Diversification Gains from ADRs and Foreign Equities:

Evidence from Australian Stocks

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Abstract

We investigate the relative advantages of ADRs, the underlying Australian stocks and the Australian equity index for a U.S. investor seeking international diversification. We find that the ADR market is priced efficiently in that the 'law of one price' holds. However, ADRs have an economically significant higher reward/risk ratio than the underlying stocks, partly due to lower transactions cost. ADRs have a low correlation with the U.S. market under high states of global and regional shocks. Portfolio managers could use the ADRs directly in enhanced indexing strategies. The dominant information flow is found to occur from the underlying stocks to the ADRs, while at the aggregate level the information flow is primarily from the U.S. to the Australian market.

Key Words: International diversification, ADR, Market shock, Law of one price.

JEL Codes: C12, G14

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1. Introduction

The American Depositary Receipts (ADRs) are securities traded in the U.S., issued by U.S. depositary institutions that represent equity shares of foreign-based companies. For U.S. investors, ADRs provide an alternative to investing in overseas equities directly without the inconveniences such as currency conversion and foreign settlement procedures. According to the Bank of New York, the leading depositary of ADRs in the U.S., the dollar trading volume of ADRs has seen an annual average increase of 36% in 1997 and 1998. This exceeds the 32% growth posted by the New York Stock Exchange dollar trading volume (excluding ADRs) for the same period. In 1998, the volume of ADR trading was $563 billion.[1] This heightened interest in the ADRs is driven by the increased desire among retail and institutional investors in the U.S. to gain the benefits of international diversification.

Rapid market integration over the past decade has been characterised by relatively unrestricted cross-border capital flows, the liberalization of financial markets, the increasing uniformity in listing requirements, advancing information technology, the availability of a multitude of international mutual funds and the global presence of large financial institutions. Given this environment, some have argued ADRs to be redundant.[2] This claim motivates us to compare the relative advantages of an ADR portfolio versus the underlying stocks and the corresponding foreign equity index. This is a reasonable comparison in the context of the ability of U.S. investors to invest in most country funds that track corresponding foreign equity indices. We compare the return characteristics and the information transmission among these portfolios using returns from January 1, 1988 to October 31, 1998. Our evaluation also covers the ability of the relevant portfolios to withstand the shocks originating from non-U.S. sources which is of interest to U.S. investors.

This research contributes to the existing literature on ADRs, international diversification and market efficiency. We incorporate a statistical methodology to test the correlation between the returns of a) the U.S. market and the ADR portfolio, and b) the U.S. market and the underlying stocks under different market conditions. Existing research has not adequately addressed the comparability of the ADRs, underlying stocks and the corresponding equity index. We employ a vector autoregression methodology to test the direction of information flow between the ADRs and the underlying stocks

There are three main implications of our research. First, we find the ADR market to be efficiently priced (ie. no arbitrage) in relation to the underlying stocks. However, this does not necessarily mean that U.S. investors should be indifferent between the two securities. We find that ADRs perform better than the underlying stocks and the equity index as measured by the reward-to-risk ratio in the mean-variance context. Although this advantage appears marginal at first, it favors the ADRs further when we account for higher transaction costs associated with the underlying stocks. This observation could provide guidance to portfolio managers using enhanced indexing strategies. It is interesting to note that the Australian Fund Managers themselves could exploit the superiority of the ADRs in forming their domestic indexing strategies. Second, we document a low correlation between the US market and ADRs under high-states of external shock, which is a source of diversification gain for the US investor. This is an important finding given the results of Solnik, Boucrelle, and Le Fur (1996) that most equity markets have a high correlation with the US markets under volatile economic conditions. Finally, the primary direction of information flow at the market level is from the U.S. to Australian stocks. However, with the ADRs, the information flow is from the original stocks to the ADRs.

This paper is structured as follows. In the ensuing section, we describe the ADR market and explain why ADRs of Australian stocks are the focus of this research. Then we present related literature and develop our hypotheses. Next we provide a description of data and methodology followed by results. Conclusion appears last.

2. What is an ADR?

A depositary receipt is a negotiable receipt representing a share of equity in a non-U.S. company. Depositary receipts in American and Global form (ADRs and GDRs, respectively) facilitate cross-border trading and equity offerings to U.S. and non-U.S. investors. ADRs are treated in the same manner as U.S. securities for all legal and administrative purposes. The main advantages of ADRs are (a) there is no currency conversion in trading and in receiving dividends, (b) they help minimise high overseas transaction costs and custodial fees, and (c) the uniformity in information available due to mandatory disclosures. A depositary bank in the U.S. issues ADRs, when the actual shares are deposited in a custodian bank overseas. The depositary bank carries out the responsibilities with respect to the payment of dividends and shareholder voting as stated in the ADRs. According to the Bank of New York, once 3% to 6% of the foreign company's shares are available in the form of ADRs, a true intra-market trading emerges. When executing an ADR trade, brokers seek to obtain the best price by comparing the ADR price in U.S. dollars to the dollar equivalent price of the actual shares in the home market. This process tends to keep the price difference (adjusted for exchange rate) between the foreign stock and the ADR to a minimum.

