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Linkages between the ADR market and home country macroeconomic fundamentals: Evidence in the context of the BRICs

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ABSTRACT

This study investigates the long-run and short-run lead–lag linkages between American Depositary Receipt (ADR) prices and home country economic fundamentals in the context of the BRICs (Brazil, Russia, India and China). In order to obtain an indication of the segmentation or integration between the ADR market and its underlying stock market, the same investigation is also undertaken in relation to the latter. We find that in the long run, economic growth positively drives ADR returns in the cases of Brazil and China but negatively in the cases of Russia and India. In the short-run, economic growth and money supply lead ADR prices but ADR prices predict inflation and oil prices with regard to Brazil while in Russia, oil prices predict ADR returns but the ADR market leads monetary policies and real economic activity. As regards India, in the short run, oil prices and economic growth lead ADR prices but ADR prices predict money supply changes. Finally, with respect to China, the ADR index lead economic growth and inflation but economic variables do not predict ADR prices in the short-run. In the long run, with the exception of China, we find the same kind of linkages between these economic fundamentals and the underlying stock market although the linkages are somewhat stronger. The short run dynamics for ADRs with respect to economic fundamentals are, however, different for that of the respective home country stock market. This would imply that the ADR market and its underlying stock market, as far as the BRICs are concerned, are integrated in the long-run but not in the short-run.

1. Introduction

The Securities and Exchange Commission (SEC) defines an American Depositary Receipt (ADR) as a 'negotiable instrument that represents an ownership interest in a specified number of securities, which the securities holders have deposited with a designated bank depository.' ADR programs have substantially increased since the 1990s. There were 836 ADR programs in 1990, which grew to 1534 in 2000. This can be attributed to the global boom in technology and the acceleration in mergers and acquisitions (Patro, 2000).

In recent years, emerging markets have accounted for a growing percentage of total ADR offerings, owing to the opening up of these markets to international investors. According to the New York Bank, 52 billion ADRs valued at USD $2.07 trillion were traded during the first half of 2008. China, Brazil and Russia collectively accounted for over 50% of the total trading value. India led the new sponsored ADRs, with 11 new programs in 2008. During the post-2008 crisis period, issuers from the four BRICs nations (Brazil, Russia, India and China) seem to continue to dominate the ADR market. As suggested by Reyes (2013) in terms of number of programs, the top four countries are from the BRICs nations, representing 35% of the depositary receipt (DR) universe.

The ADR market statistics suggest a strong demand from the US investors for foreign shares from emerging markets, particularly from the four BRICs nations. Such an investment trend seems to be in line with the conventional view that 'higher growth means higher returns'. The logic behind this is that corporate earnings are expected to portray the overall economic trend in the long run. Dividends paid by the corporate therefore should grow at a similar rate to the overall economy. As such, rapidly growing economies will yield high growth rates of dividends and hence high stock returns. Intuitively, these investors are positive about the outlook for these emerging economies. They invest in ADRs from these countries, hoping to obtain superior stock returns.

An implied assumption is that the ADR markets correctly reflect the economic trends of the underlying nations and also the future performance of the corporations issuing the ADRs. This appears to be a fair argument, in that ADRs are derivatives which derive their value from the performance of their underlying stocks. Hence, the ADR market can be viewed as being a fraction of the home country stock market. In efficient and frictionless markets, redundant assets can be priced according to the law of one price (see Kato, Linn, and Schallheim (1991)). As such, if the markets are efficient and integrated and frictionless, the transmission mechanism between ADRs and the economic fundamentals should be similar to that for the underlying stock market.

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However, in practice, ADRs may be different from their underlying stocks. For example, to list ADRs on the US market, the non-US issuing firms must comply with all the requirements of the SEC. Such rigorous regulation will lead to higher transparency in the ADR market and hence lower risks for investment in ADRs compared with the foreign equity markets. In addition, the heterogeneity of risk perceptions between US investors and local investors in the underlying foreign stock markets may also contribute to divergence between ADRs and their stocks. More importantly, the economic exposure for ADRs may be different to that of its national stock market index. This is because ADRs are cross-border listed securities; the impact of local economic factors on ADRs will be affected by the extent to which the international markets are informationally efficient and integrated with each other. Due to the above reasons, there may not be a clear correspondence between the economic fundamentals of the respective home market and ADR performance.

The interrelationship of the equity market and the real economy has been extensively investigated by empirical researchers. In general, these studies examine the causal relationship between the national stock market index and selected macroeconomic variables.[1] However, there has been little interest in the context of this relationship in the ADR markets. The existing ADR literature mainly focuses on two aspects. One group of empirical studies examines the effectiveness of ADRs as a diversification vehicle.[2] These papers generally compare the diversification benefits gained from investing in ADRs with those from their underlying stock, home market index, or alternative investment vehicles (e.g. mutual funds and multinational corporations). Another group of studies focuses on the issues that relate to the ADR pricing. In particular, extensive research has been conducted in order to gain an understanding of the law of one price in the ADR markets.[3] Hence, due to the lack of studies on this issue, there is no clarity yet as regards the linkage between home country economic variables and ADR prices and the extent to which this linkage is similar in relation to the home country stock market.

In this paper, we address this gap in the literature. We examine the linkage between home country economic fundamentals and ADR prices. Specifically, we investigate whether there is a long run relationship between the major home country economic indicators and ADR prices. We also examine the short-run lead–lag relationship between ADR prices and the home country's economic indicators. There are two views regarding the lead–lag relationship between stock returns and macroeconomic variables. One argument claims that the causality runs from the macro environment to financial markets, since economic growth leads to better stock market performance. The alternative argument asserts that if stock returns accurately reflect the expectation about underlying fundamentals in the future, then they should be used as leading indicators of future economic activities. The second objective of the study would enable us to determine whether the economic status of the country is a predictor of its corresponding ADR market in the short run, or vice versa. Finally, we also investigate whether this linkage is in line with that of its underlying stock market in order to obtain an indication of the segmentation or integration between the two markets.

This study focuses on the BRICs nations' ADR markets. The four emerging economies are in transition towards becoming more market-oriented economies. As such, these four countries provide a good experimental basis from which to identify whether changes in macroeconomic conditions in these nations will lead to changes in ADR prices. The findings of this study will have important implications for the policy makers in the BRICs nations in their quest towards developing a more attractive environment for investment. Given the growing significant role of the BRICs countries in investors' portfolio strategy, the findings about ADRs' interrelationship with the domestic macroeconomic conditions will also be of interest to US investors seeking superior returns in the BRICs nations' stock markets. To the best of the author's knowledge, this study is the first to thoroughly examine the interrelationship between cross-border listed ADRs and home country economic fundamentals.

This study essentially tests the relationship of both the ADR market and its underlying stock market with four home country economic variables: industrial production index, inflation and money supply[4] and oil prices. The sample period starts from January 2000 and ends in February 2013. The long-run analysis is based on the Johansen cointegration test while the examination of the short run lead–lag dynamics is undertaken using granger causality tests.

