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Time-Varying Correlations and Optimal Allocation in Emerging Market Equities for Australian Investors: A Study Using East European Depositary Receipts

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Abstract

Australian stock market has lower market capitalization compared to that of many other OECD countries and Australian investors can reduce their overall portfolio risk by diversifying into equities from other markets. Choosing stock markets with low correlations with the domestic market can increase the portfolio diversification benefits. For Australian investors, East European stock markets are one such asset class and this paper studies the diversification benefits to Australian investors from diversifying into the East European equities. Since the correlations between asset returns are time-varying, using unconditional estimates of correlations in a portfolio optimization model can result in misallocation of assets. To alleviate this problem, this study uses multivariate GARCH (Generalized Autoregressive Conditional Heteroskedasticity) models to estimate time varying correlations. The assets used in the portfolio optimization model for this study comprise of American Depositary Receipts (ADRs), 11 Russian, 5 Polish, 2 Hungarian and 1 Czech Republic equities and All Ordinaries Australian index. Ex-post return calculations show that unrestricted portfolios of Australian index with the ADRs outperform the returns from holding only Australian stocks. With investments restricted to 10% in ADRs there is no statistically significant diversification benefits but with 20% investment in ADRs there is evidence of statistically significant diversification benefits.

Keywords: F37 – International Finance, G15 – International Financial Markets

1. Introduction

The objective of international diversification is to improve the risk/return trade-off for investors. The benefits of international diversification as such are well documented in the academic literature. Grubel (1968) found that between 1959 and 1966, U.S. investors could have achieved superior risk and return

opportunities by investing part of their portfolio in foreign equity markets. Levy and Sarnat (1970) analyzed international correlations for the 1951-1967 period and demonstrated the diversification benefits from investing in developed and developing equity markets. Grubel and Fadner (1971) showed that between 1965 and 1967 industry correlations within countries exceed industry correlations across countries.

Investors are conscious of the fact that international stocks have different characteristics so that by diversifying between different countries or industries in countries, the performance of the portfolio can be improved. Investing in international markets differs from domestic market investment in three important ways (Lessard, 1976). First, the covariances among assets within a domestic market are much higher than the covariances among different markets. Second, barriers imposed by taxation, currency controls, or investor tradition may further segment national markets sufficiently such that assets are priced in a domestic rather than an international milieu. Finally, exchange rates between different currencies deviate from each other giving rise to currency exposure on international portfolios.

Review of theoretical and empirical research into international diversification indicates, despite increasing globalisation, benefits accrue to investors holding stocks listed in other countries. These benefits arise, in part, from differences between countries in the nature of their real economies. The greatest difference in real economy structures are between the emerging and developed markets. Thus, on theoretical grounds, emerging market investments should provide a means by which an investor can achieve higher risk-adjusted returns for a diversified portfolio. Ibrahim (2006) found there are still potential benefits in diversifying into emerging markets for an investor with long-term investment horizon. Higher volatility of the emerging markets have been of concern for the academics and practitioners in terms of accessing international diversification benefits, a model that provides more accurate measure of correlations may alleviate some of these concerns. Dynamic Conditional Correlation (DCC) GARCH model is one such model that helps to estimate correlations more accurately.

Recent working paper by Antoniou, Olusi and Paudyal (2006) look at the diversification benefits of home-made diversification strategies using DCC model and find that directly diversifying into foreign markets does not yield better results as compared with portfolio constructed using Euro zone as the home market. Our research though uses DCC model but has an entirely different focus. We look at the diversification benefits for an Australian investor and because of its smaller size and different structure an Australian investor may be exposed to factors different from an investor from a larger market[1]. Researchers have also argued that similar benefits could be achieved by investing into stocks of multinational companies as their returns are expected to be more closely correlated with the global factors than with that of the domestic factors. However, returns of Australian multinational companies are found to be closely correlated with the domestic returns and less with the global returns (Wright and McCarthy 2002). This could be because of the smaller size of Australian multinational companies.

Empirical research of Schmukler (2004) and Li, Sarkar and Wang (2003) also indicate that there are still benefits to be realized in diversifying internationally because world financial markets are still not fully integrated. The differences between emerging and developed economies are reflected in financial markets by the key characteristics of return, risk, and correlations, with correlations as the chief indicator for diversification advantages. Increasing market integration has significantly reduced the diversification benefits from a portfolio drawn from developed markets but has not influenced the benefits from emerging market investments to the same degree (Harvey, 2000). While these differences in the real and financial sectors of the emerging markets compared to those of the developed markets continue, the diversification benefits in investing into these markets are likely to continue. Research, thus far has concentrated in testing the benefits of the diversification into larger emerging markets that have comparatively better developed markets. In this study we extend this argument to include some of

[1] In case of Antoniou, Olusi and Paudyal, whole of Euro zone is considered as the home market.

the markets that are still not commonly included in the emerging market diversification studies. The benefits of diversifying into these markets could be different as the differences in the economic structures of these markets are expected to be more pronounced.

