Striking Oil: Another Puzzle?

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Abstract

Changes in oil prices predict stock market returns worldwide. In our thirty year sample of monthly returns for developed stock markets, we find statistically significant predictability for twelve out of eighteen countries as well as for the world market index. Results are similar for our shorter time series of emerging markets. We find no evidence that our results can be explained by time varying risk premia. Even though oil price shocks increase risk, investors seem to underreact to information in the price of oil: a rise in oil prices does not lead to higher stock market returns, but drastically lowers returns. For instance, an oil price shock of one standard deviation (around 10 percent) predictably lowers world market returns by one percent. Oil price changes also significantly predict negative excess returns. Our findings are consistent with the hypothesis of a delayed reaction by investors to oil price changes. In line with this hypothesis the relation between monthly stock returns and lagged monthly oil price changes becomes substantially stronger once we introduce lags of several trading days between monthly stock returns and lagged monthly oil price changes.

Key words: Return Predictability, Oil Prices, International Stock Markets, Market Efficiency, Stock Returns, Underreaction.

JEL classification code: G1

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Changes in oil prices predict stock market returns worldwide. In our thirty year sample of monthly returns for developed stock markets, we find statistically significant predictability for twelve out of eighteen countries as well as for the world market index. Results are similar for our shorter time series of emerging markets. We find no evidence that our results can be explained by time varying risk premia. Even though oil price shocks increase risk, investors seem to underreact to information in the price of oil: a rise in oil prices does not lead to higher stock market returns, but drastically lowers returns. For instance, an oil price shock of one standard deviation (around 10 percent) predictably lowers world market returns by one percent. Oil price changes also significantly predict negative excess returns. Our findings are consistent with the hypothesis of a delayed reaction by investors to oil price changes. In line with this hypothesis the relation between monthly stock returns and lagged monthly oil price changes becomes substantially stronger once we introduce lags of several trading days between monthly stock returns and lagged monthly oil price changes.

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Introduction

Oil prices did not fluctuate much before 1973. A few large US oil companies known as the *Seven Sisters* stabilized the price through price and production controls during much of the twentieth century. After the Yom Kippur War started on October 6, 1973 control over crude oil prices passed from the United States to OPEC. Since then oil prices started to behave like the prices of other commodities (see Figure 1).

Please insert Figure 1 around here

The impact of oil price changes on the world economy is large. According to Adelman (1993, p. 537), "Oil is so significant in the international economy that forecasts of economic growth are routinely qualified with the caveat: 'Provided there is no oil shock' ". The International Monetary Fund estimates that a US$5 price increase a barrel reduces global economic growth by 0.3% in the following year.[1] While numerous studies focus on the effects of oil price changes on the economy,[2] few studies analyze the relationship between oil prices and stock market prices.[3] Even more surprisingly, the question of whether oil prices forecast future stock market returns has, to the best of our knowledge, received no attention in the literature.[4,5]

This paper investigates whether changes in oil prices predict stock returns. Using stock market data from forty-eight countries, a world market index and price series of several types of oil, we find that they do. Stock returns tend to be lower after oil price increases and higher if the oil price falls in the previous month. This predictability is not only statistically significant but also economically significant in many countries, and in the world market index. For instance, an oil price shock of one standard deviation (around 10 percent) predictably lowers world market returns by one percent. We test two hypotheses for these predictability results. One explanation, frequently offered for stock market return predictability based on economic variables, is that it is a result of time varying risk premia. We find no evidence to support this hypothesis. Our evidence is consistent with an underreaction hypothesis. It seems to take time before information about oil price changes becomes fully reflected in stock market prices. At first sight this result might seem surprising. Assuming market efficiency, one would expect that information in oil prices is precisely the type of information which will almost surely and immediately be incorporated into stock market prices. Traders all over the world can easily; at no cost and on a real time basis; observe oil prices. In addition, the price of

1 "The impact of higher oil prices on the Global Economy," prepared by the research department of the International Monetary Fund (2000), www.imf.org/external/pubs/ft/oil/2000/oilrep.pdf.
2 Some recent examples include Hooker (1999), Hamilton (2000) and Hammes and Wills (2005).
3 Exceptions are studies by Chen, Roll and Ross (1986), Ferson and Harvey (1993) and Jones and Kaul (1996), which investigate whether oil price risk is priced in stock markets.
4 Jones and Kaul (1996) suggest that oil price changes might forecast stock market returns, but leave the issue for further research.
5 There is evidence that oil price changes predict exchange rates. See, for instance, Amano and Van Norden (1998).

oil is one of the most important macroeconomic factors in the world economy. But we show that, even though the price of oil is public information, our findings might be explained using the gradual information diffusion hypothesis proposed by Hong and Stein (1999). They show that underreaction can occur due to a possible difficulty for investors in assessing the impact of information on the value of stocks, or alternatively, when investors react to information at different points in time. Our evidence seems to support this gradual information diffusion hypothesis. Most notably, when we introduce lags of several trading days between the monthly stock returns and lagged monthly oil price changes, this substantially strengthens the predictability relation. In addition, the predictability effect is more pronounced in sectors where the economic impact of oil price changes is more difficult to infer. Oil sectors, or sectors where the impact of oil prices is likely to be a dominant first order effect, show less predictability.

We feel that our paper makes two important contributions to the literature. Firstly, we are the first to document statistically and economically significant predictability of stock returns using oil price changes. Secondly, we find that the predictability of stock market returns based on oil price changes does qualify as truly anomalous as it cannot be attributed to time varying risk premia. One argument against time varying risk premia is that in equilibrium higher oil prices should predict higher future stock market returns as oil price shocks increase uncertainty. However, the effect goes the other way: higher oil prices lower future stock returns. Schwert (2003)[6] states that – as an extreme standard – when predictability is not the result of time varying equilibrium returns, there should be evidence that excess stock returns are predictably negative. He points out that the well-known anomalies documented to date do not meet this extreme standard. Predictability for these variables is generally restricted to positive excess returns only. The predictability of stock returns using oil price changes also meets this standard. Oil price changes predict (and significantly and frequently so) negative excess returns.[7]

With respect to the gradual information diffusion hypothesis, our work also relates to research by Hong, Torous and Valkanov (2003), who find strong evidence in favor of this hypothesis, as returns from several sector stock market indices predict the broader stock market index. Hong, Lim and Stein (2000) and Doukas and McKnight (2005) show that the well-known momentum effect might be caused by information dispersing slowly among investors. Our approach differs from recent work by Pollet (2003), who finds that expected changes in the price of oil are able to predict relative sector

[6] There is a large literature on the predictability of stock market returns as a consequence of time varying risk premia. Schwert (2003) provides numerous sources.

[7] Note that there is clear distinction between tests for the existence of significant negative ex ante risk premia (see for instance the tests developed in Boudoukh, Richardson and Smith, 1993, or more recently Eleswarapu and Thompson, 2004) and our claim. We claim that oil price changes frequently predict negative excess stock returns for short periods of time, and that the observed relationship between lagged oil returns and stock market returns is also significant if we restrict our attention to months when expected excess stock market returns are negative. As we find that the relationship is also significant for months where expected excess stock returns are negative, these predictability results cannot be attributed to noise or measurement error. This does not imply that ex ante premia are significantly negative, but does show that our results are unlikely to be a result of time varying risk premia.

performance in the United States. We consider actual oil price changes and we focus on the impact of oil prices on stock market returns for several countries and the world market.

This paper is organized as follows. In section 2 we discuss the data, our regression model, our main predictability results and our robustness tests. In section 3 we consider the underreaction hypothesis. Section 4 discusses the tests of the alternative hypothesis of time varying risk premia. Finally, section 5 concludes.

2. Oil and the Stock Market

A. Stock market data

We start our analysis at the beginning of the Yom Kippur War in October 1973, as this is the point in time at which oil prices started to fluctuate. All series end in April 2003, so we base our results on almost thirty years of monthly observations.[8] For our investigation we calculate (continuously compounded) monthly stock returns of the value-weighted market indices[9] of eighteen countries (local currencies and measured in dollar returns[10]), and a world market index. These countries are: Australia; Austria; Belgium; Canada; Denmark; France; Germany; Hong Kong; Italy; Japan; the Netherlands; Norway; Singapore; Spain; Sweden; Switzerland; the United Kingdom; and the United States. All series are end-of-month MSCI reinvestment indices from September 1973 to April 2003, inclusive.[11] We also use data from markets for which MSCI reinvestment indices are available since 1988 or later. Table I contains some basic characteristics for all indices.

Please insert Table I around here

Among these series are several emerging markets series.[12] Claessens, Dasgupta and Glenn (1995) argue that due to their higher degree of segmentation they provide interesting out of sample tests. Whether or not emerging markets are (partially) segmented or integrated is still an ongoing discussion.[13] Many of these so-called emerging markets are, in fact, fully integrated, in the sense that there are no restrictions on capital mobility. We consider market returns of Argentina, Brazil, Chile, China, Columbia, the Czech Republic, Egypt, Finland, Hungary, India, Indonesia, Ireland, Israel, Jordan, Malaysia, Mexico, Morocco, New Zealand, Pakistan, Peru, the Philippines, Poland, Portugal, Russia, South Africa, South Korea, Taiwan, Thailand, Turkey and Venezuela.

Apart from relatively high kurtosis, most return series are well behaved in the sense that not many series are significantly skewed. We find significant skewness at the ten percent level in only five countries, which is more or less what one would expect in a sample of almost fifty countries under a

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[8] We follow the predictability literature and focus on monthly data as they tend to be less noisy than daily data.
[9] One advantage of the value weighted indices is that these indices exhibit less autocorrelation than equally weighted indices and are also less influenced by the January effect, since the January anomaly is closely related to the small firm effect (see, for instance, Hawawini and Keim, 1995).
[10] As results tend to be similar we only report results for local currency returns.
[11] In the developed markets, MSCI calculates dividend reinvestment at the end of each month as 1/12th of the indicated annual dividend. There are no lags instituted for the reinvestment of the dividend. MSCI has constructed its Emerging Markets dividends reinvested series as follows: In the period between the ex-date and the date of dividend reinvestment, a dividend receivable is a component of the index return. Dividends are deemed received on the payment date. To determine the payment date a fixed time lag is assumed to exist between the ex-date and the payment date. This time lag varies by country and is determined in accordance with general practice within that market. Reinvestment of dividends occurs at the end of the month in which the payment date falls.
[12] For ease of reference in the remainder of this paper we refer to the shorter series as emerging markets and to the longer series as developed markets.
[13] See, for instance, De Jong and De Roon (2005), or Bekaert and Harvey (1995).

null hypothesis of no skewness. There is slight evidence of positive autocorrelation in these index series - significant in eleven countries - which may be a consequence of non-synchronous trading. However, the autocorrelation tends to be small. Based on these basic characteristics it seems justified to use heteroscedasticity consistent or White standard errors in the remainder of our analysis to adjust for the high level of kurtosis (White, 1980). All our results in the remainder of this paper are based on White standard errors. However, we re-ran our regressions using both normal standard errors and heteroscedasticity and autocorrelation consistent standard errors. Generally speaking the White standard errors we report here are the most conservative. In addition, we control explicitly for autocorrelation in the stock market index returns in the remainder of this paper and our results are also robust if we model potential conditional heteroscedasticity in the stock market series more explicitly using GARCH models.

B. Oil price data

The crude oil market is the largest commodity market in the world. Total world consumption equals around 70 to 80 million barrels a day, of which the United States consumes approximately 25%. Several times the total consumption is traded daily on crude oil spot, futures and over-the-counter markets at exchanges in New York (NYMEX) and London (IPE) (Levin et al., 2003).

Prices of three types of oil (Brent, West Texas Intermediate and Dubai) serve as benchmarks for other types of crude oil. Processing costs and, therefore, prices of oil depend on two important characteristics: sulphur content and density. Oil which has a low sulphur content (referred to as *sweet*) and a low density (referred to as *light*) is cheaper to process than oil which has a high sulphur content (referred to as *sour*) and high density (referred to as *heavy*). For instance, the price of West Texas Intermediate is generally higher than Brent oil as it is sweeter and lighter than Brent oil. Of the total world oil consumption of 70 to 80 million barrels a day, Brent oil serves as a benchmark for between 40 to 50 million barrels a day; West Texas Intermediate for 12 to 15 million barrels a day; and Dubai for around 10 to 15 million barrels a day (Levin et al., 2003).

Oil is sold in different contract arrangements and in spot transactions. 'Spot markets' exist for different qualities and for different regions (For instance, Rotterdam/Northwest Europe, New York Harbor/U.S. Northeast, Chicago/U.S. Midwest, Singapore/South East Asia, and Cushing, Oklahoma/U.S. Gulf Coast). Some of the most active spot markets have 'forward' physical markets but most focus on 'prompt' delivery of readily available volumes. The evolution of a regional market into a pricing center is mostly determined by logistic reasons. These pricing centers have a ready supply, transportation choices, storage facilities, and many buyers and sellers. Spot prices are reported for transactions in these different markets and these prices are relatively transparent. They are reported by a number of sources and widely available in a variety of media. Oil is also traded in futures markets. At futures exchanges, such as the New York Mercantile Exchange or International Petroleum Exchange in London, oil is traded by open outcry.[14]

Even though price differences do exist spot oil prices and oil futures prices tend to move closely together, as shown in Figure 2 (and Table III).

Please insert Figure 2 around here

We use several oil price series in our analysis. Firstly, we use the longest oil price series (end of the month prices) available from several sources for the three most used crude oil benchmarks: Brent, West Texas and Dubai. In addition, we use the Arabian Gulf Arab Light Crude Oil Spot Price (US$/Barrel) and two futures series, one for NYMEX and one for the IPE. Typically, the NYMEX futures price tracks within a few pennies of the West Texas spot price. Closing prices for these series are reported at 17:30 New York Time at the latest (Arab Light and Dubai). As a consequence for some series, traders might not know the price of oil close before the close of stock trading on the last day of the month in many countries. This might induce spurious predictive power in our regressions. In section 3 we show that this does not affect our findings. To save space we focus mainly on results for Arab Light crude oil, as these series give a good indication of our *average* results for all series. Nevertheless, our results are robust across the different oil price series we use in our analysis.