We found that ADR prices have a significant long run relationship with the economic indicators of the home country, although different characteristics are observed across the four BRICs nations. The evidence for the short run dynamics suggests that, with the exception of China, past values of these economic indicators can be used to forecast ADR prices. Investors may be able to exploit excess returns on ADRs based on the corresponding macro-level information. In general, the short run dynamics for the case of ADRs are different from that for the stock market index. This sheds some light on the informational efficiency of the ADR market regarding macroeconomic information transmission. The evidence suggests that the market efficiency of the ADR market within the BRICs countries is at least somewhat different from that of the underlying stock market.

The rest of this study is organized as follows. Section 2 reviews related studies in the literature. Section 3 discusses hypotheses, followed by Section 4 where the data are described. Section 5 demonstrates the methodology used in this research while Section 6 discusses the empirical results, and finally Section 7 concludes.

2. Related studies

As mentioned, the ADR market is supposed to be an extension of the underlying stock market. Hence, it should reflect the same relationship that the underlying stock market has with economic variables. At present, there is already a voluminous literature on the linkages between macroeconomic variables and stock prices. Empirical research has looked at the relationship between the stock market and the real economy. It is argued that a well-functioning stock market can help to accelerate the economic growth and development process through efficiently directing the flow of savings and investment in the economy. A well-developed stock market helps to increase savings by providing savers with various financial instruments to meet different liquidity and risk preference needs of the investors. The stock market also helps to transfer these funds to the most productive investment projects. This is known as 'allocative efficiency' of the stock market. Allocative efficiency rewards well-managed and profitable firms with higher share prices and lower costs of capital. As such, in the long run, the stock market will promote economic activities and hence economic development.

2.1. Economy and stock markets

Stock markets can also signal changes of the economy in the future. Such a leading role of the stock market can be inferred from a

[1] See Bodie (1976), Jeffrey and Mandelker (1976), Nelson (1976); Fama and Schwert (1977); Fama (1981); Geske and Roll (1983); Chen et al. (1986); Muradoglu et al. (2000); Soenen and Johnson (2001); Fifield et al. (2002), Wongbangpo and Sharma (2002), McMillan (2005); Pan, Fok, and Liu (2007); Hosseini et al. (2011); Pal and Mittal (2011); Narayan and Narayan (2012); Ray (2012).

[2] See Officer and Hoffmeister (1988); Wahab and Khandwala (1993); Jiang (1998); Bekaert and Urias (1999); Alaganar and Bhar (2001); Bandopadhyaya, Chugh, and Grant (2009); Kabir, Hassan, and Maroney (2011); Peterburgsky and Yang (2013).

[3] See Rosenthal (1983); Kato et al. (1991); Wahab, Lashgari, and Cohn (1992), Park and Tavokkol (1994), Miller and Morey (1996); Karolyi and Stulz (1996); Alves and Morey (2003) and Suarez (2005).

[4] While the IPI is used to represent the real economic activities, CPI and M2 are used to represent the monetary policies of the nation, respectively.

fundamental valuation's perspective. According to the Discount Cash Flow model (DCF) (Damodaran, 1994), stock prices equal the present value of a company's expected future profitability. The DCF model suggests a positive relationship between the stock prices and the firm's earning prospects. If investors are expecting a firm's profits to increase (decrease) in the future, the stock price of the firm will rise (decline), holding capital costs constant. Given that firms' future profits are directly associated with the real economic activity, stock prices can reflect expectations about the future economy. Therefore, stock prices can be viewed as a leading indicator of the evolution of the real economy.

There also exists a counter-argument claiming that the economy drives the stock market. Intuitively, a healthy and growing economic fundamental indicates that most companies are making money; both the government and the people have more money and perhaps are more willing to invest. In this sense, improvements in the economic fundamentals will lead the development of the stock market.

Initial research generally centers on the effects of inflation rates on stock returns in the developed markets, such as the US and the UK markets (see Bodie, 1976; Jeffrey & Mandelker, 1976; Nelson, 1976; Fama & Schwert, 1977; Fama, 1981; Geske & Roll, 1983 etc.). For instance, Jeffrey and Mandelker (1976) examine the relationship between inflation and the stock returns over the period of 1953–1971. They find that stock returns are significantly negatively related to both anticipated and unanticipated inflation rates.

Similar findings are documented by Bodie (1976) and Nelson (1976), and are reinforced by Fama and Schwert (1977); Fama (1981), and Geske and Roll (1983). The commonly accepted explanation is that the negative stock return–inflation relationship is caused by demand for money and money supply effects. Chen, Roll, and Ross (1986) extend these studies and tests whether macroeconomic variables, including industrial production, inflation, interest rates and exchange rates, are sources of risks that are priced in the stock market. They find that these macroeconomic variables have significant influences on the stock market returns.

2.2. Economy and stock markets — emerging economies

With the significant growth of ASEAN stock markets during the last two decades, Wongbangpo and Sharma (2002) examine the fundamental connection between stock price and key macroeconomic variables in the five ASEAN countries (Indonesia, Malaysia, Philippines, Singapore, and Thailand). The macroeconomic variables tested include GNP, the Consumer Price Index, the money supply, the interest rates and exchange rates. Using the monthly data from 1985 to 1996 for the each of the ASEAN markets, the study documents the long-term and short-term relationships between stock prices and the selected macroeconomic variables. The study concludes that the stock market is an important factor among leading economic indicators.

Using daily data for the periods 2000–2010, Narayan and Narayan (2012) examine the impact of US macroeconomic conditions on the stock markets of seven Asian countries (China, India, the Philippines, Malaysia, Singapore, Thailand and South Korea). The variables are exchange rate and short-term interest rate. The study divides the sample into a pre-crisis period (pre-August 2007) and a crisis period (post-August 2007). The evidence suggests that only the Philippines shows significant impact of interest rate on returns in the crisis period; with the exception of China, exchange rates have a significantly negative effect on returns for all countries. The VECM analysis suggests that the long-run relationship found for India, Malaysia, the Philippines, Singapore and Thailand in the pre-crisis period disappears in the crisis period, implying that the financial crisis has actually weakened the link between stock prices and economic fundamentals.

The studies discussed above have primarily examined the issue for a group of emerging markets. There are several papers looking at the relationship between the stock market and the economy in a single market, such as China and India. Using monthly data from January 1999 to January 2009, Hosseini, Ahmad, and Lai (2011) investigate the relationships between stock market indexes and four macroeconomics variables for China and India. These variables are crude oil price, money supply, industrial production and inflation rate. Their findings suggest that the crude oil price has a positive impact on stock markets in China in the long run, while the impact is negative for India. The long-run effect of money supply on the Indian stock market is negative and is positive for China. The effect of industrial production is negative only in China. In addition, the effect of increases in inflation on these stock indexes is positive in both countries.