Research in international diversification, from the perspective of Australian investors is limited. Allen and Macdonald (1995) studied the diversification benefits available to the Australian investor over the period 1970 to 1992 and found that for most pair wise portfolios, there existed potential long-run portfolio diversification gains. Similar results are reported by Watson and Dickinson (1981), Mitchell, Wapnah and Izan (1988) and Izan, Jalleh and Ong (1991). Gupta (2006) in a review of literature in the area of international diversification from the perspective of Australian investor and find on theoretical grounds Australian investors should benefit by diversifying into emerging markets.

Market integration as such is not static and may vary over time. Bekaert and Harvey (1995) used a conditional regime switching model to study the level of integration between equity markets of several countries and found that the level of integration changes with time. Adler and Qi (2002) found that the market integration is affected by global and domestic factors as well. In recent years, there are several papers that look into the time-varying nature of return correlations and factors that cause the changes in correlations. Yang (2005) studied the correlations between Japan, Taiwan, Singapore, Hong Kong and South Korea and found that return correlations varied considerably during the period of study and correlations increased during the bear market periods. Jithendranathan (2005) studied the correlations between the U.S. and Russian equity markets and found that changes sovereign credit risk, world energy prices and exchange rate as the reasons for the changes in correlations.

The most popular method to estimate time-varying correlations is to use a moving average specification wherein correlations are estimated using a moving window of time. The weakness of this method is that it gives equal weight to all the observations during the time period used in the moving average calculations. The other method used to calculate time varying correlations is to use multivariate GARCH models. Early models of this category were based on Constant Correlation Model of Bollerslev (1990). The main weakness of these models is the assumption that correlations were constant. The second set of models in this category is based on Kroner and Ng (1998). These models, though theoretically sound, lacked computational ease as these models require estimating too many coefficients at the same time. Engle (2002) introduced another variant of the multivariate GARCH model called "Dynamic Conditional Correlation Model (DCC)", which combined theoretical appeal of time-varying correlations and the computational flexibility of the univariate models. This study will use this model to estimate time varying correlations between Australian equity index and the foreign assets.

With capital markets becoming more integrated, the scope for exploiting any "inefficiencies" may be diminishing rapidly as financial analysts identify the excess returns and then arbitrage them away (Fraser, Helliar and Power, 1992). However, there may be theoretical justification for potential gains from international diversification as investors gain access to shares in industries which are not represented or are thinly represented in the domestic market.

There are two issues that this paper aims to address based on the argument that the lower correlations occur from the differences in the underlying economic structures of the two markets (domestic market of the investor and the foreign market). First, the time-varying correlations between Australian, emerging and developed markets are studied to identify the markets that might offer the maximum diversification potential for Australian investor. Second, using a sample of emerging market equities, optimal portfolios are constructed and ex-post returns of these are compared with that of the Australian equity returns.

Based on the analysis of correlations, the equities from former Communist countries of Eastern Europe are chosen as a sample of emerging market equities for testing the diversification benefits. After the break up of the Soviet Union, market economy is developing in these countries and equities from there are available for international investors. Several stocks with large market capitalizations from these countries are listed as American Depositories Receipts and Global Depository Receipts in

the U.S. and European stock exchanges and are actively traded and can easily be available for investment by Australian investors[2].

This study covers the period from November 1997 to August 2005 and uses All Ordinaries Index for Australian equity returns and the returns of depository receipts from Russia, Hungary, Czech Republic, and Poland. Depository Receipts (DRs) from these countries are chosen instead of broad based country indices for the following reasons. Tradable indices are not available in all of these countries and DRs provide a good proxy for the market as these DRs are created with the stocks of companies which form a substantial part of the market capitalization in those countries.

The rest of the paper is organized as follows. Section 2 describes the empirical methodology and data used in this paper. Results of the empirical analysis are presented in Section 3 and the conclusions of this paper are given in Section 4.

2. Empirical Methodology and Data

In portfolio optimization models, the objective is to maximize the return and minimize the risk. The expected return of a portfolio is the weighted average of the returns of individual securities in the portfolio and the weights are the proportion of each of the securities in the portfolio, which can be expressed as follows:

$$\bar{R}_P = \sum_{i=1}^{N} X_i \bar{R}_i \tag{1}$$

where X_i is the weight of the i^{th} security in the portfolio and $\bar{R}_i$ is the expected return of that asset.

The standard deviation of a portfolio can be expressed as:

$$\sigma_P^2 = \sum_{i=1}^{N} X_i^2 \sigma_i^2 + \sum_{i=1}^{N} \sum_{\substack{k=1 \\ k \neq i}}^{N} X_i X_j \sigma_{i,k} \tag{2}$$

where σ^2s are the variances and $\sigma_{i,k}$ is the covariance between the two securities i and k.

The standard method of optimization is to find a set of portfolios which will give the maximum return for a given level of risk. This set of portfolios is called the efficient set of portfolios and based on their individual risk preferences, investors can choose a specific portfolio from this set of optimal portfolios.