Please insert Table II and Table III around here

Table II contains some basic information for our oil price series, and in Table III we report basic characteristics of oil price changes (measured as log returns). This table also contains pairwise correlations between the series. As we use return series we find little evidence of substantial first order autocorrelation and these series are not persistent. Only West Texas shows some significant first order autocorrelation. The Elliott-Rothenberg-Stock DF-GLS test statistic strongly rejects the null hypothesis of a unit root in all series.

C. Basic Regression model

To test for the existence of an oil effect we incorporate an oil variable, r_{t-1}^{oil}, in the regression:

$$r_t = \mu + \alpha_1 r_{t-1}^{oil} + \varepsilon_t \text{ with } \varepsilon_t = r_t - E_{t-1}[r_t] \tag{1}$$

[14] http://www.eia.doe.gov.

where μ is a constant and ε_t is the usual error term. In the absence of the oil variable this equation reduces to the well known random walk model. We test whether the coefficient of r_{t-1}^{oil} is significantly different from zero. When α_1 is significant, the null hypothesis of no oil effect is rejected.

D. Results

Table IV contains the individual country results. It contains our estimation results for Regression 1 for all countries and for the six different oil price series. For Arab Light we include both the estimated coefficient and the related t-value. The coefficients are almost equal, irrespective of the oil price series used. This is why we do not report the coefficients for the other oil price series but only report t-values for these series.

Please insert Table IV around here

For the developed markets, changes in oil prices (based on Arab Light) significantly predict future market returns in twelve of the eighteen countries. For West Texas we find significant results in eleven developed markets, and if we use Dubai oil we find significant t-values in fourteen developed countries. In all countries the effect is negative (only for Hong Kong do we find positive coefficients for Brent and the two oil futures series). This negative coefficient implies that, on average, a decrease in this month's oil price indicates a higher stock market return next month. The impact of changes in oil prices on stock returns tends to be economically large. Based on our results we conclude the following. In the absence of oil price changes the average monthly return for the world market index is slightly below one percent (0.8 percent). A standard deviation increase in oil prices (a rise of just over ten percent or 10.78 percent to be precise[15]) in one month lowers the expected return in the next month to below zero (-0.1 percent). On an annual basis, the average world market return is 10 percent over our sample period and one oil price shock of one standard deviation reduces this expected return in a predictable way to 9 percent. Similarly our results imply that for every decrease in the price of oil by one standard deviation investors can expect a one percent annual increase in world stock market returns.

While less pronounced, emerging markets show the same effects. If we first consider the results for emerging markets with a price history starting in 1988, we find results similar to the developed markets. For these older emerging markets results are often significant. For these sixteen countries, we find statistically significant t-values in six countries if we use the Arab Light series, and four if we use the West Texas oil price series. Based on the Dubai oil price series we find significant results in nine of these sixteen countries. Only for the shorter emerging markets series starting in 1993 or after, results are less clear (Countries are ordered by the starting date of the stock return series). Apart

[15] See Table III

from India and Israel we find no significant results for these countries although we find negative coefficients for ten of these fourteen countries. This does not necessarily indicate that there is no significant predictability. These countries might exhibit a significant oil effect, but we simply do not have enough data to confirm this.

These individual country results are not independent. Stock market returns are correlated. Therefore, we also estimate our regressions as a system of seemingly unrelated regressions with one joint statistical test that $\alpha_1 = 0$ for each country. We consider the developed markets and the emerging markets results separately. For the developed markets we strongly reject the null hypothesis of no oil effect. For every oil price series we consider, we find Wald test statistics indicating p-values smaller than 0.01 percent, confirming the evidence in Table IV. Results for the emerging markets are less clear. For West Texas, Brent and the Oil futures we cannot reject the null hypothesis (p-values of 0.162, 0.123 and 0.152, respectively). For Arab Light and Brent we reject the null hypothesis at the ten percent level (p-value of 0.018 and 0.0589, respectively). This confirms the individual emerging markets results, where we find the effect to be somewhat less strong. For the developed markets, results remain highly significant if we include the world market index returns as an additional regressor in our system of equations. Including the world market for the emerging markets, we no longer find significant results.

An important question is whether the test statistics we report here provide correct inferences. Starting with the seminal paper of Stambaugh (1999) a large literature has evolved on econometric problems in predictive regressions where the explanatory variable is persistent. Campbell and Yogo (2006) provide a good survey of the issues and approaches to the problem. Given the low first order correlation of oil price changes, persistency does not seem to be a problem and in our analysis standard t-statistics should lead to correct inferences. However, to be sure we use a pretest derived by Campbell and Yogo (2006). This pretest shows that when the correlation of the disturbances of Regression 1 with the disturbances from a regression of the explanatory variable on itself lagged one period (which they call 'delta') is small (between approximately between -0.15 and 0.15), the standard t-statistics we use are correct. When delta is outside this interval and when the explanatory variable is highly persistent, regular t-statistics may overstate true significance. In the last two columns of Table IV we report delta for both Arab Light and West Texas. For almost all countries delta is small as required. Additionally, the oil price series we use are not persistent. Therefore, in our analysis standard t-values are correct.[16]

[16] More precise, with respect to persistency of the explanatory variable Campbell and Yogo (2006) show that when the lower bound of a nuisance parameter c (calculated as $c = (\rho - 1)T$, where ρ is the first order autocorrelation of the explanatory variable and T equals the number of observations) is below approximately -80 standard t-tests are valid. Note that the first order autocorrelations for the oil price series are not significantly different from zero (Table III). Therefore, in our case c is approximately equal to minus the number of observations. Apart from the Czech Republic the number of observations is substantially larger than eighty, hence c is well below -80.

E. Robustness tests

How robust is this predictability in relation to the contemporaneous correlation of oil price changes and stock returns? How long does the predictability last and are these results robust for potential non-synchronous trading in stock returns? To answer these questions, we run regressions where we - in addition to oil price changes lagged one month - jointly include the contemporaneous oil price change, the oil price change lagged two months, and the stock market return in the last month.[17]

Please insert Table V around here

In Table V we report the results for this regression and to facilitate comparison with our previous results we include in columns three and four the estimated coefficients and related t-values for Arab Light (as in Table IV based on Regression 1). The predictability is robust to the inclusion of all other variables. Estimation results hardly change. The effect is unrelated to the contemporaneous oil price change[18] and the effect seems short-lived. While in many countries the sign for the two month lagged oil price change tends to be negative, we only find six countries where this coefficient is significantly negative. A joint test shows no significant results for the developed markets after the first lag (Wald test statistic for the joint test that estimated coefficients equal zero for the two month lagged return is 24.72 with a p-value of 0.133). For the emerging markets results are border line significant for the second lag (p-value: 0.094) The last two columns show that our results are not a consequence of non-synchronous trading in stock market indices. Results are almost similar when compared with estimates without the lagged return.

We perform several additional robustness tests. To save space, we only report the main results of these tests.

For the developed markets, we have short term interest rates available and we test whether our results are affected if we use excess returns instead of total returns.[19] Parameter estimates and related t-values are only marginally different in that case.

[17] Results are similar if we include each variable separately.

[18] We discuss the contemporaneous relation between oil price changes and stock returns in more detail in section 3.

[19] We use monthly short-term interest rates (interbank or treasury bill rates) taken from either the IMF or OECD. We use IMF interest rates where these rates are available for the full sample period; otherwise we utilise OECD or short-term interest rates. For Belgium, Canada, Singapore, Spain, Switzerland, the United Kingdom, the United States and the World index we used Treasury bill rates. We use government bond yields for France, the Netherlands and Norway; Money Market rates (Federal Funds) for Denmark and Germany; government bond yields (medium term) for Australia and Italy; and the official discount rate for Austria. For Japan we use the deposit rate. For Hong Kong we have the savings deposit rate. For Sweden we construct a time series of interest rates, as they are not available over the full sample. For Sweden we use the Treasury bill rate and, from January 2002, the discount rate.

The predictability cannot be attributed to specific time periods. We obtain similar results when we split our sample of developed markets in two parts. The predictability remains significant in both subperiods. In our first sample from November 1973 through July 1988 we find significant predictability in ten countries. In our second sample (August 1988 through April 2003) results are significant in fourteen countries. In addition, the results are robust if we exclude the most extreme 5% of oil price changes.

Oil price changes in December are negative on average. Therefore there might be a relationship with the January effect. Moreover, oil returns tend to be significantly positive in the months of August and September. Bouman and Jacobsen (2002) document the so-called Halloween effect: stock returns tend to be significantly lower during the May-October period than during the remainder of the year. Given the negative relationship we find between oil returns and stock returns, this suggests the oil effect and the Halloween effect could also be related.[20] However, if we include dummy variables for both calendar anomalies in our regression this does not substantially affect our results.

F. Economic Significance

An alternative explanation for our results might be that while statistically significant, trading strategies based on oil price changes are not exploitable. The existence of many so-called anomalies can easily be explained by introducing transaction costs. For instance, if potential benefits do not outweigh the costs of trading - of which the Monday effect is a clear example - the oil strategy would have no practical value. Therefore it is interesting to consider how a trading strategy based on the oil effect would perform. We have already considered the impact of an oil price shock of one standard deviation. Here, we compare trading results of a strategy based on oil price changes with a simple buy and hold strategy. We take the following approach: for the developed markets we split our sample in two; we estimate our model over the first half of our sample and use these estimates and the last oil price change to predict returns in the first month of the second half. Next, we re-estimate the model every month updating our model with the last month of observations. We then determine whether the expected stock market return in a specific month, based on our regression results and conditional on the oil price change in the previous month, is higher or lower than the risk free rate. If the expected return is higher (bull market) we fully invest in the market portfolio; if it is lower (bear market) we invest in short term bills. As such a strategy can easily be implemented using index futures, we assume switching costs of 0.10%. Solnik (1993) reported that 0.10% costs were at that time reasonable for the use of future contracts in mimicking market timing strategies. It seems safe to assume that if anything these costs have gone down ever since.

This approach gives us the results of our oil strategy portfolio for every developed country. We compare the risk and return characteristics of this strategy with a buy and hold portfolio, and test

[20] There is no statistically significant (lagged one month) reversed Sell in May effect in oil returns. However, for Arab Light and Dubai oil we do find a significant December effect. Some oil price series show a slight tendency to be somewhat lower during the November - April months than during the remainder of the year.

whether we can reject the null hypothesis that the risk free rate and the market portfolio span the results of this trading strategy. We compare risk and return of this trading strategy with a buy and hold benchmark and calculate Jensen's alpha. Note that our results are not complete free from a look ahead bias: we already know the effect continues to exists in the second half of our sample.

Please insert Table VI around here

In Table VI we report the estimation results for all developed markets and the world market index. Columns 3, 4 and 5 present the mean, standard deviation and Sharpe ratio for the buy and hold strategy, respectively; columns 6, 7 and 8 present the mean, standard deviation and Sharpe ratio for the oil strategy, respectively. Alpha and beta and their respective t-values (based on White standard errors) for the oil strategy reported in the last columns are calculated using the regression:

$$r_t^{oilstrategy} - r_t^f = \alpha + \beta\left(r_t^{market} - r_t^f\right) + \varepsilon_t \quad \text{with} \;\; \varepsilon_t = r_t - E_{t-1}[r_t] \tag{2}$$

where r_t^f denotes the interest rate at time t.

The null hypothesis that α (Jensen's alpha) is equal to zero is frequently rejected. In other words, in most countries the mean variance efficiency of the stock market index is rejected. Jensen's alpha (after transaction costs) is around 4% per annum, on average. Note that even with substantially higher transactions costs the strategy would remain profitable. On average the trading strategy switches about once every two months in all countries: this means that even with transactions costs around 0.5 percent the strategy would still be profitable in many countries. The estimates of β are, not surprisingly, well below one. This confirms that the oil strategy is substantially less risky than investing in the market index in the respective countries. In general, substantial increases in Sharpe ratios would have been possible by switching from a buy and hold strategy to the oil strategy. In most countries we can reject the null hypothesis that the risk free asset and the market index span the annual returns of this trading strategy. All in all, the oil strategy is interesting enough for practitioners to trade on. Outperformance; even after transactions costs; tends to be large in most countries.

Based on these results we conclude that there is a strong oil effect in stock returns; oil price changes predict future stock returns.

3. Underreaction?

Clearly, from a market efficiency point of view, it is surprising that investors seem to underreact to information in the price of oil. Oil prices are public information, which can be observed almost in real time, at no cost and by all investors. However, a possible explanation for this puzzling fact might be found in some of the literature, which claims that underreaction can occur in cases of bounded rationality of investors. In this section we consider whether this oil effect can be explained by the gradual information diffusion hypothesis introduced by Hong and Stein (1999).

A. Previous research and oil prices

Hong and Stein (1999) develop a model which explains underreaction of stock market prices to market fundamentals based on the bounded rationality of investors. In the simplest version of their model they introduce *newswatchers,* who are bounded in the sense that they do not condition on current or past prices; i.e. they do not extract information from prices. In addition, Hong and Stein (1999) assume that private information diffuses gradually across these newswatchers. In such a situation an underreaction of stock market prices to news occurs. Hong, Torous and Valkanov (2003) take this result one step further, and show that gradual information diffusion can lead to cross-asset return predictability if, for instance, many (though not necessarily all) investors in the stock markets do not pay attention to information in other asset markets. While Hong and Stein (1999) focus on private information, they show that investors might also underreact to public news if the conversion of this news into a judgment about value is non-trivial.

Thus, in cases where it might be difficult for investors to assess the impact of information on the value of stocks, we might still observe underreaction, even though the information itself may be in the public domain. The reason for such a finding is that the total market response to public news involves the aggregation of private signals. In addition, Hong, Torous and Valkanov (2003) suggest another route which could lead to underreaction in the Hong and Stein model. They point out that information might also gradually diffuse across investors when investors pay attention (or wake up) to information at different points in time. They further acknowledge that the information must have a substantial impact on economic activity to show up in empirical analysis.