2.3. Economy and the stock market — approaches

These studies are primarily based on the Arbitrage Pricing Theory (APT) of Ross (1976). The APT is put forward as an alternative asset-pricing model to overcome some of the weaknesses of the single-factor Capital Asset Pricing Model (CAPM).[5] While the CAPM assumes that there is only one source of systematic risk (that is, market risk), the APT claims that there can be several sources of systematic risk.[6] Asset pricing models such as APT and CAPM are based on the implied assumption of the uni-directional impact of the underlying variables on the asset prices and asset returns. The theoretical framework of the relationship between the stock market and real economy may require a more sophisticated model. Compared to the single-equation models, the Vector Autoregression (VAR)-based model is more appropriate in terms of testing the dynamic relationship of variables within the system. The VAR model (Sims, 1980) does not require all independent variables to be exogenous. It is able to capture possible long-run equilibrium relationships as well as the short-run lead–lag relationships among the variables tested. Given these advantages of the VAR model over a single regression model, more recent studies have widely applied the VAR approach to investigate the interdependence of the stock market and the real economy.

A considerable number of studies have applied the VAR-based method to examine the dynamic relationship between the stock prices and macroeconomic variables for emerging markets (see Muradoglu, Taksin, & Bigan, 2000; Fifield, Power, & Sinclair, 2002; Wongbangpo & Sharma, 2002; and Hosseini et al., 2011, etc.). Their findings have implications for policy makers regarding the creation of an attractive investment environment. Muradoglu et al. (2000) perhaps undertake the first study to provide a comprehensive study for all emerging markets as a whole. The authors investigate the causal relationship between macroeconomic variables and stock returns for 19 emerging markets. Variables tested are inflation, interest rates, foreign exchange rates, and industrial production. The study has demonstrated that the two-way interaction between stock returns and macroeconomic variables is mainly due to the size of the stock markets, and their integration with the global markets, through various measures of financial liberalization.

Similarly, Fifield et al. (2002) examine the relevance for 13 emerging stock markets over the period 1987–1996. The study aims to identify the extent to which global and local economic factors explain stock index returns. The local economic variables are GDP, inflation, money and interest rates, while the selected global variables are world industrial production and world inflation. The study concludes that both world and local economic factors are significant in explaining emerging market stock returns.

This section has reviewed major research on the relationship between stock markets and macroeconomic variables. In general, the early research is based on a single regression analysis which may not be able to capture the possible mutual feedback relationship between

[5] Earliest reference to single factor CAPM model is of Treynor (1961, 1962), whereas most cited reference is of Sharpe (1964). Around the same time other studies such as Lintner (1965) and Mossin (1966) presented the single factor capital asset pricing model.

[6] However, the APT has been criticized for its lack of theoretical basis for factor identifications.

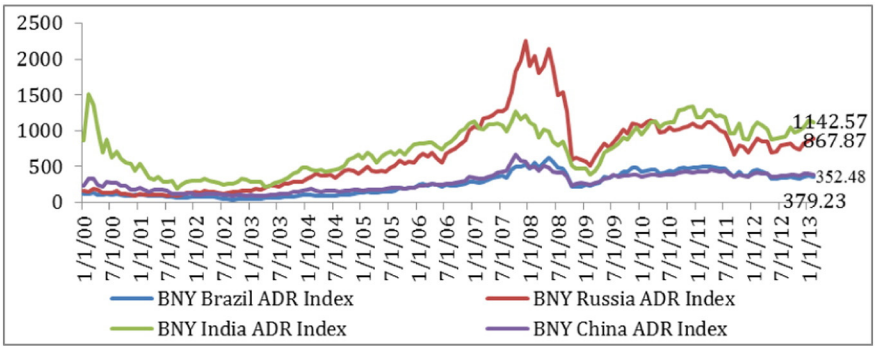

Fig. 1. Performance of BNY ADR Index of the BRICs Countries (2000–2013).

variables. The VAR-based approach has been widely adopted by recent studies. As mentioned previously, this method is more appropriate as it can estimate both the long-run and the dynamic short-run relationship of variables. The commonly examined macroeconomic variables include inflation, interest rates, exchange rates, money supply and industrial production. In general, previous research finds the existence of a long-run relationship and short-run lead–lag relationship between stock prices and major economic indicators. However, the economic variables which are significantly affecting stock prices tend to differ across countries.

As discussed, the ADR market, however, is distinct from its underlying stock market. Hence, the linkages between macroeconomic variables and the ADR market should be investigated separately. Surprisingly, at present, there is hardly any study in this regard. We therefore address this knowledge gap in this study.

3. Hypotheses

As mentioned, this study investigates the empirical linkages between the ADR market and the fundamental economies for each of the BRICs countries. It also examines whether the same relationship holds in relation to the underlying stock market. Four key economic indicators are selected based on the previous literature and the economic characteristics of the BRICs nations. These are the Industrial Production Index (IPI), inflation (CPI), money supply (M2) and crude oil prices (OP).

3.1. Industrial Production Index (IPI)

The index of industrial production of the BRICs nations is used to represent the overall economy activity. The rise in industrial production signals economic growth (Maysami, Howe, & Hamzah, 2004). Therefore, an increase in industrial production is expected to increase corporate earnings, which consequently will enhance the stock value of the firm. This hypothesis has been confirmed by previous empirical evidence (see Chen et al., 1986; Maysami et al., 2004). Therefore, the author expects that both the BNYADR and MSCI Standard Indexes are positively associated with the IPI.

3.2. Consumer Price Index (CPI)

The Consumer Price Index (CPI) is used to measure inflation, which can influence stock prices by affecting the discount rate in the valuation model. For example, an increase in inflation will raise the discount rate and hence reduce stock prices. Inflation can also affect stock prices through its influences on firms' costs and hence firms' earning prospects. Overall, it is expected that inflation will negatively affect stock prices. However, the empirical evidence for the relationship between inflation and stock prices seems to be mixed. Although the majority of the previous studies support a negative relationship between inflation and stock price, the opposing evidence of a positive relationship is also reported in the literature. This study expects that there will be a negative relationship between the CPI of the BRICs nations and the BNY ADR and MSCI Standard Indexes.

3.3. Money supply (M2)

Monetary policy is widely recognized as being the most important macroeconomic policy. It is a process by which the monetary authority of a country controls the supply of money, often targeting a rate of interest to promote economic growth and stability. The theoretical relationship between money supply and stock price is somewhat ambiguous. Money supply can simultaneously affect share prices negatively or positively by the use of different mechanisms. For instance, a loose money supply may increase the inflation and discount rate, and hence reduce stock prices. On the other hand, money supply growth may bring economic stimulus, which is expected to increase the corporate earnings and therefore the stock prices (Mukherjee & Naka, 1995). The previous empirical findings seem to be conflicting. In this study, M2 is used to represent the aggregate money supply of the BRICs nations. This study argues that the money supply of the BRICs countries would not only help to stimulate the real economy, but also to enhance confidence in the stock market. It is expected that there will be a positive relationship between the domestic M2 and the BNY ADR and MSCI Standard Indexes.