Mathematically, the optimization problem can be stated as follows:

$$Min\ \sigma_P^2 = \sum_{i=1}^{N} X_i^2 \sigma_i^2 + \sum_{i=1}^{N} \sum_{\substack{k=1 \\ k \neq i}}^{N} X_i X_j \sigma_{i,k} \tag{3}$$

Subject to the following constraint:

$$\sum_{i=1}^{N} X_i = 1 \tag{4}$$

Since short selling is not allowed or severely restricted in many of the emerging markets, the following additional constraint is imposed on the optimization model:

$$0 \leq X_i \leq 1 \tag{5}$$

To capture the time-varying nature of variances and covariances, the DCC model of Engle (2002) is used in estimating the correlations. DCC has a two step procedure for estimating the conditional variances and correlations. It is assumed that the returns of the 20 assets used in constructing the portfolios in this paper are normally distributed with zero mean conditional on the information available at t-1.

$$E_{t-1}(r_t) \sim N(0, H_t) \tag{6}$$

[2] Australian investors can invest into ADRs either directly by contacting brokers in America and recently ADRs listed on the USA stock exchanges are also available through brokers in Austrlia.

where r_t is the 20x1 vector of asset returns at time t and H_t is the conditional covariance matrix expressed as:

$$H_t \equiv D_t R_t D_t \tag{7}$$

where H_t is the 20x20 conditional covariance matrix, R_t is the conditional correlation matrix and D_t is a diagonal matrix with the time-varying standard deviations in the diagonal. In the first step the following univariate GARCH model is used to estimate the diagonal elements σ_{it} of D_t using the following GARCH(1,1) specification.

$$\sigma^2{}_{it} = \gamma_i + \alpha_i r^2_{it-1} + \beta_i \sigma^2_{it-1} \tag{8}$$

The conditional return of each of the assets is standardized by dividing it by its standard deviation obtained in the previous step. This gives the following standardized vector of returns:

$$E_{t-1}(\varepsilon_t) \sim N(0, R_t) \tag{9}$$

Correlation between any two assets i and j can be written as:

$$\rho_{ij,t} = \frac{E_{t-1}(\varepsilon_{i,t}\varepsilon_{j,t})}{\sqrt{E_{t-1}(\varepsilon^2_{i,t})E_{t-1}(\varepsilon^2_{j,t})}} = E_{t-1}(\varepsilon_{i,t}\varepsilon_{j,t}) \tag{10}$$

Using a GARCH(1,1) specification, the covariance between the random variables can be written as:

$$q_{ij,t} = \overline{\rho}_{ij} + \alpha\left(\varepsilon_{i,t-1}\varepsilon_{j,t-1} - \overline{\rho}_{ij}\right) + \beta\left(q_{ij,t-1} - \overline{\rho}_{ij}\right) \tag{11}$$

The unconditional expectation of the cross product is $\overline{\rho}_{ij}$, while for the variances it is

$\overline{\rho}_{ij} = 1$

The correlation estimator is:

$$\rho_{ij,t} = \frac{q_{ij,t}}{\sqrt{q_{ii,t}q_{jj,t}}} \tag{12}$$

This model will be mean reverting if $\alpha + \beta < 1$. The matrix version of this model can then be written as:

$$Q_t = S(1-\alpha-\beta) + \alpha(\varepsilon_{t-1}\varepsilon'_{t-1}) + \beta Q_{t-1} \tag{13}$$

where S is the unconditional correlation matrix of the disturbance terms and $Q_t = \left|q_{i,j,t}\right|$.

The log likelihood for this estimator can be written as:

$$L = -\frac{1}{2}\sum_{t=1}^{T}\left(n\log(2\pi) + 2\log\left|D_t\right| + \log\left|R_t\right| + \varepsilon'_t R_t^{-1}\varepsilon_t\right) \tag{14}$$

In the second stage of the estimation the above likelihood estimator is used in estimating the parameters of equation (10)[3].

The above model is used in estimating the correlations between the Australian equity returns and those of developed and emerging markets. As discussed earlier, this paper tries to find the maximum diversification benefit for the Australian investor by looking at possible emerging market stocks that might have the lowest correlation with the Australian stocks. The preliminary analysis showed that the stock markets from the East European countries have one of the lowest return correlations with the Australian equity market. Even though many of the Eastern European equity markets are open to foreign investors, due to legal and regulatory barriers, it is difficult for Australian investors to invest directly in these markets. Hence, it is necessary to find stocks that are relatively easily accessible by Australian investors and settled for American Depositary Receipts (ADRs) of nineteen stocks from Czech Republic, Hungary, Poland, and Russia.

There are several ways of cross-listing stocks in foreign markets, but the most commonly used method is by issuing DRs. In a DR program, an intermediary buys the underlying domestic stock and

[3] The statistical program *RATS* is used in actual estimations.

issues against it depositary receipts denominated in foreign currency in a foreign market. The most common type of DR is American Depositary Receipt (ADR). One of the requirements for issuing ADR is that the issuing firm has to follow the U.S. Securities and Exchange Commission's (SEC) guidelines on disclosure. Depending on the level of disclosure and whether the firm is using the ADR to raise new equity, these ADRs are classified into three levels. Level I is the least expensive and has relatively less stringent disclosure requirements, but can only be traded in the over-the-counter (OTC) market in the U.S. and cannot be used to raise new capital. Level II ADRs are allowed to trade in organized exchanges in the U.S., but the issuing foreign firm has to undergo full disclosure requirements as stipulated by SEC. Level II ADRs also cannot be used to raise new capital. With a Level III ADR, the issuing firm can raise new capital and list the ADR in an organized exchange in U.S., but has to provide to the SEC financial statements prepared according to the U.S. Generally Accepted Accounting Principles (GAPP) or submit a detailed summary of the differences in financial reporting between home and the U.S.