What does this imply for potential predictability of stock returns using changes in oil prices? When changes in oil prices have a substantial effect on economic activity, and when investors find it hard to assess the impact of oil price changes on the value of stocks, or when investors react at different points in time to information in the oil price change, investors might still underreact to information in the oil price, even though the oil price change is public information.

The question is whether oil price changes meet these criteria. It seems safe to assume that oil price changes do have a substantial impact on economic activity. The next question then is: how difficult is it to assess the impact of oil price changes on the value of stocks?

One method in which to show that this is not trivial is to consider all the ways oil price changes will influence future earnings of a company, and will also influence the discount rates used by investors to discount these future earnings. Of course, for companies operating in the oil industry, there will probably be a strong and dominant first order effect. For companies operating in non-oil related sectors, however, the impact might be more difficult to assess. In those cases one should at least know what the effect of an oil price change on the general economy is. Unfortunately, while the statement of the IMF which we cited in our introduction is quite strong, even in current academic research the exact effect of oil price changes on the economy remains yet unresolved (see, for instance, the discussion in Hamilton, 2003). Illustrative of how much difficulty economists seem to have in forecasting economic effects of an oil price change is a quote from the Wall Street Journal (April 7, 2005):

> *Last summer, one-third of economists who participated in The Wall Street Journal Online's economic forecasting survey said a recession would follow if crude-oil stuck between $50 and $59 a barrel — exactly where futures prices have traded since late February. But the economy isn't in peril today. In the latest forecasting survey, none of the economists feel that $50 oil will trigger a recession. About 31% said oil would have to be sustained at $80-$89 a barrel to snuff out growth, while 48% believe crude would have to top $90.*

This suggests that the effects of oil price increases and decreases on stocks not related to the oil industry might not be straightforward.

Not only might the effects be difficult to measure, but they could also show up at different points in time, which is an alternative way of applying the Hong and Stein model, in which predictability can occur. This does not seem unlikely, as oil is an important production and consumption factor and the effects of an oil shock might show up at different points in time.[21]

In their report *The impact of higher oil prices on the world economy*[22] the International Energy Agency (IEA) suggests different effects. Firstly, there is a direct effect: an oil price rise is negative for world economic growth in general, a price rise leads to an income transfer from oil importing countries to oil exporting countries. If we consider the contemporaneous correlation between stock

[21] Consider, for instance, the US producer price index for oil, which is frequently – even in academic work - used as a measure of oil prices (see for instance Chen, Roll and Ross, 1986; Jones and Kaul, 1996; or Hamilton, 2000). If one compares changes in the producer price index with price changes in real oil prices; such as West Texas Intermediate or Brent; then the oil price changes seem to have a significant lagged effect up to three months in this index. In other words, when this US producer price index is used as a proxy for oil price changes in a certain month, any observation contains the effects of price changes that occurred up to three months earlier. Therefore, if investors - like researchers in the academic world - use different price indices to measure oil price changes, this will cause differences in attention over time to the same oil price changes.

[22] http://www.worldenergyoutlook.org/prices.asp.

returns and oil price changes (in Table V) investors seem aware of this effect: net importers of oil on average have negative returns and net exporters on average have positive returns. Norway is a clear example.[23] Secondly, apart from the direct relative country effects there are delayed local and adjustment effects. A price increase leads to inflation, increased input costs and reduced demand for goods and services as countries and individuals have less to spend on other items due to the oil price increase.

The IEA states that:

> *While the general mechanism by which oil prices affect economic performance is generally well understood, the precise dynamics of these effects – especially the adjustments to the shift in the terms of trade – are uncertain. Quantitative estimates of the overall macroeconomic damage caused by past oil-price shocks and the gain from the 1986 price collapse to the economies of oil-importing countries vary substantially.*

As oil prices seem to satisfy the conditions of the model developed by Hong and Stein (1999), one might expect short term underreaction by investors to oil price changes, even though the price of oil itself is publicly available information.

While theoretically possible, we now test in several different ways empirically whether our results are likely to be caused by a delayed reaction of investors. Note that a first test is implicitly present in our previous results: stock market returns do underreact, the relationship between lagged oil price changes is a negative one, thus our results so far seem to support the Hong and Stein (1999) prediction.

B. Delayed reaction

We now introduce an alternative test for the underreaction hypothesis. In our analysis above we measure stock returns and oil price changes on a monthly basis. However, months are arbitrary time periods based on general conventions. If investors react with a delay to information in oil price changes, the predictability effect should become stronger if we introduce a (small) lag between our

[23] To be precise: if we use net energy imports (using energy data for 2002, obtained from the International Energy Agency (IEA) to determine whether a country is an importer or an exporter of energy) and group the countries into net importers and net exporters, then test whether the contemporaneous reaction oil price shocks differs across these group we find a significant different reaction. The reaction for the energy exporting countries is positive. We find an average coefficient of 0.0134 and a Wald test of the estimated coefficients being jointly equal to zero is rejected ($\chi^2(14)$=29.99 which has a p-value of 0.0077). The average reaction of the energy importing countries is negative (estimated average coefficient of -0.047) and, we also reject a null hypothesis that these coefficients are jointly equal to zero. (Wald test statistic of 62.88 with 34 degrees of freedom, implying a probability value of 0.0024). The overall effect for all countries jointly tends to be negative (see for instance the world market results). Note that this analysis assumes that companies traded on different stock markets are to some extent a reflection of all companies in a country's economy. However, this does not seem an unrealistic assumption. See, for instance, Roll (1992).

monthly stock returns and lagged monthly oil returns. As long as there is a delayed reaction, introducing a lag between our monthly oil price observations and stock returns should increase the explanatory power of our regressions as we capture more of the delayed response of investors to oil prices changes in that month. After a certain point the explanatory power should start to decrease. Unfortunately, we do not know how long it will take investors to react to an oil shock. However, if we suppose it takes at least a week, or five trading days, for the oil price change to be reflected in the total stock market return and if the underreaction hypothesis holds, introducing a lag of five trading days between the lagged monthly oil price change and the monthly stock market return should strengthen our findings and increase the explanatory power of our regressions. The last five trading days of the last month should add relatively less to the predictability than the last five trading days of the month before. Clearly, five days or more is an arbitrary choice, the lag might be shorter or longer. In fact, introducing a lag of only one day, should already improve the predictability results. We test this as follows. Using daily data for the West Texas oil price series, the longest series we could find daily data for (available from May 1983), we create a new monthly oil price series with a delay of one trading day. We exclude the oil price change on the last trading day of the month (t-1) and add the oil price return of the last trading day of the previous month (t-2). In case of a delayed reaction the last return of the previous month should have a higher information content for the stock return in the next month than the return of the last trading day of the last month. Similarly, we create an adjusted monthly oil price series where we increase the lag between the monthly stock market return and the monthly oil price change to five trading days. Table VII contains our estimation results.

Please insert Table VII around here

Table VII first reports the regression results with no lag between the monthly stock return and the monthly oil price change (West Texas) to facilitate comparison with the results for the one trading day lag and the five trading day lag. The results for the one day lag period indicate a stronger relation between lagged oil returns and stock market returns than results without any lag. T-values tend to be higher and the explanatory power measured by the R-squared[24] tends to increase for almost every country. This result is reassuring for two reasons. Firstly, the predictability results reported earlier are not driven by a time overlap between oil prices and stock market indices. As we discussed before, for some oil price series, end-of-month oil prices are calculated after the close of stock markets in several countries. This might induce spurious predictive power in our regressions. Nevertheless, excluding this overlap does not weaken our findings. Secondly, it offers support for the underreaction explanation. If we now increase the lag to five days, we find an even stronger increase in both the size of the t-value and the R-squared for almost every country. The last five trading days of the previous month (t-2) contribute more to the explanatory power of our regression than the last five trading days of month (t-1). This result is perfectly in line with a delayed reaction of investors. It

[24] We report the normal R-squared, results for the adjusted R-squared are similar although lower on average.

is also interesting to see that t-values become significant in two additional developed markets and five additional emerging markets.

The period of five days in Table VII is arbitrarily chosen. We repeat the procedure above for different lag sizes. We use a maximum of 17 trading days (the minimum number of trading days in one month in our sample) to prevent overlapping sample problems in our estimation procedure. Moreover, as results tend to be qualitatively similar for all countries we only report the results for the world market.

Please insert Figure 3 around here

Figure 3 plots the R-squared as function of the number of trading days we used as lags between the monthly stock market return and the monthly oil price changes in Regression 1. For a lag of six trading days our regression has the highest explanatory power. The R-squared is almost ten percent, the related t-value is -4.77. For lags larger than six trading days the explanatory power (and the size of the t-values) quickly decreases. It is easy to think of numerous institutional reasons why this might be the case, but the delayed reaction of a large group of investors is at least six days. We find this result consistently in a large number of countries: the explanatory power first increases up to a lag of six trading days. When we further increase the lag size explanatory power decreases. This is also not surprising given the low statistical significance we find for the oil price change lagged two months (in Table V). These results further strengthen our finding that these predictability results are a consequence of information gradually diffusing among investors.

If so, we expect to find similar results if we subdivide our sample in two. To exclude the possibility that our result is just an artifact of some specific time period in which the West Texas oil price series causes this effect, we divide our sample in two sub-periods of equal length. If institutional factors causing the delayed reaction have not fundamentally changed, we expect an optimum around six days for both samples. In Figures 4a and 4b we compare these patterns for both sub periods (May 1983 - April 1993 and May 1993 - April 2003, respectively).

Please insert Figure 4a and 4b around here

The patterns in these two figures are remarkably similar. In both sub-periods the explanatory power reaches its peak for the regressions based on a six trading day lag (maxima of 14.5% and 6.2%, respectively). Also the t-values are largest in size for a six trading day lag (-4.12 and -2.83, respectively).

To shed further light on how information in the price of oil is incorporated in stock returns we consider for the developed markets a regression based on weekly returns – also starting in May 1983 -

where we include weekly oil price changes lagged up to eight weeks. Table VIII contains our estimation results.

Please insert Table VIII around here

The effect in monthly stock returns also shows up if we focus on weekly data. While the effect in the first week is almost absent, the effect becomes stronger as we move further back in the past and especially in week five, results are significant in many countries. Also week four shows relatively strong effects. This confirms our results of a delayed reaction.

C. Sector results

As a final test of underreaction we consider whether there is a difference between the predictability results for different stock market sectors. If it is indeed the underreaction of investors which causes this effect, one would expect a difference between the strength of this predictability between oil related sectors and non-oil related sectors in the economy, as it is probably easier for investors to assess the value effects of oil price changes on companies in the oil sector. Another test of the gradual information hypothesis is, therefore, to analyze whether the oil effect is a sector-specific anomaly, or whether it manifests itself in all sectors of the economy.

We check whether the effect is found in the developed markets in all sectors, or whether the effect is concentrated in the non-oil related sectors. We use Datastream market indices and Datastream sector indices, as we have no MSCI sector indices available. Datastream assigns oil industries to the general sector *Resources*. In Panel A of Table IX we report these results for the world market index. The first row for the world market index shows the statistical significance for the total market and deviates slightly from the results for the MSCI world market index reported in Table IV.

Please insert Table IX around here

Table IX suggests that the effect is weaker in the sectors where the effect of an oil price change is easiest to assess. Not only do we not find significant results for the sector *Resources*, but the effect also tends to be weaker in sectors where oil prices play a relatively important role, such as *Utilities* and *Basic industries*. Predictability tends to be strong, however, in the non-oil related sectors, such as *Consumer Goods*, *Services*, *Information Technology* and *Financials*. While estimation results are probably somewhat more distorted for the sector data in the individual countries due to a difference in the number of observations for these sector data, we find a similar pattern if we look at the sector data in the different countries in Panel B. We report the average lagged response for the different sectors across countries. For every sector we perform a joint test across countries of no oil effect using seemingly unrelated regressions (SUR). Additionally, we report the number of significant results if we consider every sector in each country separately. The overall picture is similar to the results for the world market sector indices. While we reject the null in all sectors using SUR, significance levels tend to be lower and for individual series less frequently significant for sectors where oil has most likely a strong direct effect. Especially, *Resources* and *Utilities* show less of an effect than the other sectors. These results seem to further validate the gradual information diffusion hypothesis.[25]

[25] We find a similar result if we analyze the specific oil sector indices available from Datastream. To save space we do not report them here. Nevertheless, our main finding is, again, that the oil effect tends to be weaker for specific oil sectors. Even if the effect is found to be significant, it tends to be weaker for oil related sectors when compared to the broader market index or other sector indices.

4. Time varying risk premia?

While our evidence supports the underreaction hypothesis, return predictability can also occur as a consequence of time-varying expected equilibrium returns. The risk premium varies over time and several economic variables predicting stock returns might just indicate some predictable variation of the risk premium across the business cycle, not necessarily a market inefficiency (see for instance, Fama and French, 1989). We verify whether the observed predictability is related to (variation in) the risk premium.

A. Predictability horizons and other economic variables

Contrary to predictability generally associated with time varying risk premia (Fama and French, 1989), we showed in sections 2 and 3 that the predictability of stock market returns using oil price changes is short lived. The predictability effect almost disappears if we consider the oil price change lagged two months. For instance, if we include the oil price change lagged two months in our regression we obtain for the world market index a coefficient of -0.012 with a t-value of -0.58 (Table V). We obtain similar results when we include longer lags for the systems of equations for the developed and emerging markets.[26] In weekly data the effect is strongest in weeks four and five. Furthermore in the monthly data the effect rapidly decreases after introducing a lag of six trading days and is almost gone when we use a lag size of seventeen trading days. For the world market index, we no longer find significant predictability. These results suggest that predictability is short lived and that oil price changes do not serve as an indication of time varying risk premia.

