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SHORT-RUN AND LONG-RUN OIL PRICE SENSITIVITY OF EQUITY RETURNS: THE SOUTH ASIAN MARKETS

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This paper examines the short-run and the long-run oil price sensitivity of Indian, Pakistani and Sri Lankan equity returns using industry share price indices that are common between at least two countries. A generalised method of moments based approach is applied to a market model augmented by an oil price factor. Results are estimated using both domestic and US dollar oil prices. Several industries (e.g. chemicals, engineering and machinery, food processors and transport) are found to be statistically significantly sensitive to the oil price factor in the long run, whereas no such sensitivity is detected in the short run. Our results indicate that longer period return generating intervals might offer a better setting in which to explore the oil price sensitivity of stock market returns in the South Asian markets. Currency of measurement of oil price appears to be irrelevant.

JEL Classifications: *C20; G12; Q49*

Keywords: *South Asian markets, Short run and Long run, Oil price sensitivity.*

INTRODUCTION

Explaining the behaviour of equity returns is an issue of ongoing research in finance. In particular, understanding the factors that impact the equity returns of companies and/or portfolios is an issue of utmost relevance and importance for the investor community. There is an abundance of published papers focused on this issue (asset pricing literature), but there appears to be no consensus about the nature and number of factors that play a role in determining equity returns.

One such candidate as a factor in asset pricing is the price of crude oil and, given its dramatic and volatile movement in recent years, it is now quite opportune to augment the existing research on its importance in equity markets. Some studies indicate that higher oil prices have an adverse effect on the economy, which, in turn, is likely to be reflected in the equity markets. For example, Huang *et al*. (1996) opine that if oil plays an important role in an economy, one would expect changes in oil price to be correlated with changes in stock prices. Mussa (2000) argues that an increase in the oil price, by affecting economic activity, corporate earnings, inflation and monetary policy, has implications for asset prices and financial markets.[1] Using oil price as one of the

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measures of economic activity, Cheung and Ng (1998) provide empirical evidence of long-run comovements between the stock markets of five developed countries (Canada, Germany, Italy, Japan and the USA) and their aggregate economic activity. Hammoudeh and Li (2004) show that oil price growth is being priced in the returns demanded by investors in the US oil and transportation industries. They find similar evidence in relation to the stock markets of Mexico and Norway.

The present paper aims to examine the oil price sensitivity of three South Asian stock markets; namely, India, Pakistan and Sri Lanka; over short-run (weekly) and long-run (half-yearly and yearly) intervals. All these countries are experiencing a high demand for energy as a result of economic development and population growth. Moreover, according to recent data these three countries represent virtually all the energy consumption by the South Asian region (see Section 2). Furthermore, the emerging capital markets, such as those covered in the present study, are attracting investor attention from all over the world. This is the first study that looks into the short-run and the long-run oil price sensitivity of Indian, Pakistani and Sri Lankan equity prices. We expect that the long-run estimates could be different from the short-run (weekly) estimates for several reasons. First, the impact of oil prices might take a long time before being reflected in the earnings of companies and, hence, their share prices. Investors will be looking to assess the longer-term trends in oil prices, as these reflect the longer-term impact on companies operations, which apart from anything else will be much harder to hedge or absorb at the corporate level. Second, the delay in impact could occur because of pricing regulations, which are common practice in all three countries covered in the present study. Third, the longer return intervals have the potential to smooth out the outliers and to minimise their impact on the sensitivities. However, we do not rule out the possibility of an informational effect of oil price fluctuations, as the capital markets appear to be highly sensitive to oil price news.

The remainder of the paper is organised as follows. Section 2 gives a brief background to the importance of oil in South Asian economies. Section 3 presents a view of the data followed by a brief literature discussion in Section 4. The empirical framework is outlined in Section 5, results are discussed in Section 6 and Section 7 concludes.

THE IMPORTANCE OF OIL IN SOUTH ASIAN ECONOMIES

For several years, India, Pakistan and Sri Lanka have been experiencing a high demand for energy as a result of economic development and population growth. According to Energy Information Administration estimates for 2002 (see Energy Information Administration (EIA) reports),[2] India, Pakistan and Sri Lanka accounted for approximately 96% of total energy consumption in South Asia.[3] India, the major energy consumer in the region, accounted for approximately 84% alone. Overall, South Asia accounted for approximately 4.1% of world energy consumption in 2002, up from 2.8% in 1991. Although, based on per capita energy consumption, South Asian countries are among the lowest consumers of energy worldwide, they are among the highest consumers of energy per unit of GDP.

Oil constitutes a major component of energy consumption in India, Pakistan and Sri Lanka. Specifically, in 2002 oil accounted for approximately 32, 43 and 82% of total energy consumption in the three countries, respectively. All these countries are net importers of oil, and notably the pricing of petroleum products is regulated, e.g. fuel subsidies are a common feature.

Faced with the challenges of rising demand, inadequate supplies and increasing prices of energy, the respective governments are under pressure to make reforms and are inviting participation by the private sector. For example, in April 2002, the Indian Government ended the administered pricing mechanism (APM) for petroleum product prices. The APM used to offset the effects of crude oil price changes on retail prices. Although the Indian Government is keen for privatisation of the energy sector, many of the leading energy firms in India (e.g. Hindustan Petroleum, Bharat Petroleum and Indian Oil Corporation) are still under government control, and there is strong political opposition to their privatisation.

In Pakistan, the government owned Pakistan State Oil (PSO) holds 60% of domestic diesel fuel market share and has more than 3800 retail outlets in Pakistan. The largest oil firm in Pakistan, Pakistan Petroleum Limited (PPL), is 93% owned by the government. However, now the government is under pressure to weaken its control and a majority stake (51%) in both PSO and PPL is open for sale to private parties. Sri Lanka has no domestic oil production, and all crude oil is sourced by imports. The Sri Lankan Government is stepping up its efforts to expand domestic exploration: in July 2003, it approved both private and foreign investment in its offshore oil and gas fields.

Furthermore, despite efforts of reforms and privatisation in South Asian countries, government influence over pricing mechanisms remains. For example, although the administered pricing mechanism in India officially ended in April 2002, subsidies on some petroleum products are still being maintained as a means of providing relief to low income families. In addition, State owned oil and gas companies in India are still required to seek approval from the concerned Ministry for any proposed changes in retail prices of petroleum products. Consequently, it is unlikely that world oil prices are fully reflected in retail prices (of petroleum products) in the short run. This appears to be the case over the period covered in the present study. The EIA report on India argues that ‘This (i.e. the practice of administered pricing mechanism) has, in practice, limited movements in retail prices in response to fluctuations in world oil prices’ (www.eia.doe.gov/emeu/cabs/India/Oil.html). However, keeping in mind the fact that the governments of India, Pakistan and Sri Lanka usually run deficit budgets,[4] it is unlikely that they are able to delay the flow of world oil price increases into retail prices in the long run.

