 2006.

Stata F & Q:
http://www.stata.com/support/faqs/stat/robust_ref.html, May 12th, 2006.

Interviews

Rehnman, Gustav, Asia Growth Investors, 21st April 2006 Stockholm.

Databases

Datastream through Thomson Financial.

Appendix A: Description of variables

Table A.1

Description of explanatory variables

Market	Variable	Code	Type	Time period
China	Long-term interest rate	Time Deposit Rate 5Y – Middle Rate	Monthly	1992-12-31-2006-04-01
China	Short-term interest rate	Time Deposit Rate 3M – Middle Rate	Monthly	1992-12-31-2006-04-01
China	Consumer Price Index	CPI China	Monthly	1992-12-31-2006-04-01
China	Industrial Production	Industrial Production NADJ	Monthly	1992-12-31-2006-04-01
India	Long-term interest rate	Treasury Bond Yield: 10 Y	Monthly	1992-12-31-2006-04-01
India	Short-term interest rate	India T-Bill Primary 91 Day – Middle Rate	Monthly	1992-12-31-2006-04-01
India	Consumer Price Index	Change in CPI NADJ	Monthly	1992-12-31-2006-04-01
India	Industrial Production	Industrial Production NADJ	Monthly	1992-12-31-2006-04-01
Indonesia	Long-term interest rate	Deposit 1 Y – Middle Rate	Monthly	1992-12-31-2006-04-01
Indonesia	Short-term interest rate	Deposit 1 M – Middle Rate	Monthly	1992-12-31-2006-04-01
Indonesia	Consumer Price Index	ID CPI NADJ	Monthly	1992-12-31-2006-04-01
Indonesia	Industrial Production	ID Industrial Production Voln	Monthly	1992-12-31-2006-04-01
All markets	Oil	Crude Oil-Arab Gulf Dubai FOB U$/BBL	Monthly	1992-12-31-2006-04-01
All markets	S&P 500	S&P 500 Composite	Monthly	1992-12-31-2006-04-01
All markets	Hong Kong Stock Exchange	Hong Kong Stock Exchange	Monthly	1992-12-31-2006-04-01
All markets	Nikkei	Nikkei 500	Monthly	1992-12-31-2006-04-01

Table A.2

Description of stock indices

Market	Index	Code	Type	Time period
Indonesia	Jakarta Stock Exchange	MSCI Indonesia	Monthly	1992-12-31-2006-04-01
India	Indian stock index	MSCI India	Monthly	1992-12-31-2006-04-01
China	Shanghai Stock Exchange	Shanghai SE Composite	Monthly	1992-12-31-2006-04-01

Appendix B: Statistical Properties and Assumptions

In this appendix we provide a discussion on the stationary properties of our data sample. Furthermore, we discuss underlying assumptions related to the classical linear regression model that are necessary for the estimation technique, Ordinary Least Squares (OLS), to give valid and reliable results (Brooks, 2002).

Stationarity Properties

One first step when analyzing financial time series is to determine the stationary or non-stationary variables. A Dickey-Fuller test was carried out for the oil variable as well as for all other variables and autocorrelation functions were examined. As often is the case for financial time series we find them to be non-stationary in original form, however, by estimating all variables in their first differences we could take this problem into account.

1. Zero Mean Value and Normally Distributed Error Term

This assumption states that the average value of the error term shall be zero. This means that not included variables in the model must not systematically affect the value of the dependent variable. Calculating the mean value of the error term for the different regressions we find that they are 1.69×10^{-9} %, 2.63×10^{-9} %, -2.38×10^{-8} %, for Indonesia, India and China, respectively. Thus they can practically be taken to be zero.

Also required according the OLS assumptions is that the error term is normally distributed. In order to test for this we performed the Sharpiro-Wilk offered in the STATA software package test for the different regressions. As often is the case for financial time series we find the error term to follow a leptokurtic distribution, which is characterized by fatter tails and more peaked at the mean than the normal distributed random variable. However, even in absence of error normality, test statistics will asymptotically follow the appropriate distributions, appealing to the central limit theorem (Brooks, 2002).

2. Zero Covariance Between Explanatory Variables and Error Term

In order to fulfill this assumption we need our explanatory variables to be non-stochastic and also our first assumption of a zero mean error term to hold. The latter condition is, as above mentioned, fulfilled and as the explanatory variables by definition are non-stochastic this assumption is also fulfilled.