3.4. Oil prices (OP)

Oil prices (OP) are also considered in this study. Oil prices have received growing attention as being an important economic indicator, in that oil is an essential input in many production processes. The influence of the oil price on real economic activity depends on the importance of oil in the country's import and export markets. Rising oil prices will hence benefit the countries' trade balance, foreign exchange reserves and economic growth. As discussed in Section 2, among the BRICs countries, Brazil has transformed from a major oil importer to a net exporter of crude oil, while Russia has historically been a net exporter of oil. On the contrary, both India and China are net importers of oil. Therefore, increases in oil prices tend to negatively affect the growth of these countries' economies. An extensive body of literature has documented the strong link between oil prices and stock prices. Based on the arguments above, for Brazil and Russia, an increase in oil prices will result in favorable economic prospects for these countries, leading to increases in investment in the stock markets and therefore in the stock prices. Conversely in India and China, rising oil prices will negatively affect economic growth and hence stock prices. However, there is also the argument that an rise in oil prices can also lead to an increase in stock prices, even in net oil importing countries, particularly if the rise in prices is demand rather than supply driven, as this signals to investors an expected improved performance in the economy (see, for example, Reboredo & Rivera-Castro, 2014).

4. Data

The sample period used in this study begins in January 2000 and ends in February 2013. The starting date of the sample is set by the availability of data, as well as the consideration of the economic and financial stability of the four BRICs nations. Prior to the year 2000, stock markets in the BRICs countries were not well developed. Using data before the year 2000 will pose challenges in terms of thin trading and number of ADRs traded on the US stock markets.

Specifically, this study uses monthly data for the Bank of New York (BNY) Mellon ADR Index for each of the BRICs countries.[7] The four emerging economies began to rapidly grow after 2000. The period January 2000 to February 2013, therefore, can capture the rapid economic development of the BRICs countries. Monthly data for the underlying stock market indexes and key macroeconomic variables (Industrial Production Index (IPI), inflation (CPI), money supply (M2), and crude oil prices) of the BRICs nations are collected over the same period. Since ADR firms are in general industry leaders with large capitalization, the ADR index may represent a specific group of 'blue chips' in the underlying stock markets. To ensure comparability between the ADR market and the underlying stock market, MSCI Standard (Large + Mid) Indexes of the BRICs countries, which are expressed in USD, are used to represent the counterpart indexes of the BNY Mellon ADR Indexes. All of the data are collected from Datastream.

Fig. 1 below compares the performance of the BNY ADR Indexes for the BRICs nations between February 2000 and February 2013. It can be seen that the indexes for Russia and India appear to be more volatile than those of Brazil and China over time. Specifically, the Russian ADR index enjoyed aggressive growth during the pre-2008 crisis period, and reached its peak of 2249.77 at the end of 2007. Such spectacular performance may be largely attributed to the high oil prices during the period. However, due to the occurrence of the global financial crisis in 2008, the market dropped sharply to 468.3 during the next 12 months. From 2008 onwards, the Russian ADR index has shown a rapid recovery, although it remains unsteady. The index ended at 897.76 in February 2013.

The ADR index for India appears to consistently outperform the other three indexes until the end of 2006, when the Russian ADR index overtook the Indian ADR index. Nevertheless, the Indian ADR index has achieved better performance than those of Brazil and China during the sample period. Surprisingly, during the period researched, the performance of the ADR indexes for Brazil and China were markedly similar. These two indexes have gradually increased over time. The Chinese ADR index achieved its peak value on 31 October 2007, while that of Brazil peaked on 30 May 2008. The overall trend of ADR indexes for Brazil and China is relatively flat compared with those of Russia and India. These two ADR indexes also experienced correction around the time of the 2008 crisis period, and have been rebounding steadily thereafter.

We conduct a preliminary analysis to check for the stationarity of the data based on the Augmented Dickey–Fuller (ADF) tests (Dickey & Fuller, 1979) to detect whether unit roots exist in the data. We perform two forms of the ADF tests, that is, the model with an intercept and no trend and the model with an intercept and trend. The results of the ADF tests are reported in Table 1. It can be seen that all data series used in this study are non-stationary at the price level and are stationary at the first differences. The following section will explain the econometric models used in this study.

[7] The BNY Mellon ADR Index is a free float-adjusted capitalization-weighted index which tracks the performance of a basket of companies who have their primary equity listing on domestic stock markets and also have depositary receipts that trade on a US exchange.

5. Methodology

We investigate the relationship of the selected macroeconomic variables with the ADR and stock markets of each country within a Vector Autoregressive (VAR) context. This VAR can be expressed as

$$\Delta x_t = \varphi + \Pi x_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta x_{t-i} + \varepsilon_t \quad (2)$$

where Δ is the first-order difference operator, φ is a deterministic component which may include a linear trend term, an intercept term, or both, $\Gamma_i = \sum_{j=i+1}^{p} \Gamma_i A_j$, which is coefficient matrix and represent short-run dynamics, and $\Pi = \sum_{i=1}^{p} A_i - I$, which denotes the 'long-run matrix'. It can be written as the product of an n × r matrix α and an r × n matrix β', namely $\Pi = \alpha\beta'$.[8] Rank r of Π represents the number of cointegrating relationships.

We make use of the Johansen cointegration tests (Johansen, 1988, 1991; Johansen & Juselius, 1990)[9] to examine the long-run relationship among the variables. The tests identify the number of cointegrating

Table 1
ADF tests for stationarity.

Variables	Price level		First differences level	
	With intercept without trend	With trend and intercept	With intercept without trend	With trend and intercept
Brazil				
BNY ADR Index	−0.811	−1.808	−11.775***	−11.739***
MSCI Brazil	−1.033	−1.313	−11.289***	−11.269***
IIP	−1.281	−2.845	−3.510***	−3.527**
CPI	−1.587	−1.902	−5.666***	−5.822***
M2	−0.459	−2.923	−2.705*	−2.601
Russia				
BNY ADR Index	−1.196	−1.252	−12.176***	−12.174***
MSCI Russia	−1.792	−1.756	−10.333***	−10.354***
IIP	−1.791	−2.043	−8.141***	−8.178***
CPI	−2.080	−1.022	−3.013**	−3.392*
M2	−2.150	−1.156	−2.729*	−3.388*
India				
BNY ADR Index	−1.395	−2.716	−13.543***	−13.689***
MSCI India	−0.517	−2.257	−11.261***	−11.266***
IIP	−0.975	−2.031	−2.828*	−2.265
CPI	−1.514	−2.859	−11.352***	−11.323***
M2	−0.583	−2.478	−13.348***	−13.317***
China				
BNY ADR Index	−1.043	−2.209	−12.407***	−12.446***
MSCI China	−0.719	−2.341	−11.118***	−11.081***
IIP	−2.806*	−2.807	−14.382***	−5.289***
CPI	−2.141	−3.028	−5.456***	−5.414***
M2	0.711	−2.359	−5.508***	−5.558***
Other factor				
Crude oil prices	−1.137	−2.870	−12.303***	−12.264***

This table presents the ADF test statistics for all data used in this study. Panels A, B, C, D, and E report the results for variables in cases of Brazil, Russia, India, China and the US, respectively. The optimal lag lengths for the ADF test are determined by using the AIC method. The critical values for the ADF test statistics are −3.43, −2.86, and −2.56 on models without trend, and −3.96, −3.41 and −3.13 on models with trend for the 1%, 5% and 10% levels of statistical significance, respectively. The null hypothesis of a unit root (non-stationary) can be rejected if the ADF test statistic is less than the critical value at the chosen level of significance. ***, **, * represent rejections of the null hypothesis of a unit root at the 1%, 5% and 10% levels, respectively.