DATA

This study focused on South Asian countries for which data are available; namely, India, Pakistan and Sri Lanka. The data used are weekly Datastream calculated ‘total return’ indices for industries/sectors based on the Financial Times Stock Exchange classification. Total return indices show a theoretical growth in value of a holding over a specified period, assuming that dividends are re-invested to purchase additional units at the closing price applicable on the ex-dividend date. The composition of Datastream indices is governed by a set of rules that ensures that they remain relevant to the market. For example, indices are based on a representative list for each market and the index constituents are reviewed on a periodic basis. As part of the review process, de-listed stocks are removed on notification and new stocks are added subject to meeting the ‘suitability for inclusion’ criteria.

To be able to compare the results across countries, we choose only those industry indices that are common among at least two countries.[5] Consequently, we are left with 13 Indian industry indices and 11 and 5 industry indices, respectively, for Pakistan and Sri Lanka. Of these industries, 3 (banks, food processors and general industrials) are common for all the three countries. The number of companies used in calculation of indices (i.e. constituents of the indices) varies from market to market. For example, the Indian banks index is based on the equity prices of 13 leading banks in India, whereas the number of banks in the corresponding Pakistani and Sri Lankan indices is 9 and 6, respectively. The number of constituents of an index appears to be largely influenced by the relevance of a particular industry to the specific country. For instance, the 'general industrials' index for India includes 19 companies compared to 1 for Pakistan and 6 for Sri Lanka.

The sample period covers January 1990 to June 2004 for India and Sri Lanka, but for Pakistan from July 1992 to June 2004. Market returns are based on the Datastream total market index for each country. The total market index for India is based on 100 leading companies whereas the number of constituents in the market indices for Pakistan and Sri Lanka is 50 each. Considering that the Organization of Petroleum Exporting Countries (OPEC) is the main oil supplier for the countries in the present study, we use the OPEC (spot) oil price, measured in US dollars. The domestic currency OPEC oil prices used in this study have been obtained by applying the exchange rate between the US dollar and the domestic currency of respective country. Graphs in Figure 1 show movements in the stock markets of India, Pakistan and Sri Lanka, their domestic currency oil prices and the common sample of industry indices covered in the present study. Figure 2 shows relative movement in the domestic currency oil prices as compared to the international oil price determined in US dollars.

Considering that the oil price is central to the present study and that oil-price growth (OPG) is the main variable to be focused on in the empirical analysis, a complete summary of OPG in terms of local currencies and the US dollar is presented in Table 1. We define OPG as the natural logarithm of oil price relatives $[\log(P_t/P_{t-1})]$. In other words, OPG represents continuously compounded return implied by the price change from the beginning to end of a selected interval. Table 1 includes OPG summary statistics for short and long intervals; namely, weekly (W), half-yearly (HY; 26 weeks) and yearly (Y; 52 weeks). It is worth noting here that as the original data is weekly, the longer interval measures involve overlapping observations. For example, half-yearly OPG values are determined as $\log(P_t/P_{t-26})$, where 26 represents the approximate number of weeks in a half year. The primary reason for applying the overlapping technique is to allow sufficiently large sample sizes for the relatively longer intervals of measurement.

In general, one would expect the larger measurement intervals to generate larger returns. For example, half-yearly returns are more likely to be higher than weekly returns. Accordingly, longer period mean and median OPG values must be larger than that of smaller periods. Moreover, the more distant the period (future or past), the smaller should be the correlations between the OPG values. As can be seen from Table 1, the longer period OPG summary statistics and correlations are in line with general expectations. Therefore, the use of overlapping intervals is justifiable.

LITERATURE REVIEW

Studies such as Hamilton (1983), and Gisser and Goodwin (1986) indicate the existence of an adverse linkage between oil price shocks and the macroeconomy. International Monetary

Figure 1: Plots of Domestic Oil Prices, Stock Market Indices and Common Industry Indices

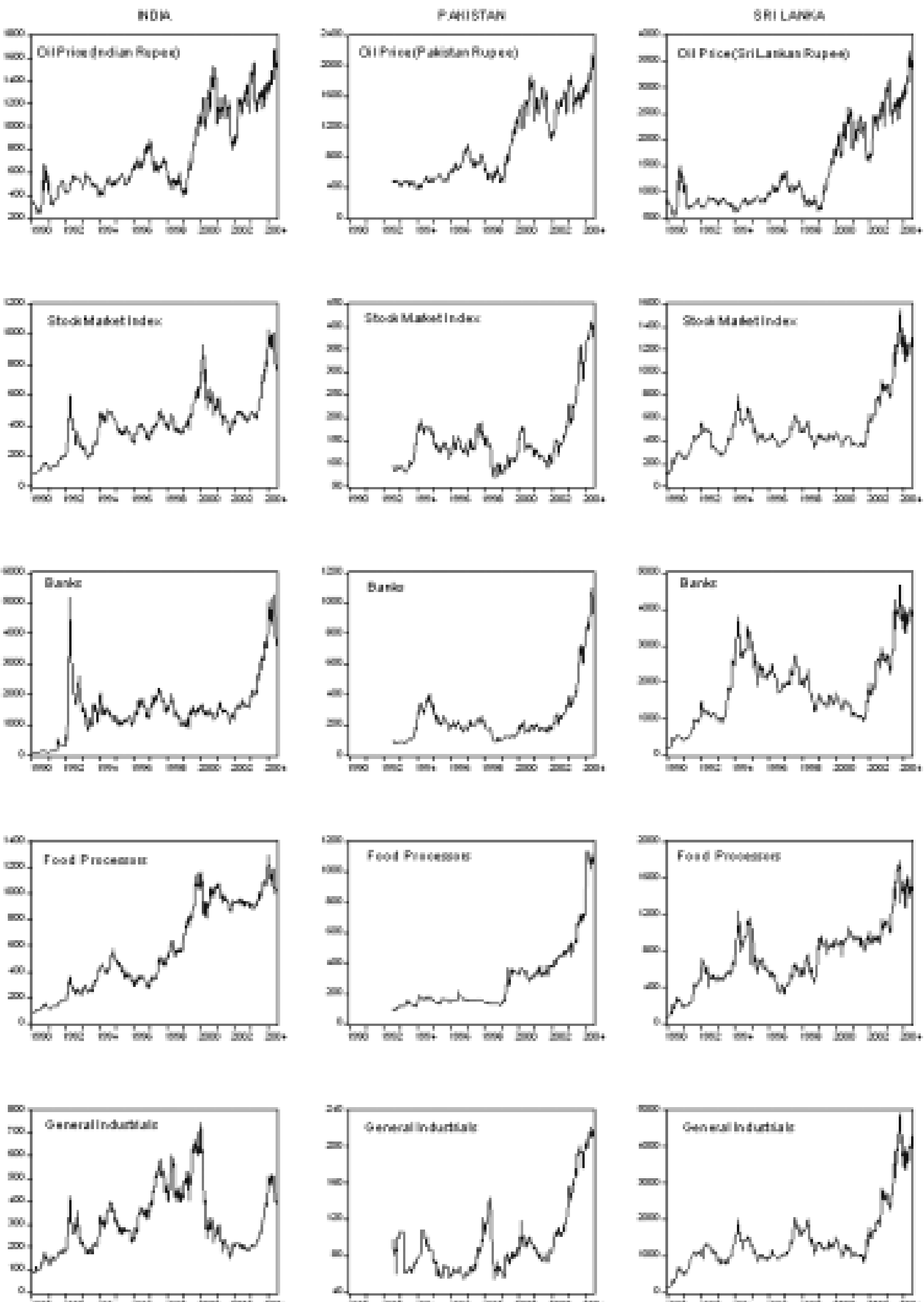

Figure 2: Plots of Domestic Currency and US dollar Oil Prices (base 22/7/1992 = 100)