A foreign firm that would like to raise capital without meeting the full disclosure requirements can do so by using private placements under Rule 144A of SEC. These private placements have a limited secondary market; only Qualified Institutional Investors[4] (QIBs) are allowed to trade these private placements. One of the other developments in the 144A market is the creation of Global Depositary Receipts (GDRs). Some of the U.S. private placements are issued for global investors and then traded in markets outside the U.S., predominantly in London and several German exchanges. These DRs for sale outside the U.S. are issued under Registration S provision and can be complementary to a 144A issue in the U.S. Since these ADRs are traded in the U.S., London, and Germany, it is assumed that these are available for Australian Investors.

Since the Eastern European ADRs are available only from the mid 1990s, it is necessary to limit the time period covered by this study to November 1997 to August 2005. In London and the U.S., ADRs are quoted in U.S. dollars, while in Germany the same are quoted in euros. Weekly prices for the nineteen ADRs are obtained in U.S. dollars and converted to Australian dollars using the appropriate exchange rate. For the Australian equity market the Australian All Ordinary Index is used as the proxy. All data for this study is obtained from Bloomberg.

The DCC estimates are made with sets of five year rolling windows, but to capture the time-varying nature of variances and covariances, the end of the period values of the same are input into the portfolio optimization model. For example, using the DCC model one can estimate 260 variances and correlations for a period of five years. But for estimating the efficient set of portfolios, only the variances and correlations for the last week of the sample period is used.[5] Weekly averages for the five year period are used as the proxy for expected returns in the portfolio optimization model.[6]

Using the above procedure, the weights of the individual stocks in each of the efficient portfolios is calculated. Using these weights and the actual returns of each of the nineteen DRs and the Australian index for periods of one-month, three-months, and six-months from the date when the efficient portfolio is created, ex-post returns of the efficient set of portfolios are calculated for each of the sixty months for which efficient sets were calculated. The performance of efficient portfolios computed using the DCC method are then compared to that of the Australian index using the following regression equation:

$$R_{j,t} = \alpha + \beta Dummy_{j,t} + \varepsilon_{j,t} \tag{15}$$

Where $R_{j,t}$ is the pooled ex-post returns of all eleven efficient portfolios for a period one, three and sixty months and $Dummy_{j,t}$ is a dummy variable, which is 1 if the portfolio with emerging market

[4] A QIB is defined as a firm that has at least US$100 million available for investments. Currently there are 4,000 QIBs and they trade on the 144A placements using the closed electronic system called PORTAL (Private Offerings, Resales, and Trading through Automated Linkages).

[5] For example, for the time period from 1/3/00 to 12/27/04, the variances and correlations used were taken for the last week of the time period, which is 12/27/04. This way it is possible to capture the full extent of the time-varying nature of these variables as it existed at the time of construction of the portfolio.

[6] Since the data starts only from November 1997, for the first month the number of observations was only 111, and for the second month 115, etc. From month 34 onwards, we had the full set of five year data (252 weekly observations).

indices included in it and 0 if it is Australian index only. If the regression coefficient β is significant, then it indicates that there is a difference in the ex-post performance of the portfolios. The value of this variable is also the difference between the ex-post returns of portfolios.

3. Results

Initially this paper tests the correlations of equity indices from emerging markets and developed markets with that of the Australian index using the DCC model for the entire time period of this study. The results of the correlations of emerging market indices with that of the Australian index are given in Table 1. The average correlation of all nineteen emerging markets with Australian index was 0.2383, with China having the lowest average correlation of 0.0039 and Peru the highest average correlation of 0.4408. Low correlation between the Chinese equity and the Australian equities can possibly be explained by the restrictions on foreign investors in Chinese equity markets and the existence of dual class of equities in that country. Explaining the high correlation between Peru and Australian indices is more difficult. One possible explanation is that the equity market in Peru is dominated by firms in the extractive industries and a sizable presence of similar firms in the Australian equity market may have contributed to the high correlation. Other countries with low average correlations with Australia are Argentina, Indonesia, Malaysia, and Czech Republic. Out of these four countries, the first three had gone through considerable economic turmoil during the period of study, which might have contributed to the low correlation with the Australian equities.

The average correlations between the developed markets and the Australian equity index are given in Table 2. As expected, the average correlations between the nineteen developed equity market indices and the Australian index is 0.4076, which is nearly double that of the emerging markets. The countries with low average correlation with the Australian equities are smaller economies in Europe such as Austria, Denmark, and Portugal. Large developed markets had average correlations close to 0.5. This high correlation might reduce the diversification benefit to Australian investors who invest in those countries.