The dividend yield, the term spread, the default spread are the most well known variables to forecast stock returns. Among others Fama and French (1989) argue that these variables predict stock returns because they contain information about future business conditions. For instance, if stock returns are high, the dividend yield is low when discount rates and expected returns are low. Chen, Roll and Ross (1986) argue that the default spread is a good indication of future business conditions. The spread is high when risk in the economy is high and, when business conditions are strong, the default spread tends to be low. The term spread often gets smaller around peaks of the business cycle and increases around a trough in the business cycle. Oil price changes might proxy for changing business conditions also captured by one of the other variables. More recently, Ang and Bekaert (2006) find that interest rates predict stock returns to some extent.

We consider correlations between these variables and oil price changes for West Texas and Arab Light. For the US we have all four variables available, for the other developed countries we only have

[26] As mentioned before for Arab Light we find no significant results for the developed market after the first lag (Wald test statistic for the joint test that estimated coefficients equals zero for the two month lagged return is 24.72 with a p-value of 0.133). For West Texas, results for lag two are significant at the ten percent level (Wald test statistic of 26.90 with a p-value of 0.081) but the predictability disappears after three months (Wald test statistic of 16.24 with a p-value of 0.576). For the emerging markets results are mixed: insignificant for West Texas oil price series; for Arab Light they are border line significant for the second lag (p-value: 0.094) and significant at lag three but in that case, significantly positive (Wald test statistic 50.67: p-value 0.008).

the interest rate, the term spread and the dividend yield. As results are consistent across countries we report individual correlations for the US only. For the other countries we report average correlations across countries. Table X contains these results.

Please insert Table X around here

Oil price changes generally have low correlations with economic variables known to predict time varying risk premia. All correlations are close to zero. This holds for the US as well as for the other individual country results. The maximum correlation we find for the term structure variable in Italy (0.13) and for Norway, we find the largest negative correlation with the dividend yield (-0.13). Additionally, correlations with interest rates are close to zero.[27] These low correlations suggest that oil price changes do not proxy for time varying predictability effects present in these other variables.

B. Equilibrium theory

There is stronger evidence why it is unlikely that our results can be explained by time varying risk premia. We observe a *negative* relation between past oil price changes and stock returns. This casts further doubt on a time varying risk explanation. Oil price shocks lead to an increasing risk in the economy (Hamilton, 2003) and therefore should lead to higher average returns in the future, not lower average returns.[28] In addition, French, Schwert and Stambaugh (1989) find evidence that the expected market risk premium is positively related to the predictable volatility of stock returns as should be the case in equilibrium. Oil price shocks increase the risk in the economy and therefore should lead to higher expected stock returns. Moreover as an oil shock tends to be considered bad news, these lower stock market prices should also become more volatile due to for instance the leverage effect. Schwert (1989), for instance, finds a strong increase in market volatility due to the oil crisis of 1973-1974. As consequence an immediate contemporaneous price reaction of an oil price change might be negative but it should be followed by higher returns on average in future periods. Our results point in the opposite direction. A rise in oil prices leads to subsequent lower stock market returns not higher returns. This suggests that this predictability is not related to a risk premium.[29]

As a last, and maybe most conclusive test whether predictability might be attributed to time varying risk premia, we follow an approach suggested by Schwert (2003).

[27] If we include the interest rate as an additional explanatory variable in regression 1 this does not affect our results. T-statistics are slightly lower but we still find the effect significantly present in all developed markets that show a significant effect in Table IV.

[28] We thank the referee for pointing this out.

[29] In addition, if we take volatility explicitly into account, this should not affect our results. When we test this using the approach in French, Schwert and Stambaugh (1989), and estimate a GARCH(1,1) in mean model for the world market returns we find that this indeed the case. This GARCH specification also allows us to include the lagged oil price change in the variance equation as an exogenous regressor (a GARCH(1,1)-X in mean model: see for instance Engle and Patton (2001)). This enables us to verify explicitly whether lagged oil price change increase future stock market volatility. We find a positive estimate for the lagged oil return in the variance equation. The coefficient is 0.001 and the related t-value is with a value of 1.85 significant at the ten percent level. This confirms that higher oil prices do cause higher volatility in stock returns.

C. Negative excess returns

Schwert (2003) suggests an extreme standard to analyze whether observed predictability is a consequence of time varying equilibrium returns, or the result of a true market inefficiency. In the latter case excess returns should be predictably negative. This is an extreme standard as it ignores risk. Schwert (2003) shows that well-known anomalies (for instance, lagged dividend yields) fail to meet this test. While these variables significantly predict changes in positive risk premia, many of them only infrequently predict negative risk premia and, if so, generally for a limited number of consecutive months.[30]

So the first question is: do oil price changes frequently predict negative excess returns? The answer is: yes. Consider, for example, the estimation results for the United States. Our regression results imply the following equation for expected returns:

$$E_{t-1}[r_t] = 0.009 - 0.086 r_{t-1}^{oil} \tag{4}$$

With a monthly standard deviation of 0.1078 (10.78%) for oil price changes,[31] an oil price increase by roughly one standard deviation would predict a negative expected return for the US stock market for the next month. As the Treasury bill rate for the United States averages 0.0054 (0.54%) per month over our sample period, any oil price increase higher than half a standard deviation from the mean forecasts negative excess returns. As a consequence, oil price changes do predict negative excess returns and, frequently so, in many months.

This conclusion also holds if we consider a lower bound based on a 95% confidence interval and use -0.039 instead of -0.086 as an estimate for a lagged oil effect. Then, we still find negative excess returns if oil price changes are higher than approximately 0.8 standard deviations or – assuming normality – roughly twenty percent of all observations. Additionally a first test of Schwert's hypothesis is already implicit in our test of economic significance: if it was only a time varying risk premium causing these predictability results one would expect only predictions above the interest rate and hardly below the interest rate. As a consequence an investor would almost always hold the market portfolio. This is however, not the case. In most countries the oil strategy frequently predicts returns lower than the interest rate.

Nevertheless, true adherents to in the notion that predictability of stock returns must be a consequence of time varying risk premia might argue that, even though oil price changes predict negative returns, our findings of statistical significance might be caused by a significant relationship

[30] For instance, for the US market Eleswarapu and Thompson (2004) found that during 1951 to 2000 that the term premium was, with 80 cases (out of 600 observations), the variable with the highest number of predictions of negative excess returns. The dividend yield predicted twelve months with negative risk premia during the same period and the default premium predicted none.

[31] Arab Light, see Table III.

between lagged oil price changes and stock returns in the positive risk premia domain, and might not be present when excess returns are negative. Stated differently, because we estimate the relation between lagged oil price changes and stock returns using the full range of oil price changes, these results might be significant due to a strong relationship for oil price changes (decreases and small oil price increases), which would imply positive excess stock market returns only. The observed relationship between oil price changes and stock returns need not hold for oil price changes (larger oil price increases) which would imply negative excess returns. Regression 1 assumes a stable relation, regardless of the size and the sign of oil price changes. This assumption might be too strong. If there is no significant relation for oil price changes which implies negative excess returns, our results might still be attributable to a time varying risk premia argument.

Raising the extreme standard put forward by Schwert (2003) even higher, we test whether the relationship between lagged oil price changes and stock returns is also significant in months when expected stock returns based on our predictability results are lower than short term interest rates. We do this by estimating the regression :

$$r_t = \mu + \alpha_1 r_{t-1}^{oil} + \alpha_2 D_t r_{t-1}^{oil} + \varepsilon_t \qquad (5)$$

The dummy variable, D_t, takes the value 1 if (based on the estimation results in Table IV) expected returns are lower than the short term interest rate (negative expected excess returns) and zero, if expected returns are higher than the short term interest rate. As a consequence α_1 measures the delayed reaction to oil price changes (decreases and marginal increases) which; assuming the relationship between lagged oil price changes and stock returns is as in Table IV; will imply positive excess returns. α_2 measures whether the relation is significantly different for (large) oil price increases which imply negative excess returns. The sum of α_1 and α_2 measures the absolute value of the lagged reaction of the market for the (large) oil price increases which imply negative excess returns. Table XI contains our estimation results.

Please insert Table XI around here

In column eight of Table XI we report the Wald test of the sum of α_1 and α_2 as being significantly different from zero. As this measures the slope of the relationship between lagged oil price changes and stock returns in case the latter are predicted to be below the interest rate, we should find no significant results in the latter case if the predictability results are only a consequence of time varying risk premia. To have enough observations we focus on the developed markets and the world market index. For the world market we use the US short term interest rate.

Table XI offers several interesting insights. The lagged reaction of the stock market is stronger for drops in the price of oil (and for small increases) than for larger oil price rises. The average value for α_1 is approximately -0.11, whereas the average value for $\alpha_1 + \alpha_2$ is around -0.06. However, only for two countries (Spain and the US) do we reject the hypothesis that slopes in the positive predicted excess return domain and the negative predicted return domain are significantly different. For the US, even though these slopes are significantly different, we still reject the hypothesis that the latter equals zero; albeit marginally; as the related p-value for the Wald test statistic equals 0.096. Moreover, in eight other countries we also reject the hypothesis that there is no relationship for the predicted negative excess return domain, with p-values ranging from 0.061 (Belgium) to 0.0008 (Switzerland).

There is one potential problem with the dummy variable in Equation 4. It is based on the estimated prediction equation using the entire sample. This might introduce a peek-ahead bias. However, our main interest is whether large oil price changes predict negative excess returns. Therefore we can use a somewhat cruder definition for the definition of the dummy variable. As a robustness check we consider three alternative specifications for the dummy variable: it takes the value 1 for positive oil price changes in the previous month, it takes the value 1 if the oil price change in the previous month is larger than the mean and it takes the value 1 if the oil price change in the previous month is larger than the mean plus half a standard deviation.[32] As these regression results are almost similar to the previous regression results, we only report the Wald tests for $\alpha_1 + \alpha_2$ in the last three columns of Table XI. Using different dummy variable definitions does not affect our conclusions. As before, if we estimate these equations as a joint system, we confirm our general findings for the individual countries. For instance, when we use a dummy based on positive and negative changes we reject the joint null hypothesis that $\alpha_1 + \alpha_2$ is equal to zero at the one percent level (p-value 0.0003). If we use the dummy based on the mean and half a standard deviation we find a p-value of 0.0013. Our results do not seem to be affected by peek-ahead bias. Based on these tests we reject the hypothesis that our predictability results are a consequence of time varying risk premia.

[32] The last two definitions might also introduce some peek-ahead bias, as we use mean and standard deviation for the whole sample. However, if an investor had estimated these after the first year he or she would have obtained higher estimates than the estimates we use for the full sample. This would only strengthen these findings.

5. Conclusions

The main contribution of our paper is that we are the first to document evidence showing that changes in oil prices forecast stock returns. This predictability is especially strong in the developed markets in our sample of countries and in the world market index. It seems unlikely that this predictability can be attributed to time varying risk premia. We conclude this because the predictability is short-lived and oil price changes tend to be uncorrelated with other economic variables generally associated with predicting time varying risk premia. But maybe more importantly, because higher oil prices predict lower stock returns. This finding is difficult to align with oil price changes as an indication for future risk premia, because oil shocks would lead to higher economic risk and therefore higher returns, not lower. Oil price changes meet the extreme standard put forward by Schwert (2003), which states that forecasts should also include forecasts in the negative excess return domain. Moreover, the relation between stock market returns and lagged oil price changes is statistically significant in many countries even if we restrict our analysis to the predicted negative excess return domain. Based on these results we conclude that oil price changes are exceptional. The predictability of all economic variables known to date might be a consequence of time varying risk premia, however, this conclusion does not hold for the predictability of stock market returns based on oil price changes. These results point in the direction of a true market inefficiency.

A possible explanation for our findings is that investors react at different points in time to changes in oil prices, or have difficulty in assessing the impact of these changes on the value of stocks not related to the oil sector. As we show, our results are consistent wih the gradual information diffusion hypothesis proposed by Hong and Stein (1999). Firstly, the delayed reaction is negative in most countries. Secondly, if we allow for lags between monthly stock index returns and lagged monthly oil price returns, we find stronger results. The explanatory power of these regressions increases up to a lag of six trading days and then rapidly decreases. As we show this finding would be in line with a delayed reaction of investors. These results suggest that investors underestimate the direct economic effect of oil price changes on the economy and act with a delay. Our finding that underreaction to oil price changes is less pronounced in oil related sectors offers further support for this hypothesis.