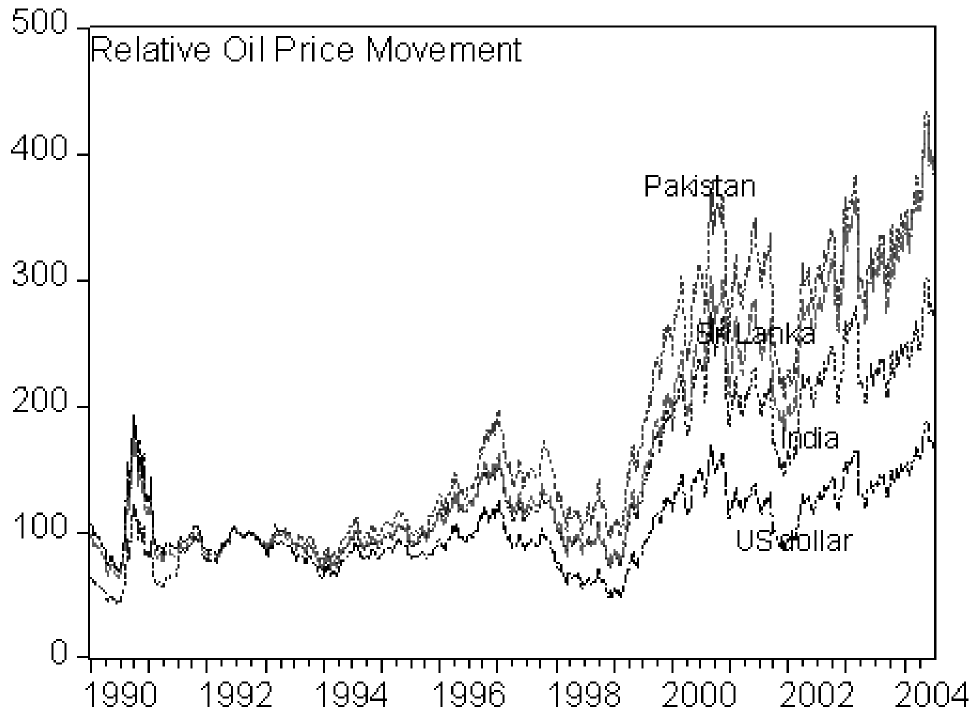

Table 1
Oil Price Growth (OPG) Summary Statistics and Correlations for Short and Long Measurement Intervals

	Indian rupee			*Pakistani rupee*			*Sri Lankan rupee*			*US dollar*		
Summary statistics	*WR*	*HYR*	*YR*	*WR*	*HYR*	*YR*	*WR*	*HYR*	*YR*	*WR*	*HYR*	*YR*
Mean	0.002	0.058	0.097	0.002	0.060	0.119	0.002	0.056	0.092	0.001	0.023	0.026
Median	0.003	0.047	0.071	0.004	0.065	0.082	0.005	0.054	0.079	0.002	0.027	0.016
Standard deviation	0.048	0.247	0.281	0.043	0.212	0.293	0.048	0.246	0.293	0.048	0.249	0.300
Observations	756	731	705	623	598	572	756	731	705	756	731	705
WR	1.00	0.12	0.19	1.00	0.17	0.18	1.00	0.13	0.18	1.00	0.14	0.17
HYR		1.00	0.53		1.00	0.68		1.00	0.57		1.00	0.58
YR			1.00			1.00			1.00			1.00

Notes: Data period: India and Sri Lanka (weekly, January 1990 to June 2004); Pakistan (weekly, July 1992 to June 2004). OPG is defined as the natural logarithm of oil price relatives [$\log(P_t/P_{t-1})$], over the selected intervals; namely, weekly (W), half-yearly (HY, 26 weeks) and yearly (Y, 52 weeks). For example, half-yearly OPG values are determined as $\log(P_t/P_{t-26})$, where 26 represents the approximate number of weeks in a quarter. Because the original data is weekly, the non-weekly measures involve overlapping. As the oil price is quoted in US dollars, the prices in domestic currencies have been converted from the Organization of Petroleum Exporting Countries oil price by applying the exchange rates of respective countries.

Fund studies also support the view that higher oil prices have a detrimental impact on the global economy. For example, Mussa (2000) estimates that an increase of $US5 per barrel in the oil price is likely to reduce the level of global output by approximately one-quarter of 1 percentage point over the first 4 years. It is commonly argued that increases in oil price would cause a rise in production costs leading to a fall in economic activity. This in turn would lower expected future cash flows and, hence, stock prices. Consistent with this argument, Jones and Kaul (1996) provide evidence that aggregate stock market returns in the USA, Canada, Japan and the UK are negatively sensitive to the adverse impact of oil price shocks on the economies of these countries.

In an industry focused study using Australian data, Faff and Brailsford (1999) report significant positive oil price sensitivity of oil and gas, and diversified resources industries. In contrast, industries like paper and packaging, banks and transport appear to demonstrate a significant negative sensitivity to oil price hikes. A firm-specific study by Al Mudhaf and Goodwin (1993) examines the returns from 29 oil companies listed on the New York stock exchange. Their findings suggest a positive impact of oil price shocks on the *ex post* returns for firms having significant assets in domestic oil production. Likewise, Sadorsky (2001) shows that stock returns of Canadian oil and gas companies are positively sensitive to oil price increases. Papapetrou (2001) finds that the oil price is an important factor in explaining stock price movements in Greece. However, Chen *et al.* (1986) argue that there is no special reward for oil price risk in the stock market. Huang *et al*. (1996) conclude that the influence of oil price shocks on the aggregate economy is far from a reality. However, Ciner (2001) contradicts the findings of Huang *et al.*, and calls for further research to produce evidence from international equity markets to support the robustness of results.

Results reported in the abovementioned published literature suggest that although a higher oil price is generally bad news for economic growth, the direction of impact on equity returns might vary because of other factors. For example, most fundamentally, it would matter whether oil is an input or output for an industry. Furthermore, there is the possibility that some industries might be in a position to pass on higher fuel costs to their customers, thus minimising the negative impact of higher oil prices on their profitability. The degree of competition or concentration within an industry, as well as the degree of price elasticity, is likely to have a considerable bearing on this ‘pass-through’ effect. Additionally, higher oil prices might influence some financial markets indirectly through monetary policy, consumer confidence, employment and so forth. Furthermore, crude oil and its derivatives have a vastly complex array of by-products. It would be hard to think of a commodity that can be utilised across such a huge range of products (e.g. aviation fuel, shampoo and shoes). As a consequence of the negative impact of oil price shocks on the economy, and oil being a direct or an indirect input for many industries, one might expect a negative impact on most of the industries except a few like oil production and exploration. More importantly, considering the presence of pricing regulation and fuel subsidies in all the countries in the present study, it is quite likely that the oil price rises might have delayed impact (e.g. half-yearly or yearly basis), which might not be captured on a weekly or monthly basis.

