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Expanding a U.S. portfolio internationally: ADRs, their underlying assets, and ETFs

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Abstract

We investigate if constructed portfolios of ADRs from six countries provide a useful vehicle for international diversification in the Markowitz sense for U.S. investors and if those diversification gains differ from the results obtained from matched portfolios of the underlying assets (UAs). We analyze 280 ADRs and their matched UAs, and consider ETFs as benchmarks. We find that investors in U.S. equities benefit from allocation towards U.S. bonds and ADRs or their UAs. The best diversification benefits are obtained by directly investing in the constructed UA portfolios rather than the constructed ADR portfolios or ETFs. The results are consistent across levels of risk-aversion and do not change when considering several rebalancing strategies, subperiods, or more realistic fixed asset allocations or market capitalization weights. A discussion with respect to possible implications of transaction costs is provided. The return-to-risk benefits of the UAs over ADRs support the strategy of investing directly in foreign equities to construct an investor's globally diversified portfolio. © 2010 Academy of Financial Services. All rights reserved.

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1. Introduction

It is a long established and well-known fact that investors can benefit from diversifying their portfolios internationally (e.g., Elton and Gruber, 1995; Errunza, 1983; Grubel, 1968; Levy and Sarant, 1970; Meyer & Rose, 2003; Solnik, 1974; Ziobrowski and Ziobrowski,

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1995). However, gains from international diversification seem to diminish over time (Errunza, 1977, 1983; Rajan and Friedman, 1997) and during times of turbulence and crisis (Longin and Solnik, 1995; Tuluca and Zwick, 2001) as world markets become more correlated. While most of the research on international diversification is based on country indexes, country mutual funds, foreign ETFs, foreign long-term bonds, and foreign real estate, less is known about the diversification benefits of American Depositary Receipts (ADRs) versus their underlying assets (UAs), especially in recent years. This issue might be of particular interest as the last decade has seen a period of enhanced cross-listing of foreign securities on U.S. stock exchanges.

Moreover, according to arbitrage conditions, one would expect that the returns of ADRs must approximate that of the UAs, which would make both investment vehicles equally suitable for international diversification. However, the financial literature provides ample evidence that ADRs are mispriced relative to their UAs (e.g., see Grossmann et al., 2007; Hsu and Wang, 2008; Suh, 2003; Wahab and Lashgari, 1992). The finding of mispriced ADRs is in line with the closed-end fund literature that reports premiums and discounts for closed-end funds versus their UAs (Bodurtha et al., 1995; Lee et al., 1991; Pontiff, 1996; Simpson and Ramchander, 2002; Zweig, 1973). This mispricing is generally explained by three main theories in the literature. First, costly arbitrage, where transaction costs and holding costs prevent arbitrageurs from eliminating the price difference (Grossmann et al., 2007; Pontiff, 1996). Second, the market sentiment hypothesis, which postulates that the price differences are because of different investor sentiments in the domestic and foreign countries (e.g., Bodurtha et al., 1995; Hsu and Wang, 2008). Third, the consumer sentiment hypothesis (Grossmann et al., 2007), which is related to the product market spillover hypothesis (Pagano et al., 2002) states that consumer sentiment differentials may play a role with respect to ADR mispricing since many companies cross-list to increase their product market and reputation.

Especially, with respect to the market sentiment hypothesis (Bodurtha et al., 1995) one might expect that ADRs behave much like domestic securities and, hence, do not provide a good vehicle for international diversification benefits. This may favor the UAs over the ADRs as an international investment vehicle, since one can expect that UAs are more correlated with the foreign market. Jiang (1998) and Choi and Kim (2000) consider samples of the 80s and the mid-90s and find some evidence that ADRs provide international diversification benefits for U.S. investors. In particular, Choi and Kim (2000) examine major determinants of returns on ADRs and their UAs, and find that the impact of the original market is more significant on the UAs than on the ADRs, while the U.S. market seems to have no impact on ADRs. They conclude that ADRs do provide some gains for U.S. investors in international diversification, those benefits, however, are less than those obtained from directly investing in the UA. If this result holds true, one might question the usefulness of ADRs for U.S. investors who want to diversify their portfolios internationally, because investors can now easily and inexpensively buy the UAs through brokers with access to the increasingly integrated global investment market.

Hence, the main purpose of this paper is to investigate, using a recent sample period from 1996 to 2007, if constructed portfolios of ADRs from Australia, Germany, France, Japan, the

United Kingdom, and Hong Kong provide a vehicle for international diversification benefits, and if those diversification gains differ from the results obtained from matched portfolios of the UAs. For this purpose, we match a total of 280 ADRs from six countries with their UAs.

While Choi and Kim (2000) draw their conclusions from studying determinants of returns on ADRs and their UAs, we construct in our analysis country portfolios of ADRs and the matched UAs to investigate directly to which extent those portfolios provide superior diversification benefits. The portfolios are constructed as described below. First, the Standard and Poor's S&P 500 Index SPDR Exchange Traded Fund (SPY) is used as the baseline investment. The investment opportunity set is then expanded (in a Markowitz sense) with the Vanguard Long-Term Bond Index Fund (VLTBX) to obtain the optimal U.S. portfolio. Second, the U.S. equity portfolio (SPY), as well as the optimal U.S. portfolio (SPY + VLTBX), are extended by the country portfolios of the UAs and the ADRs to construct mean-variance optimal portfolios across all countries and to test for their superior risk return performance. Third, we plot the efficient frontiers without a risk-free asset, providing the advantage that one can analyze risky-asset portfolio optimization considering different levels of risk aversion. Fourth, for robustness we split the sample into three subperiods. Fifth, all results are reported for six different rebalancing strategies, since portfolio weights drift from their initial levels because of different performance in each component market, suggesting rebalancing of a portfolio at a fixed frequency. Sixth, we consider several different fixed asset allocations as done, for example, by Kalra et al., (2004) or Tsai (2001), as well as a portfolio based on market capitalization. We do this because mean-variance optimal portfolio construction may create optimal portfolios that differ dramatically from investors' real world asset allocations. Seventh, we analyze and discuss our results in the light of transactions cost. Finally, to benchmark, we analyze the diversification benefits for U.S. investors from including ETFs from the six countries that track the Morgan Stanley Capital International (MSCI) indexes of each of the countries.[1]

We discover the following important findings and implications. Statistically significant evidence is presented that U.S. equity investors benefit in a mean-variance sense through allocation to foreign ADRs and UAs. The best diversification benefits, however, are obtained by directly investing in the constructed UA portfolios rather than constructed ADR portfolios or ETFs. We show that these results are robust across different levels of risk-aversion and do not change if one considers several rebalancing strategies, subperiods, or more realistic fixed asset allocations and market capitalization weights. These findings may cast doubt on the usefulness of ADRs for international diversification benefits, as U.S. investors could, in the current era of online investing, easily and inexpensively improve their positions by directly investing in the UAs. We show that even in the case that friction costs may differentially impact ADRs and UAs, those transaction cost differences are rather small and are unlikely to offset the benefits from directly investing in the UAs.

The paper is organized as follows. Section 2 provides a description of the data used in this study. Section 3 explains the statistical analysis. Section 4 presents the results. Section 5 discusses the implication of transaction costs and the presented results, and Section 6 concludes the paper.