3. No Serial Correlation and Homoscedasticity

No serial correlation means that deviations of any two values of the dependent variable from their mean must not show any systematic pattern. Homoscedasticity means that the errors have constant variance. Testing for autocorrelation we used a Portmanteau test for white noise in addition to Durbin's alternative test for serial autocorrelation. Here, some evidence of autocorrelation was found. To correct for this problem we included the lags of the dependant variable that corresponded to the significant lags in correlograms for the residuals, in the case of Indonesia and India. For China the significant lags were too distant to make any economic sense to be included in the regression model. In order to detect any problems with heteroscedasticity we conducted the Breusch-Pagan and Cook and Weisberg test for our regressions. For Indonesia and India, we could not find evidence of the presence of heteroscedasticity. In the case of China, we found there to be some issues with homoscedasticity why we used robust standard errors to correct for the possible errors in the t statistics. However, even under the violation of these assumptions, estimates are unbiased and consistent (Brooks, 2002).

5. No Specification Bias

This assumption states that the model is correctly specified. Starting with a large set of explanatory variables that were economically motivated we reduced our model to only include the most significant variables. However, there might be other factors not included in the models that would add explanatory power. Especially for China one can doubt the model specification as it shows a quite low R^2.

Appendix C: Regressions and hypotheses

Oil effect tests

The unrestricted models used for the subsequent test for oil effects are presented below. The restricted models are not explicitly presented as they are the same as the unrestricted ones, yet without any of the oil variables. In addition, they are shown above each results table.

Indonesia:

$$r_t^{Indonesia} = \alpha + \beta_1 r_{t-1}^{Indonesia} + \beta_2 r_{t-1}^{oil} + \beta_3 r_{t-2}^{oil} + \beta_4 r_{t-3}^{oil} + \beta_5 r_{t-4}^{oil} + \beta_6 r_{t-5}^{oil} + \beta_7 r_{t-6}^{oil} + \beta_8 CPI_{t-1}^{Indonesia} + \beta_9 IP_{t-5}^{Indonesia}$$
$$+ \beta_{10} Bond_{t-4}^{Short} + \beta_{11} Bond_t^{Long} + \beta_{12} r_{t-4}^{Spread} + \beta_{13} r_t^{S\&P} + \beta_{14} r_t^{HK} + \beta_{15} r_t^{NIK} + \varepsilon_t$$

India:

$$r_t^{India} = \alpha + \beta_1 r_{t-1}^{India} + \beta_2 r_{t-1}^{oil} + \beta_3 r_{t-2}^{oil} + \beta_4 r_{t-3}^{oil} + \beta_5 r_{t-4}^{oil} + \beta_6 r_{t-5}^{oil} + \beta_7 r_{t-6}^{oil} + \beta_8 CPI_t^{India}$$
$$+ \beta_9 IP_{t-1}^{India} + \beta_{10} Bond_t^{Long} + \beta_{11} r_t^{S\&P} + \beta_{12} r_t^{HK} + \beta_{13} r_t^{NIK} + \varepsilon_t$$

Shanghai:

$$r_t^{Shanghai} = \alpha + \beta_1 r_{t-1}^{Shanghai} + \beta_2 r_t^{oil} + \beta_3 r_{t-1}^{oil} + \beta_4 r_{t-2}^{oil} + \beta_5 r_{t-3}^{oil} + \beta_6 r_{t-4}^{oil} + \beta_7 r_{t-5}^{oil} + \beta_8 r_{t-6}^{oil}$$
$$+ \beta_9 CPI_{t-5}^{China} + \beta_1 Bond_t^{Long} + \beta_2 r_{t-2}^{NIK} + \varepsilon_t$$

Table C.1

Unrestricted Model
Indonesia

This table shows the coefficients estimated with standard OLS for the unrestricted model for Indonesia.

$$r_t^{Indonesia} = \alpha + \beta_1 r_{t-1}^{Indonesia} + \beta_2 r_{t-1}^{oil} + \beta_3 r_{t-2}^{oil} + \beta_4 r_{t-3}^{oil} + \beta_5 r_{t-4}^{oil} + \beta_6 r_{t-5}^{oil} + \beta_7 r_{t-6}^{oil} + \beta_8 CPI_{t-1}^{Indonesia} + \beta_9 IP_{t-5}^{Indonesia}$$
$$+ \beta_{10} Bond_{t-4}^{Short} + \beta_{11} Bond_t^{Long} + \beta_{12} r_{t-4}^{Spread} + \beta_{13} r_t^{S\&P} + \beta_{14} r_t^{HK} + \beta_{15} r_t^{NIK} + \varepsilon_t$$