EMPIRICAL FRAMEWORK

Numerous asset pricing studies show that the market factor is a significant, but not the only determinant of stock price returns. With a view to examine the significance of the oil price in determining stock market returns, this study applies a standard market model augmented by the oil price growth factor. Such models have been widely used in the published literature (Al-Mudhaf and Goodwin, 1993; Faff and Brailsford, 1999; Sadorsky, 2001). For a specific share price index i, the basic model can be expressed as:

$$R_{it} = \alpha_i + \beta_{1i} R_{mt} + \gamma_{1i} OPG_{DC\,t} + \varepsilon_{i\,t}, \quad (1)$$

where α_i is the intercept, β_{1i} is the market exposure and γ_{1i} is the domestic currency oil price exposure (or domestic currency OPG gamma) for the ith industry. R_{it} is the return on the ith asset (i.e. industry index) in period t. R_{mt} and OPG_{DCt} are the market return and domestic currency oil price growth implied by the corresponding indices over period t. A typical return, R_t, is measured as $Ln(P_t/P_{t-1})$, where P_t and P_{t-1} are index values at the end and beginning of period t.

Furthermore, as argued by Faff and Brailsford (1999), an additional dimension of investing in international portfolios is hedging for foreign exchange risk. Because oil price is determined in a global market denominated in US dollars, the foreign exchange risk against the US dollar becomes more relevant. Consequently, we can think of the domestic currency oil price factor composed of a pure oil price factor (denominated in US dollars) and an exchange rate factor against the US dollar. As we derive the domestic oil prices from the US dollar price by applying the corresponding exchange rates, we can test the restriction in (1) by implementing the following model:[6]

$$R_{it} = \alpha_i + \beta_{2i} R_{m\,t} + \gamma_{2i} OPG_{US\,t} + \delta_i R_{xr\,t} + \varepsilon_{it}. \quad (2)$$

Additional to the explanations provided under model 1, here $R_{xr\,t}$ is the exchange rate return from holding US dollars and is defined as, $R_{xr\,t} = Ln(XR_t / XR_{t-1})$ such that XR is the number of domestic currency units per $US1 (e.g. if US$1 = 40 Indian rupees, then XR = 40). OPG_{US} indicates US dollar oil price growth, and γ_{2i} is the US dollar oil price exposure of the ith industry. It is important to note that equality of γ_{2i} and δ_i coefficients will indicate that exchange rate has no influence on returns except through its impact on oil price converted to domestic currency. Furthermore, the rejection of the null, $\gamma_{2i} = \delta_I$, would suggest that equation (1) is misspecified.

To examine the long-run impact, we estimate the results for half-yearly and yearly intervals using models 1 and 2.[7] As mentioned previously, to have sufficiently large sample sizes for longer intervals, we use overlapping observations for measuring the half-yearly and yearly returns. The use of overlapping data is common in the published literature, particularly when conducting studies with longer period returns. It is argued that tests with annual returns yield relatively more powerful results; however, as the longer period return data are not available in sufficient numbers, desired tests are made feasible by taking this approach. Fama and French (1988) and Handa *et al.* (1993) are among many others who use overlapping data to generate annual returns used in their studies.

A major drawback of this approach is that the overlapping process induces autocorrelated errors and heteroskedasticity and, consequently, ordinary least squares inferences might be unreliable. MacKinlay and Richardson (1991) suggest that generalised method of moments (GMM) based tests are potentially more robust than commonly used tests that rely on unrealistic assumptions about the distribution of asset returns. GMM was first introduced by Hansen (1982), and as the name suggests, is a very general estimation method. Most of the commonly used estimation methods (e.g. ordinary least squares, generalised least squares and instrumental variables estimation) can be considered as special cases of GMM. GMM is a robust estimator in that it does not require strong assumptions regarding the distribution of the disturbances. GMM estimation is based upon the assumption that the disturbances in the equations are uncorrelated with a set of instrumental variables. The GMM estimator selects estimates so that the correlations between the instruments and disturbances are as close to zero as possible, as defined by a criterion function. Considering such attractive properties, GMM appears to be the most suitable approach for this study. To avoid further complexity (additional to overlapping), we choose the regressor variables to be instruments for themselves (see MacKinlay and Richardson, 1991). For more on applications of GMM see, for example, Faff and Lau (1997) and Baum *et al.* (2003).

DISCUSSION OF RESULTS

This study examines the oil price sensitivity of Indian, Pakistani and Sri Lankan share price industrial indices (see data section for sample details). Results are estimated for the domestic currency oil prices and US dollar oil price using models 1 and 2, respectively. Some preliminary results for the non-overlapping weekly data, which includes market beta and commonly used diagnostics, are reported in Table 2. From Table 2, it is clear that all the beta estimates (except for Pakistan engineering and machinery) are statistically significant at the 1% level, and the goodness of fit of the equations (as indicated by the Durbin-Watson test and adjusted R^2) are mostly encouraging. Specifically, we see that all Durbin–Watson values lie very close to the theoretically preferred value of 2: the minimum case being 1.76 (Indian banks), while the maximum case is 2.36 (Sri Lankan general industrials). Also, in terms of R^2 the values are generally quite high: for example, Indian basic industries; Pakistani chemicals and utilities; and Sri Lankan banks all exhibiting figures above 70%. There are only 5 cases in which R^2 is less than 20% and these all occur for Pakistani industries.

Considering that our primary focus is on the oil price, the short-run oil price sensitivity estimates (i.e. weekly gammas) are presented in Table 3 and the long run (half-yearly and yearly) results are shown in Table 4. The market beta estimates are shown in separate tables in the Appendix, and briefly it is worth mentioning that all the beta estimates (except Pakistan engineering and machinery corresponding to weekly returns) for both models 1 and 2 are statistically significant at the 1% level.

