AN EMPIRICAL INVESTIGATION BETWEEN OIL PRICES AND THE STOCK PRICE IN CHINA AND INDIA

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Abstract

This paper explores the long run relationship between the oil price index and the stock price index in China and India during mid 1996 to 2007. We utilize three new tests for cointegration that allow for two unknown structural breaks. Our test results show that the null hypothesis of no cointegration in the presence of two unknown structural breaks can not be rejected by any test in both countries. We find that there is no long-run relationship between the oil price and the stock price index in both China and as well as India. We interpret these finds as empirical support for the efficient market hypothesis in semi-strong form.

Keywords: Multiple breaks, Cointegration, China, India.

JEL Classification: G14, C20.

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1. Introduction

Oil appears to be the lifeblood of modern civilization. It fuels most of the transportation worldwide and is a feedstock for pharmaceuticals, agriculture, plastics and a myriad of other products used in everyday life. As countries urbanize and modernize their demand for oil increases significantly (Basher and Sadorsky, 2006). Energy, financial markets and the economy are all explicitly linked together on a country's path of economic growth. Adelman (1993, p.537) writes: "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'." Mork (1994) surveys a large body of academic research investigating the relationship between oil price and macro-economy and finds significant impact of oil price shocks on economic output. Studies such as Hamilton (1983 and 2003) and Kilian (2008) argue that fluctuations in oil prices cause exogenous shocks to the economy.

Since asset returns are inextricably linked to the expected cash flows, it is plausible to suggest that futures realizations of macroeconomic factors influence asset returns through information about future cash flows (Pollet, 2004). As stock markets are closely linked with economic activity, it appears that oil price might have some influence in determining the stock market prices. Increases in oil demand without offsetting increases in supply lead to higher oil prices. The impact of higher oil prices on income, business profits and inflation lowers the value of financial assets (Brychcy, 2006). Oil along with capital, labour and materials represent important components into the production of most goods and services and changes in the prices of these inputs affects cash flows. Rising oil prices, which, in absence of any direct alternative lead to higher production costs? Higher production costs dampen cash flows and reduce stock prices (Basher and Sadorsky, 2006). Rising oil prices also impact the discount rate used in the equity pricing formula. For example, Huang *et al*. (1996) argue 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. At international level impact of changes in oil prices is through oil-importing countries to oil-exporting countries.

The adverse economic impact of higher oil prices on oil importing developing countries is generally more severe than that for industrialized countries. This is mainly because these countries are more energy intensive, as they experience a

rapid economic growth, and generally, energy is used less efficiently.

Jones and Kaul (1996) have shown negative stock reactions to oil shocks in the United States, Canada, Japan, and the United Kingdom during the post-World War II period. In contrast, Huang *et al*. (1996) find that oil futures returns do not have significant impact on broad-based market indices like S&P 500. Sadorsky (1999) provides evidence that oil price and oil price volatility both play roles in stock returns. Papapetrou (2001) finds that the oil price is an important factor in explaining stock price movements in Greece. Wei (2003) concludes that decline in stock prices due to oil shocks after the 1973/74 crises seems too large to be explained by the rise in oil prices. Kilian and Park (2007) show that the response of aggregate stock market returns to oil price shocks differ significantly depending on whether the increase in oil price is driven by demand or supply shocks in the crude oil market.

Hammoudeh and Li (2004) show oil price growth having influence on the returns demanded by investors in the US oil and transportation industries and the stock markets of Mexico and Norway. Other studies examining the link between the change in oil prices and stock returns at the aggregate market level include Chen et al (1986), Hamao (1989), Ferson and Harvey (1991), Kaneko and Lee (1995), Basher and Sardosky (2006), and Nandha and Hammoudeh (2006). However, there is no consensus among financial economists about the relationship between crude oil prices and stock prices, and accordingly further studies in this direction are important.

Globalization and integration of international markets, characterized with increased level of capital flows and international investments in emerging economies, have made global investors more vulnerable to oil price impact on emerging stock markets. Traders all over the world can easily; at no cost and on a real time basis; observe oil prices. Assuming market efficiency, one would expect that information in oil prices is precisely the type of information that will almost surely and immediately be incorporated in stock market prices. Otherwise in such a world, asset pricing models include a risk premium term that contains the covariance of the return on an asset with the oil price factor. Therefore, understanding the level of susceptibility of stock prices in emerging economies to movement in global oil prices is very important. Several fund managers are offering emerging market funds, and the bigger slice of emerging markets' pie obviously belongs to China and India. China and India stock at least two characteristics: their populations are huge and their economies have been growing very fast for at least 10 years (Winters and Yusuf, 2007).