3. Why Australian ADRs?

Our motivation to study Australian ADRs stem from many peculiarities associated with Australian equities. Empirical studies on international diversification provide conflicting evidence with regard to the degree of correlation and therefore the diversification benefits of direct Australian equity investing to U.S. investors.[3] Analysts have shown a tendency to classify the Australian equity market under a regional grouping called Asia-Pacific.[4] However, in the context of the recent turmoil in the Asian economies, Australian stocks have managed to avoid a serious downturn, which casts doubts on the validity of this grouping. The Australian equity market, despite its use of advanced technology and regulations, still constitutes a very small percentage of the global equity market.[5] The Australian economy is dominated by primary sector industries such as mining and agriculture**.** As Rudd (1994) reveals, the integration of industries across countries is not uniform. Some sectors show greater integration than others do. The industrial composition of a given country, therefore, influences the diversification benefits of international investing. In terms of information flow, financial reporting, most aspects of market regulations and ownership restrictions, Australian and U.S. financial markets are mostly harmonious. U.S. investors have access to Australian company information readily in a comprehensible form. Finally, the trading hours of Australian Stock Exchange do not overlap with those in the U.S. This non-overlapping trading provides a fertile ground to test lead-lag information flow patterns between a big economy such as the U.S.'s and of a small equity market.

4. Literature Review

We discuss three closely related areas of research relevant to our study. (a) *International Diversification*: Bailey and Stulz (1990) document substantial benefits of diversification in the Asia-Pacific region equities. They report a very low correlation coefficient of 0.085

between the daily returns of Australian stocks and U.S. stocks during the period from 1977 to 1985. They also report that using a one-day lag return, where the U.S. leads Australia by one trading day, the correlation coefficient becomes higher (from 0.085 to 0.292) and such a lead-lag relationship is more realistic of the typical influence of the U.S. market on the region.[6] Odier and Solnik (1993) and Solnik, Boucrelle, and Le Fur (1996) suggest the existence of an unfavourable linkage between volatility and correlation among international equity markets. When there is a strong negative shock in the domestic market, the correlation of returns tend to be high which is quite the opposite of what a domestic investor seeks from international diversification. They also recognise that global institutional investors are becoming an important force in all national markets, often resulting in herd behaviour. Erb, Harvey and Viskanta (1997) show that correlation between equity markets change over time.

Several recent research papers have demonstrated that the correlations between international equity markets have increased over time. Such papers include Karolyi and Stulz (1996), Longin and Solnik (1995), and Solnik, Bourcelle and Le Fur (1996). Also, the correlations tend to be higher during periods of high market volatility. An explanation for this based on different phases of business cycles was given in Erb, Harvey and Viskanta (1994). Rudd (1994) distinguishes between country effects and industry effects in the context of international diversification. He points out the existence of some industries with high cross market-correlations. Banking, oil, precious metals, mining and forestry are examples of industries that exhibit global characteristics.

(b) *Market Efficiency and Dual Listings*: Chowdhry and Nanda (1991) show that when a security is traded in several markets, informed traders have greater opportunities to exploit private information. They further show that the expected return of informed traders is affected by the timely transmission of pricing information to satellite markets. This is attributed to competing market makers that serve as low-cost information providers. Kato, Linn and Schallhein (1991) also document the efficient pricing of ADRs, although they found some peculiarities in the correlation. Hauser, Tanchuma and Yaari (1998) find that the causality of dually listed stocks in Tel Aviv Stock Exchange and NASDAQ is unidirectional from the domestic market to the foreign market. Their study relied on stock return series on five individual companies. Copeland and Copeland (1998) document a significant contemporaneous impact of the U.S. market on foreign equity markets with arbitrage opportunities that could be exploited by institutional traders.

(c) *ADRs*: Officer and Hoffmeister (1987) examine 45 ADRs from 1973 to 1983 and find that ADRs are very effective in delivering international diversification benefits. More recently, Wahab and Khandawala (1993) find similar diversifications gains using 31 ADRs. However, these researches did not use the corresponding foreign country equity portfolios or indices as alternative investment vehicles.

5. Research Questions

Hypothesis I (HI):

The price determination process of ADRs, as explained by the depositary banks, suggests that the price of an ADR should match the price of the foreign stock with an exchange rate adjustment. Thus, with non-overlapping trading hours, Monday's returns of the Australian stocks should be equal to the same day's (Monday's) returns of the ADRs in the U.S. in the absence of new information. However, matching trading days for comparing daily returns need to take account of differences in trading schedules. As discussed in Fatemi and Park (1996), these differences between two countries may occur due to (a) time zone differences, (b) additional trading on Saturdays and, (c) national holidays. The use the same day returns or one-day lagged returns, as explained in Bailey and Stulz (1990), does not matter for returns over long horizons. Copeland and Copeland (1998) observe, with daily returns, the U.S. returns to affect the overseas market returns on the following day, giving a leadership role to the U.S. market. In addition, given the global nature of operations of most of the companies with ADR listings, new information that emerges in the U.S. market is likely to affect the stock prices of the Australian companies the next day. It is also possible for the ADRs to respond pre-emptive to new information. A systematic influence of the U.S. returns on ADRs while the Australian market is closed could distort the theoretical similarity of daily returns between the ADR portfolio and the Australian stocks**.** *Thus, under HI, we hypothesise that the ADRs are priced efficiently in line with the underlying stocks and that risk-return characteristic of the ADR portfolio is similar to that of the foreign stocks.*

