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Is Australian stock market integrated to the equity markets of its major trading partners?

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This paper examines whether the Australian stock market is integrated to the equity markets of its major trading partners under the influence of globalization. This paper uses the cointegration technique of Johansen (1996, 2000) to ascertain whether the Australian stock market is interrelated with the UK, USA, the Canadian, German, French and the Japanese stock markets. Essentially, the long-run relationship among selected markets is investigated using 1945 to 2002 annual data. This paper considers the exchange rate risk element into the model. The results show that although selected markets are integrated yet not all are significant enough. The significant overseas markets for Australia are the UK, Canadian and German of which the UK is dominating.

Field of Research: Stock market integration, global stock markets, International APT, Australian securities marke

1. Introduction & Background

This paper intends to examine the common intuition about the integrated global financial markets from Australian view point. In doing so, the theoretical basis of the common intuition has also been acknowledged as it traced in the earlier mean-variance analyses of international share price integration or international asset pricing analyses namely the International Asset Pricing Model (IAPM) and International Arbitrage Pricing Theory (IAPT) (Solnik 1974a, Sutlz 1981).

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IAPM is the extended versions of Capital Asset Pricing Theory (CAPM) of Sharpe (1963, 1964) and Lintner (1965) while the IAPT is influenced by the Arbitrage Pricing Theory (APT) of Ross (1976), Roll (1977), and Roll and Ross (1980). However, the Portfolio Theory of Markowitz (1952) has been the foundation of all asset pricing theories in the literature. Other studies that include Grubel (1968), Levy and Sarnat (1970), Solnik (1974b, 1983), Sutlz (1981), Lessard (1973), Ripley (1973), Panton, et al (1976), Eun and Resnick (1984), Errunza (1983), Chan, et. al (1992), Maldanado and Saunders (1981), Phillippatos, et al (1983), Arshanapalli and Doukas (1993), Aggarwal and Rivoli (1980), Bekart and Harkey (1995), Eun and Beswick (1984), Janakiramannan and Lamba (1998), Joen and Chiang (1991), and Cha and Oh (2000) aimed to assess the integration patterns of global stock markets using correlation and other methods.

Recent studies of interrelationship between various markets using cointegration analysis on international share prices, among others, are found in Mills and Mills (1991), Kasa (1992), Cheung and Mak (1992), Arshanapalli and Doukes (1993), Nasseh and Strauss (2000), Lim and McNelis (1998), Maysami and Kho (2000), Leong and Felmingham (2001), and Shamsuddin and Kim (2003). Further theoretical relevance of studying for the interdependence of share markets is traced in research works on market efficiency or efficient market hypothesis (EMH) of Roca (1999), Chan and Oh (2000), and Roca et al. (1998).

Typically, any potential gain from international diversification of portfolio is inversely related to the extent of stock market integration. A low correlation between returns of national and overseas indices allows investors to minimize portfolio risk through international diversification. Thus, an analysis of the long-run co-movement of Australian stock prices with that of overseas trading partners and their short-run temporal relationships is important to Australian investors for managing their international portfolios. Besides, interdependence in stock prices across countries under the prevailing global economic order reflects economic integration in the form of trade linkages and foreign direct investment. Co-movement of the underlying macroeconomic variables across nations often leads to co-movement of stock prices (Bracker et al. 1999).

In this respect, a group of investors often think that the foreign exchange risk is an important consideration while investing in foreign stocks. Accordingly, the literature on stock market integration is broadly classified into two categories based on the foreign exchange risk component. The first category considers the exchange rate factor into the analysis (Taylor and Tonks 1989, Bekaert and Harvey 1997); while the second category ignores completely the exchange rate risk component. The proponents of second category are also divided into two groups based on their assumption. One group assumes that since the foreign exchange risks can be hedged while investing in overseas markets, use local currency into the analysis (Bracker et al. 1999, Ragunathan, et al. 1999). While, the second group ignores the exchange rate risk as they are thought to be

priced in the efficient international asset markets (Dumas and Solnik 1995, Iorio and Faff 2000, Khoo 1994, and Choi et al. 1998).