For a discussion on oil price sensitivity, let us begin with the short-run estimates in Table 3. The resources sector in India and the banks in Pakistan and Sri Lanka exhibit short-run statistically significant sensitivity to the oil price factor irrespective of whether the oil price factor is measured in domestic currency or US dollar terms. Exchange rates appear to play no significant role except in the case of Indian Electricity. Wald tests also indicate that exchange rates have no influence on equity returns except through their impact on oil prices converted to domestic currency. Of course, Pakistani banks are an exception where rejection of the null hypothesis of equality by the Wald test might indicate that equation (1) is misspecified in this case. It is

Table 2
Some Preliminary Results

Industry/ Sector	India β_{1i} (t-stat)	India γ_{1i} (t-stat)	India DW	India Adjusted R^2	Pakistan β_{1i} (t-stat)	Pakistan γ_{1i} (t-stat)	Pakistan DW	Pakistan Adjusted R^2	Sri Lanka β_{1i} (t-stat)	Sri Lanka γ_{1i} (t-stat)	Sri Lanka DW	Sri Lanka Adjusted
Auto parts	0.6100 (10.59)	–0.0227 (–0.50)	2.0517	0.2722	0.5715 (6.62)	0.0369 (0.57)	2.0438	0.1261	— —	— —	—	—
Banks	1.0216 (10.11)	0.0813 (1.37)	1.7644	0.3112	0.9575 (20.99)	0.0754 (2.32)	2.1900	0.5637	1.0837 (11.82)	–0.0619 (–3.48)	2.2267	0.7574
Basic industries	0.8691 (18.15)	–0.0015 (–0.08)	2.1801	0.7140	— —	— —	—	—	0.6641 (11.04)	0.0225 (0.90)	2.1744	0.4564
Chemicals	0.7985 (14.36)	–0.0102 (–0.46)	2.2734	0.6024	0.9204 (25.10)	–0.0080 (–0.38)	2.0058	0.7493	— —	— —	—	—
Electricity	0.9463 (11.64)	0.0923 (1.77)	2.0159	0.3853	1.1867 (21.65)	–0.0117 (–0.33)	2.1646	0.6218	— —	— —	—	—
Engineering and machinery	0.7562 (14.05)	0.0406 (1.50)	2.0820	0.3773	0.1828 (1.69)	–0.0600 (–1.13)	1.8816	0.0104	— —	— —	—	—
Food processors	0.6219 (14.67)	–0.0108 (–0.59)	2.1776	0.4704	0.1697 (3.01)	0.0188 (0.43)	2.2651	0.0251	0.9181 (9.94)	–0.0145 (–0.45)	2.3208	0.3861
General industrials	0.9688 (21.02)	0.0044 (0.25)	2.0375	0.6565	0.4489 (6.30)	0.0218 (0.55)	2.1757	0.1423	1.0581 (10.78)	0.0270 (0.90)	2.3593	0.6122
Leisure and hotels	0.8019 (5.80)	–0.0036 (–0.09)	2.1972	0.2661	— —	— —	—	—	0.7729 (8.84)	–0.0289 (–1.21)	2.1421	0.3960
Pharmaceuticals	0.7282 (16.23)	0.0295 (1.16)	2.0783	0.3282	0.2036 (5.24)	0.0155 (0.41)	1.8951	0.0485	— —	— —	—	—
Resources	1.0650 (6.47)	–0.0763 (–2.28)	2.0540	0.4044	0.8489 (17.22)	0.0343 (1.20)	1.9814	0.5778	— —	— —	—	—
Transport	0.8732 (10.52)	0.0280 (0.70)	1.9836	0.3198	1.0426 (11.09)	–0.0191 (–0.29)	2.1813	0.3133	— —	— —	—	—
Utilities	0.9412 (11.52)	0.0827 (1.63)	1.9921	0.3923	1.1966 (30.09)	–0.0027 (–0.10)	2.1443	0.7489	— —	— —	—	—

Notes: This table reports the results from estimating:

$$R_{it} = \alpha_i + \beta_{1i} R_{mt} + \gamma_{1i} OPG_{DC,t} + \varepsilon_{1it}, \quad (1)$$

where R_{it} is the return on the ith industry index in period t and R_{mt} is the market return. A typical return, R_t, is measured as $\log(P_t/P_{t-1})$, where P_t and P_{t-1} are index values at the end and beginning of period t. OPG is the oil price growth measured in domestic currency (DC) oil prices. Empty spaces indicate that results are not available as the corresponding data does not exist.

Table 3
Domestic Currency and US Dollar Oil Price Sensitivity Estimates using Weekly Data

	India				Pakistan				Sri Lanka			
Industry/Sector	*Oil_dcg* γ_{1i} (t-stat)	*Oil_us* γ_{2i} (t-stat)	δ_i (t-stat)	*Wald:* $\gamma_{2i} = \delta_i$ (p-value)	*Oil_dc* γ_{1i} (t-stat)	*Oil_us* γ_{2i} (t-stat)	δ_i (t-stat)	*Wald:* $\gamma_{2i} = \delta_i$ (p-value)	*Oil_dc* γ_{1i} (t-stat)	*Oil_us* γ_{2i} (t-stat)	δ_i (t-stat)	*Wald:* $\gamma_{2i} = \delta_i$ (p-value)
Auto parts	–0.0227	–0.0237	0.0081	0.0334	0.0369	0.0466	–0.1397	1.1885	—	—	—	—
	(–0.50)	(–0.51)	(0.05)	(0.86)	(0.57)	(0.72)	(–0.81)	(0.28)	—	—	—	—
Banks	0.0813	0.0467	1.1207	2.0780	0.0754	0.0938	-0.2622	6.4523	-0.0619	-0.0648	0.0919	3.4813
	(1.37)	(1.02)	(1.48)	(0.15)	(2.32)	(2.93)	(–1.89)	(0.01)	(–3.48)	(–3.61)	(1.13)	(0.06)
Basic Industries	–0.0015	0.0013	–0.0866	0.5989	—	—	—	—	0.0225	0.0238	–0.0440	0.3233
	(–0.08)	(0.07)	(–0.76)	(0.44)	—	—	—	—	(0.90)	(0.93)	(–0.38)	(0.57)
Chemicals	–0.0102	–0.0035	–0.2104	2.0091	–0.0080	–0.0102	0.0321	0.2780	—	—	—	—
	(–0.46)	(–0.16)	(–1.44)	(0.16)	(–0.38)	(–0.47)	(0.41)	(0.60)	—	—	—	—
Electricity	0.0923	0.0801	0.4599	3.3745	–0.0117	–0.0066	–0.1045	0.5331	—	—	—	—
	(1.77)	(1.48)	(2.35)	(0.07)	(–0.33)	(–0.18)	(–0.82)	(0.47)	—	—	—	—
Engineering and	0.0406	0.0374	0.1357	0.3296	–0.0600	–0.0598	–0.0630	0.0002	—	—	—	—
machinery	(1.50)	(1.37)	(0.80)	(0.57)	(–1.13)	(–1.12)	(–0.30)	(0.99)	—	—	—	—
Food processors	–0.0108	–0.0086	–0.0780	0.3435	0.0188	0.0213	–0.0279	0.1143	–0.0145	–0.0156	0.0425	0.1457
	(–0.59)	(–0.47)	(–0.66)	(0.56)	(0.43)	(0.47)	(–0.20)	(0.74)	(–0.45)	(–0.49)	(0.28)	(0.70)
General industrials	0.0044	0.0075	–0.0897	1.1891	0.0218	0.0195	0.0637	0.0972	0.0270	0.0327	–0.2735	3.7307
	(0.25)	(0.41)	(–1.05)	(0.28)	(0.55)	(0.47)	(0.48)	(0.76)	(0.90)	(1.06)	(–1.81)	(0.05)
Leisure and otels	–0.0036	0.0031	–0.2035	0.2095	—	—	—	—	–0.0289	–0.0305	0.0543	0.2117
	(–0.09)	(0.08)	(–0.45)	(0.65)	—	—	—	—	(–1.21)	(–1.23)	(0.30)	(0.65)
Pharmaceuticals	0.0295	0.0239	0.1983	0.8577	0.0155	0.0238	–0.1360	1.8211	—	—	—	—
	(1.16)	(0.95)	(1.06)	(0.35)	(0.41)	(0.61)	(–1.20)	(0.18)	—	—	—	—
Resources	–0.0763	–0.0724	–0.1936	0.5130	0.0343	0.0358	0.0059	0.0703	—	—	—	—
	(–2.28)	(–2.10)	(–1.18)	(0.47)	(1.20)	(1.24)	(0.05)	(0.79)	—	—	—	—
Transport	0.0280	0.0106	0.5487	2.6285	–0.0191	–0.0064	–0.2511	1.4672	—	—	—	—
	(0.70)	(0.28)	(1.66)	(0.11)	(–0.29)	(–0.09)	(–1.31)	(0.23)	—	—	—	—
Utilities	0.0827	0.0731	0.3707	2.0973	–0.0027	0.0023	–0.0941	0.8312	—	—	—	—
	(1.63)	(1.39)	(1.89)	(0.15)	(-0.10)	(0.08)	(–0.92)	(0.36)	—	—	—	—