The ADRs included in the study are listed in Table 3, which include 11 ADRs from Russian, 5 from Poland, 1 from Czech Republic, and 2 from Hungary. The descriptive statistics of the weekly returns for the 19 ADRs, and Australian index included in the study are given in Table 4. Out of 19 ADRs 11 have positive mean returns, 8 have negative mean returns; the Australian index has positive mean return. All the ADRs have a higher standard deviation as compared to the Australian index suggesting a higher risk as compared with the Australian index. Skewness, Kurtosis and Jarque-Bera statistics for ADRs indicate that these ADRs do not have normal distribution.

Average correlations of each of the ADRs with the Australian index are given in the Table 5. The results indicate a low correlation of Australian index with each of the ADRs, suggesting a potential for diversification benefits in diversifying into these equities.

Summary statistics of ex-post returns of efficient portfolios created with ADRs and Australian index, as well as Australian index are presented in Table 6. For each of 60 months, one minimum variance portfolio and ten efficient portfolios are created and the ex-post returns of each of these portfolios are calculated for periods of one-month, three-months and six-months. Furthermore, these portfolios are divided into two groups based on the standard deviations of the efficient portfolios. For each month, the sample is divided into a set of low risk portfolios comprising minimum variance portfolio and five of the least variance portfolios and another set of high risk portfolio comprising five portfolios with the maximum risk.

The results of regressions using equation (15) are given in Table 7. Pooled ex-post returns of efficient portfolios are regressed against the dummy variable which has a value of one for those portfolios that contain emerging market indices. Three sets of regressions are made; one for the total sample, one for the low risk portfolios, and one for the high risk portfolios. The results indicate that the efficient portfolios created with emerging market indices clearly dominate the returns of Australian

index alone. This shows that Australian investors can achieve statistically significant higher returns by diversifying their portfolios to include emerging market stocks.

Even though unrestricted optimization may look attractive, many investors are reluctant to diversify more than a certain percentage of their assets into emerging market equities. Table 8 shows the weights of the different ADRs within the efficient portfolios. As can be seen from this table, the weights of the individual ADR can vary from 0 to 0.6 and of Australian index from 0 to 0.3, which indicates that in a certain efficient portfolios the weight of Australian index could be zero and 100% of the investments could be in ADRs. Based on the common practice in the portfolio management practice, called 'prudent man rule' derived from the argument that a portfolio manager is usually risk averse and will not be willing to diversify away from the domestic securities, despite the fact that portfolio optimization models suggest higher investment in foreign equities. Often this translates into restricting foreign equity share to a certain proportion of the total portfolio. This proportion is often based on the market practice or arbitrarily decided by the portfolio manager based on his/her risk aversion. Following this, we test the portfolio diversification benefits with restrictions on the maximum amount that can be invested in ADRs.

The diversification benefits with the investment in ADRs restricted to 10% and 20% of the total investment are tested. With the investment in ADRs restricted to 10% the portfolios with ADRs do not yield statistically significant higher return while allowing up to 20% investment in ADRs there is some indication of diversification benefits. The results of ex-post performance of portfolios with investment up to 20% in ADRs are given in Table 9. Ex-post returns of these portfolios are calculated as in the case of unrestricted portfolios and compared with the ex-post returns of the All Australian portfolio for periods of one, three, and six months. Results indicate that there are benefits in diversifying into these ADRs with a restriction of 20% into the ADRs and specifically for the six month portfolios.

Transactions costs in the emerging markets are likely to be higher than in the developed markets, Bekaert et al (1997) estimate 1.1% transactions costs for investing in the emerging markets and similar costs are considered by Kargin (2002). After adjusting for 1.1% transactions costs, the benefits are still significant at 20% investments in ADRs.

4. Conclusions

This paper attempts to estimate diversification benefits that can accrue to an Australian investor by diversifying into the former Soviet bloc countries through the U.S. listed American Depository Receipts (ADRs). Over the years, practitioners and academicians have looked into the benefits of diversification into the international markets and as the world markets are integrating, the benefits of diversification into international markets are diminishing. Maximum benefits of diversification are derived in the markets which are segregated with the developed markets. In this paper we suggest using ADRs as an alternative to directly invest in these markets and find that low level of correlations between these markets and Australia offer diversification opportunities for the investors. Relatively high returns and low correlations offer better diversification benefits, while the high variability in the equity returns of these markets require better econometric models to capture the time-varying nature of the variances and correlations. The use of DCC model in estimating correlations has shown to improve the portfolio optimization model. Unrestricted diversification into East European ADRs offer the most diversification benefits but even with restricted diversification there are benefits and these benefits can be practically realized using ADRs as a vehicle for diversification.