2. Data

Data are sampled at a weekly frequency (Friday to Friday returns) and cover June 28, 1996 to June 15, 2007, representing 573 weekly returns for each series. Security-level data used in this study are obtained from DataStream. The sample of ADRs is drawn from all 935 cross-listed securities available through DataStream. There is a tradeoff between the length of the sample and the number of ADRs that can be included in the sample. Hence, considering the limited number of ADRs that were available in the early 90s, we start our sample in June 1996.

For a security to be considered in this study, we require that both ADRs and UAs are available over the chosen sample period. After matching each of the cross-listed securities with the available UA, 547 pairs of ADRs and UAs remain. To insure that the constructed portfolio for each country provides some level of diversification, we consider only stocks from countries from which we are able to match at least 20 ADRs with their UAs.[2] This process results in a total of 280 ADRs from six countries: Germany (24), Japan (88), United Kingdom (70), France (33), Australia (30), and Hong Kong (35).[3] The number of securities considered for each country changes over time as existing ADRs are delisted and new ADRs are created. Prices are obtained in U.S. dollars and the parity value of the UA is calculated by adjusting for the ratio of ADR shares to the number of shares of the underlying security. Value-weighted portfolios within each country are created based upon the market capitalization of each security. In this manner, the ADR and UA portfolios are constructed for each foreign country. The data for the Vanguard Long-Term Bond Index fund (VLTBX) are taken from the company's Website and the data for the Barclay's iShares ETFs are obtained from the Barclay's Website. For comparison reasons, we also show the results for the Morgan Stanley Capital International (MSCI) indexes, the underlying indexes of the ETFs, obtained from Morgan Stanley's Website. Finally, the risk-free rate used is the Fama-French T-bill return, which is the weekly rate that compounds to the 1-month T-Bill rate from Ibbotson and Associates, Inc.

3. Methodology

First, we construct efficient frontiers following Markowitz (1959), since in portfolio optimization efficient frontiers of investment opportunities map out the best combinations of assets to achieve the optimal allocations, depending on the level of risk-aversion.[4] Efficient frontier, optimal portfolio, and minimum variance portfolio allocations are established by a linear constraint optimization, constraining all allocations to be non-negative. This constraint results in zero or positive allocations to each available investment, which is consistent with the approach of most individual investors. We first construct optimal portfolios of the U.S. investor's domestic equity investment (SPY) and the U.S. bond mutual fund (VLTBX).

Second, the U.S. equity portfolio (SPY), as well as the optimal U.S. portfolio (SPY + VLTBX), are extended by the country portfolios of the UAs and the ADRs. Further, we obtain optimal portfolios across all countries and test for their superior risk return performance based on calculated Sharpe ratios and the Memmel test.[5]

Third, we plot the efficient frontiers starting with the U.S. portfolio as the baseline investment and extend it by inclusion of either ADR or UA portfolios. This approach has the added advantage that one can analyze portfolio optimization considering different levels of risk aversion, while avoiding potential bias resulting from errors in constructing the proxy for the investor's risk-free return.

Fourth, we split the sample into three subperiods to test if obtained optimal portfolio allocations yield superior diversification benefits in future subperiods. The first subperiod is used as the portfolio formation period for the second subperiod and the second subperiod as the portfolio formation period for the third subperiod.

Fifth, Tsai (2001), Laker (2003), and Kalra et al. (2004) show that portfolio weights drift from their initial levels because of differential performance in each component market, hence, the findings suggest rebalancing of portfolios at fixed intervals. Consequently, we report results for six different rebalancing strategies: (1) No rebalancing, (2) annual rebalancing, (3) quarterly rebalancing, (4) monthly rebalancing, (5) rebalancing if any asset class drifts by more than five percentage points at quarter-end (Quarterly 5%), and (6) rebalancing if any asset class drifts by more than five percentage points at month-end (Monthly 5%).

Sixth, portfolio construction in the Markowitz sense may create optimal portfolios that are far from real world asset allocations. Consequently, we consider different fixed asset allocations, as done in Kalra et al., (2004), and market capitalization portfolios.

Finally, to obtain a benchmark, we analyze the diversification benefits for U.S. investors from including ETFs from the six countries that track the Morgan Stanley Capital International (MSCI) indexes of each of the countries.

4. Results

4.1. Summary statistics

Table 1 shows the summary statistics, as well as the Sharpe ratios of the considered investment vehicles. Panel A shows the summary statistics of Vanguard U.S. Long-Term Bond Index Fund (VLTBX) and S&P 500 Index SPDR Exchange Traded Fund (SPY). As expected, SPY has a higher average return than the long-term bonds, while the standard deviation of the SPY returns (.0231) is nearly double of those of the long-term bonds (.0120). As a result, the Sharpe ratio for the domestic long-term bond portfolio (.0598) is greater than for the domestic equity ETF (.0414).

Panel B and Panel C present the summary statistics for the MSCI indexes and the ETFs that track the indexes of the six countries. The potential benefit of foreign equity allocations over U.S. equity allocations is clearly exhibited, as the Sharpe ratios of Australia, France, Germany, and the United Kingdom are higher than that of the U.S. (SPY). Furthermore, the foreign ETFs provide lower returns, standard deviations, and Sharpe ratios than their benchmark MSCI indexes. This result may reflect the management costs of the ETFs and very minimal smoothing of returns for the ETFs because of tracking methods used to lower turnover and transaction costs.

Panel D shows the summary statistics of the constructed ADR portfolios of the six

Table 1 Summary statistics

Country/fund	Mean	SD	Min	Max	Sharpe
Panel A: U.S.					
VLTBX	0.148%	0.012	−4.50%	3.50%	0.0598
SPY	0.172%	0.023	−11.60%	7.80%	0.0414
Average	0.160%	0.018	−8.05%	5.65%	0.0506
Panel B: MSCIs					
Australia	0.264%	0.024	−14.40%	7.50%	0.0783
France	0.262%	0.027	−14.30%	12.00%	0.0686
Germany	0.257%	0.032	−16.70%	14.20%	0.0570
Hong Kong	0.183%	0.034	−18.10%	15.00%	0.0313
Japan	0.054%	0.031	−8.90%	12.30%	−0.0071
United Kingdom	0.223%	0.022	−11.30%	12.00%	0.0667
Average	0.207%	0.028	−13.95%	12.17%	0.0491
Panel C: ETFs					
Australia	0.261%	0.024	−14.30%	7.60%	0.0776
France	0.256%	0.027	−14.30%	11.80%	0.0669
Germany	0.250%	0.031	−16.80%	14.10%	0.0554
Hong Kong	0.146%	0.034	−18.20%	14.10%	0.0206
Japan	0.040%	0.031	−8.90%	12.30%	−0.0116
United Kingdom	0.211%	0.022	−11.40%	11.70%	0.0614
Average	0.194%	0.028	−13.98%	11.93%	0.0451
Panel D: ADRs					
Australia	0.232%	0.025	−11.70%	6.60%	0.0629
France	0.282%	0.028	−14.70%	12.50%	0.0725
Germany	0.254%	0.033	−14.50%	14.20%	0.0544
Hong Kong	0.124%	0.040	−21.00%	19.30%	0.0119
Japan	0.168%	0.032	−11.60%	16.00%	0.0289
United Kingdom	0.237%	0.022	−8.50%	10.20%	0.0738
Average	0.216%	0.030	−13.67%	13.13%	0.0507
Panel E: UAs					
Australia	0.236%	0.025	−8.70%	7.50%	0.0641
France	0.298%	0.028	−9.20%	12.70%	0.0788
Germany	0.268%	0.033	−10.90%	13.90%	0.0589
Hong Kong	0.136%	0.041	−19.90%	19.30%	0.0146
Japan	0.175%	0.033	−11.90%	15.40%	0.0295
United Kingdom	0.252%	0.022	−7.80%	11.20%	0.0789
Average	0.228%	0.030	−11.40%	13.33%	0.0541

This table shows the summary statistics sampled at a weekly frequency over the time period from June 28, 1996 to June 15, 2007, as well as the Sharpe ratio of the considered investment vehicles. VLTBX represents the Vanguard U.S. long-term bonds mutual fund and SPY represents the S&P 500 Index SPDR Exchange Traded Fund. MSCIs, ETFs, ADRs, and UAs represent the Morgan Stanley Capital indexes, the ETFs that track the indexes, the constructed portfolios of ADRs and the constructed portfolios of the matched UAs of the six investigated countries, respectively.

countries. The value-weighted ADR portfolios from three countries (France, Japan, and the United Kingdom) provide improved returns and Sharpe ratios versus ETF investing, while we do not find superior Sharpe ratios for the ADR portfolios from Australia, Germany, and Hong Kong.