The values in parentheses are t-values. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Constant	$r_{t-1}^{Indonesia}$	r_t^{oil}	r_{t-1}^{oil}	r_{t-2}^{oil}	r_{t-3}^{oil}	r_{t-4}^{oil}	r_{t-5}^{oil}	r_{t-6}^{oil}	$CPI_{t-1}^{Indonesia}$
1.218 (-0.87)	0.180** (2.28)	0.042 (0.34)	-0.028 (-0.21)	0.128 (1.06)	0.024 (0.21)	0.209* (1.73)	-0.132 (-1.13)	0.024 (0.20)	0.514 (0.76)

$IP_{t-5}^{Indonesia}$	$Bond_{t-4}^{Short}$	$Bond_t^{Long}$	r_{t-4}^{Spread}	$r_t^{S\&P}$	r_t^{HK}	r_t^{NIK}	$Adj. R^2$	N
-0.260 (-2.31)	0.161 (1.19)	-0.314** (-2.13)	0.556*** (2.80)	0.072 (0.21)	0.724*** (4.27)	0.238 (1.18)	0.36	141

Table C.2

Restricted Model
Indonesia

This table shows the coefficients estimated with standard OLS for the restricted model for Indonesia:

$$r_t^{Indonesia} = \alpha + \beta_1 r_{t-1}^{Indonesia} + \beta_2 CPI_{t-1}^{Indonesia} + \beta_3 IP_{t-5}^{Indonesia} + \beta_4 Bond_{t-4}^{Short} + \beta_5 Bond_t^{Long} + \beta_6 r_{t-4}^{Spread} + \beta_7 r_t^{S\&P} + \beta_8 r_t^{HK} + \beta_9 r_t^{NIK} + \varepsilon_t$$

The values in parentheses are t-values. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Constant	$r_{t-1}^{Indonesia}$	$CPI_{t-1}^{Indonesia}$	$IP_{t-5}^{Indonesia}$	$Bond_{t-4}^{Short}$	$Bond_t^{Long}$
-0.699 (-0.58)	0.183** (2.39)	0.241 (0.39)	-0.281** (-2.58)	0.144 (1.09)	-0.365** (-2.55)

r_{t-4}^{Spread}	$r_t^{S\&P}$	r_t^{HK}	r_t^{NIK}	$Adj. R^2$	N
0.482** (2.55)	0.132 (0.43)	0.708*** (4.39)	0.209 (1.11)	0.37	141

Table C.3

Unrestricted Model
India

This table shows the coefficients estimated with standard OLS for the unrestricted model for India.

$$r_t^{India} = \alpha + \beta_1 r_{t-1}^{India} + \beta_2 r_{t-1}^{oil} + \beta_3 r_{t-2}^{oil} + \beta_4 r_{t-3}^{oil} + \beta_5 r_{t-4}^{oil} + \beta_6 r_{t-5}^{oil} + \beta_7 r_{t-6}^{oil} + \beta_8 CPI_t^{India} + \beta_9 IP_{t-1}^{India} + \beta_{10} Bond_t^{Long} + \beta_{11} r_t^{S\&P} + \beta_{12} r_t^{HK} + \beta_{13} r_t^{NIK} + \varepsilon_t$$

The values in parentheses are t-values. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Constant	r_{t-1}^{India}	r_{t-1}^{oil}	r_{t-2}^{oil}	r_{t-3}^{oil}	r_{t-4}^{oil}	r_{t-5}^{oil}	r_{t-6}^{oil}
0.725 (0.97)	-0.086 (-1.12)	0.062 (1.89)	0.020 (0.28)	-0.017 (-0.25)	0.149** (2.23)	0.109 (1.59)	0.149 (2.23)

CPI_t^{India}	IP_{t-1}^{India}	$Bond_t^{Long}$	$r_t^{S\&P}$	r_t^{HK}	r_t^{NIK}	$Adj. R^2$	N
-1.80** (-2.46)	-0.090 (-0.70)	-0.613*** (-3.72)	0.019 (0.10)	0.149 (1.52)	0.434*** (3.83)	0.33	133

Table C.4

Restricted Model
India

This table shows the coefficients estimated with standard OLS for the restricted model for India:

$r_t^{India} = \alpha + \beta_1 r_{t-1}^{India} + \beta\ CPI_t^{India} + \beta_9 IP_{t-1}^{India} + \beta_{10} Bond_t^{Long} + \beta_{11} r_t^{S\&P} + \beta_{11} r_t^{HK} + \beta_{12} r_t^{NIK} + \varepsilon_t$ The values in parentheses are t-values. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Constant	r_{t-1}^{India}	CPI_t^{India}	IP_{t-1}^{India}	$Bond_t^{Long}$	$r_t^{S\&P}$	r_t^{HK}	r_t^{NIK}	$Adj. R^2$	N
1.191 (1.62)	-0.079 (-1.02)	-2.15*** (-2.91)	-0.068 (-0.52)	-0.614*** (-3.67)	0.046 (0.26)	0.109 (1.12)	0.453*** (4.12)	0.28	133

Table C.5

Unrestricted Model

China

This table shows the coefficients estimated with standard OLS for the unrestricted model for Shanghai.