According to recent EIA reports[1] China is the world's second-largest consumer of oil behind the United States, and the third-largest net importer of oil after the U.S. and Japan. India is also a growing net importer of oil and was the fifth largest consumer of oil in the world during 2006. In the next two decades, China's oil consumption is expected to grow at a rate of 7.5% per year and India's 5.5% (compare to 1% growth of industrialized countries)[2]. China and India together account for more than 1/3rd of world population and are rapidly growing economies. The combination of huge consumer base and impressive growth rate is being seen as an attractive investment opportunity by the corporate and institutional investors from all over the world. Growing foreign participation in emerging financial markets contributes to greater financial market depth and efficiency.

The aim of this paper is to explore the potential relationship between the oil prices and the equity market in China and India at aggregate level. These two countries are among the most growing economies and they are also considered to be two of the largest emerging financial markets. These countries are increasingly becoming main consumers of raw oil (petroleum) due to their economic expansion. Thus, investigating the impact of oil prices on the financial markets of these countries is an important issue for policy makers as well as investors in the global market. We implement our empirical analysis by performing new tests for cointegration that allows for two unknown structural breaks.

The reminder of this paper is organized in the following manner. Section 2 provides the background information on the financial markets in China and India respectively. Section 3 specifies the empirical model and describes the econometric methodology. In Section 4 we present the estimation results and the last section provides conclusions.

2. Background Information on China and India

In recent years many countries in the Asia-Pacific region have significantly increased their consumption and imports of crude oil, and they now constitute the fastest growing region of oil demand. Specifically China and India, as two big powers in Asia, will be the main energy consumers of the region. Burgeoning industrial growth and

[1] www.eia.doe.gov/emeu/cabs/China/Full.html (Last Updated: August 2006)
www.eia.doe.gov/emeu/cabs/India/Full.html (Last Updated: January 2007)

[2] www.iags.org/futureofoil.html (Last Updated: August 2006)

other energy-consuming activities are part of their economic development. Though the economic growth rates of China and India are different, their energy-consumption growth is almost same. Moreover, both are imported-energy dependent nations. India and China, the growth of these countries are up to an extent is dependent on the oil price. These two countries have started attracting global investors; and oil price a topical global issue. In addition, the oil price is one of the most important macro economic factors in the world economy. Moreover, the growth of these giant economies will affect not only goods markets but also flows of savings, investment, and even people around the world, and will place heavy demands on the global commons, such as the oceans and the atmosphere (Winters and Yusuf, 2007)

China is the world's most populous country and the second largest energy consumer behind the United States. Rising oil demand and imports have made China a significant factor in world oil markets. China is the third-largest net importer of oil after the U.S. and Japan. According to Oil & Gas Journal (OGS), China had 18.3 billion barrels of proven oil reserves as of January 2006, EIA[3] data forecasts that China's increase in oil demand will represent 38 percent of the world total increase in demand. Roughly 85 percent of Chinese oil production capacity is located onshore. China's national oil companies are currently planning or building several new refineries and upgrading existing plants. Recently, offshore oil exploration in China has been the greater focus of the oil majors.

The Chinese capital market has progressed in parallel with the Chinese economic structural reform, which is now an important component of the Chinese socialist market economy system. The rapidly growing capital market has played an important role in restructuring state-owned enterprises (SOEs) and the financial market, optimizing resource allocation, and promoting economic growth and structural adjustment (Zhongli, 2005). The Chinese stock markets have grown at a phenomenal pace since their inception: the number of listed stocks has increased from 13 in 1991 to 1440 by the end of 2006 and the aggregate market capitalization has risen from US$1.3 billion to more than US$2400 during the same period (see table-4 in appendix). In terms of market capitalization, the Chinese stock markets are now among the largest in the Asia-Pacific region after Japan. Considering China is one of the fastest growing economies in the world, and the fact that the Chinese government is committed to continuous privatization and liberalization, the rapid development of Chinese stock markets and its openness to foreign investors will likely continue into the foreseeable future (Eun and Huang, 2007)

The Indian economy continues to show impressive economic growth. Together with this impressive growth, India has also become a significant consumer of energy resources. According to EIA[4] estimates, India was the fifth consumer of oil in the world during 2006. The combination of rising oil consumption and fairly stable production levels leaves India increasingly dependent on imports to meet consumption needs. India's oil sector is dominated by State-owned enterprises, although the government has taken steps in recent years to deregulate the hydrocarbons industry and encourage greater foreign involvement. As a net importer of oil, the Indian government has introduced policies aimed at increasing domestic oil production and oil exploration activities.

Improving macroeconomic fundamentals, a sizeable skilled labour force and greater integration with the world economy have increased India's global competitiveness, placing the country on the radar screens of investors' world over. Indian capital markets have experienced sweeping changes since the beginning of the last decade. Its market infrastructure has advanced while corporate governance has progressed faster than in many other emerging market economies. A vibrant, well-developed capital market has been shown to facilitate investment and economic growth.

