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

The Australian stock market has lower market capitalization compared to that of many other developed 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, the East European stock markets are one such asset class. In this paper we study the diversification benefits to Australian investors from diversifying into the East European equities. Several studies indicate that correlations between asset returns are time-varying and using unconditional estimates of correlations in a portfolio optimization model can result in misallocation of assets. For this study, multivariate Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models are used to estimate time varying correlations to alleviate this problem. The assets used in this portfolio optimization model comprise of American Depositary Receipts (ADRs) of 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 Australian only returns. With investments restricted to 10% in ADRs we do not find statistically significant diversification benefits but as we increase the restriction to 20% we do find statistically significant diversification benefits.

Key words: **International Finance, International Financial Markets, Multivariate GARCH, Emerging Markets, American Depositary Receipts, Portfolio Optimization**

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1. Introduction

The objective of international diversification is to improve the risk/return trade-off for investors. The benefits of international diversification per se 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.

A key factor in determining the benefits from international diversification is country risk. Rajan and Friedman (1997) used a two-factor CAPM consisting of a world stock index and country risk factor to show that an international portfolio contains a statistically significant country risk premium. They argued that the traditional perceptions of country risk encompassed the effects of political conditions and restrictions on foreign ownership of domestic stocks. Capital controls may limit global investments to less developed nations and not to developed nations, thus adding to the segmentation of the less developed markets from the developed markets. This view is mitigated by defining country risk in a broader context to include all the above and discriminatory tax regulations, lack of information, transactions costs, and liquidity differences among foreign and domestic stocks. Hence, the definition of country risk becomes more explicitly recognized in both developed and developing nations. Ex-post results show that country risk is priced by the investors, but the size of the risk premium varies over time. Clark and Tunaru (2001) measure the impact of political risk on portfolio investment when the political risks are multivariate and correlated across countries and find that individual political risks are not uncorrelated with each other. The authors considered the case of multiple sources of risks that are correlated across countries and integrated the cross-country correlations in the estimation of exposure to loss.

Statistical characteristics of returns for emerging and developed markets arise from the underlying real and financial nature of these economies. The nature of capital flows of a country with the rest of the world is different. Different countries have different legal framework, labor market, and are at a different stage of development which leads to the argument that there may be potential gains from diversification across countries because of these differences.

This review of the 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. In turn, the greatest difference in real economy structures arise when comparing the emerging markets with the 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.

Empirical research of Schmukler (2004) and Li, et al. (2003) indicate that there are still benefits to be realized in diversifying internationally because world financial markets are still not fully integrated. These 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. Also, these financial characteristics are time-varying as a result of the increasing globalisation of the world's economies.

Increasing market integration has significantly reduced the diversification benefits from a portfolio drawn from developed markets but has not influenced the benefits from emerging markets investments to the same degree (Harvey, 2000). While differences continue in the real and financial sectors of emerging markets compared to those of the developed markets, these diversification advantages are likely to continue. Intuitively these differences are expected to be more pronounced in terms of Australia and the assets from the countries that were part of former Soviet bloc because of the nature of these economies.

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, et al. (1988) and Izan, et al. (1991). Australian investors may differ in the size of the diversification benefits received from diversifying internationally as compared to investors from other major equity markets because of the nature of Australia's economic and financial markets. The diversification benefits for investing in foreign assets are different to Australian investors as compared with the investors of other larger developed markets because of the similarities and or dissimilarities between the macro economic factors of the markets.

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, this research will look into the diversification benefits from the standpoint of an Australian investor, as the benefits from an Australian investor's viewpoint may be different from that of the investor from other major markets because of the nature of Australian economy and or size of the market[2]. Second, this paper addresses the issue of changes in correlations and the resulting changes in the diversification benefits over time. Studies over the past two decades have found that correlations of asset returns change over time for example Erb, Harvey and Viskanta (1994) and Longin and Solnik (1995).

Market integration per se 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.

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 Blooerslev (1990). The main weakness of these models was the

[2] The Australian share market is small compared to the major overseas markets. Country size matters in two ways (Bernstein and Weinstein (1998)). First economic activity in a small country may be geographically localized, so the nearby geographical activity, e.g. monsoons or other local "acts of God" might have local market-wide effects that would not be as evident in a larger economy. Second, economic specialization is predicted by standard international trade theory across geographical units of similar size, but not across countries. This is consistent with larger countries having less uniform factor endowments and implies that the stocks of firms in large economies should respond less.

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", which combined theoretical appeal of time-varying correlations and the computational flexibility of the univariate models. For this study we will use this model to estimate time varying correlations between Australian Index and the foreign assets.

The main focus of this paper is to test if the efficient portfolios created with correlations estimates using the multivariate GARCH models will have superior ex-post performance over the Australia only portfolio. This paper differs from previous research in this field as it uses a multivariate GARCH model which allows the correlations to change over time.

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, et al., 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. This expansion in the menu of shares available to the potential investor is advantageous by an expanding feasible set and changing shape of the mean variance efficient frontier, even if the capital markets were fully integrated. Another contribution of this paper is that it looks at the

diversification benefits from the perspective of an investor from a smaller market into less developed countries which are being ignored in terms of the portfolio literature. The benefits into investing into these markets may be very different from that of into developing markets (emerging markets).

We choose the equities from former Communist countries of Eastern Europe as a sample for testing the diversification benefits because after the break up of the Soviet Union, market economy is developing in these countries and equities from there are available for international investors. Many of the stocks 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. As discussed earlier, the reason for correlations between two equity markets to change is the integration of the markets itself. Integration of the markets is a gradual process and begins with the opening up of the domestic markets to foreign investment. The other necessary condition is the removal/elimination of the barriers to cross border investments. Some of the other factors which may impact integration are; discriminatory taxation, capital flow restrictions, and market regulation.