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Tables and Figures

Table I. Summary Statistics of Stock Market Returns

Country	Starting Date	# obs.	Mean (%)	Std. dev. (%)	Kurtosis	Skewness (× 10^{-3})	Skewness P-value	$\rho(1)$ est.	$\rho(1)$ t-value
Australia	1973-10	355	1.0	6.2	20.09	-0.469	0.294	0.00	0.07
Austria	1973-10	355	0.5	5.6	7.53	0.000	0.999	0.15	**1.76**
Belgium	1973-10	355	0.9	5.2	6.74	-0.048	0.500	0.14	**2.42**
Canada	1973-10	355	0.8	5.2	5.76	-0.097	0.109	0.04	0.65
Denmark	1973-10	355	0.8	5.2	3.34	-0.033	0.182	0.07	1.16
France	1973-10	355	0.9	6.3	4.00	-0.086	0.212	0.08	1.38
Germany	1973-10	355	0.7	6.0	6.22	-0.186	**0.055**	0.04	0.54
Hong Kong	1973-10	355	1.0	9.7	7.17	-0.746	0.195	0.07	1.46
Italy	1973-10	355	0.9	7.2	3.50	0.090	0.240	0.07	1.15
Japan	1973-10	355	0.4	5.3	4.37	-0.032	0.455	0.04	0.54
Netherlands	1973-10	355	1.0	5.4	5.91	-0.111	**0.095**	0.07	0.97
Norway	1973-10	355	0.6	7.5	4.92	-0.272	0.086	0.12	**1.89**
Singapore	1973-10	355	0.4	8.0	10.21	-0.398	0.409	0.10	**1.69**
Spain	1973-10	355	0.8	6.4	5.11	-0.106	0.291	0.10	1.63
Sweden	1973-10	355	1.3	7.0	4.43	-0.061	0.545	0.13	**2.06**
Switzerland	1973-10	355	0.7	5.1	6.41	-0.102	0.123	0.11	1.52
UK	1973-10	355	1.0	6.1	11.34	0.075	0.746	0.08	1.06
US	1973-10	355	0.9	4.7	5.37	-0.057	0.210	0.00	0.02
World Market	**1973-10**	**355**	**0.7**	**4.2**	5.94	-0.065	**0.065**	0.08	1.30
Argentina	1988-01	184	5.9	23.6	13.53	33.945	**0.039**	0.16	0.92
Brazil	1988-01	184	11.3	19.8	4.04	3.375	0.195	0.25	**2.36**
Chile	1988-01	184	1.9	7.0	5.65	-0.121	0.594	0.17	**2.29**
Finland	1988-01	184	1.1	10.1	4.13	-0.288	0.438	0.24	**2.97**
Indonesia	1988-01	184	1.1	12.9	9.75	2.000	0.334	0.09	1.02
Ireland	1988-01	184	0.8	6.1	3.82	-0.081	0.265	0.13	**1.73**
Jordan	1988-01	184	0.5	4.2	3.40	0.018	0.349	0.16	**1.91**
Malaysia	1988-01	184	0.6	8.9	4.73	-0.033	0.909	0.09	0.91
Mexico	1988-01	184	2.5	8.9	3.45	-0.085	0.693	0.01	0.13
New Zealand	1988-01	184	0.4	6.0	4.62	0.049	0.604	-0.14	-1.55
Philippines	1988-01	184	0.5	9.1	3.96	0.019	0.941	0.18	**2.31**
Portugal	1988-01	184	0.3	6.4	4.14	0.037	0.689	0.11	1.21
South Korea	1988-01	184	0.4	10.1	4.59	0.486	0.292	0.07	1.10
Taiwan	1988-01	184	0.4	11.5	4.10	-0.052	0.922	0.10	1.19
Thailand	1988-01	184	0.4	11.7	4.10	-0.102	0.841	0.00	0.00
Turkey	1988-01	184	4.5	16.8	3.76	1.472	0.325	0.06	0.91
China	1993-01	124	-1.4	11.6	4.34	-0.180	0.516	0.07	0.57
Columbia	1993-01	124	1.2	8.9	4.03	0.076	0.791	0.10	1.34
India	1993-01	124	0.3	8.2	2.66	-0.011	0.919	0.01	0.12
Israel	1993-01	124	0.6	7.7	3.27	-0.174	0.189	0.05	0.42
Pakistan	1993-01	124	0.8	11.9	4.75	-0.566	0.533	-0.06	-0.48
Peru	1993-01	124	1.3	8.9	5.92	-0.288	0.568	0.02	0.24
Poland	1993-01	124	1.8	14.7	8.75	3.584	0.339	0.10	0.81
South Africa	1993-01	124	0.9	6.6	7.17	-0.219	0.339	0.00	0.03
Venezuela	1993-01	124	2.4	13.0	4.60	-0.332	0.785	-0.13	-1.40
Egypt	1995-01	100	0.8	8.1	4.42	0.477	**0.088**	0.18	1.71
Hungary	1995-01	100	1.9	11.2	6.69	-0.484	0.687	0.01	0.07
Morocco	1995-01	100	0.6	4.4	3.35	0.039	0.274	0.16	1.30
Russia	1995-01	100	1.2	21.1	5.86	-6.112	0.443	0.10	0.63
Czech Rep.	1997-01	76	0.7	9.6	3.92	-0.493	0.285	-0.04	-0.29

Notes: summary statistics on value weighted MSCI re-investment indices for several countries. Monthly mean returns as percentage, monthly standard deviation as percentage. Skewness is measured as:

$s = \frac{1}{T}\sum_{t=0}^{T}\left(r_t - \hat{\mu}\right)^3$; we test whether we are able to reject the null hypothesis of no skewness using the following test statistic:

$$w = \frac{1}{T}\frac{\left[\sum_{t=0}^{T}\left(\left[r_t - \hat{\mu}\right]^3\right)\right]^2}{Var\left(\left[r_t - \hat{\mu}\right]^3 - (r_t - \hat{\mu})\hat{\sigma}_r^2\right)}$$

which takes into account the fact that we have to estimate the mean μ. This statistic has under the null hypothesis of no skewness and standard regularity conditions a Chi squared distribution with one degree of freedom. We use asterisks to denote significance at the ten percent level (*) or 5 percent level (**) respectively.

Table II. Oil price series used

Short Name	Full name	Source	Starting Date Series	Starting Date Used
Arab Light	Arabian Gulf Arab Light Crude Oil Spot Price (US$/Barrel)	Bloomberg	December 1969	October 1973
West Texas	West Texas Intermediate Oil Price (US$/Barrel)	Global Financial Data	May 1860	October 1973
Dubai	Dubai Oil Spot Price (US$/Barrel)	Bloomberg	November 1981	November 1981
Brent	Brent Crude – Physical FOB (US$/Barrel)	Datastream	May 1987	May 1987
Brent Future	IPE Brent Crude Oil continuous set. price (US$/Barrel)	Datastream	January 1989	January 1989
Oil Future	NYMEX Light crude oil continuous set. price (US$/Barrel)	Datastream	March 1983	March 1983

Table III. Basic characteristics of oil price changes

	Arab Light	Brent	West Texas	Dubai	Brent Fut.	Oil Fut.
Mean (%)	0.59	0.13	0.52	-0.15	0.26	-0.05
Maximum (%)	83.79	38.92	37.14	53.68	37.96	36.89
Minimum (%)	-48.51	-39.14	-35.25	-37.76	-34.31	-35.07
Std. Dev. (%)	10.78	10.99	8.50	10.34	9.61	9.70
# of Obs.	355	191	355	257	178	241
$\rho(1)$	0.047	0.011	**0.221**	0.161	0.148	0.142
s.e. $\rho(1)$	0.071	0.110	0.093	0.110	0.102	0.103
DF-GLS	**-17.85**	**-13.00**	**-14.39**	**-13.49**	**-10.75**	**-12.34**
P-value	0.000	0.000	0.000	0.000	0.000	0.000
Correlations	Arab Light	Brent	West Texas	Dubai	Brent Fut.	Oil Fut.
Arab Light	1	0.87	0.74	0.90	0.92	0.76
Brent	0.87	1	0.93	0.89	0.96	0.94
West Texas	0.74	0.93	1	0.87	0.96	1.00
Dubai	0.90	0.89	0.87	1	0.94	0.88
Brent Future	0.92	0.96	0.96	0.94	1	0.97
Oil Future	0.76	0.94	1.00	0.88	0.97	1

Notes: summary results on oil price changes (measured as log returns). Monthly mean returns, maximum and minimum as percentage, monthly standard deviation as percentage. Correlations are pair wise correlations. Series end in April 2003. Arab Light series and West Texas Intermediate series starts October 1973, Dubai oil price series starts December 1981, Brent oil price series starts June 1987, Brent futures series starts January 1989, the light crude oil futures series starts April 1983. $\rho(1)$ denotes first order autocorrelation of these series. First order autocorrelation for West Texas is significantly different from zero at the 5% level. Additionally we report the Elliott-Rothenberg-Stock Dickey Fuller Generalized Least Squares test (DF-GLS) which tests the null hypothesis of a unit root in these oil price series and the related p-value.

Table IV. Stock market returns and lagged oil price changes

Country	Starting Date	α_1	t-value Arab Light	t-values for additional series: WT (1973)	Dubai (1982)	Brent (1987)	Brent (F) (1989)	Oil (F) (1983)	delta: Arab Light	West Texas
Australia	1973-10	-0.031	-0.99	-1.14	**-1.96**	**-2.43**	**-2.55**	**-2.01**	-0.06	-0.05
Austria	1973-10	-0.067	-1.65	-1.23	**-2.15**	-1.20	-1.23	-1.29	-0.12	-0.08
Belgium	1973-10	-0.095	**-3.61**	**-3.74**	**-3.72**	**-2.78**	**-2.91**	**-3.43**	-0.13	-0.13
Canada	1973-10	-0.040	-1.64	-1.11	**-2.29**	-1.54	-1.32	-1.29	-0.04	-0.05
Denmark	1973-10	-0.062	**-2.04**	**-2.53**	**-2.09**	**-2.07**	**-2.24**	**-1.73**	-0.04	-0.02
France	1973-10	-0.090	**-2.56**	**-3.36**	**-3.64**	**-2.11**	**-2.29**	**-3.03**	-0.07	-0.08
Germany	1973-10	-0.121	**-3.13**	**-3.31**	**-3.41**	**-2.57**	**-2.33**	**-2.93**	-0.04	-0.06
Hong Kong	1973-10	-0.017	-0.31	-0.73	-0.21	0.45	0.57	0.17	-0.01	-0.01
Italy	1973-10	-0.153	**-3.52**	**-4.74**	**-6.23**	**-4.78**	**-4.25**	**-5.42**	-0.04	-0.01
Japan	1973-10	-0.061	-1.46	-1.21	-1.22	-1.01	-0.58	-1.00	-0.03	-0.01
Netherlands	1973-10	-0.107	**-4.52**	**-3.21**	**-3.84**	**-2.84**	**-2.54**	**-2.83**	-0.02	-0.01
Norway	1973-10	-0.067	**-2.22**	-0.44	-1.10	-1.21	-1.18	-0.23	-0.16	-0.12
Singapore	1973-10	-0.044	-0.95	-0.60	-1.01	-0.88	-0.68	-0.38	0.00	-0.01
Spain	1973-10	-0.112	**-2.38**	**-2.81**	**-3.26**	**-2.51**	**-2.48**	**-2.90**	-0.12	-0.12
Sweden	1973-10	-0.122	**-2.64**	**-3.20**	**-3.65**	**-3.23**	**-3.18**	**-3.42**	-0.08	-0.08
Switzerland	1973-10	-0.114	**-4.35**	**-3.13**	**-3.68**	**-2.93**	**-2.68**	**-2.90**	-0.04	-0.08
UK	1973-10	-0.068	**-2.14**	**-3.58**	**-3.72**	**-3.08**	**-2.73**	**-3.49**	-0.06	-0.06
US	1973-10	-0.086	**-3.57**	**-3.47**	**-4.09**	**-3.40**	**-3.12**	**-3.08**	-0.04	-0.07
World Market	1973-10	-0.081	**-2.90**	**-3.08**	**-3.41**	**-2.59**	**-2.24**	**-2.78**	-0.04	-0.06
Argentina	1988-01	-0.171	-1.28	-0.83	-1.10	-1.29	-0.91	-0.78	-0.03	0.05
Brazil	1988-01	-0.315	**-2.63**	-1.35	**-2.33**	**-1.76**	**-1.77**	-1.45	-0.03	-0.05
Chile	1988-01	-0.075	-1.51	-1.25	-1.64	-1.55	-0.92	-1.28	0.00	-0.06
Finland	1988-01	-0.210	**-2.69**	**-3.01**	**-3.07**	**-2.82**	**-3.00**	**-3.06**	-0.05	-0.05
Indonesia	1988-01	-0.130	-1.35	-0.34	-1.45	-0.70	-0.44	-0.40	-0.03	-0.06
Ireland	1988-01	-0.086	-1.51	-1.53	**-1.74**	-1.46	-1.55	**-1.65**	-0.13	-0.18
Jordan	1988-01	-0.072	**-2.50**	**-2.43**	**-2.49**	**-2.56**	**-2.95**	**-2.48**	-0.08	-0.09
Malaysia	1988-01	-0.020	-0.22	-0.51	-0.97	-0.62	-0.55	-0.57	-0.12	-0.04
Mexico	1988-01	-0.094	-1.41	-1.32	-1.48	-1.22	-0.96	-1.35	0.00	-0.02
New Zealand	1988-01	-0.100	**-2.06**	**-1.84**	**-2.21**	**-2.54**	**-2.13**	**-2.05**	0.00	-0.02
Philippines	1988-01	-0.083	-1.01	-0.55	-1.49	-0.74	-0.66	-0.61	-0.17	-0.13
Portugal	1988-01	-0.152	**-3.51**	**-2.62**	**-3.83**	**-2.62**	**-3.21**	**-2.73**	-0.15	-0.17
South Korea	1988-01	-0.172	**-1.67**	-1.53	**-2.16**	**-1.68**	-1.57	-1.62	-0.10	-0.08
Taiwan	1988-01	-0.169	-1.53	-1.18	**-1.90**	-1.43	-1.11	-1.18	-0.09	-0.10
Thailand	1988-01	-0.188	-1.53	-1.50	**-1.93**	**-2.17**	-1.49	-1.59	-0.07	-0.05
Turkey	1988-01	-0.092	-0.95	-1.18	-1.60	-1.41	-1.28	-1.30	-0.04	-0.03
China	1993-01	0.026	0.21	-0.44	-0.16	-0.17	0.25	-0.42	-0.04	-0.13
Columbia	1993-01	0.017	0.14	0.31	0.13	0.13	0.46	0.26	-0.02	-0.08
India	1993-01	-0.128	**-1.78**	-1.36	**-1.74**	-1.33	-1.52	-1.50	-0.12	-0.21
Israel	1993-01	-0.178	**-2.43**	-1.53	**-2.32**	-1.57	**-1.75**	**-1.66**	-0.01	-0.03
Pakistan	1993-01	-0.110	-1.10	-0.31	-0.86	-0.99	-0.51	-0.39	-0.05	-0.08
Peru	1993-01	-0.010	-0.10	-0.03	-0.08	-0.29	0.26	-0.03	-0.01	-0.03
Poland	1993-01	-0.015	-0.14	0.04	-0.22	0.11	-0.03	-0.10	-0.12	-0.07
South Africa	1993-01	-0.035	-0.54	-0.08	-0.82	-0.73	-0.23	-0.24	-0.06	-0.12
Venezuela	1993-01	0.038	0.24	0.40	0.29	0.32	0.62	0.35	-0.11	-0.15
Egypt	1995-01	-0.030	-0.47	0.16	-0.69	-0.65	-0.43	0.09	-0.15	-0.15
Hungary	1995-01	-0.069	-0.75	0.27	-0.97	-0.42	0.15	0.21	-0.14	-0.11
Morocco	1995-01	-0.019	-0.38	-0.66	-0.52	-0.32	-0.51	-0.67	-0.03	-0.02
Russia	1995-01	-0.027	-0.13	0.62	-0.37	-0.45	0.56	0.48	-0.04	-0.03
Czech Rep.	1997-01	0.000	0.00	0.78	-0.54	-0.20	0.50	0.72	-0.03	-0.08

Notes: estimation results of regression equation (1) in the text: $r_t = \mu + \alpha_1 r_{t-1}^{oil} + \varepsilon_t$, for the different oil price series. We report related t-values based on heteroscedasticity consistent standard errors for Arab Light oil price series from Bloomberg. T-values in bold are significant at the 10% level. The next five columns contain t-values for the oil price series described in Table II. In the last two columns Delta measures the correlation of the disturbances of the regression as above in equation 1, with the disturbances from a regression of the oil variable on itself lagged one period.