Following the implementation of reforms in the securities industry in the past years, Indian stock markets have stood out in the world rankings. As may be seen from Table-3 in appendix, India stands second only to USA in terms of number of listed companies. India posted a turnover ratio of 93.1%, which, was quite comparable to the other developed markets. As per Standard and Poor's Fact Book 2007, India ranked 15th in terms of market capitalization and 18th in terms of total value traded in stock exchanges.

3. Empirical Specification and Methodology

The question of whether there is a long-run steady state relation between oil price and stock return of both these countries can be answered by conducting tests for cointegration. The data used in this study, namely equity indices of China and India and OPEC oil basked price are sourced from

[3] China Energy Data, Statistics and Analysis- Oil, Gas, Electricity, Coal, page 1-17, last updated August 2006, downloaded on August 18, 2008, source www.eia.doe.gov.

[4] India Energy Data, Statistics and Analysis- Oil, Gas, Electricity, Coal, page 1-10, last updated January 2007, downloaded on August 18, 2008, source www.eia.doe.gov.

DataStream. We have taken weekly observations from June 1997 to November 2006. We estimate the following regression for each country that take into account for the effect of two unknown structural breaks:

$$SP_t = \alpha_0 + \alpha_1 D_{1t} + \alpha_2 D_{2t} + \beta_0 OP_t + \beta_1 D_{1t} OP_t + \beta_2 D_{2t} OP_t + u_t, \quad (1)$$

where SP signifies the stock price index, OP is the oil price index. The variables are expressed in logarithmic form. D_{1t} and D_{2t} represent binary variables that are identified as the following:

$$D_{1t} = \begin{cases} 0 & if \quad t \le [n\tau_1] \\ 1 & if \quad t > [n\tau_1] \end{cases}$$

and

$$D_{2t} = \begin{cases} 0 & if \quad t \le [n\tau_2] \\ 1 & if \quad t > [n\tau_2] \end{cases}$$

The unknown parameters $\tau_1 \in (0,1)$ and $\tau_2 \in (0,1)$ indicate the relative timing of the regime change points and the bracket denotes the integer part since *n* is the number of observations.

There are two tests in the literature denoted by Z_α and Z_t respectively that can be used to test for cointegration under such circumstances. These test statistics are based on estimating the following bias-corrected first-order serial correlation coefficient:

$$\rho^* = \frac{\sum_{t=1}^{n-1}\left(\hat{u}_t\hat{u}_{t+1} - \sum_{j=1}^{B} w(j/B)\hat{\gamma}(j)\right)}{\sum_{t=1}^{n-1}\hat{u}_t^2}, \quad (2)$$

where $w(\cdot)$ is a function that determines the kernel weights fulfilling the standard conditions for spectral density estimators, *B* denotes the bandwidth. The autocovariance function is defined by

$$\hat{\gamma}(j) = \frac{1}{n}\sum_{t=j+1}^{T}(\hat{u}_{t-j} - \hat{\rho}\hat{u}_{t-j-1})(\hat{u}_t - \hat{\rho}\hat{u}_{t-1}), \quad (3)$$

where $\hat{\rho}$ is the OLS estimate of the effect (without intercept) of $\hat{u}_{t-1}$ on $\hat{u}_t$. The Z_α and Z_t test statistics are formulated as

$$Z_\alpha = n(\rho^* - 1), \quad (4)$$

and

$$Z_t = \frac{(\rho^* - 1)}{(\hat{\gamma}(0) + 2\sum_{j=1}^{B} w(j/B)\hat{\gamma}(j))\Big/\sum_{1}^{n-1}\hat{u}_t^2}, \quad (5)$$

where $\hat{\gamma}(0) + 2\sum_{j=1}^{B} w(j/B)\hat{\gamma}(j)$ is the long-run variance estimate of the residuals of a regression of $\hat{u}_t$ on $\hat{u}_{t-1}$.[5] These two test statistics have nonstandard distributions and the critical values for two unknown structural breaks have been produced by Hatemi-J (2007).[6]

Our appropriate test statistics are the smallest values of these two tests across all possible values for τ_1 and τ_2, with $\tau_1 \in T_1$ =(0.15, 0.70) and $\tau_2 \in T_2$=(0.15+ τ_1, 0.85). The reason for choosing the smallest value of each test is that the smallest value provides the empirical evidence against the

[5] The long-run variance is estimated by using an automatic bandwidth estimator and a prewhitened quadratic spectral kernel with a first-order autoregression for the prewhitening. For details see Andrews (1991) and Andrews and Monahan (1992).