Hypothesis II (HII):

In portfolio selection strategies the correlation matrix plays a very important role. In the allocation of assets between various asset classes, it is customary to assume that this matrix may not change appreciably over the horizon of interest. Gorman (1998) mentions five principle sources of international correlation which are non-synchronized economic and interest cycles, industry concentration differences, collective company level idiosyncrasies, exchange rate translation, and bench mark construction. These five sources do not have a mitigating effect and as a consequence correlation cannot be ignored.

Das and Uppal (1996) have shown that correlations between international equity markets increase following a large shock to the market. They demonstrate that this characteristic could be utilised to form portfolios of international equities with better performance. Although the volatility transmission between different asset markets has been studied extensively, the issue of changes in correlation between international equity returns is of relatively recent origin. We investigate whether the correlation between the U.S. equity market and the ADR portfolio behave the same way as the correlation between the U.S. equity market and the underlying stocks. If the behaviour of the correlations is different then it may add a complex dimension to the choice between the ADRs and the foreign stocks. In addition, these correlations have implications on the relative mean-variance dominance of the ADR portfolio when combined with another portfolio. This hypothesis focuses on the variation of the above correlations due to shocks to the market from two different sources: (a) global market and (b) regional (non-U.S.) market. These are two of the main sources of shock that are faced by U.S. investors seeking international diversification. *Under Hypothesis II (HII), we state that the correlation coefficient between the U.S. equity market and the ADR portfolio is similar to that between the U.S. equity market and the underlying stocks.*

Hypothesis III (HIII):

Dual listing of stocks as in the case of ADRs naturally raises the question of causal relations between the prices of the two markets. Since the assets underlying the ADRs are the Australian stocks, we may hypothesise that the main source of information for price formation is in Australia, similar to the conclusions of Hauser, Tanchuma and Yaari (1998). It is possible that in situations like this, the geographical spread of operations of the companies may influence the result. Many of the companies in the Australian ADRs have extensive global operations. It is, therefore, not clear that in our study causality will be only unidirectional from the Australian stocks to the ADRs. It is also possible for the ADRs to show a pre-emptive response to new information before the Australian market opens. As documented by Copeland and Copeland (1998), the well-established leadership role of the U.S. equity market may create profitable arbitrage opportunities. Yet, the theoretical pricing mechanism given by the depositary banks is indicative of a uni-directional information flow ignoring the U.S. led influence on other markets. *Hypothesis III (HIII) postulates that there* *is a uni-directional causality and transfer of pricing information from the domestic (Australian) market to the ADR market.*

6. Data

We examine 24 Australian ADRs traded in the U.S. Appendix A contains a list of these companies with additional information such as the listing dates, conversion ratio (number of Australian stocks per ADR), industry classification and percentage representation in the Australian equity index. We obtain daily closing prices for the ADRs and the underlying Australian stocks from Datastream International. The period studied spans from January 1, 1988 to October 31, 1998 and thus postdates the October 1987 stock market crash. We compute the returns as log differences of adjusted prices over the entire sample period. The daily returns, therefore, correspond to close-to-close prices including dividends. We exclude weekends and holidays in both the countries in calculating daily returns. In this sense the returns are over a trading day and may cover more than one calendar day, while monthly returns are based on two consecutive month ending prices.

We form a value weighted portfolio of the ADR stocks (in U.S.$) and a portfolio of the underlying stocks (in Australian dollars, AU$), where the weight is determined by the market capitlaization at the beginning of the month. These two portfolios are labelled as the ADR portfolio and the foreign portfolio (from the U.S. investors' perspective). One of the major problems in using daily returns across countries is the non-synchronous trading periods for different markets. The portfolio approach helps us avoid this problem when dealing with the ADR portfolio returns and the U.S. market index returns. Karolyi and Stulz (1996) point out that this is of special concern when the two markets are not open at the same time, which is the case with Australia and the U.S. We also reduce the errors-in-variable problem, as suggested in Fatemi and Park (1996), using this portfolio approach.

In addition to the individual stock price data from both markets, we extract the daily data on the market indices and exchange rate (U.S.$/Australian $) from Datastream International. These daily indexes include the Australian market index, the U.S. market index, World market index and the Europe, Australia and Far East (EAFE) index. Latter two are used to study the effect of external shocks on correlation coefficients. In order to ensure uniformity in the index construction, all the indices are provided by Datastream International.

We also include a recently introduced financial instrument that provides an alternative to investing in the Australian equity index. Australian WEBS (World Equity Benchmark Shares) having traded on the American stock exchange since March 1997. Australian WEBS are priced on the basis of the value of the constituent in the MSCI Australia, which represent about 62% of the Australian equity value at August 31, 1998.