Although both schools are acceptable to investors, the second school is more relevant to institutional investors and fund managers who are able to diversify the foreign exchange risk factors through effective hedging mechanism. Often ordinary investors are not equally efficient in hedging the foreign exchange risk element while investing in overseas stocks, first school would be more appropriate for them. However, this paper attempts to investigate the global stock market integration issue from the perspective of ordinary Australian investors. Accordingly, the first school of thought that postulates the foreign exchange component is important for consideration in assessing the stock market integration is considered. A non-structural model of Johansen type is developed. The analyses are carried out on TWI (Trade Weighted Index) adjusted data to proxy the foreign exchange risk element into the models.

Structure of this paper follows: Section 2 provides data and preliminary tests; Section 3 deals with the methodology; while Section 4 presents the analysis and results; Section 5 concludes the paper.

2. Data and Preliminary Tests

This study used most comprehensive stock market indices of seven developed markets that include Australia, USA, UK, Canada, Germany, France, and Japan. The data series consist of the yearly index values of the All Ordinaries (ALLORDS), Dow Jones Industrial Average (DJIA), FTA, SBF250, DAX, TSX300, and NIKKEI for Australia, USA, UK, Canada, Germany, France, and Japan respectively. The data were gathered from various sources that include the Australian Bureau of Statistics (ABS), the Reserve Bank of Australia (RBA), and the world wide website of Harcourt College Publishers. The period of study based on the collected annual data series from 1945 to 2002.

Necessary tests are carried out in selecting the optimal lag length. The lag length selection test statistics of LR, FPE, SBC and HQ presented clearly suggest that a lag of one period is the optimal lag length. Accordingly, the lag length of 1 is considered for the analysis.

Additionally, no significant effect of the stock market crash of October 1987 is detected in the time series as the Chow Breakpoint test (Chow 1960) fails to reject the hypothesis of no Breakpoint effect in the 1987 data even at the 10% level. The observed F-statistic is 0.814644 with *p*-value 0.580112, and that of the Log likelihood ratio statistic is 7.068216 with corresponding *p*-value of 0.421812 which are not significant at acceptable levels. As a result, no exogenous dummy variable is considered in the model.

The necessary unit root tests results using both the ADF (Dickey and Fuller 1979, 1981) and PP (Phillips and Perron 1988) test procedures are obtained as

these test results are required at the outset to undertake cointegration analysis in the trail of Johansen.

The test results are compared against the MacKinnon (1990) critical values for rejection of the null hypothesis of no unit root. It clearly suggests that all of the seven series are integrated to order one I(1) in levels and are of order zero I(0) in first differences meaning that they are non-stationary in levels and stationary in first differences.

As the aim of this paper is to verify if the selected overseas stock markets are linked to the Australian market when the foreign exchange risk component is taken into consideration, TWI adjusted data are considered for the analysis. The relative weight of each country in the Trading Weighted Index (TWI) composed by the Reserve Bank of Australia [Becker and Davies (2002)] is used. The percentage weights in TWI for US dollar, UK pound, Canadian dollar, and Japanese yen in 2002-03 were 15.07, 5.14, 1.57, and 17.21 respectively. Since both France and Germany now use common currency, the TWI weight for European euro was considered for these countries. The percentage weight of euro for all common currency affiliated European countries (except the UK) was 12.40 in terms of Australian dollar. As TWI for euro is relevant to this study, the weight based on the % trading relationships is readjusted. The % positions of the average international trades (exports and imports) between Australia and both France and Germany are 13.8% and 23.4% respectively. Accordingly, adjusted TWI values for France and Germany become 1.7 (=12.4 $\times$ 13.8%) and 3.0 (=12.4 $\times$ 23.4%) respectively. The natural logarithms of data are used.