Panel E shows the summary statistics of the constructed portfolios of the matched UAs of the six investigated countries, respectively. All country portfolios indicate improved Sharpe ratios compared to the ADR portfolios. Additionally, the average returns and Sharpe ratios

Table 2 Country by country correlation matrix between the three investment vehicles

Country	UA/ADR	UA/ETF	ADR/ETF
Australia	0.926	0.914	0.863
Germany	0.956	0.945	0.927
France	0.954	0.954	0.948
Hong Kong	0.945	0.948	0.923
Japan	0.919	0.959	0.884
United Kingdom	0.949	0.962	0.927
Average	0.942	0.947	0.912

This table shows the correlation coefficients between the three chosen investment vehicles: Underlying Assets (UA), American Depository Receipts (ADR), and Exchange Traded Funds (ETF).

of the matched UAs are higher compared to those obtained for the ADRs and ETFs. This suggests that a U.S. investor may be better off investing in country portfolios of UAs of cross-listed companies, rather than investing in the portfolios of ADRs or the broadly diversified country ETFs.

Table 2 shows the correlation coefficients among the six countries and the three chosen investment vehicles (UAs, ADRs, and ETFs). The table indicates that the UAs and the ADRs are not perfectly correlated. Table 3 shows the correlation coefficients between the U.S. bond or U.S. equity portfolio as well as the three chosen international investment vehicles from the six countries. The correlation coefficients illustrate that the UAs provide lower average correlation coefficients with the U.S. equity portfolio (SPY) than the ADRs or the ETFs. Thus, the UAs may provide greater risk reduction opportunities for U.S. investors searching for international diversification benefits, when compared to the ADRs.

4.2. Optimal portfolios

Table 4 presents the portfolio allocations, summary statistics, and Sharpe ratios for the optimal U.S. portfolio. The optimal allocation is 73.6% to VLTBX and 26.4% to SPY, with

Table 3 U.S. bonds/U.S. equity and country by country portfolios correlation matrix

	ADRs		UAs		ETFs	
	VLTBX	SPY	VLTBX	SPY	VLTBX	SPY
Australia	0.003	0.482	0.003	0.361	0.023	0.460
Germany	−0.111	0.694	−0.108	0.651	−0.090	0.689
France	−0.029	0.745	−0.024	0.690	−0.030	0.712
Hong Kong	−0.054	0.465	−0.090	0.428	−0.082	0.448
Japan	−0.098	0.371	−0.063	0.307	−0.066	0.261
United Kingdom	−0.032	0.701	−0.019	0.636	−0.014	0.670
Average	−0.054	0.576	−0.050	0.512	−0.043	0.540

This table shows the correlation coefficients between the Vanguard U.S. long-term bonds mutual fund (VLTBX) and the S&P500 Index SPDR Exchange Traded Fund (SPY) with the three chosen investment vehicles: Underlying Assets (UA), American Depository Receipts (ADR), and Exchange Traded Funds (ETF), from the six countries.

Table 4 U.S. portfolio

Weight VLTBX	Weight SPY	Mean	SD	Sharpe	
100.00%	0.00%	0.148%	1.200%	0.0598	
92.70%	7.30%	0.150%	1.130%	0.0653	
78.90%	21.10%	0.153%	1.070%	0.0720	MV
73.60%	26.40%	0.155%	1.080%	0.0725	OPT
71.70%	28.30%	0.155%	1.080%	0.0725	
50.60%	49.40%	0.160%	1.290%	0.0645	
29.60%	70.40%	0.165%	1.660%	0.0532	
8.60%	91.40%	0.170%	2.110%	0.0443	
0.00%	100.00%	0.172%	2.310%	0.0414	

This table shows the portfolio allocation (weights), returns, standard deviations (SD), and Sharpe ratios of the U.S. portfolio, which consists of the Vanguard U.S. long-term bonds mutual fund (VLTBX) and the S&P500 Index SPDR Exchange Traded Fund (SPY). MV indicates the minimum variance portfolio and OPT indicates the optimal portfolio.

a Sharpe ratio of 0.0725. The volatile and relatively low equity returns (about 9% annual) contribute to this sizeable allocation to the bond mutual fund.

In Table 5, we show optimal portfolios constructed through combinations of each of the foreign investment vehicles with a U.S. domestic portfolio comprised of SPY and the VLTBX long-term bond fund. First, note that in the case of France, Germany, and the United Kingdom the allocations to SPY are low or zero, confirming the expectations based on its lower Sharpe ratio relative to VLTBX. The higher risk for SPY dominates its higher return in establishing its allocation in these optimal portfolios. Second, the Sharpe ratios of each of the internationally diversified portfolios are higher than the Sharpe ratio of the optimal U.S. portfolio (.0725; see Table 4). Third, the optimal portfolios have standard deviations constrained in a narrow range across all 16 analyses. The greatest dispersion is in the UA portfolios (Panel C). Thus, the mean return is the primary driver of the Sharpe ratios in the optimal selections.

Fourth, with respect to the individual international investable vehicles (ETFs, ADRs, and UAs) the UAs (Panel C) provide the highest Sharpe ratios for the optimal portfolio for France, Germany, Japan, and the United Kingdom; while for Australia and Hong Kong, the highest Sharpe ratio is obtained using ETFs (Panel A). Note that the optimal Hong Kong ADR and Japanese ETF portfolios do not include the non-U.S. equities and, hence, provide the same Sharpe ratio as the optimal U.S. portfolio. Furthermore, among the ADRs (Panel B) and the UAs (Panel C) the highest return and Sharpe ratio is obtained utilizing the French or the United Kingdom portfolios.

Fifth, constructing the optimal portfolio with the U.S. and either all six ETF, ADR, or UA portfolios shows that the combination with UA portfolios provides the highest Sharpe ratio. Hence, this result suggests that a U.S. investor may be better off investing in constructed country portfolios of UAs of cross-listed companies, rather than investing in the portfolios of ADRs or the more broadly diversified country ETFs. Interestingly, these optimal portfolios call for no investment in the U.S. equities, and for no investment in equities from Germany, Japan, or Hong Kong (see Appendix A).