$r_t^{Shanghai} = \alpha + \beta_1 r_{t-1}^{Shanghai} + \beta_2 r_t^{oil} + \beta_3 r_{t-1}^{oil} + \beta_4 r_{t-2}^{oil} + \beta_5 r_{t-3}^{oil} + \beta_6 r_{t-4}^{oil} + \beta_7 r_{t-5}^{oil} + \beta_8 r_{t-6}^{oil} + \beta_9 CPI_{t-5}^{China} + \beta_1 Bond_t^{Long} + \beta_2 r_{t-2}^{NIK} + \varepsilon_t$

The values in parentheses are t-values. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Constant	$r_{t-1}^{Shanghai}$	r_t^{oil}	r_{t-1}^{oil}	r_{t-2}^{oil}	r_{t-3}^{oil}	r_{t-4}^{oil}	r_{t-5}^{oil}
-0.613 (-0.63)	-0.097 (-1.19)	-0.104 (-0.97)	0.034 (0.31)	0.082 (0.73)	-0.032 (-0.29)	0.142 (1.33)	0.008 (0.07)

r_{t-6}^{oil}	CPI_{t-5}^{China}	$Bond_t^{Short}$	$Bond_t^{Long}$	r_{t-2}^{NIK}	$Adj.R^2$	N
0.033 (0.31)	-2.964** (-2.32)	-0.137 (-0.53)	-0.212 (-0.86)	0.214 (1.33)	0.03	153

Table C.6

Restricted Model

China

This table shows the coefficients estimated with standard OLS for the restricted model for Shanghai.

$r_t^{Shanghai} = \alpha + \beta_1 r_{t-1}^{Shanghai} + \beta_2 r_t^{oil} + \beta_3 r_{t-1}^{oil} + \beta_4 r_{t-2}^{oil} + \beta_5 r_{t-3}^{oil} + \beta_6 r_{t-4}^{oil} + \beta_7 r_{t-5}^{oil} + \beta_8 r_{t-6}^{oil} + \beta_9 CPI_{t-5}^{China} + \beta_1 Bond_t^{Long} + \beta_2 r_{t-2}^{NIK} + \varepsilon_t$

The values in parentheses are t-values. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level (two-tailed test).

Constant	$r_{t-1}^{Shanghai}$	CPI_{t-5}^{China}	$Bond_t^{Short}$	$Bond_t^{Long}$	r_{t-2}^{NIK}	$Adj.R^2$	N
-0.424 (-0.46)	-0.106 (-1.37)	-2.811** (-2.27)	-0.136 (-0.54)	-0.168 (-0.71)	0.244 (1.67)	0.06	154

Regime testing

Example of regime hypothesis testing including the hypotheses for each regime as shown below:

Regression for India:

$$r_t^{India} = R_L(\alpha_L + \beta_{L1} r_{t-1}^{India} + \beta_{L2} r_{t-3}^{India} + \beta_{L3} r_{t-1}^{oil} + \beta_{L4} r_{t-4}^{oil} + \beta_{L5} r_{t-5}^{oil} + \beta_{L6} r_{t-6}^{oil}$$
$$+ \beta_{L7} CPI_t^{India} + \beta_{L8} Bond_t^{Long} + \beta_{L9} r_t^{HK} + \beta_{L10} r_t^{NIK})$$
$$R_M(\alpha_M + \beta_{M1} r_{t-1}^{India} + \beta_{M2} r_{t-3}^{India} + \beta_{M3} r_{t-1}^{oil} + \beta_{M4} r_{t-4}^{oil} + \beta_{M5} r_{t-5}^{oil} + \beta_{M6} r_{t-6}^{oil}$$
$$+ \beta_{M7} CPI_t^{India} + \beta_{M8} Bond_t^{Long} + \beta_{M9} r_t^{HK} + \beta_{M10} r_t^{NIK})$$
$$R_H(\alpha_H + \beta_{H1}^{a} r_{t-1}^{India} + \beta_{H2} r_{t-3}^{India} + \beta_{H3} r_{t-1}^{oil} + \beta_{H4}^{a} r_{t-4}^{oil} + \beta_{H5} r_{t-5}^{oil} + \beta_{H6} r_{t-6}^{oil}$$
$$+ \beta_{H7} CPI_t^{India} + \beta_{H8} Bond_t^{Long} + \beta_{H9} r_t^{HK} + \beta_{H10} r_t^{NIK}) + \varepsilon_t$$

Corresponding regime hypotheses:

Table C.7

Regime hypotheses

This table shows the hypotheses tested for each of the countries' regime regressions under section 6.4. Please note that the, regressions vary in length why the hypotheses must be adjusted for the number of regressors.