This study covers the period from November 1997 to June 2005 and uses All Ordinaries Index for Australian equity returns and the returns of depository receipts for Russia, Hungary, Czech Republic, and Poland. Depository receipts (DRs) from these countries are chosen instead of broad based country indices for the following reasons. First, the tradable indexes are not available in all of these countries and DRs provide a good proxy for the market as these DRs are written on

the stocks of the companies which form a substantial part of the market capitalization and will have a beta close to 1 with the market. These markets are small and at times lead by one single large company in the market and generally it would be the same company listing their depository receipts on foreign stock exchanges.

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:

$$\bar{R}_P = \sum_{i=1}^{N} X_i \bar{R}_i \qquad (1)$$

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:

$$s_P^2 = \sum_{i=1}^{N} X_i^2 s_i^2 + \sum_{i=1}^{N} \sum_{\substack{k=1 \\ k \neq i}}^{N} X_i X_j s_{i,k} \qquad (2)$$

where s^2s are the variances and $s_{i,k}$ 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 preference, investors can choose a specific portfolio from this set of optimal portfolios.

Mathematically, the optimization problem can be stated as follows:

$$Min\ s_P^2 = \sum_{i=1}^{N} X_i^2 s_i^2 + \sum_{i=1}^{N} \sum_{\substack{k=1 \\ k \neq i}}^{N} X_i X_j s_{i,k} \tag{3}$$

Subject to the following constraint:

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

Portfolios can be created with or without short selling constraints. In this paper the portfolios are constructed with short selling constraints which require the following additional constraint:

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

To capture the time varying nature of variances and covariances, we use the Dynamic Conditional Correlation (DCC) model of Engle (2002). The conditional correlation between two random variable r_1 and r_2 that have mean zero can be written as:

$$r_{12,t} = \frac{E_{t-1}(r_{1,t} r_{2,t})}{\sqrt{E_{t-1}(r_{1,t}^2) E_{t-1}(r_{2,t}^2)}} \tag{6}$$

Let $h_{i,t} = E_{t-1}(r_{i,t}^2)$ *and* $r_{i,t} = \sqrt{h_{i,t}} e_{i,t}$ *for* $i = 1,2$, where $e_{i,t}$ is a standardized disturbance that has zero mean and variance of one.

Substituting the above into equation (6) we can get:

$$r_{12,t} = \frac{E_{t-1}(e_{1,t} e_{2,t})}{\sqrt{E_{t-1}(e_{1,t}^2) E_{t-1}(e_{2,t}^2)}} = E_{t-1}(e_{1,t} e_{2,t}) \tag{7}$$

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

$$q_{12,t} = \overline{r}_{12} + a\left(e_{1,t-1}e_{2,t-1} - \overline{r}_{12}\right) + b\left(q_{12,t-1} - \overline{r}_{12}\right) \tag{8}$$

The unconditional expectation of the cross product is $\overline{r}_{12}$, while for the variance it is

$\overline{r}_{12} = 1$

The correlation estimator is:

$$r_{12,t} = \frac{q_{12,t}}{\sqrt{q_{11,t}q_{22,t}}} \tag{9}$$

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

$$Q_t = S(1 - a - b) + a(e_{t-1}e'_{t-1}) + bQ_{t-1} \tag{10}$$

where S is the unconditional correlation matrix of the disturbance terms and $Q_t = \left|q_{1,2,t}\right|$.

The log likelihood for this estimator can be written as:

$$L = -\frac{1}{2}\sum_{t=1}^{T}\left(n\log(2p) + 2\log\left|D_t\right| + \log\left|R_t\right| + e'_t R_t^{-1} e_t\right) \tag{11}$$

where $D_t = diag\left\{\sqrt{h_{i,t}}\right\}$ and R_t is the time-varying correlation matrix. With these estimates of variances and correlations, the covariance matrix is constructed.

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, we have to find stocks that are relatively easily accessible for Australian investors and settled on 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 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[3] (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 US, 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 US dollars, while in Germany the same are quoted in euros. We obtained the weekly prices for the nineteen ADRs and converted it to Australian dollars using the appropriate exchange rate. For Australian equity market we used the Australian All Ordinary Index as the proxy. All data for this study was obtained from *Bloomberg.*

[3] 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).

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 was 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.[4] Weekly averages for the five year period are used as the proxy for expected returns in the portfolio optimization model.[5]

Using the above procedure, we are able to get the weights of the individual stocks in each of the efficient portfolios. Using these weights and the actual returns of each of the twenty indices for periods of one-month, three-months, and six-months from the date when the efficient portfolio was created, ex-post returns of the efficient set of portfolios were 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:

$$R_{j,t} = a + bDummy_{j,t} + e_{j,t} \qquad (12)$$

Where $R_{j,t}$ is the pooled returns of all eleven efficient portfolios for a period of sixty months and $Dummy_{j,t}$ is a dummy variable, which is 1 if the portfolio with emerging market indices included in it and 0 if it is estimated using the rolling

[4] 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.

[5] 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).

method. If the regression coefficient ß 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 list of ADRs included in the study is 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 ADR 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 (12) 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 with in 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 portfolio 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.

We test the diversification benefits with the investment in ADRs restricted to 10% and 20% of the total investment. With the investment in ADRs restricted to 10% we do not find any statistically significant higher return while allowing up to 20% investment in ADRs shows 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.

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 Country 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 Country 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 DRs 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 06/29/05

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
Seversky 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 Country Indices and S&P 500 Index From 11/19/95 to 06/29/05

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
Seversky 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

	a (t-stat)	**ß (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

	a (t-stat)	**ß (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%