[8] The elements of α is known as the adjustment parameters in the vector error correction model and each column of β is a cointegrating vector.

[9] Studies argue that the Johansen procedure (Johansen, 1988, 1991; Johansen & Juselius, 1990) for testing the cointegration is preferred over the Engle–Granger method (Engle & Granger, 1987) as the test allows more than one cointegrating relationship. Therefore, this study uses the Johansen method to test whether there is a cointegrating relationship in our data.

relationships among the variables using a maximum likelihood estimation procedure. The trace and maximum eigenvalue tests statistics can be used to identify the presence of cointegrating relationship. The trace statistic is given by $\lambda trace = -T\sum_{i=r+1}^{n} \ln(1-\lambda_r)$. In the trace test, the null hypothesis of r cointegrating vectors (H_0: $r \le r_0$) is tested against the alternative of r or more cointegrating vectors (H_1: $r > r_0$). Alternatively, the maximal eigenvalues statistic tests the null hypothesis that there are at most r cointegrating vectors (H_0: $r \le r_0$) against the alternative of r + 1 cointegrating vectors (H_1: $r = r_0 + 1$). The maximal eigenvalue statistic is given by $\lambda max = -T \ln(1-\lambda_{r+1})$.

Given that the trace statistics consider all the smallest eigenvalues, the trace test is more powerful than the maximum eigenvalue statistics (Kasa, 1992; Serletis & King, 1997). Moreover, Johansen and Juselius (1990) suggest that the trace statistics can be used when the results of the two tests are inconsistent. Therefore, this study relies on the results of the trace test. However, Reimers (1992)[10] pointed out that the trace test, in small samples, can over reject the null hypothesis. This problem, however, can be overcome by modifying the trace test based on a procedure developed by Reinsel and Ahn (1992). We therefore perform the trace test based on the modifications suggested by Reinsel and Ahn (1992).

After examining the long-run relationship, the study then proceeds to investigate the short-run dynamic relationships. To examine the short-run dynamics between the home country's macroeconomic variables and the ADR market as well as the stock market, this study conducts Granger causality tests (Granger, 1963) which provides an understanding of the direction of the lead–lag relationship among the variables tested. If the results of the Johansen cointegration tests suggest that there is a long-run relationship among the variables, a vector error correction (VECM) model is employed to capture short-run relationships between the variables and the adjustments over the short run to achieve equilibrium in the long run which is captured by the error correction term, although the adjustments are not the focus of this study. Otherwise, a standard VAR model is sufficient to estimate the dynamic relationships between the variables.

Based on Granger (1986) and Engle and Granger (1987), if coefficients on the lagged values of an economic variable are jointly significant, then it can be concluded that the said economic variable granger causes the dependent variable — the ADR and stock prices. This suggests that the past values of this variable can be used as a leading indicator for current ADR and stock price fluctuations. The empirical findings are discussed in the following section.

Before estimating the VAR or VECM, the optimal lag-length needs to be determined. To this end, we use the Akaike Information Criterion (AIC). Prior to conducting the cointegration tests, we also need to ensure that the data are stationary. Hence, we also performed tests for non-stationarity. For test of stationarity, we employ the Augmented Dickey–Fuller (ADF) tests (Dickey & Fuller, 1979).

6. Empirical results

This study aims to obtain an in-depth understanding of the linkages between the ADR market and four key economic indicators — industrial production, inflation, money supply and oil prices, for each of the BRICs nations. It also assesses whether the same interrelationships hold between the underlying stock market and the said macroeconomic variables in relation to each country. A long run analysis is conducted based on the Johansen cointegration test while a short-run lead–lag examination is undertaken using Granger causality tests.

[10] We thank the anonymous reviewer for his/her suggestion to use a modified trace test based on Reinsel and Ahn (1992). See also Diebold et al. (1994) for further insights on this issue.

Table 2
Johansen cointegration test results.

Number of cointegrating equations		ADR market	Stock market
		Trace statistics	Trace statistics
Brazil	$r = 0$	75.154**	81.051**
	$r \le 1$	31.027	31.674
	$r \le 2$	13.267	16.544
	$r \le 3$	4.504	7.685
	$r \le 4$	0.001	0.945
Russia	$r = 0$	91.737**	83.742**
	$r \le 1$	49.273**	38.175
	$r \le 2$	24.368	19.233
	$r \le 3$	13.155	8.682
	$r \le 4$	2.741	2.096
India	$r = 0$	82.440**	103.533**
	$r \le 1$	45.226	45.059
	$r \le 2$	25.247	25.799
	$r \le 3$	10.633	7.956
	$r \le 4$	2.390	0.033
China	$r = 0$	69.950**	66.278
	$r \le 1$	39.077	36.862
	$r \le 2$	18.674	20.086
	$r \le 3$	4.929	5.034
	$r \le 4$	0.195	0.073

Where "**" indicates the rejection of null hypothesis of no cointegration at 5% significance level. The appropriate lag length has been selected based on AIC. We also made sure that the selected lag length is free from residual serial correlations. Each model is estimated using five variables such as, ADR/Stock, CPI, IPI, M2, and OP.
Notes: The finite sample bias is corrected by multiplying the Johansen trace statistics with the scale factor (T − pk)/T, where T is the number of observations, p is the number of variables and k is the lag order of the underlying VAR model in levels. The detailed discussion on this procedure can be found in Reinsel and Ahn (1992) and Reimers (1992). The critical values are taken from MacKinnon et al. (1999), and are also valid for the small sample correction.

6.1. Long run relationship

The results of the Johansen cointegration tests among the selected macroeconomic variables and the (a) ADR market and (b) stock market, respectively, are reported in Table 2 as detailed in preceding discussion, the number of cointegrating vectors is identified based on the modified trace test following Reinsel and Ahn (1992).