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Table 1: Average Return Correlations Between Emerging Market Indices and Australian Index From 11/19/95 to 8/31/05

Name	Mean	Std. Dev.	Minimum	Maximum
Argentina	0.0509	0.0883	-0.4853	0.9747
Brazil	0.3725	0.0373	0.1832	0.5606
Mexico	0.2959	0.0449	0.0684	0.4339
Peru	0.4408	0.0259	0.3306	0.5937
Latin America	**0.2690**	**0.0297**	**0.0740**	**0.4544**
Chile	0.1847	0.0219	0.0674	0.3100
China	0.0039	0.0689	-0.3255	0.6720
India	0.2340	0.0877	-0.0555	0.5090
Indonesia	0.0976	0.0508	-0.1105	0.9723
Malaysia	0.1642	0.0699	0.0389	0.9987
Philippines	0.2778	0.0779	-0.0907	0.6145
South Korea	0.3261	0.0494	0.0404	0.5170
Taiwan	0.2876	0.0359	0.1412	0.4326
Asia	**0.1987**	**0.0258**	**0.1172**	**0.3554**
Czech Republic	0.1432	0.0912	-0.6625	0.6210
Hungary	0.2897	0.1073	-0.9611	0.6056
Poland	0.3356	0.0547	0.1159	1.0000
Russia	0.2066	0.0628	-0.0765	0.5535
Eastern Europe	**0.2438**	**0.0529**	**-0.1434**	**0.4463**
Israel	0.3031	0.0481	0.0907	0.5187
Greece	0.2895	0.0622	0.1069	0.4751
Turkey	0.2243	0.0579	-0.0386	0.4733
Others	**0.2723**	**0.0290**	**0.1427**	**0.3772**
Average for All Emerging Markets	**0.2383**	**0.0141**	**0.1517**	**0.3112**

Table 2: Average Return Correlations Between Developed Market Indices and Australian Index From 11/19/95 to 8/31/05

Name	Mean	Std. Dev.	Minimum	Maximum
Austria	0.1491	0.0995	-0.7163	0.5093
Belgium	0.4162	0.0118	0.3523	0.4819
Canada	0.4895	0.0758	0.1430	0.7566
Denmark	0.1493	0.0990	-0.8034	0.6644
Finland	0.3754	0.0507	0.2232	0.4841
France	0.4878	0.1014	0.1120	0.7751
Germany	0.5143	0.0521	0.2339	0.7660
Hong Kong	0.4874	0.0594	-0.3479	1.0000
Ireland	0.4340	0.1684	-0.2778	0.6515
Japan	0.3561	0.1029	0.0303	0.6812
Netherlands	0.5058	0.0661	0.3755	0.6667
Norway	0.4438	0.0534	-0.0298	0.9043
Portugal	0.2188	0.0402	-0.0538	0.4778
Singapore	0.3840	0.1036	-0.1464	1.0000
Spain	0.4777	0.1004	-1.0000	0.8622
Sweden	0.4872	0.0271	0.3449	0.5539
Switzerland	0.4204	0.1314	0.1300	0.7254
United Kingdom	0.4766	0.0687	0.0942	0.7507
United States	0.4712	0.0002	0.4693	0.4726
Average for All Developed Markets	**0.4076**	**0.0308**	**0.1769**	**0.4962**

Table 3: List of ADRs in the Portfolios

Name	Country	Industry	Exchanges Where DR is traded	Listing date of DR
AO Surgutneftegaz	Russia	Oil & Gas Producers	U.S., London, Germany	12/30/1996
AO Mosenergo	Russia	Electricity	U.S., London, Germany	07/17/1997
Gazprom	Russia	Oil & Gas Producers	U.S., London, Germany	10/21/1996
GUM (AO Torgovy Dom)	Russia	General Retailers	U.S., Germany	06/07/1996
Irkutskenergo	Russia	Electricity	U.S., Germany	01/23/1997
Lukoil	Russia	Oil & Gas Producers	U.S., London, Germany	12/01/1995
Unified Energy Systems	Russia	Electricity	U.S., London, Germany	05/12/1997
Tatneft	Russia	Oil & Gas Producers	U.S., London, Germany	03/06/96
Vimpel Communications	Russia	Mobile Telecom.	U.S., Germany	11/15/1996
OJSC Rostelecom	Russia	Fixed Line Telecom.	U.S., London, Germany	09/01/1995
Seversky Tube Works	Russia	Industrial Metals	U.S., Germany	02/01/1996
Bank BPH	Poland	Banks	London, Germany	02/06/1995
Bank Millennium	Poland	Banks	Germany	07/28/1997
KGHM Polska Meidz	Poland	Industrial Metals	London, Germany	07/14/1997
Komercni Banka	Czech Republic	Banks	U.S., London, Germany	06/29/05
Magyar Telecom	Hungary	Fixed Line Telecom.	U.S., London, Germany	11/19/1997
Mol Magyar	Hungary	Oil & Gas Producers	London, Germany	11/27/1995
Mostostal Export	Poland	Construct.& Materials	U.S., Germany	02/18/1997
Stalexport	Poland	Industrial Metals	Germany	12/30/1994