Appendix A presents the efficient frontier portfolio allocations (weights) and Sharpe ratios

Table 5 Optimal portfolios

Country/Fund	w(VLTBX)	w(SPY)	w(i)	Mean	SD	Sharpe
Panel A: ETFs						
Australia	58.90%	4.00%	37.10%	0.19%	0.0118	0.0971
France	66.90%	0.00%	33.10%	0.18%	0.0118	0.0911
Germany	73.60%	0.00%	26.40%	0.18%	0.0115	0.0855
Hong Kong	72.90%	23.30%	3.80%	0.15%	0.0106	0.0730
Japan	73.60%	26.40%	0.00%	0.16%	0.0108	0.0725
United Kingdom	64.00%	0.00%	36.00%	0.17%	0.0109	0.0863
All ETFs	56.60%	0.00%	43.40%	0.20%	0.0117	0.1027
Panel B: ADRs						
Australia	63.30%	7.80%	28.90%	0.17%	0.0112	0.0876
France	66.30%	0.00%	33.70%	0.19%	0.0122	0.0954
Germany	74.60%	0.00%	25.40%	0.18%	0.0115	0.0857
Hong Kong	73.60%	26.40%	0.00%	0.16%	0.0108	0.0725
Japan	70.70%	19.40%	9.90%	0.16%	0.0104	0.0755
United Kingdom	59.80%	0.00%	40.20%	0.18%	0.0111	0.0966
All ADRs	56.90%	0.00%	43.10%	0.19%	0.0113	0.1022
Panel C: UAs						
Australia	61.10%	11.00%	27.90%	0.18%	0.011	0.0896
France	64.40%	0.00%	35.60%	0.20%	0.0125	0.1001
Germany	73.30%	0.00%	26.70%	0.18%	0.0117	0.0889
Hong Kong	73.50%	25.40%	1.10%	0.15%	0.0107	0.0726
Japan	70.20%	20.30%	9.40%	0.16%	0.0104	0.0757
United Kingdom	58.70%	0.00%	41.30%	0.19%	0.0115	0.0999
All UAs	54.80%	0.00%	45.20%	0.20%	1.15%	0.1076

The table shows the portfolio allocation (weights), returns, standard deviations (SD), and Sharpe ratios of the optimal portfolios. The optimal portfolio is constructed by using the 573-week average of the Fama-French 1-month T-bill return as the risk-free rate. ETFs, ADRs, and UAs represent the ETFs that track the MSCI indexes, the constructed portfolios of ADRs and the constructed portfolios of the matched UAs of the six countries, respectively.

of the U.S. portfolios with all six ETF (Panel A), ADR (Panel B), or UA (Panel C) portfolios. All portfolios along the efficient frontier show heavy allocations to VLTBX, while equity allocations are most concentrated in Australia, France, and the United Kingdom. As noted earlier, U.S. equities (SPY) are not included for any of the optimal portfolio allocation investment sets, and the highest Sharpe ratio is provided in the optimal UA portfolio (Panel C) with 54.8% allocated to VLTBX and 45.2% to non-U.S. equities (12.9% Australia, 15.9% France, and 16.1% United Kingdom).

Table 6 shows the Memmel test results for the optimal portfolio allocations as shown in Table 5 (U.S. portfolio) and Appendix A (internationally diversified portfolios).[6] In the table, we show tests for expansion of the investment opportunities from SPY (U.S. equity) to SPY and VLTBX (the U.S. portfolio), from SPY (U.S. equity) to the optimal internationally diversified portfolios, and from the U.S. portfolio to the optimal internationally diversified portfolios. The table indicates that the inclusion of the VLTBX (U.S. long-term bond mutual fund) to a SPY (U.S. equity) portfolio (row 1), as well as moving from a U.S. portfolio (SPY + VLTBX) to optimal internationally diversified portfolios, (rows 2 to 4), provides no statistically significant improvement in the Sharpe ratio. However, the expansion from the SPY (U.S. equity) portfolio to the optimal internationally diversified portfolios, shows

Table 6 Memmel test results for optimal portfolio allocations

From	To	Z-statistic (p-value)	Benefit 5%/10%
SPY	US	0.803 (.211)	No/no
(SPY + VLTBX)	US + ETFs ALL	1.074 (.141)	No/no
(SPY + VLTBX)	US + ADRs ALL	1.214 (.112)	No/no
(SPY + VLTBX)	US + UAs ALL	1.260 (.104)	No/no
SPY	US + ETFs ALL	1.505 (.066)	No/yes
SPY	US + ADRs ALL	1.661 (.048)	Yes/yes
SPY	US + UAs ALL	1.710 (.044)	Yes/yes

This table shows the Memmel test results for the optimal portfolio allocations. The U.S. portfolio (US) consists of the Vanguard U.S. long-term bonds mutual fund (VLTBX) and the S&P 500 Index SPDR Exchange Traded Fund (SPY). ETFs, ADRs, and UAs represent the ETFs that track the MSCI indexes, the constructed portfolios of ADRs and the constructed portfolios of the matched UAs of the six investigated countries, respectively. The test indicates the statistical significance of the difference in the Sharpe ratios of SPY and the U.S. portfolios vs. the optimal internationally diversified portfolios.

statistically significant diversification improvements for all three chosen investment vehicles (rows 5 to 7). In a strict portfolio optimization sense, these results suggest that a U.S. investor may obtain significant diversification benefits by moving his assets from an all U.S. equity position to an internationally diversified portfolio, consisting of U.S. long-term bonds (VLTBX) and either constructed country ADR portfolios or country portfolios of the matched UAs; while the best results are obtained by using the UAs.

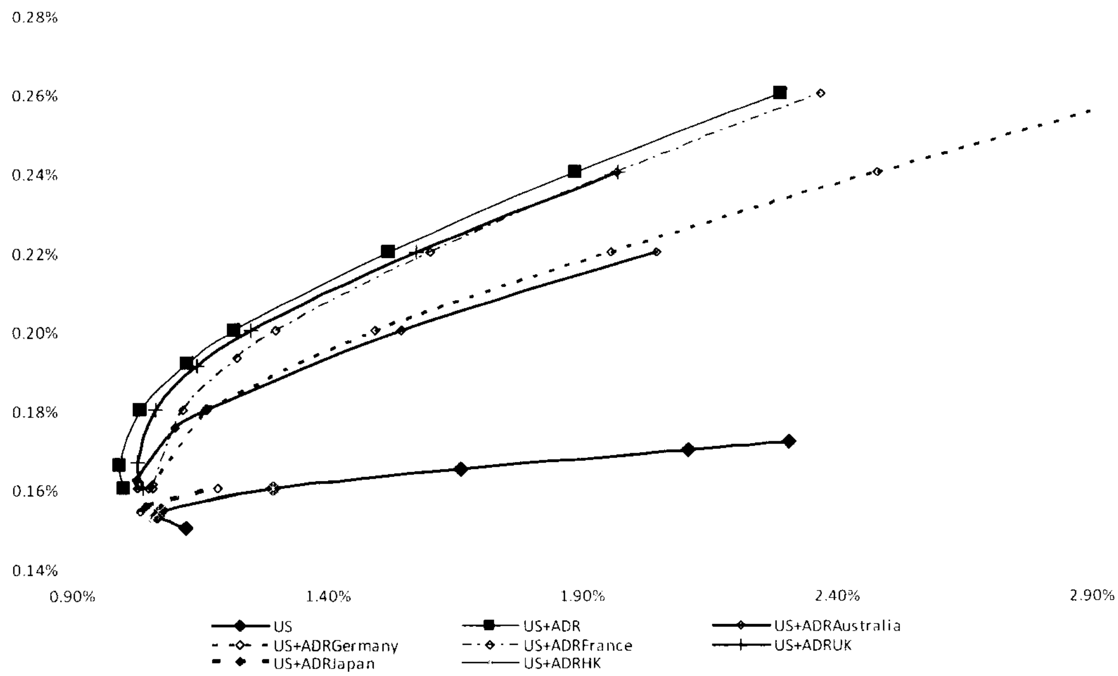
However, a word of caution may be needed. While the result of superior international diversification benefits through UAs, rather than ADRs or ETFs, is useful information for U.S. investors, the lack of any U.S. equity allocation in the optimal portfolios is clearly unrealistic for a typical internationally diversified U.S. investor. We address this issue in Section 4.6.