[6] These two tests were originally introduced by Phillips (1987) to be used to test for cointegration without any breaks. Gregory and Hansen (1996) extended these tests for cointegration with one unknown break and Hatemi-J (2008) extended them for cointegration with two unknown breaks.

null hypothesis of no cointegration. These test statistics are thus defined as

$$Z_t^* = \inf_{(\tau_1,\tau_2)\in T} Z_t(\tau_1,\tau_2), \quad (6)$$

$$Z_\alpha^* = \inf_{(\tau_1,\tau_2)\in T} Z_\alpha(\tau_1,\tau_2), \quad (7)$$

where $T = (0.15n, 0.85n)$. The idea to truncate the data by 15% on each side is suggested by Gregory and Hansen (1996). Based on the same logic we also let the distance between the two regime shifts be at least 15%.

4. Results

Before testing for cointegration we tested for unit roots by using Ng and Perron (2001) test. This test has good size and power properties and it is not sensitive to the existence of structural breaks. The results, presented in Table 1, show that each variable has a unit root even in the presence of two unknown breaks in their deterministic components. The finding that the stock price index has a unit roots in each market provides empirical support for the efficient market hypothesis in each case. We proceed our analysis by testing for cointegration with two unknown structural breaks using three test developed by Hatemi-J (2008). The results of these tests are presented in Table 2. Based on these results we can conclude that there is no long-run relationship between the oil price index and the stock price index in each country. We interpret these results as empirical support for the efficient market hypothesis in the semi-strong form. This is at least the case if the information set for the public information consists of the oil price index.

Table 1. Results of Tests for Unit Roots Using the Ng-Perron Test

H_0: I(1), H_1: I(0)	Test Value	H_0: I(2), H_1: I(1)	Test Value
OP	-7.905 (1)	OP	-246.686* (0)
China SP	-9.41129 (1)	China SP	-73.533* (2)
India SP	-2.253 (0)	India SP	-48.428* (7)

Notes:
1. OP stands for oil price index and SP signifies stock price index.
2. The critical value is -23.800, -17.300, and -14.200 at the 1%, 5% and 10%, respectively.
3. The notation * implies significance at the 1% significance level.
4. The numbers in parentheses indicate the number of lags included in the test to remove autocorrelation.
5. The deterministic trend components were selected by a procedure suggested by Hacker and Hatemi-J (2008).

Table 2. The results of tests for cointegration

Country	Test Statistic	Estimated Test Value	1% Critical Value	5% Critical Value	10% Critical Value
China	*ADF**	-4.768	–-6.503	-6.015	-5.653
	Z^*_t	-4.313	-6.503	-6.015	-5.653
	Z^*_α	-40.027	-90.794	-76.003	-52.232
India	*ADF**	-5.138	–-6.503	-6.015	-5.653
	Z^*_t	-4.856	-6.503	-6.015	-5.653
	Z^*_α	-49.196	-90.794	-76.003	-52.232

Notes: The critical values are collected from Hatemi-J (2008).

5. Conclusions

The aim of this paper has been to investigate the long-run relationship between the oil price index and the stock market in China and India during the period June 1997 to mid November 2006. The frequency of the data is weekly. We test for unit roots by applying the Ng-Perron test which is robust to the existence of structural breaks. We find that each variable has one unit root. The existence of a unit root in each stock market indicates that the change in each stock market index is totally random. Hence, the presence of a unit root can be interpreted as empirical support for the efficient market hypothesis in the weak form. Since the variables are found to be integrated we need to test for cointegration in order to avoid spurious results. We test for cointegration by using three tests developed recently by Hatemi-J (2008) that allow for two unknown structural breaks. The results from these tests show that the null hypothesis of no cointegration can not be rejected even if two unknown structural breaks are allowed for in the estimation. We interpret these results as empirical evidence for the efficient market hypothesis in the semi-strong form in China and India respectively. This means that the investors can not obtain abnormal returns in these markets by trying to make use of the time path of the oil price index in order to predict the time path of the stock market index.

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Appendix

Table 4. International Comparison: end December 2006

Particulars	USA	UK	Japan	Germany	Hong Kong	China	India
No. of listed companies	5,133	2,913	3,362	656	1,165	1,440	4,796
Market Cap ($bn)	19,426	3,794	4,726	1,638	1,715	2,426	819
Market Cap Ratio (%)	150.4	166.9	94.9	56.96	892.6	106.9	101.84
Turnover ($bn)	33,268	4,242	6,252	2,487	831	1,635	638
Turnover Ratio (%)	182.8	123.8	132.1	173.9	60.0	102.0	93.1

Market Capitalisation Ratio is computed as a percentage of GNI 2005
Source: ISMR-2007, National Stock Exchange of India.