Table 4: Descriptive Statistics of Weekly Returns from 11/19/97 to 08/31/05

Name	Mean	Std. dev.	Skewness	Kurtosis	Jarque- Bera
AO Surgutneftegaz	0.003368	0.099226	0.097263	3.963020	260.4215
AO Mosenergo	-0.001480	0.112452	0.879165	8.922619	1368.076
Gazprom	0.000938	0.076031	0.026121	1.501474	37.3370
GUM (AO Torgovy Dom)	-0.001236	0.107697	1.738598	11.499580	2387.478
Irkutskenergo	-0.000493	0.170885	0.000868	8.844600	1294.004
Lukoil	0.001312	0.077172	-0.050612	3.471529	199.5215
Unified Energy Systems	0.000267	0.103269	-0.309374	4.560939	350.4354
Tatneft	0.000723	0.094737	-0.310963	3.194026	175.1529
Vimpel Communications	0.002761	0.095957	-0.817172	6.228714	685.9492
OJSC Rostelecom	-0.000951	0.098192	0.397087	4.546388	352.3434
Severskу Tube Works	-0.002325	0.110569	0.594620	5.446129	514.0259
Bank BPH	0.002685	0.054529	-0.238496	1.045595	21.84805
Bank Millennium	0.000627	0.080900	0.173089	4.760008	376.7781
KGHM Polska Meidz	0.001525	0.060924	-0.112088	0.412880	3.65115
Komercni Banka	0.002566	0.071856	-0.877067	12.431205	2607.1626
Magyar Telecom	0.000049	0.050624	-0.086916	0.911462	14.24204
Mol Magyar	0.003188	0.052548	-0.030061	1.539794	39.27949
Mostostal Export	-0.004978	0.077237	-0.286580	4.623886	359.1002
Stalexport	-0.006720	0.097970	0.097833	5.958136	587.8522
Australian index	0.001376	0.015306	-0.192503	0.453071	5.847526

Table 5: Average Return Correlations Between ADRs and Australian Index From 11/19/95 to 08/31/05

Name	Mean	Std. Dev.	Minimum	Maximum
AO Surgutneftegaz	0.17905	0.06206	-0.10596	0.99999
AO Mosenergo	0.08504	0.03604	-0.24353	0.26926
Gazprom	0.14323	0.06672	-0.35306	0.62976
GUM (AO Torgovy Dom)	0.14907	0.04184	-0.02698	0.56451
Irkutskenergo	0.12059	0.07396	-0.33901	0.60958
Lukoil	0.14331	0.07098	-0.31198	0.64405
Unified Energy Systems	0.16242	0.08259	-0.42208	0.58898
Tatneft	0.23362	0.04788	-0.04652	0.48930
Vimpel Communications	0.24788	0.07788	-0.99910	0.66920
OJSC Rostelecom	0.15760	0.06708	-0.31794	0.99999
Severskу Tube Works	0.10561	0.10107	-0.90720	0.99995
Bank BPH	0.19643	0.04882	-0.12147	0.42180
Bank Millennium	0.12721	0.03753	0.03243	0.19155
KGHM Polska Meidz	0.20033	0.02982	0.10667	0.33901
Komercni Banka	0.04120	0.05724	-0.99992	0.39245
Magyar Telecom	0.18648	0.11151	-0.36156	0.51041
Mol Magyar	0.16626	0.10089	-0.99999	0.99864
Mostostal Export	0.21671	0.09611	-0.98181	0.68407
Stalexport	0.13233	0.03711	-0.03683	0.51852

Table 6: Descriptive Statistics of Ex-post Returns of Portfolios

Name	Mean	Std. dev.	Skewness	Kurtosis (Excess)	Jarque- Bera
All efficient portfolios					
One month	0.004468	0.023249	0.875284	6.028410	1101.73
Three months	0.004284	0.012471	1.229592	4.802493	813.909
Six months	0.004159	0.007486	1.386103	5.439667	1042.14
Low risk efficient portfolios					
One month	0.003022	0.016364	-0.443222	0.112660	12.1767
Three months	0.002842	0.008882	0.044373	-0.289715	1.40011
Six months	0.002837	0.005192	-0.223446	-0.851512	14.1029
High risk efficient portfolios					
One month	0.006203	0.029397	0.926520	4.220567	270.013
Three months	0.006015	0.015574	1.159899	3.166661	195.825
Six months	0.005745	0.009302	1.288896	3.473383	237.765
Australian index					
One month	0.001027	0.007896	-0.949343	2.415247	23.9893
Three months	0.001042	0.003788	-0.432083	0.759070	3.36255
Six months	0.001112	0.002544	-0.369517	-0.075106	1.40252

Table 7: OLS Regression Output for Ex-post Returns Against Efficient Portfolio Dummy

	α (t-stat)	β (t-stat)	Adj. R^2 (F-stat)	Obs.
All portfolios				
One month	0.001027 (1.53404)	0.00344 (3.63256) *	0.00901 (13.1955) *	1320
Three months	0.00104 (2.93110) *	0.00324 (6.44686) *	0.02936 (41.5620) *	1320
Six months	0.00111 (5.15521) *	0.00305 (9.99031) *	0.068625 (99.8064) *	1320
Low risk portfolios				
One month	0.00103 (1.53180)	0.00199 (2.10314) **	0.004661 (4.4232) **	720
Three months	0.00104 (2.92313) *	0.00180 (3.56900) *	0.015803 (12.7378) *	720
Six months	0.00111 (5.20975) *	0.00173 (5.71667) *	0.041538 (32.6804) *	720
High risk portfolios				
One month	0.00103 (0.83399)	0.00518 (2.97061) *	0.012685 (8.8245) *	600
Three months	0.00104 (1.60657)	0.00497 (5.42007) *	0.044522 (29.3772) *	600
Six months	0.00111 (2.84874) *	0.00463 (8.39418) *	0.102382 (70.4622) *	600