It can be seen from Table 2 that in the cases of Brazil and India, there is at most one cointegrating vector associated with the relationship of its stock market and ADR market with the selected macroeconomic variables. Hence, there is a long run relationship between its ADR as well as stock market and the selected macroeconomic variables. China and Russia, however, provide a different scenario. With regard to China, there is at most one cointegrating relationship between the selected macroeconomic variables and its ADR market but no relationship with its stock market. Hence, China's ADR market has a long run relationship with the selected macroeconomic variables. Its stock market, however, does not. The case of Russia is interesting as the trace tests point out to at most one cointegrating relationship between its stock market and the selected economic variables but there are at most two cointegrating vectors that hold the relationship between its ADR market and the said economic variables. These results indicate that both the stock and ADR markets of Russia have a long run relationship with the selected macroeconomic variables. For ADR market, however, there is a stronger association among ADR prices and the macroeconomic variables. We have identified the first cointegrating vector as defining a relationship between ADR prices and the macroeconomic variables while the second cointegrating vector defines a long run relationship between inflation and the other variables. We present in Table 3 the coefficients of the cointegrating equation with respect to each variable. The coefficients indicate the long-term relationship of each selected economic variable with ADR prices.

As can be seen in Table 3, with regard to Brazil, IPI, M2 and OP significantly affect its ADR market in the long run. The first variable, contrary to expectation, is negatively associated with the ADR market while the

Table 3
Normalized cointegrating vector. This table displays the estimated cointegration vector normalized on ADR (stock) and estimated cointegrating equation. The numbers in parentheses are t-statistics. If the t statistics are greater than the t critical values, we reject the null hypothesis that there is no significant relationship between the dependent variable and the independent variables. The critical values are 2.58, 1.96, and 1.65 for 1%, 5%, and 10% levels, respectively. ***, **, * represent rejections of the null hypothesis at the 1%, 5% and 10% levels, respectively.

Panel A: ADR market

Cointegrating eq	ADR	CPI	IPI	M2	OP
Brazil	1.000	0.049	−14.867***	0.563**	0.858**
		(−1.593)	(6.880)	(−1.893)	(−2.090)
Russia	1.000	0.000	−0.921	−3.638***	4.575***
			(1.541)	(5.929)	(−4.568)
	0.000	1.000	0.047	−0.247***	−0.119
			(−1.042)	(5.253)	(1.554)
India	1.000	11.769***	17.887***	−17.938***	1.782***
		(−4.585)	(−3.626)	(5.252)	(−2.482)
China	1.000	−15.579***		−87.94***	671.099***
			621.322***		
		(10.404)	(128.866)	(20.501)	(154.914)

Panel B: Underlying stock market

Cointegrating eq	UND	CPI	IPI	M2	OP
Brazil	1.000	0.026*	−7.952***	0.175	0.277
		(−1.749)	(7.554)	(−1.225)	(−1.374)
Russia	1.000	2.439***	−0.928***	−0.276	−0.609***
		(−2.937)	(7.779)	(0.689)	(3.877)
India	1.000	−4.198**	−23.382***	13.469***	−0.045
		(2.435)	(8.528)	(−7.315)	(0.093)
China	1.000	NA	NA	NA	NA

last two variables, as expected, positively impact the ADR market. In the case of the stock market, the CPI and IPI variables drive it with the former variable having a positive impact and the latter one — a negative one. Hence, the ADR and stock markets of Brazil are driven by a different set of variables with the IPI being the only common variable. These results indicate that the two markets are segmented.

In the case of Russia, as mentioned earlier, two cointegrating vectors were found in relation to its ADR market. In order to interpret these cointegrating equations, for the first cointegrating vector, we normalize it with respect to the ADR variable. As can be seen in Table 2, the coefficients of the first cointegrating vector show that M2 negatively affects the ADR market while OP positively impacts it. We normalized the second cointegrating vector with regard to CPI. The results of the second cointegrating vector is not of much interest as our focus is on the ADR variable only and not on other variables. However, the second cointegrating vector coefficient estimates also show that the IPI variable is not a significant determinant of CPI as well. Hence, this provides further confirmation that the IPI variable is not a significant one that drives the long-term relationship among these variables.

With regard to Russia's stock market, there was only one cointegrating vector that was found. The coefficients of this cointegrating equation are presented in Table 3 which indicate that three economic variables significantly impact the Russia's stock markets — CPI, IPI and OP. The fist economic variable positively affect the stock market while the latter two have the opposite effect. It is interesting to note that while OP positively affect the ADR, it has a contrary impact on the stock market. These results imply that the ADR and stock markets of Russia are segmented.

In India's case, Table 3 shows that all the selected economic variables significantly impact its ADR market. The variables CPI, IPI and OP positively affect the said market while M2 has a negative effect. It is interesting that inspite being a net importer of oil, investors in India's ADRs view a rise (decline) in oil prices to be positive (negative) news. Again, as previously discussed, it could be that investors in that market are interpreting oil price increases (decreases) as an indicator of the good (bad) performance of the economy. In relation to the country's stock market, except for OP, all the other variables are also significant. Hence, the two markets seem to be driven by almost the same kind of variables which could indicate that there is a better alignment of the ADR and stock markets of India.

With regard to China, Table 3 shows that all selected economic variables strongly affect the ADR market in the long-run. CPI and M2 have a negative impact while IPI and OP have a positive effect on China's ADR market. On the other hand, all the selected economic variables have no long run impact on China's stock market. Thus, there seems to be segmentation of the ADR and stock markets of China.

Overall, the cointegration results indicate that the BRICs differ from each other in terms of how their respective stock and ADR markets are affected by the selected economic variables. The results also point out that with the exception of India, the stock and ADR markets of these countries are segmented. Moreover, these findings also indicate that the BRIC countries ADR and stock markets differ from each other in terms economic variables that drive these markets.

6.2. Short-run dynamics

After considering the long-run relationship, this study investigates the lead–lag relationships among the variables in the short run. The direction and strength of the short-run causality between the ADR (stock) and the economic indicators are examined using the Granger causality test based on the VECM, whenever cointegration is present, and on the VAR, in the absence of cointegration. The aim of the Granger causality test is to identify (1) whether the past values of ADR (stock) can be viewed as a leading indicator of their economic fundamentals; and (2) whether the historical performance of the macroeconomic activities has predictive power over ADR (stock) price movements. The results are reported in Table 4. Panel A reports findings for the ADR index, while panel B displays results for the stock market index.[11]

The evidence suggests that for Brazil, both economic growth and money supply can be viewed as a predictor for its ADR market. The F-statistics for variations in the lagged values of IPI and M2 are significant at the 5% and 1% level, respectively. On the other hand, the F-statistics suggest that the changes in past values of ADRs are significant in the equations of oil prices and CPI. This indicates that the ADR market has predictive power over oil prices and inflation. Similar findings are observed for the stock market index. There is a short-run causality from IPI and M2 to the stock market index. Moreover, past stock returns lead changes in current variations in oil prices, CPI and IPI. Overall, the short-run lead–lag relationship is similar for cases of the ADRs and the underlying stocks, with the exception that the ADR index cannot be viewed as a leading indicator of the economic growth of Brazil.