4.3. *Efficient frontiers*

Previously, we discussed the international diversification benefits for U.S. investors comparing optimal portfolios by extending a domestic portfolio using either country ETFs, ADRs, or their UAs. Constructing optimal portfolios, however, depends on the chosen proxy for the risk-free rate. In our case, we use the 573-week average of the Fama-French T-bill return. Because the actual risk-free rate is never observable, the results from a portfolio optimization approach might be imprecise and biased with respect to the chosen proxy. Hence, we also plot solely the efficient frontiers (Fig. 1) starting with the U.S. portfolio as a reference point and extend it either by ADR portfolios (Panel A) or UA portfolios (Panel B). This approach has the added advantage that one can analyze portfolio optimization considering different levels of risk aversion.

Fig. 1, Panel A, shows that with respect to the constructed ADR portfolios, adding the United Kingdom provides the highest gains at the lower risk levels in comparison to all other country ADR portfolios; while at levels of higher risk the French ADR portfolio seems to generate the best efficient frontier. Yet, extending the U.S. portfolio with a portfolio

Panel A: U.S. Portfolio (US) plus constructed ADR portfolios



Panel B: U.S. Portfolio (US) plus constructed (ADR matched) underlying asset (UA) portfolios

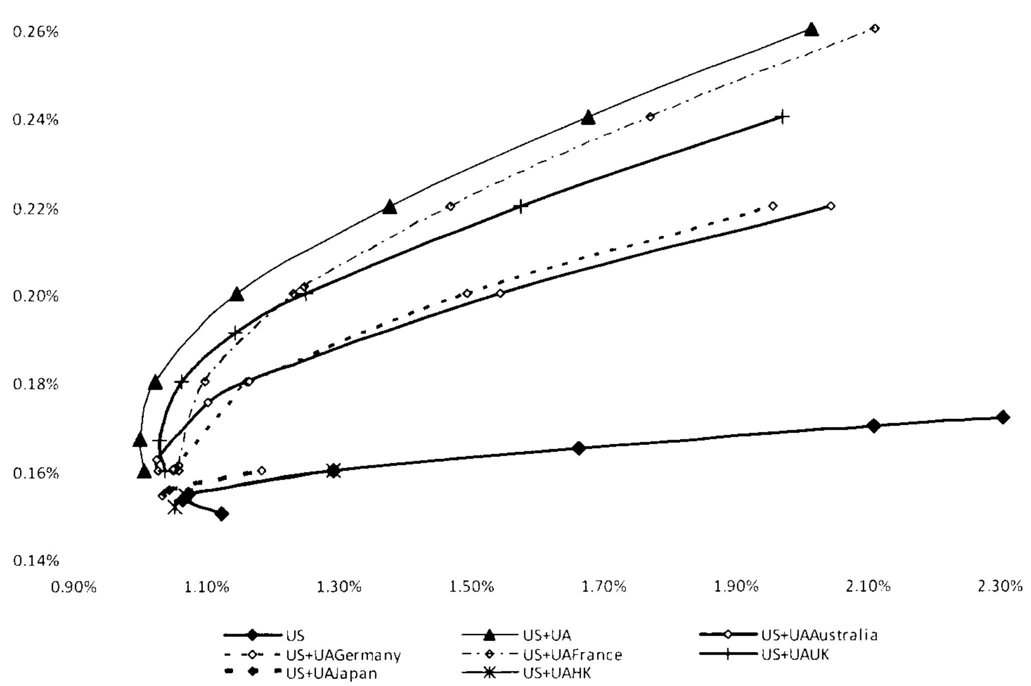


Fig. 1. Portfolio frontiers. Panel A: U.S. Portfolio (US) plus constructed ADR portfolios. Panel B: U.S. Portfolio (US) plus constructed (ADR matched) underlying asset (UA) portfolios.

Panel C: Most efficient frontiers from panels A and B

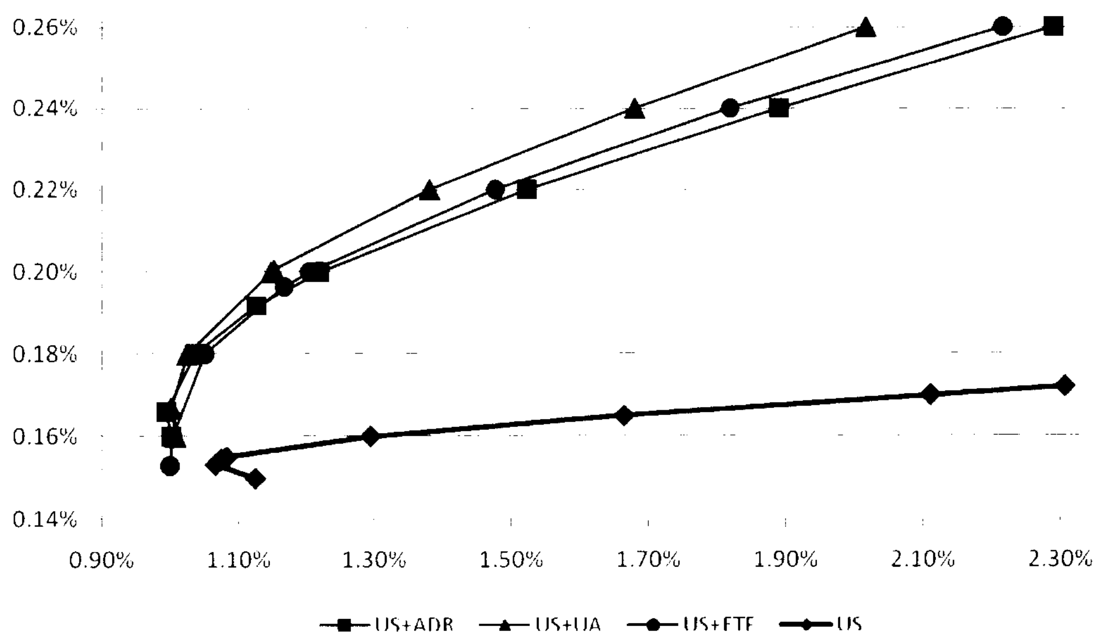


Fig. 1. (Continued) Panel C: Most efficient frontiers from panels A and B.

combining the ADR portfolios from all six countries (US + ADR) generates an efficient frontier superior to those frontiers that are constructed solely based upon one of the individual country ADR portfolios. Appendix A shows that at the high level of risk-aversion the most efficient portfolio contains the U.S. portfolio plus ADRs from Australia, Japan, and the United Kingdom; while for less risk-averse investors, the superior portfolio combines only U.S. long-term bonds with ADRs from Australia, France, and the United Kingdom.