Table V. Robustness checks

Country	Date	oil(t-1)	t-value	oil(t-1)	t-value	oil(t-2)	t-value	oil(t)	t-value	r(t-1)	t-value
Australia	1973-10	-0.031	-0.99	-0.031	-1.02	-0.027	-0.86	0.036	1.35	0.008	0.14
Austria	1973-10	-0.067	-1.65	-0.053	-1.49	-0.042	-1.48	-0.063	**-1.67**	0.129	1.57
Belgium	1973-10	-0.095	**-3.61**	-0.084	**-3.43**	-0.030	-1.39	-0.059	**-2.13**	0.097	**1.65**
Canada	1973-10	-0.04	-1.64	-0.042	**-1.69**	0.014	0.58	0.022	1.23	0.046	0.79
Denmark	1973-10	-0.062	**-2.04**	-0.060	**-1.96**	-0.023	-0.79	-0.016	-0.78	0.052	0.91
France	1973-10	-0.09	**-2.56**	-0.084	**-2.44**	-0.030	-1.02	-0.037	-1.17	0.058	0.98
Germany	1973-10	-0.121	**-3.13**	-0.119	**-3.13**	-0.016	-0.60	-0.019	-0.53	0.023	0.30
Hong Kong	1973-10	-0.017	-0.31	-0.013	-0.22	-0.079	**-1.79**	-0.006	-0.14	0.072	1.45
Italy	1973-10	-0.153	**-3.52**	-0.151	**-3.56**	0.028	0.78	-0.024	-0.59	0.061	1.08
Japan	1973-10	-0.061	-1.46	-0.060	-1.43	-0.046	-1.49	0.015	0.43	0.029	0.41
Netherlands	1973-10	-0.107	**-4.52**	-0.107	**-4.46**	-0.014	-0.63	0.010	0.49	0.065	0.90
Norway	1973-10	-0.067	**-2.22**	-0.083	**-2.67**	-0.052	**-1.82**	0.109	**3.80**	0.125	**2.02**
Singapore	1973-10	-0.044	-0.95	-0.042	-0.93	-0.023	-0.49	0.003	0.07	0.094	**1.65**
Spain	1973-10	-0.112	**-2.38**	-0.103	**-2.35**	-0.025	-0.86	-0.066	-1.62	0.063	1.12
Sweden	1973-10	-0.122	**-2.64**	-0.112	**-2.63**	-0.009	-0.27	-0.051	-1.46	0.114	**1.78**
Switzerland	1973-10	-0.114	**-4.35**	-0.111	**-4.26**	-0.007	-0.30	-0.015	-0.56	0.089	1.22
UK	1973-10	-0.068	**-2.14**	-0.063	**-1.95**	-0.045	-0.98	-0.032	-1.57	0.061	0.75
US	1973-10	-0.086	**-3.57**	-0.085	**-3.55**	0.009	0.44	-0.018	-0.94	-0.007	-0.11
World Market	1973-10	-0.081	**-2.90**	-0.079	**-2.89**	-0.012	-0.58	-0.012	-0.58	0.060	1.00
Argentina	1988-01	-0.171	-1.28	-0.200	-1.36	0.044	0.25	0.091	0.60	0.166	0.95
Brazil	1988-01	-0.315	**-2.63**	-0.271	**-2.22**	0.029	0.21	-0.052	-0.35	0.242	**2.21**
Chile	1988-01	-0.075	-1.51	-0.077	-1.45	0.032	0.58	0.009	0.20	0.178	**2.36**
Finland	1988-01	-0.21	**-2.69**	-0.199	**-2.42**	0.059	0.68	-0.033	-0.47	0.232	**2.84**
Indonesia	1988-01	-0.13	-1.35	-0.114	-1.11	-0.038	-0.42	-0.031	-0.31	0.076	0.92
Ireland	1988-01	-0.086	-1.51	-0.046	-0.84	-0.066	-1.33	-0.079	-1.53	0.080	1.05
Jordan	1988-01	-0.072	**-2.5**	-0.058	**-2.01**	-0.033	-1.17	-0.029	-0.85	0.119	1.40
Malaysia	1988-01	-0.02	-0.22	0.017	0.19	-0.045	-0.66	-0.100	-1.46	0.078	0.81
Mexico	1988-01	-0.094	-1.41	-0.072	-1.02	-0.055	-0.78	-0.013	-0.20	0.001	0.01
New Zealand	1988-01	-0.1	**-2.06**	-0.088	**-1.89**	-0.099	**-2.36**	-0.010	-0.24	-0.177	**-2.05**
Philippines	1988-01	-0.083	-1.01	-0.022	-0.26	-0.083	-1.36	-0.143	**-2.24**	0.141	**1.80**
Portugal	1988-01	-0.152	**-3.51**	-0.115	**-2.51**	-0.051	-1.12	-0.097	**-2.61**	0.051	0.56
South Korea	1988-01	-0.172	**-1.67**	-0.192	**-1.76**	0.024	0.34	0.103	1.41	0.100	1.49
Taiwan	1988-01	-0.169	-1.53	-0.152	-1.50	0.120	1.47	-0.087	-0.80	0.090	1.14
Thailand	1988-01	-0.188	-1.53	-0.155	-1.21	-0.081	-1.09	-0.093	-1.10	-0.039	-0.45
Turkey	1988-01	-0.092	-0.95	-0.096	-0.88	0.010	0.07	0.057	0.53	0.061	0.94
China	1993-01	0.026	0.21	-0.077	-1.45	0.032	0.58	0.009	0.20	0.178	**2.36**
Columbia	1993-01	0.017	0.14	0.018	0.14	0.035	0.37	-0.024	-0.28	0.100	1.21
India	1993-01	-0.128	**-1.78**	-0.130	**-1.77**	-0.039	-0.39	0.094	1.32	0.025	0.29
Israel	1993-01	-0.178	**-2.43**	-0.177	**-2.41**	0.047	0.63	0.011	0.19	0.061	0.55
Pakistan	1993-01	-0.11	-1.10	-0.112	-1.11	0.128	1.36	-0.034	-0.28	-0.047	-0.41
Peru	1993-01	-0.01	-0.10	-0.020	-0.22	-0.066	-1.01	0.007	0.10	0.022	0.25
Poland	1993-01	-0.015	-0.14	0.001	0.01	-0.180	-1.29	-0.186	-1.58	0.081	0.63
South Africa	1993-01	-0.035	-0.54	-0.033	-0.54	-0.124	**-2.35**	0.026	0.45	-0.003	-0.04
Venezuela	1993-01	0.038	0.24	0.049	0.31	0.123	1.14	0.149	1.37	-0.130	-1.42
Egypt	1995-01	-0.03	-0.47	-0.060	-0.94	0.035	0.38	0.130	**1.97**	0.198	**1.87**
Hungary	1995-01	-0.069	-0.75	-0.013	-0.22	-0.079	**-1.79**	-0.006	-0.14	0.072	1.45
Morocco	1995-01	-0.019	-0.38	-0.013	-0.29	-0.154	**-3.85**	-0.036	-0.86	0.161	1.40
Russia	1995-01	-0.027	-0.13	-0.050	-0.21	0.116	0.66	-0.262	-1.26	0.193	1.36
Czech Rep.	1997-01	0.000	0.00	-0.004	-0.04	0.089	0.71	-0.012	-0.09	-0.040	-0.28

Notes: Column three and four: estimation results of regression equation (1) in the text (as before) compared with the estimation results of the regression : $r_t = \mu + \alpha_1 r^{oil}_{t-1} + \alpha_2 r^{oil}_{t-2} + \alpha_3 r^{oil}_{t} + \alpha_4 r_{t-1} + \varepsilon_t$, for Arab Light. We report related t-values based on heteroscedasticity consistent standard and t-values in bold are significant at the 10% level.

Table VI. Economic significance of the oil strategy

Country		Buy & Hold Strategy			Oil Strategy						
	# Obs.	Mean (yearly in %)	Std.Dev. (yearly in %)	Sharpe Ratio	mean (yearly in %)	std.dev. (yearly in %)	Sharpe Ratio	alpha (yearly in %)	t-value	Beta	t-value
Australia	177	8.2	13.8	0.03	9.9	8.8	0.23	1.87	1.05	0.41	**7.18**
Austria	177	5.9	23.4	0.07	9.6	15.6	0.34	4.55	1.50	0.44	**5.42**
Belgium	177	7.2	17.5	0.09	11.3	10.6	0.54	5.11	**2.33**	0.38	**5.36**
Canada	177	7.9	15.7	0.11	8.0	9.1	0.20	1.21	0.62	0.33	**4.94**
Denmark	177	10.0	19.3	0.17	14.0	12.9	0.57	5.84	**2.35**	0.45	**7.59**
France	177	8.4	20.1	0.07	11.1	12.2	0.35	3.66	1.44	0.37	**6.45**
Germany	177	6.7	23.2	0.06	12.1	13.8	0.50	6.34	**2.20**	0.36	**5.10**
Hong Kong	177	9.3	28.6	0.20	5.7	18.9	0.11	-0.33	-0.09	0.43	**5.50**
Italy	177	7.2	23.6	-0.06	16.5	15.5	0.50	8.48	**2.81**	0.44	**6.99**
Japan	177	-6.1	20.3	-0.37	-0.7	14.3	-0.14	1.67	0.64	0.50	**6.61**
Netherlands	177	9.5	18.6	0.16	12.3	10.8	0.54	4.77	**2.06**	0.34	**5.26**
Norway	177	5.9	23.3	-0.07	9.0	13.3	0.12	2.11	0.75	0.32	**5.50**
Singapore	177	2.5	24.3	0.02	3.4	17.3	0.08	1.17	0.37	0.50	**6.30**
Spain	177	9.1	22.9	0.05	15.7	14.8	0.52	7.26	**2.48**	0.43	**6.26**
Sweden	177	11.3	26.9	0.15	16.7	18.4	0.52	7.55	**2.18**	0.47	**6.31**
Switzerland	177	10.7	18.2	0.38	13.0	11.9	0.77	6.19	**2.53**	0.43	**6.10**
UK	177	8.2	15.6	0.06	11.2	10.2	0.38	3.44	**1.73**	0.42	**6.80**
US	177	10.7	15.1	0.39	11.9	9.8	0.72	4.58	**2.32**	0.43	**6.76**
World	177	5.9	14.6	0.07	9.3	9.2	0.49	4.05	**2.18**	0.40	**6.28**

Notes: Economic significance results for all developed countries and the world market index over the period August 1988-April 2003. Results for the oil strategy are based on updated parameter estimates of the regression model in Equation 1 starting from October 1973. Alpha and beta are estimated by regression Equation 2 in the text. T-values are based on heteroscedasticity consistent standard errors for Arab Light oil price series. The t-values in bold indicate significance at least at the 10% level.

Table VII. Regression results with different lags between stock returns and lagged oil price changes