Regime	Low	Medium	High
H_0 :	$\alpha_L = \beta_{L1} = ... = \beta_{L11} = 0$	$\alpha_M = \beta_{M1} = ... = \beta_{M11} = 0$	$\alpha_H = \beta_{H1} = ... = \beta_{H11} = 0$
H_1 :	$\alpha_L ,..., \beta_{L10}$ and/or $\beta_{L11} \neq 0$	$\alpha_M ,..., \beta_{M10}$ and/or $\beta_{M11} \neq 0$	$\alpha_H ,..., \beta_{H10}$ and/or $\beta_{H11} \neq 0$

Robustness tests

The following equations were the ones used in order to test robustness:
Period 1: January 1993-July 1999

Period 2: August 1999 – April 2006

Regression for Indonesia:

$$r_t^{Indonesia} = \alpha + \beta_1 r_{t-1}^{Indonesia} + \beta_2 r_{t-2}^{Indonesia} + \beta_3 r_{t-4}^{Indonesia} + \beta_4 r_{t-4}^{oil} + \beta_5 r_{t-5}^{oil}$$
$$\beta_6 IP_{t-5}^{Indonesia} + \beta_7 Bond_{t-4}^{Short} + \beta_8 Bond_t^{Long} + \beta_9 r_{t-4}^{Spread} + \beta_{10} r_t^{HK} + \beta_{11} r_t^{NIK}$$
$$+ D(\alpha_D + \beta_{D1} r_{t-1}^{Indonesia} + \beta_{D2} r_{t-2}^{Indonesia} + \beta_{D3} r_{t-4}^{Indonesia} + \beta_{D4} r_{t-4}^{oil} + \beta_{D5} r_{t-5}^{oil}$$
$$\beta_{D6} IP_{t-5}^{Indonesia} + \beta_{D7} Bond_{t-4}^{Short} + \beta_{D8} Bond_t^{Long} + \beta_{D9} r_{t-4}^{Spread} + \beta_{D10} r_t^{HK} + \beta_{D11} r_t^{NIK}) + \varepsilon_t$$

Regression for India:

$$r_t^{India} = \alpha + \beta_1 r_{t-1}^{India} + \beta_2 r_{t-3}^{India} + \beta_3 r_{t-1}^{oil} + \beta_4 r_{t-4}^{oil} + \beta_5 r_{t-5}^{oil} + \beta_6 r_{t-6}^{oil}$$
$$+ \beta_7 CPI_t^{India} + \beta_8 Bond_t^{Long} + \beta_9 r_t^{HK} + \beta_{10} r_t^{NIK}$$
$$+ D(\alpha_D + \beta_{D1} r_{t-1}^{India} + \beta_{D2} r_{t-3}^{India} + \beta_{D3} r_{t-1}^{oil} + \beta_{D4} r_{t-4}^{oil} + \beta_{D5} r_{t-5}^{oil} + \beta_{D6} r_{t-6}^{oil}$$
$$+ \beta_{D7} CPI_t^{India} + \beta_{D8} Bond_t^{Long} + \beta_{D9} r_t^{HK} + \beta_{D10} r_t^{NIK}) + \varepsilon_t$$

Regression for Shanghai:

$$r_t^{Shanghai} = \alpha + \beta_1 r_{t-1}^{Shanghai} + \beta_2 r_t^{oil} + \beta_3 r_{t-4}^{oil} + \beta_4^i CPI_{t-5}^{China} + \beta_5 Bond_t^{Long} + \beta_6 r_{t-2}^{NIK}$$
$$R_D(\alpha_D + \beta_{D1} r_{t-1}^{Shanghai} + \beta_{D2} r_t^{oil} + \beta_{D3} r_{t-4}^{oil} + \beta_{D4} CPI_{t-5}^{China} + \beta_{D5} Bond_t^{Long} + \beta_{D6} r_{t-2}^{NIK}) + \varepsilon_t$$

Corresponding hypothesis for the robustness test (example for India):

$H_0 : \alpha_D = \beta_{D1} = ... = \beta_{D10} = 0$

$H_1 : \alpha_D ,..., \beta_{D5}$ and/or $\beta_{D10} \neq 0$