For the case of Russia, only oil prices are found to lead the ADR market in the short run. The F-statistics suggest that current ADR price variations are only correlated with past oil price changes. Given that Russia is a net exporter of crude oil, it is therefore reasonable to observe the leading role oil prices play in the country's ADR market. Similarly, past values of oil prices have predictive power in the current returns for stocks. Moreover, the ADR index is found to lead economic growth and inflation in the short run. The null hypothesis that ADR prices do not Granger-cause IPI and CPI can be rejected at the 1% and 10% significant level, respectively. This short-run lead–lag relationship is different from that of the underlying stock. It appears that US investors have different perceptions regarding macroeconomic information from Russia compared to domestic Russian investors. It is found that current changes in stock prices are correlated with variations in past IPI, rather than in oil prices, indicating that Russian investors view the country's economic growth as an important indicator of future stock market performance. There is also a reverse causality from the Russian stock index to IPI.

[11] In order to ensure that the VECMs are not miss-specified, autocorrelation tests (i.e. LM tests) were conducted on the residuals. The results revealed independence in the residuals.

Table 4
Short run granger causality tests. This table displays the t-statistics from Granger causality tests based on the VECM or VAR.[a] ***, **, * represent the rejection of the null hypothesis that A does not Granger cause B at the 1%, 5% and 10% levels, respectively. In the panel A, results are reported for the ADR index while panel B presents the findings for the stock market index for each of the BRICs nations.

	Dependent variables	Δ (ADR)	Δ (OP)	Δ (IPI)	Δ (M2)	Δ (CPI)
Panel A						
Brazil	Δ (ADR)	NA	2.065	10.494**	20.946***	0.546
	Δ (OP)	12.311***	NA	1.363	3.386	2.121
	Δ (IPI)	1.701	3.396	NA	25.729***	0.670
	Δ (M2)	0.941	2.234	10.321**	NA	3.204
	Δ (CPI)	10.322**	11.032**	3.672	2.319	NA
Russia	Δ (ADR)	NA	6.361**	4.355	0.795	1.251
	Δ (OP)	1.591	NA	9.364***	1.409	6.354**
	Δ (IPI)	11.650***	1.208	NA	2.511	4.987*
	Δ (M2)	3.644	0.134	2.252	NA	0.021
	Δ (CPI)	5.922*	4.941*	1.139	65.981***	NA
India	Δ (ADR)	NA	21.460***	17.039***	8.526	4.089
	Δ (OP)	3.115	NA	3.201	5.391	7.136
	Δ (IPI)	3.981	2.199	NA	13.905**	29.964***
	Δ (M2)	11.750*	17.632***	15.512**	NA	6.490
	Δ (CPI)	D (CPI)	14.191**	35.047***	13.602**	NA
China	Δ (ADR)	NA	9.797	5.307	4.929	2.030
	Δ (OP)	7.595	NA	9.932	7.183	10.011
	Δ (IPI)	16.368**	20.156***	NA	5.745	19.102***
	Δ (M2)	1.868	21.500***	12.264*	NA	19.240***
	Δ (CPI)	12.632**	1.884	5.548	42.389***	NA
Panel B						
Brazil	Δ(UND)	NA	0.751	7.521*	14.109***	2.223
	Δ (OP)	14.324***	NA	1.188	2.929	2.474
	Δ (IPI)	6.505*	5.005	NA	25.896***	1.041
	Δ (M2)	2.737	2.806	9.306**	NA	3.182
	Δ (CPI)	12.998***	11.257**	3.450	2.705	NA
Russia	Δ (UND)	NA	2.036	4.666*	3.388	2.516
	Δ (OP)	6.569**	NA	8.154**	2.356	5.652*
	Δ (IPI)	39.301***	2.473	NA	3.138	5.372*
	Δ (M2)	4.414	0.090	0.980	NA	0.047
	Δ (CPI)	2.167	2.833	2.080	61.690***	NA
India	Δ (UND)	NA	15.466**	11.754*	5.766	12.110*
	Δ (OP)	6.200	NA	3.103	5.808	8.782
	Δ (IPI)	2.604	4.276	NA	18.729***	26.679***
	Δ (M2)	12.625**	16.770**	14.948**	NA	7.389
	Δ (CPI)	3.488	10.903*	41.973***	12.914**	NA
China	Δ (UND)	NA	6.207	6.488	5.630	5.191
	Δ (OP)	9.244	NA	7.153	6.665	8.498
	Δ (IPI)	8.879	16.375**	NA	4.371	17.721***
	Δ (M2)	2.603	20.391***	13.696**	NA	19.646***
	Δ (CPI)	15.084**	3.286	6.667	44.470***	NA

Note: The VECM is used in cases where there is cointegration; otherwise VAR is used. We no longer show the error correction terms as the adjustment of the variable over the short-term to the long-term equilibrium is not of interest to this table; the focus of the table is on the short-run effect of each variable on each other.

[a] Please refer to section Methodology for the presentation of equations.

The findings for the case of India suggest that oil prices and economic growth lead the ADR market. The F-statistics suggest that variations in historical values of oil prices and IPI help to predict the current variations in ADR prices. On the other hand, the ADR is found to Granger cause M2 in the short run, indicating that ADR prices can be viewed as a leading indicator of money supply. Similar relationships are found for the underlying stock market index. The evidence suggests that oil prices, economic growth and inflation have predictability over the stock market in India; there is a short-run Granger Causality from stock prices to money supply.

Finally, for the case of China we find that lagged returns of China's ADR index are significant in the equations for IPI and CPI, suggesting that the Chinese ADR market can be viewed as a leading indicator of the country's economic growth and inflation. However, there is no causality between the stock market index and the major economic indicators. The F-statistics are found to be statistically insignificant for all equations. This may be because the firms that constitute the ADR index are generally large and reputable companies which play a leading role in their respective industries. Such a group of firms could therefore be more sensitive to the country's economic conditions, whereas the stock market index cover broader firms with diverse performance. As such, the stock market index may average out the sensitivity to fundamentals. Table 5 below provides a summary of the short-run lead–lag relationship between the ADR index and major economic indicators.

Table 5
Summary of lead–lag relationship in the short run. This table summarizes main findings of the short-run lead–lag relationship for each of the BRIC countries. Panel A displays findings for the dynamic relationship between the ADR index and the corresponding home country's economic indicators, while panel B presents findings for the respective stock market index.