Country	No lag Coeff.	t-value	R-squared	One day lag Coeff.	t-value	R-squared	Five day lag Coeff.	t-value	R-squared
Australia	-0.056	**-1.86**	0.91%	-0.071	**-2.47**	1.49%	-0.074	**-2.48**	1.73%
Austria	-0.067	-1.17	0.90%	-0.059	-1.07	0.74%	-0.077	-1.34	1.32%
Belgium	-0.129	**-3.34**	4.98%	-0.131	**-3.36**	5.20%	-0.115	**-3.30**	4.36%
Canada	-0.035	-1.16	0.49%	-0.039	-1.28	0.65%	-0.061	**-2.07**	1.71%
Denmark	-0.072	**-1.72**	1.49%	-0.096	**-2.32**	2.76%	-0.093	**-2.50**	2.75%
France	-0.136	**-2.92**	4.39%	-0.142	**-3.12**	4.98%	-0.140	**-3.56**	5.18%
Germany	-0.147	**-2.74**	4.32%	-0.163	**-3.07**	5.44%	-0.155	**-3.13**	5.32%
Hong Kong	0.017	0.28	0.03%	0.017	0.30	0.03%	-0.011	-0.18	0.01%
Italy	-0.263	**-5.23**	12.74%	-0.264	**-5.19**	13.22%	-0.241	**-5.31**	11.77%
Japan	-0.062	-1.03	1.00%	-0.052	-0.90	0.01%	-0.094	**-1.82**	2.58%
Netherlands	-0.096	**-2.68**	2.73%	-0.104	**-3.01**	3.31%	-0.104	**-3.09**	3.50%
Norway	-0.004	-0.09	0.00%	-0.026	-0.62	0.13%	-0.048	-1.13	0.46%
Singapore	-0.011	-0.18	0.02%	-0.006	-0.11	0.01%	-0.059	-1.03	0.59%
Spain	-0.173	**-2.89**	5.78%	-0.179	**-3.07**	6.34%	-0.183	**-3.60**	7.10%
Sweden	-0.180	**-3.30**	5.24%	-0.197	**-3.66**	6.43%	-0.189	**-3.42**	6.40%
Switzerland	-0.102	**-2.68**	3.31%	-0.115	**-3.09**	4.27%	-0.112	**-3.11**	4.42%
UK	-0.110	**-3.36**	4.42%	-0.112	**-3.50**	4.73%	-0.111	**-3.58**	5.01%
US	-0.092	**-2.96**	3.66%	-0.092	**-3.10**	3.79%	-0.096	**-3.30**	4.36%
World Market	-0.094	**-2.69**	4.39%	-0.094	**-2.74**	4.56%	-0.106	**-3.45**	6.18%
Argentina	-0.111	-0.83	0.19%	0.003	0.02	0.00%	-0.219	-1.06	0.86%
Brazil	-0.183	-1.35	0.72%	-0.159	-1.10	0.42%	-0.211	-1.62	1.14%
Chile	-0.067	-1.25	0.77%	-0.039	-1.28	0.65%	-0.084	**-1.80**	1.45%
Finland	-0.252	**-3.01**	5.24%	-0.248	**-2.80**	5.55%	-0.247	**-2.79**	6.00%
Indonesia	-0.040	-0.34	0.08%	-0.049	-0.48	0.13%	-0.034	-0.39	0.07%
Ireland	-0.098	-1.53	2.18%	-0.091	-1.53	2.07%	-0.092	**-1.99**	2.31%
Jordan	-0.081	**-2.43**	3.09%	-0.068	**-2.21**	2.43%	-0.074	**-2.10**	3.06%
Malaysia	-0.049	-0.51	0.26%	-0.044	-0.51	0.23%	-0.055	-0.66	0.39%
Mexico	-0.101	-1.32	1.08%	-0.074	-1.04	0.63%	-0.120	**-1.84**	1.83%
New Zealand	-0.099	**-1.84**	2.28%	-0.109	**-2.26**	3.00%	-0.097	**-2.13**	2.61%
Philippines	-0.050	-0.55	0.26%	-0.045	-0.54	0.23%	-0.099	-1.31	1.20%
Portugal	-0.138	**-2.62**	3.88%	-0.134	**-2.77**	3.98%	-0.113	**-2.44**	3.08%
South Korea	-0.174	-1.53	2.51%	-0.149	-1.40	2.01%	-0.173	**-2.01**	2.98%
Taiwan	-0.150	-1.18	1.43%	-0.113	-0.94	0.88%	-0.140	-1.35	1.49%
Thailand	-0.193	-1.50	2.26%	-0.162	-1.41	1.76%	-0.192	**-1.68**	2.69%
Turkey	-0.136	-1.18	0.55%	-0.158	-1.32	0.81%	-0.071	-0.64	0.18%
China	-0.058	-0.44	0.19%	-0.034	-0.31	0.08%	-0.063	-0.56	0.27%
Columbia	0.039	0.31	0.15%	0.007	0.06	0.01%	0.017	0.15	0.03%
India	-0.116	-1.36	1.54%	-0.078	-1.02	0.80%	-0.111	-1.46	1.69%
Israel	-0.116	-1.53	1.75%	-0.125	**-1.73**	2.31%	-0.117	-1.55	2.16%
Pakistan	-0.037	-0.31	0.07%	0.001	0.01	0.00%	0.009	0.07	0.00%
Peru	-0.003	-0.03	0.00%	-0.007	-0.08	0.01%	-0.091	-1.26	0.97%
Poland	0.004	0.04	0.00%	0.040	0.41	0.07%	-0.061	-0.61	0.16%
South Africa	-0.006	-0.08	0.01%	-0.006	-0.09	0.01%	-0.022	-0.34	0.10%
Venezuela	0.058	0.40	0.15%	0.002	0.02	0.00%	0.052	0.42	0.15%
Egypt	0.013	0.16	0.02%	0.009	0.11	0.01%	-0.042	-0.49	0.29%
Hungary	0.025	0.27	0.04%	-0.021	-0.25	0.04%	0.071	0.76	0.42%
Morocco	-0.035	-0.66	0.54%	-0.006	-0.13	0.02%	-0.057	-1.17	1.76%
Russia	0.275	1.28	1.65%	0.000	-0.01	0.00%	0.164	0.75	0.71%
Czech Rep.	0.072	0.78	0.58%	0.046	0.51	0.27%	0.038	0.41	0.20%

Notes: estimation results of regression equation (1) in the text: $r_t = \mu + \alpha_1 r_{t-1}^{oil} + \varepsilon_t$ with lags of a different number of trading days between monthly stock market returns and lagged monthly oil price changes. We report results for West Texas oil price series over the period May 1983 - April 2003, with lags of 0, 1, and 5 trading days, respectively. T-values are based on heteroscedasticity consistent standard errors and t-values in bold refer to significant t-values at the 10% level.

Table VIII. Weekly predictability results

Country	Constant	Oil(-1)	Oil(-2)	Oil(-3)	Oil(-4)	Oil(-5)	Oil(-6)	Oil(-7)	Oil(-8)
Australia	0.002	-0.011	-0.020	-0.022	0.014	-0.036	-0.012	-0.019	-0.010
	[2.03]	[-0.83]	[-1.59]	**[-1.65]**	[1.08]	**[-3.11]**	[-0.96]	[-1.42]	[-0.71]
Austria	0.001	-0.010	-0.030	-0.020	-0.007	0.003	-0.028	-0.027	0.004
	[1.48]	[-0.63]	[-1.52]	[-1.09]	[-0.33]	[0.19]	[-1.64]	[-1.09]	[0.24]
Belgium	0.002	-0.042	-0.043	-0.029	-0.029	-0.038	-0.003	-0.014	-0.009
	[1.97]	**[-2.85]**	**[-2.58]**	**[-1.70]**	**[-1.95]**	**[-2.63]**	[-0.18]	[-0.82]	[-0.61]
Canada	0.001	0.017	-0.007	-0.002	-0.016	-0.019	-0.019	0.004	0.005
	[1.51]	[1.31]	[-0.53]	[-0.12]	[-1.25]	[-1.19]	[-1.40]	[0.30]	[0.43]
Denmark	0.001	0.015	-0.019	-0.006	-0.015	-0.041	-0.019	0.006	-0.014
	[1.78]	[1.14]	[-1.28]	[-0.33]	[-0.97]	**[-2.69]**	[-1.16]	[0.33]	[-0.89]
France	0.002	-0.009	-0.031	-0.019	-0.051	-0.059	-0.005	-0.034	0.022
	[2.07]	[-0.53]	[-1.63]	[-0.93]	**[-2.69]**	**[-3.21]**	[-0.23]	[-1.50]	[0.99]
Germany	0.001	-0.022	-0.033	0.007	-0.027	-0.076	-0.022	-0.031	-0.012
	[1.22]	[-1.29]	[-1.50]	[0.38]	[-1.38]	**[-3.94]**	[-1.13]	[-1.60]	[-0.64]
Hong Kong	0.002	-0.013	-0.036	0.016	0.011	-0.014	-0.008	-0.004	0.003
	[1.43]	[-0.54]	**[-1.67]**	[0.66]	[0.49]	[-0.59]	[-0.36]	[-0.18]	[0.13]
Italia	0.002	0.003	-0.044	-0.046	-0.072	-0.091	-0.022	-0.051	-0.055
	[1.71]	[0.13]	**[-1.85]**	**[-1.99]**	**[-3.23]**	**[-4.01]**	[-0.94]	**[-2.28]**	**[-2.56]**
Japan	0.000	-0.012	0.012	0.000	-0.010	0.001	-0.015	-0.047	-0.064
	[0.31]	[-0.60]	[0.63]	[-0.01]	[-0.49]	[0.05]	[-0.81]	**[-2.53]**	**[-2.94]**
Netherlands	0.002	-0.004	-0.032	-0.012	-0.017	-0.048	-0.018	0.000	-0.017
	[1.78]	[-0.30]	**[-1.83]**	[-0.79]	[-1.05]	**[-3.15]**	[-1.07]	[-0.01]	[-1.04]
Norway	0.001	0.007	0.002	-0.014	0.014	-0.003	-0.037	-0.005	-0.019
	[1.21]	[0.47]	[0.13]	[-0.70]	[0.84]	[-0.21]	**[-2.04]**	[-0.27]	[-1.01]
Singapore	0.000	-0.020	-0.002	-0.008	0.029	-0.022	0.013	-0.013	0.007
	[0.17]	[-1.01]	[-0.08]	[-0.33]	[1.36]	[-1.21]	[0.65]	[-0.60]	[0.30]
Spain	0.002	-0.023	-0.029	-0.034	-0.035	-0.054	-0.038	-0.042	-0.013
	[2.17]	[-1.26]	[-1.37]	**[-1.66]**	[-1.61]	**[-2.85]**	[-1.64]	**[-1.90]**	[-0.61]
Sweden	0.002	-0.026	-0.022	-0.009	-0.035	-0.072	-0.032	-0.051	-0.016
	[1.84]	[-1.22]	[-1.00]	[-0.46]	**[-1.76]**	**[-3.64]**	[-1.55]	**[-2.40]**	[-0.70]
Switzerland	0.002	-0.009	-0.026	-0.022	-0.030	-0.043	-0.004	-0.021	-0.001
	[2.02]	[-0.52]	[-1.58]	[-1.46]	**[-1.80]**	**[-2.66]**	[-0.21]	[-1.30]	[-0.07]
United Kingdom	0.001	0.001	-0.023	-0.023	-0.009	-0.049	-0.008	-0.007	-0.013
	[1.93]	[0.04]	[-1.50]	**[-1.70]**	[-0.57]	**[-3.98]**	[-0.56]	[-0.50]	[-0.93]
United States	0.002	0.015	-0.032	-0.017	-0.023	-0.032	-0.006	-0.005	0.005
	[2.15]	[1.03]	**[-2.29]**	[-1.15]	**[-1.78]**	**[-2.24]**	[-0.42]	[-0.30]	[0.36]
World	0.001	-0.001	-0.018	-0.016	-0.019	-0.031	-0.012	-0.018	-0.020
	[2.00]	[-0.10]	[-1.44]	[-1.26]	[-1.48]	**[-2.75]**	[-0.98]	[-1.41]	**[-1.71]**

Notes: estimation results of regression equation:
$r_t = \mu + \alpha_1 r_{t-1}^{oil} + \alpha_2 r_{t-2}^{oil} + \alpha_3 r_{t-3}^{oil} + \alpha_4 r_{t-4}^{oil} + \alpha_5 r_{t-5}^{oil} + \alpha_6 r_{t-6}^{oil} + \alpha_7 r_{t-7}^{oil} + \alpha_8 r_{t-8}^{oil} + \varepsilon_t$ using weekly data. We report results for West Texas oil price series over the period May 1983 - April 2003. First row for each country contains the estimated coefficients. The second row contains t-values in square brackets based on heteroscedasticity consistent standard errors and t-values in bold refer to significant t-values at the 10% level.

Table IX. Summary Statistics of Sector Returns and Oil effect

Sector	Start	# obs.	mean return (%)	std. dev. (%)	μ	t-value	α_1	t-value
World Market	1973-11	354	0.81	4.37	0.01	**3.76**	-0.06	**-2.10**
Utilities	1973-11	354	0.88	4.16	0.01	**4.06**	-0.02	-0.86
Resources	1973-11	354	0.91	5.09	0.01	**3.47**	-0.04	-1.56
Basic Industries	1973-11	354	0.66	5.03	0.01	**2.62**	-0.04	-1.05
General Industrials	1973-11	354	0.78	4.97	0.01	**3.15**	-0.06	**-1.66**
Non Cyc.Cons.Gds	1973-11	354	0.98	4.22	0.01	**4.62**	-0.06	**-2.23**
Non Cyc. Services	1973-11	354	0.84	4.84	0.01	**3.45**	-0.06	**-1.78**
Financials	1973-11	354	0.88	5.21	0.01	**3.37**	-0.06	**-1.67**
Cyc.Cons.Goods	1973-11	354	0.67	5.17	0.01	**2.67**	-0.08	**-1.83**
Cyclical Service	1973-11	354	0.74	4.76	0.01	**3.20**	-0.08	**-2.38**
Information Tech.	1973-11	354	0.77	6.92	0.01	**2.31**	-0.11	**-3.02**

Panel A

Sector	Average coefficient	χ^2	Degrees of freedom	p-value	# obs	Significant number of countries 10% level	5% level	1% level	0.1% level	Total Significant
Utilities	-0.033	**27.27**	17	0.054	4599	1	4	0	0	5
Resources	-0.019	**33.56**	14	0.002	3844	2	2	0	1	5
Basic Industries	-0.078	**41.36**	18	0.001	5874	1	4	4	0	9
General Industries	-0.088	**40.15**	18	0.002	6037	0	6	5	1	12
Non Cyc. Cons. Goods	-0.061	**43.62**	18	0.001	5536	2	6	2	2	12
Non. Cyc. Services	-0.104	**58.53**	18	0.000	4946	0	5	4	3	12
Financials	-0.076	**55.40**	18	0.000	6037	3	2	0	5	10
Cyc. Cons. Goods	-0.103	**66.48**	18	0.000	4982	2	0	3	6	11
Cyc. Services	-0.096	**48.87**	18	0.000	5821	3	4	3	3	13
Information Tech.	-0.175	**40.21**	18	0.002	3925	0	6	1	4	11

Panel B

Notes: Summary results on Datastream market indices and sector indices for sectors of the developed countries and the world market index.
Panel A: Monthly mean returns as percentages. Monthly standard deviation as percentage. μ and α_1 refer to the parameters of Regression 1. In addition we report related t-values based on heteroscedasticity consistent standard errors for Arab Light Oil price series from Bloomberg. t-values in bold refer to significant t-values at the 10% level.
Panel B: Estimation results for different sectors in different countries. Coefficients are averaged over different countries. We test the null hypothesis of a significant effect in the different sectors using the sector data from the different countries for each sector jointly using seemingly unrelated regressions (SUR). χ^2 reports the value for the test statistic and has a degrees of freedom as reported in the next column. based on the degrees of freedom in the next column (equal to the number of countries for which we have sector data) we report p-values. The 'Significant number of countries' relates to the significance of individual coefficients in individual sector regressions for each country.