7. Methodology

Since ADRs represent claims on the same underlying assets and cash flows as the corresponding foreign stocks, we should not expect to observe any systematic pricing differences between the two markets. This, of course, assumes that there is no impediment to flow of information or other institutional barriers. We test HI by comparing calendar day matched returns from the two markets on the portfolios constructed as explained earlier. Of course, the national holidays may differ and this may lead to different sample sizes covering the same calendar period. In Fatemi and Park (1996), while matching daily ADR returns and the returns from the original stocks, they excluded both returns when one of them was missing. We consider the close-to-close daily return and exclude those cases when one of the two countries has a holiday. Thus, when we collect the returns from the two markets based on the day of the week we have samples with equal sizes. Therefore, the matched pair t-test to analyse the return differences based on the day of the week, as in Fatemi and Park (1996), can be applied.

In HII, we examine the variation of these correlations due to shocks to the market from two sources: (a) global market and (b) non-U.S. global market, which is of interest to a U.S. investor. The Datastream global equity index and the Datastream EAFE index represent these two sources respectively. We define the shock as the absolute difference between two consecutive monthly returns of the representative index.

We follow the approach given in Das and Uppal (1996) using monthly returns to examine the effect of these shocks on the correlations between the U.S. index return and the ADR portfolio return and that between the U.S. index return and the underlying stock returns. We divide the time series of the returns into two sub-samples based on the absolute value of each of the shock sources and then calculate the correlations for the two sub-samples. This allows us to compare the correlations between the high-shock state and the low-shock state.

The results obtained from this analysis, however, will not directly provide evidence of statistical significance between the correlations of the two portfolios for a given state of shock. This is accomplished by computing standard errors of this difference by Monte-Carlo simulations. We use the mean vector and the covariance matrix of the three portfolio return series (US market, ADR portfolio, and underlying stock portfolio) to generate 1000 samples of return series under a normal distribution. This allows us to compute 1000 high-shock state and 1000 low-shock state correlations and therefore, the standard deviations of the differences.

In order to test the causality assumed under HIII, we adopt the Vector Auto Regression (VAR) framework. Similar approach was taken in Hauser et al (1998) and Lee (1992). In the VAR approach all the variables are treated as endogenous and no restrictions are placed based on supposed a priori knowledge. We use a four variable system to model what is known as 'innovation accounting' on daily returns to examine the information flow from one source to the other. These variables represent returns from a) the ADR portfolio, b) the underlying stock portfolio, c) the Australian index, and d) the U.S. index.[7]

8. Results

Panel A of Table 1 provides the summary statistics of the four portfolios: the ADR portfolio (AA), the underlying stock portfolio in foreign currency (BB), the underlying stock portfolio in U.S. dollars (CC), the Australian index in U.S. dollars (DD) and the Australian WEBS (EE). A U.S. investor seeking gains from international diversification must examine the risk-return profile of AA, BB, CC, DD and EE[8]. To the U.S. investor, the U.S. dollar denominated Australian index (portfolio DD), represents an unhedged index fund. This is readily available in the form of specialised country funds. The portfolio, BB, on the other hand, requires purchasing foreign stocks and managing currency risks, which may only be within the means of large institutional investors.

Casual observation of Panel A reveals that daily and monthly returns of all portfolios have similar mean returns and risks (standard deviation). However, a more appropriate measure of risk should take into account of the covariance between these portfolios and the U.S. index return. In this context we first estimate the market model beta coefficient for each portfolio against the U.S. index. The ratio of the mean return and the beta coefficient is displayed as the reward-to-risk ratio in the table. This indicates that the best performing portfolio is BB (Australian dollar denominated underlying stocks) in terms of both the daily and monthly returns, which includes the exchange rate risk.

We perform standard t-tests to examine the statistical significance of any day of the week effect in the portfolio returns or in differential returns of portfolios. Since our daily returns are based on closing prices, Monday’s return captures the weekend. Similarly, when holidays occur daily returns can span more than one day. First four rows of Panel B of Table 1 contain the results of the day of the week effect tests on individual portfolio returns (AA, BB, CC, and DD). We observe that the individual portfolio returns do not deviate from zero at usually acceptable levels of significance. The same tests on incremental returns of BB, CC and DD against the ADR portfolio (AA), as given in the last three rows of Panel B in table 1, also do not show significance.[9] We also fail to reject the null hypothesis that the overall daily mean return is zero for all portfolios as indicated by the results in the last column of Panel B of Table 1.[10]

Next we examine the economic significance of the difference in portfolio mean returns using transaction costs. The annualized return difference between the monthly returns of BB and AA is about 0.7%.[11] However, Gorman (1998) reports an annualized incremental cost of 1.75% for a 50% currency hedged EAFE equity portfolio.[12] With these incremental costs, portfolio BB's higher return is unrealistic.

This leaves the US investor having to choose between portfolios AA and CC, where it is clear that AA is superior to CC with a higher reward-to-risk ratio. This superiority is further enhanced when higher transaction costs of portfolio CC are incorporated. Lynn (1994) compares an international ADR fund and an equivalent foreign stock portfolio consisting of 200 stocks, and finds that the ADR fund saves about 1.75% per year.