Fig. 1, Panel B, plots the efficient frontiers for the constructed UA portfolios, which are, with respect to the country portfolios, similar to the results obtained using ADRs. That is to say, adding United Kingdom provides the highest gains at the lower risk levels; while at levels of higher risk the French ADR portfolio generates the most efficient frontier. However, extending the U.S. portfolio with a portfolio combining the UA portfolios from all six countries (US + UA) generates an efficient frontier that is superior across all levels of risk-aversion. While Appendix A shows that at the high level of risk-aversion the superior portfolio consists of a combination of the U.S. portfolio with all other countries, except France; less risk-averse investors should choose a combination of U.S. long-term bonds with UAs from Australia, France, and the United Kingdom.

Fig. 1, Panel C, presents the U.S. portfolio efficient frontier versus the efficient frontiers of the three investment vehicles (ETFs, ADRs, UAs) that combine the portfolios from all six countries. The plot shows that, with the exception of a highly risk-averse investor, a portfolio combining the UA portfolios from all six countries (US + UA) generates the superior efficient frontier across all levels of risk-aversion.

Table 7 Full sample: Sharpe ratios of optimal internationally diversified portfolios

Optimal portfolio	ETFs	ADRs	UAs
No rebalancing	0.11821	0.11076	0.11622
Annually	0.12377	0.12284	0.12848
Quarterly	0.12331	0.12267	0.12889
Monthly	0.11749	0.11735	0.12303
Quarterly 5%	0.12316	0.12428	0.13000
Monthly 5%	0.11926	0.12357	0.12952

This table shows the Sharpe ratios of several rebalancing strategies, using the optimal diversified portfolios weights. The rebalancing frequencies are indicated, including rebalancing if any asset class drifts by more than five percentage points at quarter-end (Quarterly 5%), and rebalancing if any asset class drifts by more than five percentage points at month-end (Monthly 5%).

Hence, looking at the plots of efficient frontiers suggests again that a U.S. investor may obtain significant diversification benefits by moving his assets from an all U.S. equity position to an internationally diversified portfolio, consisting of U.S. long-term bonds (VLTBX) and a combined foreign country portfolio of UAs, a result that holds across all levels of risk-aversion.

4.4. The optimal portfolio and rebalancing

Several authors have pointed out that asset allocation weights of portfolios will drift from the initially set levels because of differential performance across the component markets (e.g., Kalra et al., (2004); Tsai (2001)). Hence, the literature suggests rebalancing of the initial portfolio at certain frequencies. To address this issue and to provide more validity to our results, we also calculate Sharpe ratios for different rebalancing strategies, as mentioned in Section 3. Table 7 presents the results of the initial optimal portfolio, as shown in Table 5 (all ETFs, all ADRs, and all UAs), for the six different rebalancing strategies. In all cases, the Sharpe ratios using UAs are superior to the use of ADRs. Thus, Table 7 confirms our main result that a U.S. investor may be better off investing in constructed country portfolios of UAs, rather than investing in the constructed portfolio of ADRs, or even the more broadly diversified ETFs.

4.5. The optimal portfolio and subperiods

The initial asset allocations, as discussed above, reflect an in-sample analysis, using the whole sample period to determine the optimal portfolio. To provide a more realistic analysis, yet retaining consistency with the initial scope of the paper, we establish Markowitz optimal portfolio allocations and split the sample into three subperiods, following Choi and Kim (2000). The first subperiod is used as the portfolio formation period for the second subperiod and the second subperiod is the portfolio formation period for the third subperiod.

Table 8, Panels A and B confirms our main results obtained from using the whole sample period, as the Sharpe ratios are the highest by diversifying the U.S. portfolio with constructed UA portfolios, rather than the ADRs. Further, the results hold for all six rebalancing

Table 8 Sub-periods: Sharpe ratios of optimal internationally diversified portfolio

Panel A: Results for second sub-period, first sub-period used as portfolio formation period			
Period 2	(SPY + VLTBX) ETFs	(SPY + VLTBX) ADRs	(SPY + VLTBX) UAs
No rebalancing	−0.05270	−0.04548	−0.04201
Annually	−0.03920	−0.03157	−0.02508
Quarterly	−0.03595	−0.02890	−0.02315
Monthly	−0.04070	−0.03246	−0.02752
Quarterly 5%	−0.03391	−0.02612	−0.01992
Monthly 5%	−0.03652	−0.02696	−0.02085
Panel B: Results for third sub-period, second sub-period used as portfolio formation period			
Period 3	(SPY + VLTBX) ETFs	(SPY + VLTBX) ADRs	(SPY + VLTBX) UAs
No rebalancing	0.12844	0.11706	0.12289
Annually	0.12215	0.11796	0.12057
Quarterly	0.11843	0.11691	0.11934
Monthly	0.11685	0.11561	0.11796
Quarterly 5%	0.12316	0.11101	0.11962
Monthly 5%	0.10451	0.11203	0.11989

This table shows the Sharpe ratios over two subperiods using several rebalancing strategies, based on the optimal diversified portfolios weights. The first sub-period is used as the portfolio formation period for the second sub-period and the second sub-period as the portfolio formation period for the third sub-period. The rebalancing frequencies are indicated, including rebalancing if any asset class drifts by more than five percentage points at quarter-end (Quarterly 5%), and rebalancing if any asset class drifts by more than five percentage points at month-end (Monthly 5%).

strategies. In Panel A, all Sharpe ratios are negative, indicating that during the second subperiod the risk-free rate was higher than the average return for the chosen investment vehicle. With respect to the ETFs, Panel B only partially supports the results which are obtained from using the whole sample period. Only for three rebalancing strategies (quarterly, monthly, monthly 5%) the Sharpe ratios are the highest by diversifying the U.S. portfolio with constructed UA portfolios; while for three rebalancing strategies (no rebalancing, annually, quarterly 5%) the more broadly diversified ETFs portfolio provides the highest Sharpe ratios.

4.6. Fixed weights and rebalancing

The internationally diversified optimal portfolio, as initially presented in this paper, holds no U.S. equity allocation, which may be seen as an unrealistic implication for a typical internationally diversified U.S. investor who is usually heavily committed to global equities. Hence, to provide more practical results, we also investigate portfolios that consider fixed allocations (e.g., see Kalra et al., 2004; Tsai, 2001) of U.S. equity and/or U.S. bonds in combination with equal foreign portfolio weights. The fixed weights are based on 20%, 40%, 60%, and 80% U.S. asset allocations (SPY or SPY + VLTBX), as well as equal weighted foreign portfolio components. Finally, we also consider a diversified portfolio that is based on market capitalizations. The market capitalization weights are constructed from the equity market capitalizations provided by MSCI. The bond capitalization data were obtained from the Bank for International Settlement's Website.

Table 9 verifies again our main results. It shows that for all fixed U.S. portfolio allocations, the portfolio based on market capitalizations, as well as for all six rebalancing strategies, one obtains the highest Sharpe ratios by investing in constructed UA portfolios rather than the portfolio of ADRs or the more broadly diversified ETFs. Further, the Sharpe ratios are always higher if a U.S. investor invests equally in U.S. equity and U.S. bonds rather than in U.S. equity alone. Moreover, the best risk-return performance is obtained for relatively lower U.S. portfolio allocations. For example, a U.S. investor who allocates domestically only in equities is best off by allocating only 20% towards the U.S. portfolio; while a U.S. investor who allocates domestically in equities and bonds is best off by allocating 60% towards the U.S. portfolio (30% to U.S. equity (SPY) and 30% to U.S. bonds (VTLBX), respectively).