Table X. Correlations between oil price changes and several economic variables

Panel A: US

	West Texas	Arab Light
Default spread	-0.05	-0.04
Term structure	-0.11	-0.08
Dividend yield	0.01	0.00
Interest rate	0.04	0.08

Panel B: Other developed markets

	West Texas	Arab Light
Default spread	-	-
Term structure	0.04	0.04
Dividend yield	0.01	0.01
Interest rate	-0.02	0.04

Table XI. Lagged oil price changes for positive and negative predicted excess returns

Country	Constant	t-value	α_1	t-value	α_2	t-value	$\alpha_1+\alpha_2$	Wald Test	Wald Test Zero	Wald Test Mean	Wald Test 0.5 stddev
Australia	0.010	2.95	-0.058	**-2.22**	0.061	1.01	0.003	0.00	0.05	0.00	0.00
Austria	0.005	1.51	-0.079	-1.38	0.020	0.23	-0.059	1.00	1.18	1.20	1.05
Belgium	0.007	2.04	-0.149	**-2.76**	0.087	1.27	-0.061	**3.52**	**4.47**	**4.53**	**4.46**
Canada	0.007	2.15	-0.073	**-2.30**	0.057	1.10	-0.017	0.21	0.25	0.26	0.21
Denmark	0.008	2.49	-0.096	**-1.66**	0.055	0.75	-0.041	1.10	1.51	1.51	1.29
France	0.010	2.35	-0.090	-1.26	0.001	0.01	-0.089	**4.02**	**4.30**	**4.34**	**4.04**
Germany	0.007	2.02	-0.117	-1.62	-0.007	-0.07	-0.123	**5.67**	**6.00**	**6.06**	**5.30**
Hong Kong	0.012	2.24	0.054	1.05	-0.207	**-2.13**	-0.153	**3.54**	0.25	0.25	0.09
Italy	0.005	1.14	-0.248	**-3.33**	0.153	1.57	-0.095	**3.67**	**3.37**	**3.40**	**3.84**
Japan	0.002	0.50	-0.119	**-1.91**	0.095	1.07	-0.025	0.19	0.24	0.24	0.35
Netherlands	0.008	2.44	-0.159	**-3.89**	0.085	1.47	-0.074	**5.02**	**6.42**	**6.44**	**5.05**
Norway	0.007	1.50	-0.048	-0.83	-0.030	-0.41	-0.078	**4.09**	2.50	2.56	1.71
Singapore	0.004	0.71	-0.068	-0.96	0.040	0.38	-0.028	0.17	0.19	0.19	0.07
Spain	0.003	0.80	-0.251	**-3.68**	0.223	**2.34**	-0.027	0.23	0.23	0.24	0.51
Sweden	0.010	2.45	-0.203	**-4.10**	0.135	1.53	-0.069	1.10	1.35	1.36	1.39
Switzerland	0.006	2.07	-0.139	**-3.08**	0.041	0.65	-0.098	**7.03**	**8.15**	**8.24**	**7.53**
UK	0.010	2.56	-0.090	**-2.07**	0.036	0.52	-0.054	1.23	1.45	1.47	1.34
US	0.007	2.77	-0.144	**-4.33**	0.090	**1.84**	-0.054	**2.77**	**3.46**	**3.48**	**3.15**
World Market	0.006	2.37	-0.126	**-3.65**	0.072	1.26	-0.053	1.69	2.00	2.01	2.00

Notes: Estimation results of the regression :

$$r_t = \mu + \alpha_1 r_{t-1}^{oil} + \alpha_2 D_t r_{t-1}^{oil} + \varepsilon_t$$

The dummy variable takes the value 1 if; based on the estimation results in Table I; the expected returns are lower than the short term interest rate (negative expected excess returns), and the value 0 if expected returns are higher than the short term interest rate. This implies that α_1 measures the delayed reaction to oil price changes (decreases and marginal increases)which ; assuming the relationship between lagged oil price changes and stock returns is as in Table I; will imply positive excess returns. α_2 measures whether the relationship is significantly different for oil price (large) increases, which would imply a negative excess return. The sum of α_1 and α_2 measures the absolute value of the lagged reaction of the market for the (large) oil price increases which imply negative excess returns. The last four columns report the Wald test of the sum of α_1 and α_2 , being significantly different from zero ($\chi^2(1)$). T-values and Wald test are based on White standard errors. Values in bold indicate significance at the 10% level. The last three Wald tests use alternative dummy variable definitions: oil price changes larger than zero, oil price changes larger than the mean and oil price changes larger than the mean plus half a standard deviation, respectively.

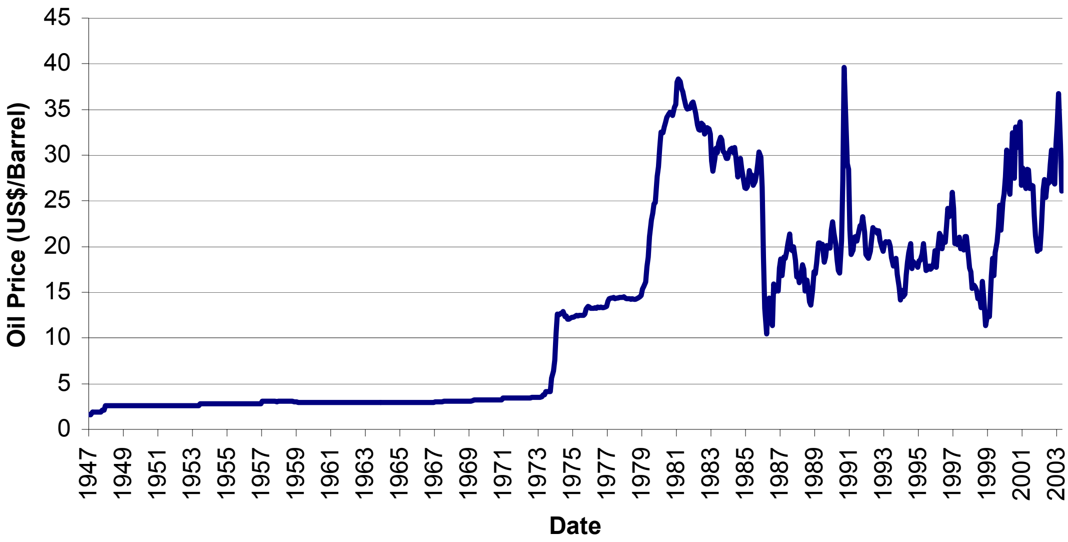


Figure 1. West Texas Intermediate Oil Price (US$/Barrel) from 1947 to 2003.
Notes: *source: Global Financial Data Inc..*

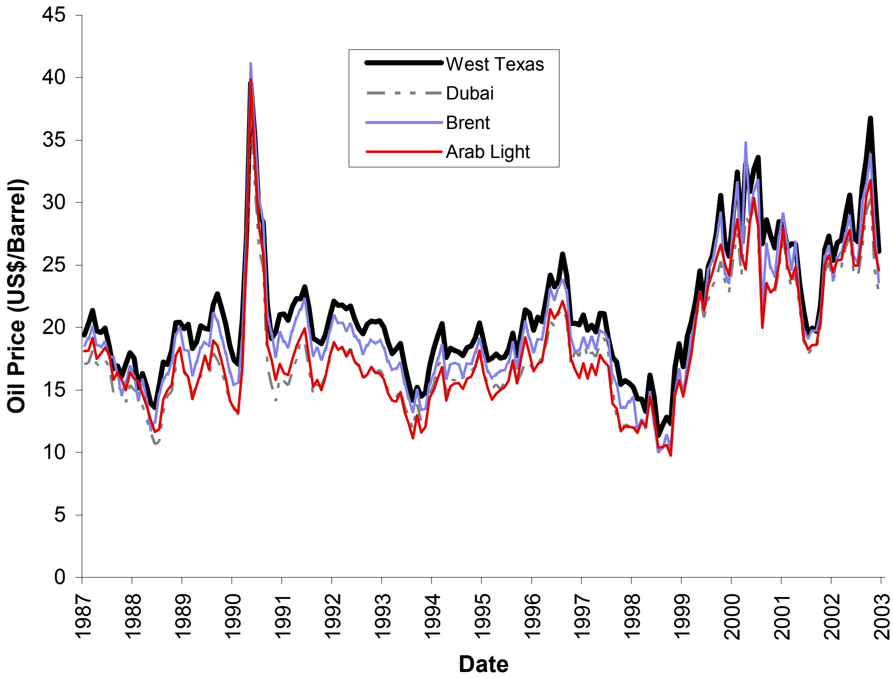


Figure 2. Oil price development.
Notes: Oil price development over the period May 1987 through April 2003 of four types of oil: West Texas; Brent; Dubai; and Arab Light.

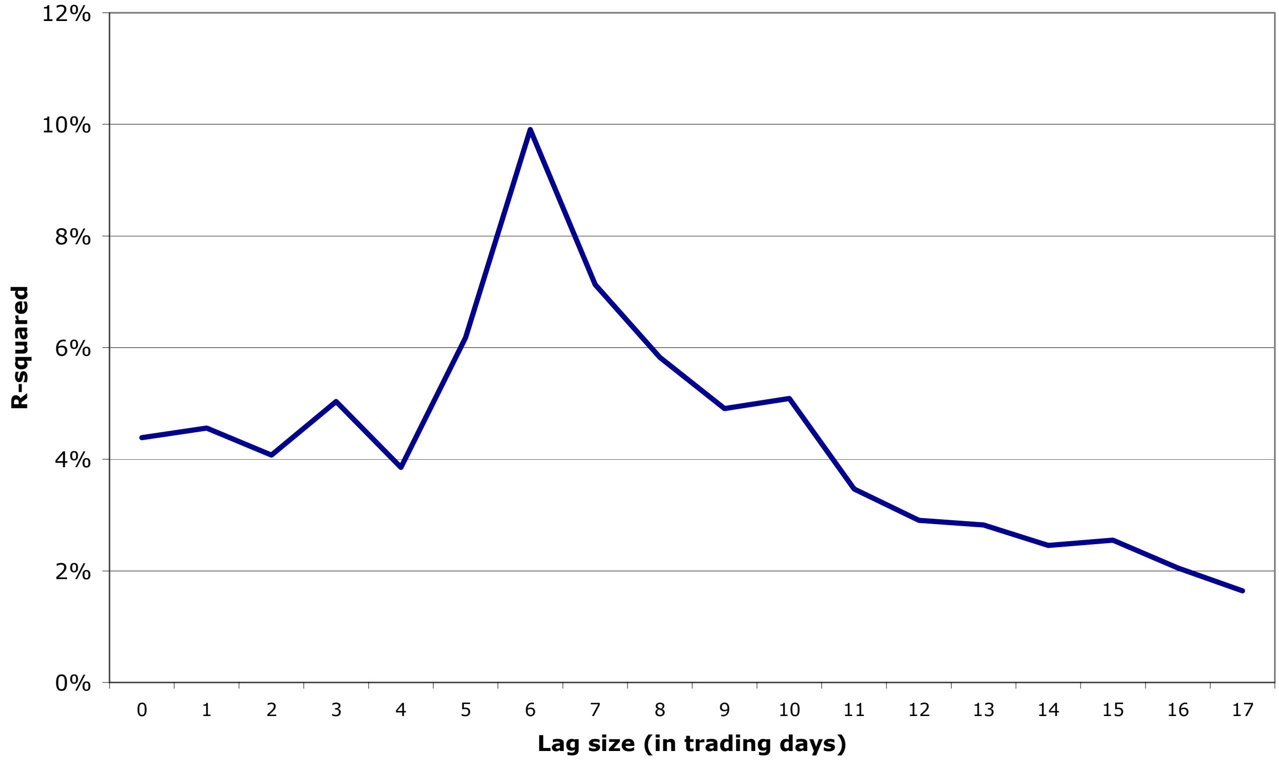
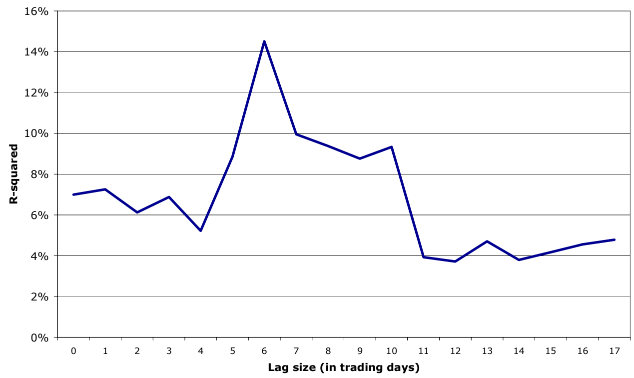


Figure 3. Explanatory power: world market total period.

Notes: R-squared of the regressions $r_t = \mu + \alpha_1 r_{t-1}^{oil} + \varepsilon_t$ with different lag sizes between West Texas monthly oil price returns and monthly World market index returns over the period May 1983 - April 2003.



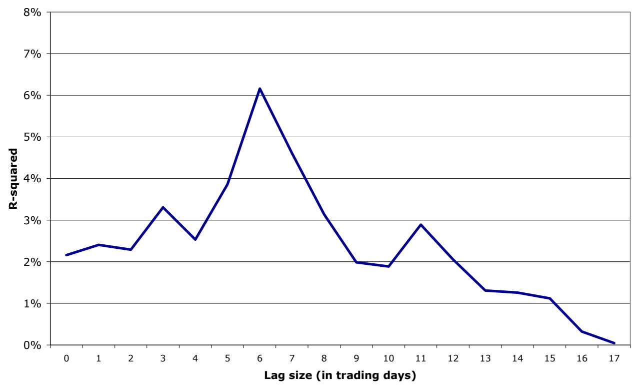


Figure 4a and 4b. Explanatory power for sub-periods.

Notes: R-squared of the regressions $r_t = \mu + \alpha_1 r_{t-1}^{oil} + \varepsilon_t$ with different lag sizes between West Texas monthly oil price returns and monthly world market index returns over the period May 1983 - April 1993 and May 1993 - April 2003, respectively.