We also note that an Australian investor seeking a pure domestic portfolio could use Australian stocks with ADR listing to achieve superior results than the Australian index. This excess return is free of any day of the week effect. This result thus provides better insight to portfolio managers, both U.S. and non- U.S., engaged in enhanced indexing.

Next, we investigate whether the reward-to-risk dominance of the ADR portfolio is consistent with other properties such as low correlation with the US market index in volatile markets. We study the effects of two different sources of external shocks namely, world market shocks and the regional market (EAFE) shocks. An international investor prefers a low correlation with the US market, in particular, during states of high external shocks. The results in Table 2 show both the ADR portfolio (AA) and the underlying stocks (CC) have similar abilities to be a source of low correlation for US investors. This result has added importance since Solnik, Boucrelle, and Le Fur (1996) find higher correlation between the US index and international equities in times of higher volatility.

In order to identify the direction and magnitude of information flow from the underlying stocks to the ADRs and from the U.S. market to the Australian market, we use a variance decomposition technique with a four variable VAR system involving the returns of the Australian stocks in U.S.$ (DD), matching ADRs (AA), Australian index (CC), and the U.S.

index (EE). It is known that the results of the VAR procedure is very sensitive to the ordering of the variables studied. In order to identify a logical sequence of the four variables, we calculate the simple correlation coefficient between the daily returns of AA and CC, and between DD and EE. Non-overlapping trading hours between Australia and the U.S. helps us to carry out a preliminary test on information flow based on the correlation between the returns of interest. When the Australian return precedes the daily U.S. index return chronologically (eg. U.S. Monday and Australia Monday matched), U.S. and Australian indexes (EE and DD) have a correlation of 0.38 and that between the ADRs and underlying stocks is 0.30 (AA and CC). When U.S. precedes Australian returns (eg. U.S. Monday and Australia Tuesday matched), the above correlation changes to 0.05 and 0.71, respectively. These results indicate a dominant information flow from the U.S. market to the Australian market, while the information flow for ADRs is from the foreign market to the U.S. Hence, the order of the variables used in VAR is as follows: (1) U.S. index, (2) Australian Index, (3) underlying stocks, and (4) the ADRs.

The results of the VAR analysis given in Table 3 allow us to examine the information transmission process. This is similar to Hauser et al (1998). However, we use a portfolio based approach as oppose to their analysis based on individual ADRs. The diagonal elements in Table 3 are reflective of the degree of exogeneity of each return series. U.S. index is the most exogenous of all portfolios. The innovations in the U.S. market explain 14.99% of the forecast error variance of the Australian index while the reverse influence is just 0.02%. For ADRs, the innovations in the underlying stocks explain 13.94% of the forecast error variance of the ADRs and the reverse is just 5.82%. This asymmetry of information transmission supports our earlier observation on correlation coefficients differences. In essence, information flow from the foreign stocks to the ADRs helps to mitigate the dominant influence at the market level from the U.S. to the overseas market.

The analysis below follows Lee (1992) and interprets the impulse response function derived from the VAR analysis. Horizontal scale in the figures 1-4 represents trading days (U.S. market opening after the Australian market closure). From Figure 1, the shock from the U.S. index return affects the ADRs contemporaneously, while the shock flows to the underlying stocks next day when the Australian market opens. However, the disturbances stabilise in two days. The shocks originating in the Australian index affect the underlying stocks contemporaneously, while the flow to ADRs are reflected on the same trading day. There is no noticeable impact on the U.S. index, as given in Figure 2. In Figure 3, it is shown that the shocks in the underlying foreign stocks affect the ADRs on the same trading day with stabilizing in two days. These results are consistent with the earlier finding that the most dominant information flow is from the U.S. index to the Australian index.

9. Conclusion

In this paper we investigate several characteristics of the Australian stocks traded in the U.S. as ADRs. We postulate and test three hypotheses using over ten years of daily and monthly returns. First, we establish that the 'law of one price" holds for ADRs. For a global investor, an ADR portfolio is a cost-effective means of obtaining superiority in the mean-variance context as measured by the reward-to-risk ratio. We also find that that the ADR portfolio offers a low correlation with the US index under high external shock states, which is of interest to US investors seeking global diversification. The above advantages also suggest that ADRs could be used by international portfolio managers in enhanced indexing strategies. Finally, we detect unidirectional information transmission from the underlying stocks to the

ADRs, which help offset the strong information flow from the aggregate U.S. market to the foreign market. Overall, we conclude that the ADRs are not superfluous and that they deliver a valuable and economically efficient service to U.S. investors seeking international diversification. We note that our results, which are based on ex-post data, may have been time specific and/or influenced by the particular industrial structure of the Australian economy.