3. Methodology

To detect both the long- and short-run relationships between the Australian stock market and those of six major developed markets all seven variables are treated as endogenous series in this analysis. This is presented as under:

$$y_t = (AUSTRALIA, USA, UK, CANADA, GERMANY, FRANCE, JAPAN)' \quad (1)$$

where the logged stock market indices of 7 countries (including Australia) are assumed to be integrated of order one, I(1), and also they are thought to be cointegrated. The generalised vector autoregressive (VAR) model with *k* lags containing all variables (*g* =7) is adapted as under:

$$y_t = \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + \cdots + \Phi_k y_{t-k} + u_t \quad (2)$$

where y_t is a vector of order 7×1, Φ is a 7×7 matrix, and u_t is a 7×1 vector. As Johansen cointegration technique requires that the above VAR is converted into an error correction form, the full form of vector error correction model (VECM) is constructed as under:

$$\Delta y_t = \prod y_{t-k} + \Gamma_1 \Delta y_{t-1} + \cdots + \Gamma_{k-1} \Delta y_{t-(k-1)} + \varepsilon_t \quad (3)$$

where $\prod = (\sum_{i=1}^{k} \beta_i) - I_g$ is the long-run coefficient matrix of the lagged y_t, while $\Gamma_i = (\sum_{j=1}^{i} \beta_j) - I_g$ is a coefficient matrix of *k-1* lagged difference variables, Δy_t, on the RHS of the equation refers to short-run dynamics. For intensive analysis, the reduced form of VECM is derived as follows:

$$\Delta y_t = \prod y_{t-k} + \sum_{i=1}^{k-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t \,, \quad (4)$$

where $\prod = \alpha\beta'$ as per Johansen (1988, 1991, 1996, 2000).

4. Analysis

The analysis is conducted using the cointegration approach of Johansen. Both trace and max-eigenvalue tests show the existence of cointegrating relationship at 5% level. This test also indicates that the linear combination of all variables is cointegrated in the long-run while there are short-term dynamics within the markets for error corrections.

First cointegration analysis is carried out on basic model-1 that considers all seven markets including the Australian. From the resulted *t*-statistics it appears that within its cointegrating equation, 5 markets are significant at 5% levels. These significant markets for Australia are the US, the UK, the Canadian, the German and the Japanese. Yet, from the LR tests it is revealed that only three markets are significant between 5% and 10% levels. These markets are the UK, the German and the Japanese of which the UK market is significant at 10% level and remainder markets are significant at 5% levels. With respect of short-run dynamic adjustment, the Australian market is being auto corrected at the speed of only 9.4%. However, the error correction mechanism ECM_{-1} for Australia is found insignificant and not all markets are significant enough. As a result, further tests are required by dropping the insignificant market/s from the model until such time the ECM_{-1} for Australia becomes significant. Accordingly, three additional tests are performed.

The test on model-2 that considers six markets including that of Australian indicates that although 5 overseas markets are cointegrated to Australian market and all variables are significant at 5% levels from their corresponding *t*-statistics, yet the error correction mechanism ECM_{-1} for Australia is insignificant. Besides, from LR test results it is found that the US market is insignificant. Accordingly, USA is dropped from the adjusted model-3.

The test result on adjusted model-3 indicates that model needs to run one more time dropping even the Japanese market. Therefore, the final adjusted model-4

considers only the UK, Canadian and German markets. This time the ECM_{-1} for Australia is observed significant at 5% level, while all variables are also significant at 5% levels from both *t*-test and LR test statistics. Here, the linear combination of markets that include AUSTRALIA, UK, CANADA and GERMANY is also found cointegrated.