5. Transaction costs

For the sample examined, the findings indicate robust results that investments in the UAs provide superior diversification benefits to their matched ADRs (and to ETFs) for originally U.S.-constructed portfolios. However, the above analysis does not take transaction costs into account, which will increase with a more frequent rebalancing strategy. Any portfolio turnover and related transactions costs should impact the UAs and the ADRs similarly and, hence, only present a minor concern with respect to the research question addressed in this paper. Moreover, including transaction costs directly into the analysis may be problematic, because transaction costs have changed dramatically over the chosen sample period. Later in the analysis, we calculate the dollar benefits of using UAs in contrast to the other investment vehicles.

While some argue that ADRs are a convenient and cost-effective way to invest in foreign equity, others provide the counter argument that transaction costs for ADRs are higher than for their UAs. This is mainly related to the fact that ADRs include additional processing fees for depositing the local stocks at an account of the local custodian of a U.S. bank, collecting dividend payments on the UAs, making currency conversions, and distributing dividend payments. For example, BRANDES Investment Partners (2008) state that:

> "In theory, ADRs are slightly more expensive – roughly pennies per ADR – than UAs, since ADR prices include a processing fee."

Of course, transaction costs are not necessarily the same across countries, and the UAs may just be more expensive because the average transaction costs in a specific country are higher than in the U.S. However, there is ample evidence that nowadays transaction costs are very similar between developed countries, while significant differences seem to exist between developing countries (e.g., Domowitz et al., 2001). However, even if significant differences in transaction costs exist between countries, the creation of an ADR requires that the UA is purchased initially in the country of origin and the possible higher foreign transaction costs may be passed on to U.S. investors. For example, Grossmann et al. (2007) find that the

Table 9 Sharpe ratios using fixed-asset allocation and market capitalization weighted asset allocations

Panel A: No rebalancing					
U.S. weight	0.2	0.4	0.6	0.8	MktCap
SPY + ETFs	0.06608	0.06180	0.05562	0.04859	0.05048
SPY + ADRs	0.06753	0.06512	0.05821	0.05010	0.06005
SPY + UAs	0.07534	0.07106	0.06263	0.05241	0.06474
(SPY + VLTBX) + ETFs	0.07412	0.07888	0.08012	0.07655	0.07289
(SPY + VLTBX) + ADRs	0.07763	0.08110	0.08182	0.07796	0.08087
(SPY + VLTBX) + UAs	0.08405	0.08749	0.08747	0.08153	0.08518
Panel B: Annual rebalancing					
U.S. weight	0.2	0.4	0.6	0.8	MktCap
SPY + ETFs	0.06843	0.06536	0.05929	0.05098	0.04815
SPY + ADRs	0.07095	0.07024	0.06248	0.05259	0.05078
SPY + UAs	0.07951	0.07579	0.06663	0.05473	0.05290
(SPY + VLTBX) + ETFs	0.07684	0.08442	0.08923	0.08810	0.08573
(SPY + VLTBX) + ADRs	0.08471	0.09081	0.09387	0.09080	0.08920
(SPY + VLTBX) + UAs	0.09060	0.09673	0.09922	0.09419	0.09259
Panel C: Quarterly rebalancing					
U.S. Weight	0.2	0.4	0.6	0.8	MktCap
SPY + ETFs	0.06795	0.06472	0.05873	0.05064	0.05247
SPY + ADRs	0.07523	0.06992	0.06209	0.05232	0.06358
SPY + UAs	0.08157	0.07569	0.06638	0.05452	0.06807
(SPY + VLTBX) + ETFs	0.07596	0.08288	0.08740	0.08662	0.08051
(SPY + VLTBX) + ADRs	0.08424	0.08954	0.09217	0.08930	0.09141
(SPY + VLTBX) + UAs	0.09056	0.09589	0.09787	0.09293	0.09556
Panel D: Monthly rebalancing					
U.S. weight	0.2	0.4	0.6	0.8	MktCap
SPY + ETFs	0.06586	0.06298	0.05748	0.04999	0.05098
SPY + ADRs	0.07275	0.06791	0.06069	0.05160	0.06221
SPY + UAs	0.07869	0.07334	0.06473	0.05368	0.06629
(SPY + VLTBX) + ETF	0.07257	0.07857	0.08254	0.08191	0.07558
(SPY + VLTBX) + ADRs	0.08037	0.08481	0.08699	0.08437	0.08650
(SPY + VLTBX) + UAs	0.08624	0.09071	0.09228	0.08774	0.09019
Panel E: Quarterly five percent rebalancing					
U.S. weight	0.2	0.4	0.6	0.8	MktCap
SPY + ETFs	0.06795	0.06472	0.05873	0.05064	0.05247
SPY + ADRs	0.07528	0.06992	0.06208	0.05230	0.06349
SPY + UAs	0.08157	0.07569	0.06638	0.05452	0.06807
(SPY + VLTBX) + ETF	0.07674	0.08385	0.08837	0.08735	0.08137
(SPY + VLTBX) + ADRs	0.08581	0.09152	0.09427	0.09110	0.09378
(SPY + VLTBX) + UAs	0.09119	0.09685	0.09901	0.09402	0.09704

Continued

Table 9 (Continued)

Panel F: Monthly five percent rebalancing

U.S. weight	0.2	0.4	0.6	0.8	MktCap
SPY + ETFs	0.06638	0.06345	0.05783	0.05019	0.05144
SPY + ADRs	0.07317	0.06827	0.06094	0.05173	0.06246
SPY + UAs	0.07939	0.07395	0.06518	0.05391	0.06678
(SPY + VLTBX) + ETF	0.07615	0.08305	0.08759	0.08690	0.08060
(SPY + VLTBX) + ADRs	0.08622	0.09200	0.09482	0.09167	0.09433
(SPY + VLTBX) + UAs	0.09138	0.09708	0.09935	0.09451	0.09755

This table shows the Sharpe ratios based on different fixed U.S. asset allocation (20%, 40%, 60%, 80%), with equal weighting of the remaining country allocations, as well as a portfolio based on market capitalization weights (MktCap). Panels A to F present the results for six different rebalancing strategies. The optimal U.S. portfolio (SPY + VLTBX) consists of the S&P 500 Index SPDR Exchange Traded Fund (SPY) and the Vanguard U.S. long-term bonds mutual fund (VLTBX). ETFs, ADRs, and UAs represent the ETFs that track the MSCI indexes, the constructed portfolios of ADRs and the constructed portfolios of the matched UAs of the six investigated countries, respectively.

difference between the bid-ask spread of the UAs and the ADRs can partially explain the price difference between UAs and ADRs, which may provide evidence that the difference in transaction costs are passed on to the investor.

We address the concern with respect to transaction costs differences between the U.S. and the six foreign countries via Table 10, with data obtained from the Global Stock Markets Factbook (Standard and Poor's Corporation, 2009). The table indicates that the difference in total trading costs for institutional investors is rather small among the countries under investigation, with an exception for Hong Kong and the United Kingdom.

Another concern with respect to selling and purchasing UAs versus ADRs might be inherited in the bid-ask spread of currency transactions. As mentioned above, buying and selling an ADR requires for the U.S. ADR bank to purchase and to deposit the local stocks at an account of the local custodian of the U.S. bank, convert them into U.S. dollars and

Table 10 Total cost of trading in different countries

	Total trading cost	Percent difference via the U.S.	Per $1 million
Australia	0.33%	0.18%	$1,800
France	0.26%	0.11%	$1,100
Germany	0.23%	0.08%	$800
Hong Kong	0.40%	0.25%	$2,500
Japan	0.26%	0.11%	$1,100
United Kingdom	Buy 0.76%	0.61%	$6,100
	Sell 0.26%	0.11%	$1,100
U.S.	0.15%		

Source: Global Stock Markets Factbook, 2009.