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Table 1

Panel A

Descriptive Statistics of Daily Returns (January 1, 1988 – October 31, 1998)							
Portfolio	Mean	Std. Dev.	Median	Skewness	Kurtosis	JB-Statistic	Reward-to – risk ratio
AA: ADR	0.00012	0.01023	0.00007	-0.0878	1.7942	146.68	2.48
BB: Foreign (AU$)	0.00019	0.01021	0.00021	-0.3192	3.0774	40.86	3.27
CC: Foreign (US$)	0.00013	0.01178	0.00041	-0.3553	2.4514	79.62	2.43
DD: Aust. Index	0.00014	0.01079	0.00019	-0.4762	5.7375	829.95	2.51
EE: Aust WEBS	-0.00002	0.01432	0.00000	-0.6077	7.4112	61.14	-0.03

Reward-to-risk is computed as the ratio of the mean return and the beta coefficient (obtained by regressing the portfolio return against the U.S. index return). JB-statistic is the Jarque-Bera test statistic for normality and is based on the excess skewness and kurtosis coefficients. It is asymptotically distributed Chi-square with two degrees of freedom. Critical values are 5.99 at the 5% significance level and 9.21 at 1% significance level. All the five distributions deviate from normality. Portfolio EE has only 423 observations (due to its recent introduction) whereas the others have 2540 observations.

Descriptive Statistics of Monthly Returns (January 1, 1988 – October 31, 1998)							
Portfolio	Mean	Std. Dev.	Median	Skewness	Kurtosis	JB-Statistic	Reward-to-risk ratio
AA: ADR	0.00788	0.05738	0.01095	-0.2915	0.4068	38.27	1.16
BB: Foreign (AU$)	0.00844	0.04609	0.00753	-0.0698	0.0642	50.96	1.40
CC: Foreign (US$)	0.00731	0.05808	0.00410	-0.1340	0.6826	29.48	1.09
DD:AUS Ind(US$)	0.00584	0.05488	0.00590	-0.0186	0.4708	34.66	0.99

Reward-to-risk is computed as the ratio of the mean return and the beta coefficient (obtained by regressing the portfolio return against the U.S. index return). JB-statistic is the Jarque-Bera test statistic for normality and is based on the excess skewness and kurtosis coefficients. It is asymptotically distributed Chi-square with two degrees of freedom. Critical values are 5.99 at the 5% significance level and 9.21 at 1% significance level. All the five distributions deviate from normality.

Table 1 (Contd.)

Panel B

Day of the Week Effect of Individual Portfolio Returns and Mean Difference Tests January 1, 1988 - October 31, 1998						
Series	Mon	Tue	Wed	Thu	Fri	All Days
AA: ADR	0.00007	0.00021	0.00033	-0.00010	9.1E-05	0.00012
	(0.14)	(0.0.45)	(0.75)	(-0.22)	(0.19)	(0.59)
BB: Foreign (AU$)	-0.00005	0.00043	0.00063	-0.00003	-6E-06	0.00019
	(-0.07)	(0.92)	(0.1.45)	(-0.06)	(-0.01)	(0.89)
CC: Foreign (US$)	-0.00030	0.00021	0.00089	-8E-06	-0.00020	0.00013
	(-0.46)	(0.39)	(1.77)	(-0.02)	(-0.35)	(0.52)
DD: AUS Index (US$)	-0.00040	0.00017	0.00055	0.00024	4.7E-05	0.00014
	(-0.58)	(0.35)	(1.16)	(0.53)	(0.10)	(0.64)
Difference (BB – AA)	-0.00010	0.00022	0.00030	7.5E-05	-0.00010	0.00006
	(-0.27)	(0.48)	(0.82)	(0.22)	(-0.23)	(0.33)
Difference (CC – AA)	-0.00040	-7E-07	0.00056	9.3E-05	-0.00030	0.00003
	(-0.87)	(-0.00)	(1.63)	(0.27)	(-0.67)	(0.02)
Difference (DD – AA)	-0.00040	-0.00004	0.00023	0.00034	-0.00004	0.00002
	(-0.92)	(-0.07)	(0.60)	(0.93)	(-0.10)	(0.12)

T-Statistic, given in parentheses below the estimate, corresponds to the hypothesis test that a given series (individual or incremental) has a mean return of zero. Following the suggestions of an anonymous referee, we also conducted the equality of means test across the days of the week for the four portfolios. The test indicates that there is no significant difference in the mean returns across the days of the week for each of the portfolios.

Table 2

Effect of Global and Regional Shocks on Correlations in Monthly Returns
January 1988 - October 1998

Shock Source	Shock State	Correlation With U.S. Index		T_Stats. of Difference
		ADR Portfolio	Portfolio CC	
World Market	High	0.3492	0.3744	-1.16
	Low	0.5524	0.5232	1.24
		ADR Portfolio	Portfolio CC	
Regional Market	High	0.2711	0.2831	-0.56
	Low	0.5662	0.5491	0.12

World market index and the EAFE index are obtained from Datastream. Shock is defined as absolute value of the first difference of the corresponding index. Time series of returns are sorted according to the decreasing order of these shocks. The first half of these sorted series provide the high state correlation and the second half provides the low state correlation. The numbers in the right hand column are the t-statistics of the differences in correlations obtained from Monte-Carlo simulations as explained in the paper. Portfolio CC is defined as in Table 1. Full sample period correlation between the U.S. index and the ADR portfolio is 0.4494 whereas that between the U.S. index and the portfolio CC is 0.4366.