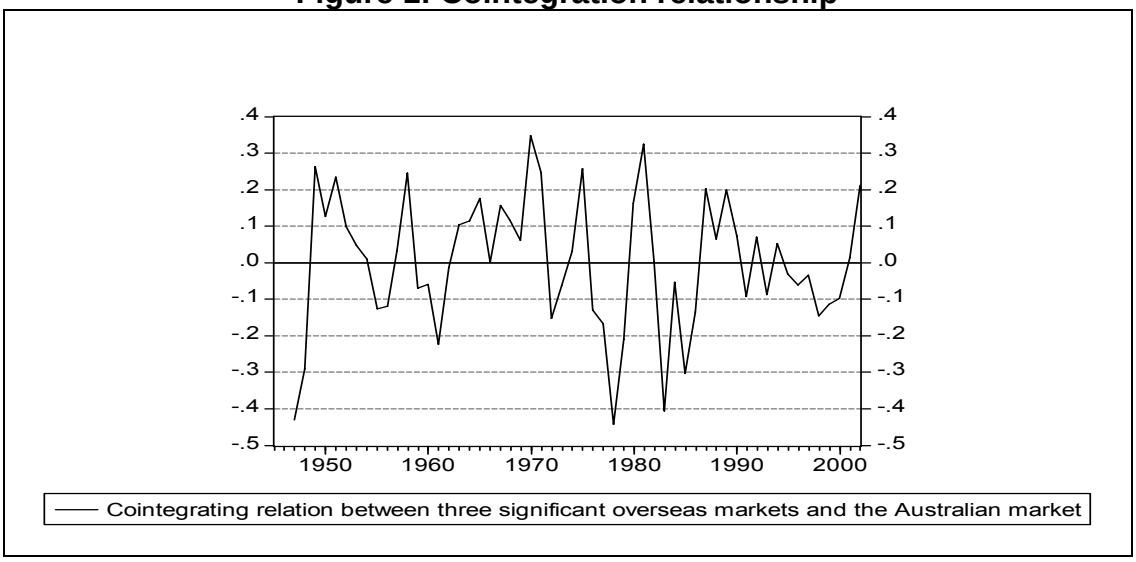
The summary of the test results is provided in Table 1.

Table 1: Snapshot of Results

Items	Tests on model-1	Tests on model-2	Tests on model-3	Tests on model-4
Variables in the Model	AUSTRALIA, USA, UK, CANADA, FRANCE, GERMANY, JAPAN	AUSTRALIA, USA, UK, CANADA, GERMANY, JAPAN	AUSTRALIA, UK, CANADA, GERMANY, JAPAN	AUSTRALIA, UK, CANADA, GERMANY
Test Relationship	Cointegrated	Cointegrated	Cointegrated	Cointegrated
Significance of ECM_{-1} for Australia	Not-Significant	Not-Significant	Not-Significant	Significant
Overseas market's Significance from *t*- test at 5% level	USA, UK, CANADA, GERMANY, JAPAN	UK, CANADA, GERMANY, JAPAN	UK, CANADA, GERMANY, JAPAN	UK, CANADA, GERMANY
Overseas market's Significance from LR test at 5% level	GERMANY, JAPAN	UK, CANADA, GERMANY, JAPAN	UK, CANADA, GERMANY	UK, CANADA, GERMANY
Overseas market's Significance from LR test at 10% level	UK, GERMANY, JAPAN	UK, CANADA, GERMANY, JAPAN	UK, CANADA, GERMANY	UK, CANADA, GERMANY
Australian market's significance from LR test at 5% level	Not-Significant	Not-Significant	Significant	Significant

It appears from the Table 1 that the results of the cointegration tests on adjusted model-4 are very satisfactory. Here, all modelled variables are found cointegrated as well as significant. The error correction mechanism ECM_{-1} for Australia is also significant at 5% level from both LR and *t*-tests. The cointegration relationship of the final model is depicted in Figure 1.

Figure 1: Cointegration relationship



Above results appear to be in conformity with the general notion and common intuition of investors under the prevailing global setups. The significant stock markets in the cointegration analyses infer to the fact that the UK, Canadian, and German stock markets are moving in the same way as that of Australian.

5. Conclusion

This paper has examined the cointegrating relationship between Australian stock price movements and that of its trading partners using the Johansen cointegration approach. This paper considers that risk factor of foreign exchange into the model from the perspective of ordinary Australian investors. Analyses confirm that Australian stock market has a long-run relationship with overseas equity markets. Although not all markets are equally influential, yet they are integrated. The significant overseas markets for Australia are the UK, Canadian and German. Out of these significant markets, the most influential market for Australia is the UK. The Australian stock market's error correction mechanism is found significant at the 5% level. In this context, it is apparent that Australian investors would have little scope to include stocks of the UK, Canadian and German in their portfolio for effective diversification when Australian stock market is bearish. On the contrary, although the US, French and Japanese stock markets appear to be insignificant for Australia in the cointegrating equation, Australian investors would have opportunities to effectively diversify their portfolio risks by considering stocks of these markets.

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