Panel A
Lead–lag relationship between ADR index and economic indicators

	Economic indicators lead ADR	ADR leads economic indicators
Brazil	IPI	Oil prices
	M2	CPI
Russia	Oil prices	IPI
		CPI
India	Oil prices	M2
	IPI	
China	–	IPI
		CPI

Panel B
Lead–lag relationship between stock market index and economic indicators

	Economic indicators lead stock	Stock Prices lead economic indicators
Brazil	IPI	Oil prices
	M2	IPI
		CPI
Russia	IPI	Oil prices
		IPI
India	Oil prices	M2
	IPI	
	CPI	
China	–	CPI

This subsection has discussed the results of the short-run lead–lag relationship between the ADR (stock) market index and the key economic indicators for each of the BRICs countries. The evidence suggests that, with the exception of China, short-run variations in ADRs prices for Brazil, Russia and India are correlated with changes in past values of major economic indicators, including IPI, M2 and oil prices. Specifically, returns on Brazilian ADRs are sensitive to changes in the country's economic growth and money supply. Both Russian and Indian ADRs are found to be vulnerable to short-run fluctuations in oil prices. ADRs from India can also be predicted by the magnitude of economic growth in the previous periods. In the cases of Brazil and India, similar lead–lag relationships are observed for the counterpart stock markets.

There is no evidence of a leading role for the major economic indicators in the case of China. This suggests that the transmission mechanism of macroeconomic information is still underdeveloped. On the other hand, the ADR market has predictive ability over the major economic indicators of the four nations, indicating the increasingly important role of the ADR market in economic development. It is found that the ADR price changes can predict variations in oil prices and CPI for Brazil, IPI and CPI for Russia, M2 for India, and IPI and CPI for China. Overall, such predictive power is similar in relation to the corresponding stock market for all cases, with the exception of Russia.[12] The lead–lag relationship between the Russian ADR market and the country's major economic indicators diverges from that of the underlying stock market and the economic factors.

[12] A comparison in case of Russia for ADR and underlying stock relationship may be problematic because Russia has only four ADR issuing firms in its ADR index whereas the underlying stock market index is based on all medium and large capitalization firms.

7. Conclusions

This study examined the linkage between the four BRICs countries' ADR markets and the respective home countries' macroeconomic fundamentals in both long run and short run. The analysis was conducted to provide an understanding of the macroeconomic transmission mechanism of ADRs from emerging markets. In order to get an indication of the extent of segmentation and/or integration between the ADR market and its underlying stock market, the study also examined whether the same linkage with economic fundamentals holds true for the underlying stock market. It is contended that if the law of one price holds, then the macroeconomic transmission mechanism of ADRs ought to be similar to that of the underlying shares. However, in practice the correspondence between ADRs and the home country's macroeconomic fundamentals is not clear.

Specifically, the study has explored the long-run as well as short run relationship of both the ADR market and its underlying stock market with key economic indicators — economic growth, inflation, money supply and oil prices, of the respective country over the period between January 2000 and February 2013. The long-run analysis was conducted based on the Johansen cointegration tests while the short-run examination was based on granger causality tests within a vector autoregression context.

Based on the Johansen cointegration tests, it is found that the country's economic growth is significantly related to equity returns in the long run, although the number of cointegrating vectors is found to be different across the BRICs nations. The difference can be attributed to the country's specific economic structures and financial characteristics. The results from the estimated VECM suggest that there is a significant positive long-run relationship between the country's economic strength and the ADR index performance for the cases of Brazil and China. However, investors who seek high return investments in Russia or India may need to be cautious in that high growth in these countries does not necessarily result in the good performance of the ADR market.

Meanwhile, a similar long-run relationship is recorded for the underlying stock market in the cases of Brazil, Russia and China. This implies that the ADR market is fundamentally efficient in that the ADR market well reflects the trend of the respective real economy. In general, the influences of the major economic indicators on the underlying stock market index are found to be smaller than those of the ADR index. This can be attributed to the leading role ADR firms play in their industries. Given that ADR firms are generally large and reputable companies and play a pioneering role in their particular industry, the ADR market may represent a subsector of the home country's stock market, which is more sensitive to fluctuations in the economic fundamentals than the broad stock market overall. US investors may require higher returns and assign greater loadings for risk factors compared to domestic investors because of their perceived unfamiliarity with the foreign markets.

Overall, the signs for some macro-variables are different across BRIC countries and, for a given country, between ADRs and underlying stock indices. This instability or diversity of results suggests that US investors should be country-specific in their ADR investments, that is, the BRIC countries are not homogeneous. There might be evidence of cointegration for all of them but the cointegrating relationships and their implications differ.

This study also examined the short-run lead–lag relationship between the major economic indicators and the ADR market using Granger causality tests based on the VECM. The results suggest that all BRICs (except Russia) have a similar lead–lag relationship for their ADR and underlying stock markets. This dynamic relationship, however, differs across countries. In the case of Brazil, the current real economic activity and monetary policies have predictive power over the future fluctuations in ADR prices. ADR returns can be viewed as leading indicators for future variations in oil prices and inflation.

Among the major economic indicators, only oil prices lead the ADR index returns in the case of Russia, which indicates that variations in past oil prices will influence current ADR returns. Russia's ADR index returns lead the changes in the nation's economic growth and inflation. This reveals that movements in the ADR market tend to predict changes in the real economic activity and inflation targeted monetary policies.

In the case of the India, the evidence suggests that the current ADR returns are correlated with variations in the past values of oil prices and historical economic growth. ADR returns have some predictive power over India's monetary policies. Similar to the case of Russia, price changes of China's ADR index lead to variations in economic growth and inflation. However, none of these macroeconomic variables lead China's ADR index.

The same relationship with macroeconomic fundamentals seem to apply to the underlying stock market in the long-run which would imply that the ADR market and its underlying market are integrated. However, compared with the national stock market, the ADR market has a weaker transmission mechanism for macroeconomic information from the home country. The underlying stock markets have a stronger correlation with variations in economic fundamentals. This may be because of the existence of information asymmetries, and US investors' heterogeneous beliefs and risk perceptions. However, in the short run, the lead–lag linkages between economic variables and ADR markets are different from that of its underlying market. This implies that the ADR market and its underlying market are integrated in the long run but segmented in the short run.

These findings are of interest to US investors seeking investment opportunities in the BRICs nations. The evidence of a significant long-run relationship between the ADR markets and the major economic indicators supports the conventional view that 'high growth means high returns'. Investors may be better off by investing in these rapidly growing economies.

For investors seeking excess returns, the short-run predictability of some of the economic indicators of the ADR returns may bring about the opportunity for exploiting potential profits. The findings of the short-run lead–lag relationship are also important for the BRICs countries' economic policy makers and stock market regulators. Since the BRICs nations are in transition to becoming developed economies, along with economic liberalization, policy makers may be able to improve the investment environment for investors via the transmission mechanism.

Caution, however, is needed in exploiting the results of this study, given that these are based on relatively small samples. The potential of improved predictability (and exploiting profits) based on the estimated relationships requires superior out-of-sample forecasts based on a properly specified VECM model relative to a benchmark model. See Diebold, Gardeazabal, and Yilmaz (1994) for the implementation of such an exercise in a different setting. This issue could be addressed in future research.

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