Table 3

Percentage of 10-Day Forecast Error Variance Explained by Innovations in Each Variable of the Four Variable VAR System

Variables Explained	By Innovations in			
	U.S. Index (EE)	Australian Index (DD)	Foreign stocks (CC)	ADRs (AA)
EE: U.S. Index	99.61	0.02	0.30	0.08
DD: Australian Index	14.99	76.97	5.11	2.92
CC: Foreign stocks	13.42	57.82	22.93	5.82
AA: ADRs	14.65	43.31	13.94	28.11

Forecast error variance is computed using the four variables with three lags and a constant. Daily return data used in this analysis.

Figures 1-4

Impulse Responses to Choleski Factored Shocks

Series 1: U.S. Index, Series 2: Australian Index in US$, Series 3: Foreign Stock portfolio in US $, Series 4: ADR Portfolio

Figure 1

Responses to Shocks in U.S. Index (EE)

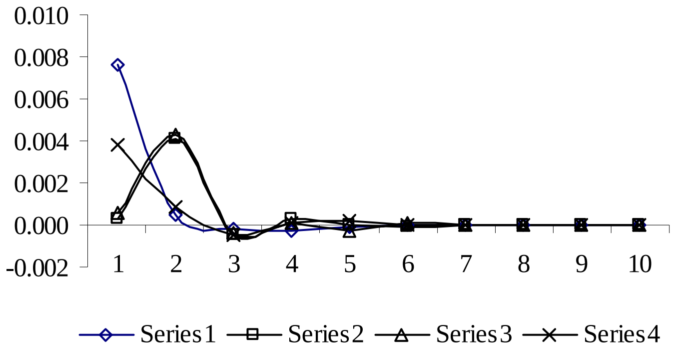


Figure 2

Responses to Shocks in Australian Index (DD)

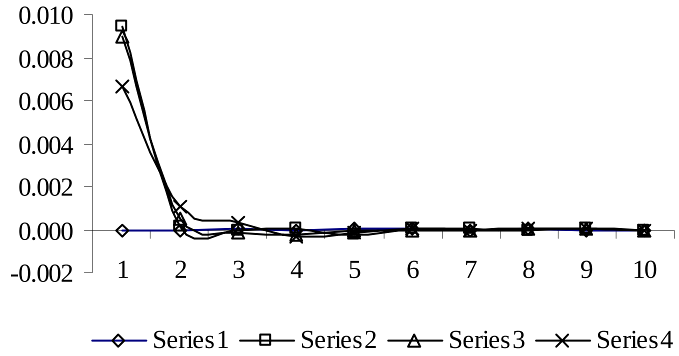


Figure 3

Responses to Shocks in the Foreign Stock Portfolio in US$ (CC)

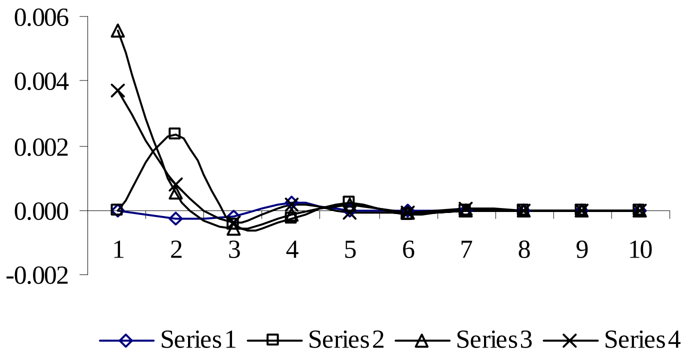
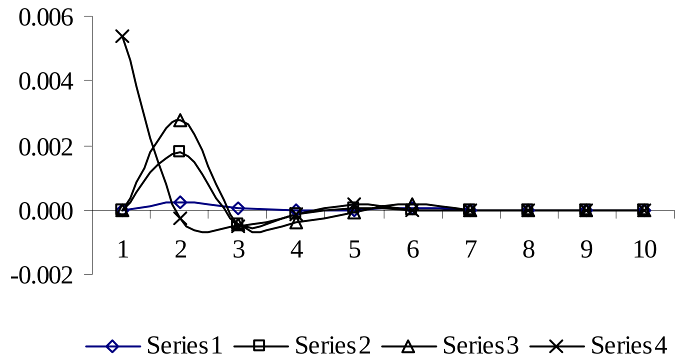


Figure 4

Responses to Shocks in the ADR Portfolio (AA)