Notes: This table reports the oil price sensitivity estimates (γ_1 and γ_2) and exchange rate exposure estimates (δ) from estimating:

$$R_{it} = \alpha_i + \beta_{1i} R_{m\,t} + \gamma_{1i}\, OPG_{DC\,t} + \varepsilon_{1it} \quad (1)$$

$$R_{it} = \alpha_i + \beta_{2i} R_{m\,t} + \gamma_{2i}\, OPG_{US\,t} + \delta_i R_{xr\,t} + \varepsilon_{2it}, \quad (2)$$

where R_{it} is the return on the ith industry index in period t and R_{mt} is the market return. A typical return, R_t, is measured as $\log(P_t/P_{t-1})$, where P_t and P_{t-1} are index values at the end and beginning of period t. OPG is the oil price growth measured in domestic currency (DC) and US dollar oil prices. Oil_dc indicates oil price is measured in domestic currency by using the Organization of Petroleum Exporting Countries (OPEC) oil price and corresponding exchange rates. Oil_us indicates OPEC oil price measured in US dollars. Empty spaces indicate that results are not available as the corresponding data does not exist.

interesting to note that the banks in Pakistan show positive sensitivity, which directly contradicts the negative oil price sensitivity of banks in Sri Lanka. This contradiction might indicate that oil price rises are generally good news (in the short run) for banks in Islamic countries, and bad/no news elsewhere. Compared to short-run results, we now turn our attention to see if a different story is being revealed by the long-run results in Table 4.

First, we notice (from Table 4) that the number of Industries with statistically significant gammas (based on yearly returns), is much higher (India, 7; Pakistan, 7; and Sri Lanka, 3) compared to a solitary counterpart for each country in the short run. Perhaps this is an indication that longer period return generating intervals might offer a better explanation for the oil price sensitivity of equity returns in South Asian markets. As mentioned earlier, because of the regulated nature of fuel pricing in all three countries, it could take time before the price change is allowed to impact on the consumers and firms. Furthermore, maybe the financial markets of countries covered in this study are more responsive to actual earnings results than the more frequent international news of oil price. Considering that the impact of oil price might take time to be reflected through earnings, the possibility of a long-run association between oil price growth and stock market returns is not ruled out. Second, similar to the short-run estimates, the equity returns appear to be independent from the influence of exchange rates except through its impact on oil price converted to domestic currency. Barring a few exceptions (auto parts and transport in Pakistan, and the banks in Sri Lanka), if a long-run gamma is statistically significant, it is significant for both the domestic currency and US dollar measures of the oil price.

Overall, we also find some disparities in the results across the countries covered in the study. For example, the Indian resources sector shows statistically significant negative sensitivity (both in the short run and long run) against the positive oil price sensitivity of the Pakistani resources sector. Furthermore, short-run results for the banking sector are statistically significant for both Pakistan and Sri Lanka, but they have opposite signs. Long-run estimates for Pakistani food processors exhibit statistically significant positive sensitivity against significant negative sensitivities of that sector in India and Sri Lanka. However, considering that these countries have many differing characteristics (e.g. democratic system in India, military rule in Pakistan and a long continuing civil war in Sri Lanka), different results are not surprising.

SUMMARY AND CONCLUSIONS

Using Indian, Pakistani and Sri Lankan industry share price indices, this study examines short-run and long-run oil price sensitivity of equity returns. We apply a standard market model augmented by an oil price factor measured in terms of domestic as well as US dollar oil prices. A GMM based approach is applied to estimate short-run (weekly) and long-run (half-yearly and yearly) results. Several industries appear to be significantly sensitive to the oil price factor in the long run, whereas no such sensitivity is detected in the short run. This might be an indication that because of the regulated nature of fuel pricing in all the three countries, it could take time before the price change is allowed to impact consumers and firms. Furthermore, the currency of measurement of the oil price factor (domestic currency or US dollar price) appears to be irrelevant. In most cases analysed, if the results are found to be statistically significant, they are significant for both the domestic currency and US dollar measures. However, results are not consistent across all countries, which might because of disparities across countries.

Table 4
Domestic Currency and US Dollar Oil Price Sensitivity Estimates using Half-Yearly (HY) and Yearly (Y) Returns