* Significant at 1%
** Significant at 5%
*** Significant at 10%

Table 8: Weights of Individual ADRs in Unrestricted Portfolios

	All portfolios			Low risk portfolios			High risk portfolios		
	Mean	**Std. dev.**	**Min.- Max.**	**Mean**	**Std. dev.**	**Min.- Max.**	**Mean**	**Std. dev.**	**Min.-Max.**
AO Surgutneftegaz	0.12046	0.11237	0.000-0.507	0.08439	0.05669	0.001-0.268	0.16375	0.14327	0.000-0.507
AO Mosenergo	0.02076	0.02500	0.000-0.134	0.03139	0.02077	0.002-0.115	0.00800	0.02366	0.000-0.134
Gazprom	0.01898	0.02885	0.000-0.228	0.02825	0.02386	0.007-0.161	0.00785	0.03038	0.000-0.228
GUM (AO Torgovy Dom)	0.04096	0.03368	0.000-0.149	0.04820	0.02494	0.002-0.137	0.03228	0.04018	0.000-0.149
Irkutskenergo	0.32014	0.31404	0.000-1.000	0.11183	0.13338	0.002-0.972	0.57011	0.28472	0.071-1.000
Lukoil	0.02154	0.02309	0.000-0.087	0.03637	0.01910	0.000-0.088	0.00375	0.01244	0.000-0.076
Unified Energy Systems	0.03249	0.03310	0.000-0.201	0.04024	0.01991	0.000-0.125	0.02318	0.04219	0.000-0.201
Tatneft	0.04264	0.06393	0.000-0.501	0.04014	0.02849	0.000-0.151	0.04564	0.08954	0.000-0.502
Vimpel Communications	0.04402	0.04404	0.000-0.370	0.05236	0.02254	0.000-0.128	0.03402	0.05900	0.000-0.370
OJSC Rostelecom	0.01954	0.02157	0.000-0.122	0.02989	0.01667	0.000-0.104	0.00713	0.02019	0.000-0.122
Seversky Tube Works	0.03077	0.03682	0.000-0.218	0.03753	0.02551	0.002-0.185	0.02266	0.04566	0.000-0.218
Bank BPH	0.02729	0.02997	0.000-0.100	0.04935	0.02360	0.006-0.100	0.00083	0.00476	0.000-0.042
Bank Millennium	0.05639	0.07500	0.000-0.611	0.06213	0.05228	0.000-0.266	0.04949	0.09502	0.000-0.611
KGHM Polska Meidz	0.02556	0.03015	0.000-0.114	0.04586	0.02677	0.000-0.114	0.00120	0.00722	0.000-0.082
Komercni Banka	0.04636	0.05001	0.000-0.259	0.06309	0.04044	0.008-0.225	0.02628	0.05298	0.000-0.260
Magyar Telecom	0.02494	0.03637	0.000-0.173	0.04298	0.03768	0.000-0.173	0.00330	0.01868	0.000-0.173
Mol Magyar	0.02273	0.03020	0.000-0.227	0.04127	0.03006	0.004-0.227	0.00048	0.00383	0.000-0.047
Mostostal Export	0.00750	0.01572	0.000-0.065	0.01375	0.01916	0.000-0.065	0.00000	0.00005	0.000-0.001
Stalexport	0.00680	0.01438	0.000-0.071	0.01247	0.01758	0.000-0.071	0.00000	0.00003	0.000-0.001
Australian index	0.07011	0.09490	0.000-0.312	0.12849	0.09492	0.000-0.312	0.00004	0.00041	0.000-0.006

Table 9: OLS Regression Output for Ex-post Returns Against Efficient Portfolio Dummy: With Investments in ADRs Restricted to 20% of the Portfolio

	α (t-stat)	**β (t-stat)**	**Adj. R^2 (F-stat)**	**Obs.**
All portfolios				
One month	0.00103 (3.14098) *	0.00011 (0.24468)	0.000702 (0.0599)	1320
Three months	0.00104 (6.24469) *	0.00032 (1.33979)	0.000593 (1.7950)	1320
Six months	0.00111 (10.29121) *	0.00036 (2.33416) **	0.003306 (5.4483) **	1320
Low risk portfolios				
One month	0.00103 (2.37149) **	0.00033 (0.54611)	0.000961 (0.2982)	720
Three months	0.00104 (4.76282) *	0.00049 (1.59493)	0.002107 (2.5438)	720
Six months	0.00111 (7.78728) *	0.00046 (2.29268) **	0.005789 (5.2564) **	720
High risk portfolios				
One month	0.00103 (2.06251) **	-0.00015 (0.21649)	0.001568 (0.0469)	600
Three months	0.00104 (4.05897) *	0.00010 (0.28478)	0.001511 (0.0811)	600
Six months	0.00111 (6.74463) *	0.00023 (0.98262)	0.000057 (0.9655)	600

* Significant at 1%
** Significant at 5%
*** Significant at 10%