Appendix A

List of Australian Companies in the ADR Sample

Name	Ratio Stock:ADR	Beginning Date* In Datastream	Weight in AOI As of 31/05/1997#	Industry
Amcor	1:04	06/26/92	1.40	Pulp and paper
Ashton Mining	1:05	08/02/93	0.03	Metals
Aus.& NZ Banking	1:05	04/04/95	3.40	Banking and Financial
Boral	1:08	01/04/88	1.21	Building materials
Broken Hill Pty	1:02	01/04/88	9.48	Mining
Central Pacific	1:02	01/04/88	0.16	Mining
Coles Myer	1:08	01/04/88	1.68	Retail
Comalco	1:05	12/27/94	1.04	Metals
Delta Gold	1:01	12/27/94	0.11	Mining
Email	1:02	08/02/93	0.30	Building materials
FAI Insurance	1:05	01/04/88	0.04	Insurance
Faulding	1:04	12/27/94	0.25	Health care
Goodman Fielder	1:04	12/27/94	0.53	Food
National Aus. Bank	1:05	01/04/88	7.01	Banking and Financial
News Corporation	1:04	01/04/88	4.80	Media
Orbital Engine	1:08	12/04/91	0.03	Industrial machinery
Pacific Dunlop	1:04	12/02/94	0.95	Industrial
Pioneer International	1:01	01/03/95	1.00	Building materials
Resolute	1:04	12/27/94	0.07	Mining
Santos	1:04	01/04/88	0.82	Energy
Simsmetal	1:04	01/16/95	0.12	Steel
Southern Pacific	1:02	01/04/88	0.27	Mining
Westpac Banking	1:05	03/17/89	3.21	Banking and Financial
WMC	1:04	01/10/90	2.42	Mining
		Total	40.33	

* It is not necessarily the same as the listing date.
# AOI represents the commonly quoted index of Australian equities, All Ordinaries Share Price Index. This is a capitalization-weighted index covering about 90% of the total market capitalization.

End Notes:

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[1] Data on trading volume is obtained from the ADR segment of the Bank of New York 's website: **http://www.bankofny.com/adr/**

[2] A participant questions Richard A. Grasso, Chairman of the NYSE, at a conference on "Equity Market Globalization" at Fordham University, New York on January 13, 1997. **(Source: http://www.nyse.com/public/)**

[3] See Solnik (1974), Erb, Harvey, and Viskanta (1994) for details.

[4] For example, Bailey and Stulz (1990)

[5] According to the Morgan Stanley Capital Index (MSCI) as of April 1998, Australian equity market represented about 2% of the global market capitalization.

[6]They show that correlation coefficients are low with daily returns due to noise contained in daily data. However, using a one-day lag between the U.S. and foreign equity returns is one method of correcting this shortcoming associated with daily data. This could be an alternative to using monthly data.

[7] From the work of Sims (1980), the vector $Z(t)$, the return from these four variables may be represented by,

$$Z_t = \sum_{k=0}^{\infty} B_k \varepsilon_{t-k}$$

Where, ε_t is the 4×1 forecasting error of the best linear prediction of $Z(t)$, B_k is a 4×4 matrix of coefficients representing the dynamic response of each of the variables to a shock ε_{t-k} after k periods. This innovation form of representation allows us to account for the reaction of a particular variable to future changes in any of the four variables.

To simulate the effect of the shock sources, it should be noted that even if ε_t is serially uncorrelated, some of its components may be contemporaneously correlated. Therefore, to infer the response behaviour unambiguously, we need to apply orthogonal transformation to ε_t. This is achieved by Cholesky decomposition of the covariance matrix of ε_t, $\Omega = \Sigma'\Sigma$. Therefore,

$$Z_t = \sum_{k=0}^{\infty} B_k \Sigma^{-1} \Sigma \varepsilon_{t-k} = \sum_{k=0}^{\infty} B_k \Sigma^{-1} u_{t-k} = \sum_{k=0}^{\infty} C_k u_{t-k}.$$

The coefficients of the new matrix C_k represent the responses to shocks in particular variables and the variance of each element in $Z(t)$ is attributable to the sources in the elements of u since u is now serially and contemporaneously uncorrelated. The component of the error variance in the t-step ahead forecast accounted for by the shocks in Z_j is given by (see Lee (1992) for further details),

$$\sum_{k=0}^{t-1} c_{ij,k}^2 \Big/ \sum_{j=1}^{4} \sum_{k=0}^{t-1} c_{ij,k}^2 .$$

[8] Due to the small sample size of the Australian WEBS (423 daily observations), it is difficult make reasonable inferences. For this reason we have limited our comments on the WEBS.

We thank an anonymous referee for suggesting the WEBS as an alternative investment vehicle.

[9] We repeat the test on panel B using two sub-periods for two reasons: (a)our sample contains fewer stocks in the earlier years, and (b) it is claimed that the ADR market has matured only in recent years. The first sub-period is from January 1, 1988 to December 31, 1993 and the second from January 1, 1994 to October 31, 1998. We obtain consistent results (available upon request) for these sub-periods supporting a persistent efficiency in the ADR market.

[10] We also test the law of one price for all the stocks in our sample using the daily closing prices from both markets and the daily exchange rates. The null hypothesis is that there is no significant difference between the two prices. We fail to reject the null hypothesis for each of the stocks in the sample. We are indebted to an anonymous referee for suggesting this test based upon prices.

[11] Monthly return difference between AA and BB is 0.00056, which is about 0.7% when annualized.

[12] Gorman (1998, p. 88-89) reports, for a EAFE stock portfolio of size $200 million with a 50% currency hedge, incremental annual cost faced by the U.S. investor is 56 basis points which includes custody, clearing and management fees. Physical transaction costs will add another 119 basis points.