	India				Pakistan				Sri Lanka			
	Oil_dc		Oil_us		Oil_dc		Oil_us		Oil_dc		Oil_us	
Industry/Sector	$\gamma_{1i\,HY}$	$\gamma_{1i\,Y}$	$\gamma_{2i\,HY}$	$\gamma_{2i\,Y}$	$\gamma_{1i\,HY}$	$\gamma_{1i\,Y}$	$\gamma_{2i\,HY}$	$\gamma_{2i\,Y}$	$\gamma_{1i\,HY}$	$\gamma_{1i\,Y}$	$\gamma_{2i\,HY}$	$\gamma_{2i\,Y}$
Auto parts	0.0259	0.0035	0.0184	0.0003	–0.1308	–0.3892	–0.0713	–0.4188	—	—	—	—
	(0.35)	(0.03)	(0.25)	(0.00)	(–0.84)	(–1.89)	(–0.46)	(–2.25)	—	—	—	—
Banks	–0.1472	0.0548	–0.1914	0.1108	–0.0976	–0.2044	–0.1044	–0.2020	–0.0611	–0.0666	–0.0666	–0.0928
	(–1.26)	(0.35)	(–1.77)	(0.81)	(–1.83)	(–3.34)	(–1.90)	(–3.32)	(–1.72)	(–1.45)	(–1.86)	(–2.13)
Basic industries	0.0727	–0.0259	0.0807	–0.0377	—	—	—	—	0.1340	0.1937	0.1417	0.2156
	(2.19)	(–0.69)	(2.50)	(–1.05)	—	—	—	—	(3.60)	(4.92)	(4.00)	(5.28)
Chemicals	0.0614	–0.0652	0.0652	–0.0735	–0.1031	–0.1374	–0.1121	–0.1333	—	—	—	—
	(1.48)	(–1.97)	(1.56)	(–2.47)	(–2.75)	(–3.55)	(–3.09)	(–3.69)	—	—	—	—
Electricity	0.2154	–0.0439	0.2136	–0.0487	–0.0525	0.0809	–0.0729	0.0866	—	—	—	—
	(1.94)	(–0.49)	(1.91)	(–0.53)	(–0.79)	(1.01)	(–1.12)	(1.12)	—	—	—	—
Engineering and machinery	–0.1633	–0.5268	–0.1578	–0.5359	–0.4429	–0.5724	–0.4771	–0.5579	—	—	—	—
	(–2.77)	(–4.43)	(–2.60)	(–4.44)	(–2.60)	(–2.57)	(–2.82)	(–2.53)	—	—	—	—
Food processors	–0.0479	–0.1702	–0.0576	–0.1611	0.2469	0.3397	0.2780	0.3362	–0.0947	–0.1729	–0.0914	–0.1818
	(–1.22)	(–2.56)	(–1.40)	(–2.43)	(2.19)	(3.35)	(2.60)	(3.33)	(–1.55)	(–2.31)	(–1.50)	(–2.37)
General industrials	–0.0334	–0.2508	–0.0253	–0.2620	–0.0772	–0.1028	–0.0485	–0.1113	0.0636	–0.0056	0.0511	–0.0366
	(–0.75)	(–2.54)	(–0.55)	(–2.60)	(–0.93)	(–1.06)	(–0.59)	(–1.25)	(0.95)	(–0.14)	(0.82)	(–1.03)
Leisure and hotels	–0.0282	–0.2888	–0.0356	–0.2850	—	—	—	—	0.1776	0.2283	0.1699	0.2054
	(–0.33)	(–1.75)	(–0.41)	(–1.73)	—	—	—	—	(2.48)	(4.01)	(2.43)	(3.60)
Pharmaceuticals	–0.1221	–0.3834	–0.1368	–0.3733	–0.1056	–0.1077	–0.0930	–0.1140	—	—	—	—
	(–2.05)	(–3.67)	(–2.24)	(–3.53)	(–1.52)	(–1.30)	(–1.37)	(–1.43)	—	—	—	—
Resources	–0.2604	–0.4438	–0.2510	–0.4619	0.2013	0.2757	0.1958	0.2762	—	—	—	—
	(–3.31)	(–4.98)	(–3.15)	(–5.33)	(4.32)	(5.78)	(4.42)	(5.82)	—	—	—	—
Transport	–0.1351	–0.3797	–0.1856	–0.3470	0.3337	0.3292	0.3681	0.3175	—	—	—	—
	(–1.01)	(–2.74)	(–1.50)	(–2.68)	(1.94)	(2.06)	(2.15)	(2.01)	—	—	—	—
Utilities	0.2057	–0.1928	0.2037	–0.2002	–0.0212	0.1150	–0.0293	0.1158	—	—	—	—
	(1.81)	(–1.87)	(1.78)	(–1.90)	(–0.45)	(2.25)	(–0.65)	(2.27)	—	—	—	—

Notes: This table reports the oil price sensitivity estimates (γ_1 and γ_2) from estimating:

$$R_{it} = \alpha_i + \beta_{1i} R_{m\,t} + \gamma_{1i}\, OPG_{DC\,t} + \varepsilon_{1it} \quad (1)$$

$$R_{it} = \alpha_i + \beta_{2i} R_{m\,t} + \gamma_{2i}\, OPG_{US\,t} + \delta_i R_{xr\,t} + \varepsilon_{2it}, \quad (2)$$

where R_{it} is the return on the ith industry index in period t and R_{mt} is the market return. A typical return, R_t, is measured as log (P_t/P_{t-1}), where P_t and P_{t-1} are index values at the end and beginning of period t. OPG is the oil price growth measured in domestic currency (DC) and US dollar oil prices. Oil_dc indicates oil price is measured in domestic currency by using the OPEC oil price and corresponding exchange rates. Oil_us indicates Organization of Petroleum Exporting Countries (OPEC) oil price measured in US dollars. Half-yearly returns are measured as $\log(P_t/P_{t-26})$, where 26 is the number of approximate weeks in the half-year. Empty spaces indicate that results are not available as the corresponding data does not exist.

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NOTES

1. A research report prepared by the IMF's research department and approved by Michael Mussa.
2. South Asia: *www.eia.doe.gov/emeu/cabs/sasia.html#oil*
   India: *www.eia.doe.gov/emeu/cabs/India/Oil.html*
   Pakistan: *www.eia.doe.gov/emeu/cabs/Pakistan/Oil.html*
   Sri Lanka: *www.eia.doe.gov/emeu/cabs/srilanka.html#oil*
3. Indicates consumption of commercial energy; accordingly, does not include 'non-commercial' sources such as animal waste, wood, and other biomass.
4. See 2005 budget estimates in country factbooks at: *www.cia.gov/cia/publications/factbook/index.html*
5. Due to structural differences among the countries, some indices may be irrelevant or involve duplications. To deal with this problem, we had a pre-screening of industry indices which lead us to eliminate a number of duplicates and highly correlated indices.
6. Note that we determine the domestic currency oil price (DCOIL) by using $DCOIL_t = USOIL_t \times XR_t$, therefore, $Ln(DCOIL_t / DCOIL_{t-1}) = Ln(USOIL_t \times XR_t / USOIL_{t-1} \times XR_{t-1}) = Ln(USOIL_t / USOIL_{t-1}) + Ln(XR_t/XR_{t-1})$; hence, $OPG_{LCt} = OPG_{US\,t} + R_{xr\,t}$. Replacing $OPG_{LC\,t}$ in (1) with $OPG_{US\,t} + R_{xr\,t}$, we obtain equation (2).
7. The argument is that shorter sampling intervals are incapable of showing up the underlying relationship –either due to noise or due to the fact that the link is more long-term in nature. We will only be able to assess this if we go to the longer intervals and see what happens.

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APPENDIX

Table A1
Market Beta Estimates using Weekly (W), Half-Yearly (HY) and Yearly (Y) Returns for the Domestic Currency and US Dollar Oil Prices

	India						Pakistan						Sri Lanka					
	Oil_dc			Oil_us			Oil_dc			Oil_us			Oil_dc			Oil_us		
Industry/Sector	$\beta_{1i\,W}$	$\beta_{1i\,HY}$	$\beta_{1i\,Y}$	$\beta_{2i\,W}$	$\beta_{2i\,HY}$	$\beta_{2i\,Y}$	$\beta_{1i\,W}$	$\beta_{1i\,HY}$	$\beta_{1i\,Y}$	$\beta_{2i\,W}$	$\beta_{2i\,HY}$	$\beta_{2i\,Y}$	$\beta_{1i\,W}$	$\beta_{1i\,HY}$	$\beta_{1i\,Y}$	$\beta_{2i\,W}$	$\beta_{2i\,HY}$	$\beta_{2i\,Y}$
Auto parts	0.6100	0.7140	0.8245	0.6103	0.7156	0.8286	0.5715	0.7739	0.9737	0.5728	0.6133	0.6422	…	…	…	…	…	…
	(10.59)	(11.14)	(10.65)	(10.61)	(11.03)	(10.39)	(6.62)	(5.05)	(5.90)	(6.62)	(4.06)	(4.25)	…	…	…	…	…	…
Banks	1.0216	1.2837	1.2968	1.0317	1.2931	1.2256	0.9575	1.1646	1.2746	0.9599	1.1828	1.3014	1.0837	1.0836	1.0877	1.0833	1.0649	1.0362
	(10.11)	(6.62)	(7.39)	(9.66)	(7.21)	(10.43)	(20.99)	(20.40)	(22.94)	(20.96)	(19.61)	(22.85)	(11.82)	(19.84)	(19.31)	(11.82)	(18.10)	(17.67)
Basic industries	0.8691	0.8329	0.8207	0.8682	0.8312	0.8357	…	…	…	…	…	…	0.6641	0.8440	0.7953	0.6643	0.8702	0.8383
	(18.15)	(21.88)	(26.17)	(18.17)	(23.30)	(29.75)	…	…	…	…	…	…	(11.04)	(23.61)	(26.83)	(11.04)	(22.36)	(25.66)
Chemicals	0.7985	0.6646	0.6334	0.7965	0.6638	0.6439	0.9204	0.9259	0.9833	0.9201	0.9503	1.0297	…	…	…	…	…	…
	(14.36)	(22.27)	(23.24)	(14.59)	(22.61)	(23.11)	(25.10)	(24.62)	(30.32)	(25.12)	(21.63)	(30.15)	…	…	…	…	…	…
Electricity	0.9463	0.7268	0.7193	0.9499	0.7272	0.7253	1.1867	1.2834	1.0555	1.1874	1.3386	1.1184	…	…	…	…	…	…
	(11.64)	(8.96)	(11.03)	(11.91)	(8.92)	(11.04)	(21.65)	(12.27)	(12.81)	(21.63)	(12.36)	(12.74)	…	…	…	…	…	…
Engineering and machinery	0.7562	0.6992	0.7940	0.7572	0.6981	0.8056	0.1828	0.8112	1.0567	0.1829	0.9035	1.2196	…	…	…	…	…	…
	(14.05)	(12.36)	(12.50)	(13.99)	(12.74)	(12.67)	(1.69)	(3.31)	(5.98)	(1.69)	(3.68)	(7.31)	…	…	…	…	…	…
Food processors	0.6219	0.5204	0.5236	0.6213	0.5225	0.5120	0.1697	0.3363	0.3503	0.1700	0.2522	0.3107	0.9181	0.8324	0.7071	0.9179	0.8436	0.6896
	(14.67)	(14.19)	(13.44)	(14.80)	(15.19)	(14.07)	(3.01)	(5.27)	(6.60)	(3.02)	(3.83)	(5.46)	(9.94)	(10.75)	(9.52)	(9.94)	(9.91)	(7.98)
General industrials	0.9688	0.8504	0.9039	0.9679	0.8487	0.9181	0.4489	0.6364	0.6151	0.4486	0.5588	0.5201	1.0581	1.0963	1.0417	1.0588	1.0537	0.9808
	(21.02)	(16.51)	(16.15)	(20.97)	(17.06)	(17.35)	(6.30)	(8.73)	(8.20)	(6.31)	(7.80)	(5.40)	(10.78)	(16.07)	(20.96)	(10.78)	(15.60)	(19.24)
Leisure and hotels	0.8019	0.7973	0.9455	0.7999	0.7989	0.9407	…	…	…	…	…	…	0.7729	0.8448	0.9578	0.7727	0.8185	0.9126
	(5.80)	(8.96)	(9.23)	(5.93)	(9.11)	(9.19)	…	…	…	…	…	…	(8.84)	(12.04)	(12.34)	(8.83)	(11.19)	(11.54)
Pharmaceuticals	0.7282	0.7690	0.9316	0.7298	0.7721	0.9189	0.2036	0.4848	0.6075	0.2046	0.4510	0.5368	…	…	…	…	…	…
	(16.23)	(10.80)	(12.08)	(16.34)	(10.41)	(11.62)	(5.24)	(7.37)	(10.59)	(5.26)	(6.56)	(9.07)	…	…	…	…	…	…
Resources	1.0650	1.3308	1.2895	1.0639	1.3288	1.3124	0.8489	1.1325	1.1037	0.8491	1.1473	1.1092	…	…	…	…	…	…
	(6.47)	(12.42)	(12.61)	(6.45)	(12.18)	(12.97)	(17.22)	(17.28)	(21.12)	(17.26)	(16.96)	(19.11)	…	…	…	…	…	…
Transport	0.8732	0.6905	0.7717	0.8783	0.7012	0.7301	1.0426	1.1019	1.1438	1.0443	1.0091	1.0122	…	…	…	…	…	…
	(10.52)	(6.95)	(6.24)	(10.47)	(6.85)	(6.75)	(11.09)	(9.02)	(10.68)	(11.11)	(8.77)	(9.75)	…	…	…	…	…	…
Utilities	0.9412	0.7442	0.7370	0.9440	0.7446	0.7465	1.1966	1.2439	1.0927	1.1972	1.2658	1.1021	…	…	…	…	…	…
	(11.52)	(9.02)	(10.97)	(11.73)	(8.98)	(11.01)	(30.09)	(15.10)	(19.13)	(30.08)	(15.09)	(18.80)	…	…	…	…	…	…

Notes: This table reports the market betas (b_1 and b_2) from estimating:

$R_{it} = \alpha_i + \beta_{1i} R_{m\,t} + \gamma_{1i}\, OPG_{DC\,t} + \varepsilon_{1it}$ (1)

$R_{it} = \alpha_i + \beta_{2i} R_{m\,t} + \gamma_{2i}\, OPG_{US\,t} + \delta_i R_{xr\,t} + \varepsilon_{2it}$, (2)

where R_{it} is the return on the ith industry index in period t and R_{mt} is the market return. A typical return, R_t, is measured as $\log(P_t/P_{t-1})$, where P_t and P_{t-1} are index values at the end and beginning of period t. OPG is the oil price growth measured in domestic currency (DC) and US dollar oil prices. Oil_dc indicates oil price is measured in domestic currency by using the Organization of Petroleum Exporting Countries (OPEC) oil price and corresponding exchange rates. Oil_us indicates OPEC oil price measured in US dollars. Half-yearly returns are measured as $\log(P_t/P_{t-26})$, where 26 is the number of approximate weeks in the half-year. Empty spaces indicate that results are not available as the corresponding data does not exist.