This table shows the total trading cost for institutional investors and includes cost of commission, fees and market impact.

Table 11 Bid-ask spread in currency transactions

	Australia	France	Germany	Hong Kong	Japan	U.K.
Average daily bid-ask spread (in percentage)	−0.11%	−0.05%	−0.06%	−0.01%	−0.07%	−0.05%
Per $1 million	$1113.1	$503.0	$562.7	$139.6	$666.9	$470.7

Source: DataStream.

The table shows the average daily bid-ask spreads in currency transactions for each country's currency vs. the U.S. Dollar over the investigated sample period.

reissue them in the United States. Hence, the higher transaction costs, because of the bid-ask spread in currency transaction, may occur to the U.S. ADR bank and any direct buyer of the UA alike. Moreover, Table 11 reports the average daily bid-ask spreads in currency transactions for each of the six countries over our sample period. The table confirms that daily bid-ask spread in currency transactions, maybe with an exception for Australia, are again rather small.

In addition to the above discussion, we try to establish the economic benefits available to investors choosing to diversify internationally by way of investing in the UAs in contrast to their ADRs and the broadly diversified foreign ETFs. Because the data confirm higher Sharpe ratios for the UAs, we calculate the return differential afforded to optimal portfolio investment in the UAs that would generate equivalent reward to risk ratios (cost-adjusted Sharpe ratios) in contrast to investments in the optimal portfolios including ADRs or ETFs. The breakeven cost is calculated as follows:

$$Cost_{BE} = \mu_{UA} - \mu_B(\sigma_{UA}/\sigma_B) = \sigma_{UA}(Sh_{UA} - Sh_B) \qquad (1)$$

where μ_{UA} is the excess return on the optimal portfolio constructed by including the UAs, μ_B is the excess return on the optimal portfolio constructed by including the benchmark assets (ADRs or ETFs), σ_{UA} and σ_B are the standard deviations of the respective returns, and Sh_{UA} and Sh_B are the Sharpe ratios of the respective returns.

We find a breakeven cost of 0.00611% on a weekly basis when the ADR-extended portfolio is the benchmark, representing an annual 0.318% allowable cost. The breakeven cost is 0.00555% on a weekly basis when the ETF-constructed portfolio is the benchmark, representing an annual 0.289% allowable cost. Thus, additional transaction costs of up to $3,177.85 for each $1 million under management in the UA-extended portfolio may provide a superior cost-adjusted Sharpe ratio when benchmarked against the ADR-extended portfolio. Hence, even if we assume that transactions costs are higher for UAs than for ADRs, the benefits from investing directly in the UAs, rather than the ADRs, may be sufficient to offset additional transactions costs. As Table 10 indicates, the $3,177.85 are less than the total cost of trading differential among the United States and the six countries under consideration, with an exception of the United Kingdom.[7] When benchmarked against the ETF-extended optimal portfolio, $2,887.39 in annual transaction costs per $1 million under management results in a breakeven between the UA-extended and the ETF-extended portfolios.

In summary, the mechanism of buying and selling may equally impact the returns from investing in ADRs and UAs. Moreover, in the case that cross-country transaction costs and currency bid-ask spreads differ across ADRs and UAs, the analysis indicates that the implied transaction cost differences between the two investment vehicles are rather small and likely do not offset the benefits from directly investing in the UAs.

6. Conclusion

The paper investigates, using a recent sample period from 1996 to 2007, if constructed portfolios of ADRs from six countries provide a vehicle for international diversification benefits in the Markowitz sense and if those diversification gains differ from the results obtained from matched portfolios of the UAs. For this purpose, a total of 280 ADRs are matched with their UAs, and ETFs are considered as a benchmark.

Our results indicate that U.S. investors can benefit their U.S.-based equity portfolio by including allocations to U.S. long-term bonds and foreign equities. In particular, with respect to optimal portfolio allocation, the benefit of ADRs and UAs for this purpose is supported. The best diversification benefits, however, are obtained by directly investing in the constructed UA portfolios rather than the constructed ADR portfolios.

Considering solely the efficient frontiers shows that across levels of risk-aversion a portfolio of U.S. long-term bonds combined with constructed country portfolios of UAs provides superior international diversification benefits than similar portfolios of chosen ADRs or country ETFs. Moreover, our results based on the obtained optimal portfolios are robust with respect to several rebalancing strategies, as well as different subperiods.

Acknowledging that the obtained internationally diversified optimal portfolio does not include any U.S. asset allocation, we also investigate portfolios that maintain fixed allocations of U.S. equity and/or U.S. bonds in combination with equal foreign portfolio weights, as well as a diversified portfolio that is based on market capitalizations. These portfolios verify our main results that one obtains the highest Sharpe ratios by investing in constructed UA portfolios rather than the portfolio of ADRs or the more broadly diversified ETFs. Moreover, the international diversification benefits are always higher based on an equal weighted U.S. equity/bond portfolio versus a portfolio that is solely based on U.S. equity. Additionally, the best risk-return performance is obtained for relatively lower U.S. portfolio allocations. Again, the results are robust with respect to several rebalancing strategies.

We show that even in the unlikely case that friction costs do differentially impact ADRs and UAs, those transaction cost differences are rather small and should not offset the benefits from directly investing in the UAs. Our results may cast doubt on the practicality of ADRs for obtaining international diversification benefits, as U.S. investors could, in the age of online investing, improve easily and inexpensively their position by directly investing in the UAs.

While we find that country ETFs do provide international diversification benefits, the inferior performance of the ETFs, in comparison to the chosen ADRs and UAs, may be because of a positive selection bias of ADRs accessible to U.S. investors, introduced by the fact that large, globally oriented firms are more likely to cross-list.

Notes

1. We consider only country ETFs as the benchmarks for international diversification since Ziobrowski and Ziobrowski (1995) find that foreign equity investments provide the best benefits, in terms of risk and return, for U.S. investors.
2. Evans and Archer (1968) and Fama (1976) suggest that as few as 20 stocks may be sufficient to obtain a well-diversified portfolio.
3. The list of the chosen ADRs and UAs is available from the authors upon request.
4. This approach is mainly based on the assumption that past average returns are a good estimate of expected future returns.
5. Memmel (2003) provides a correction to the Jobson and Korkie (1981) test of statistically significant difference in two Sharpe Ratios. The Memmel test can be used to identify if the addition of assets to a portfolio enhances the risk and return profile of the portfolio. The Sharpe Ratio *Sh* is the expected excess return divided by the return standard deviation. The return standard deviations used in Sharpe ratios for the Memmel test are based on excess returns. The return standard deviations used in all other Sharpe ratios are based on the raw returns, consistent with the optimization routine methodology and for ease of presentation. The null hypothesis to test for improvement in the Sharpe ratio for a new portfolio (Sh_n) in comparison to an original portfolio (Sh_O) is H_0: $Sh_n > Sh_O$. The z-statistic for this test is:

$$z = \frac{Sh_n - Sh_O}{\sqrt{V}}$$

with the asymptotic variance V of the differences in the two Sharpe ratios as follows:

$$V = \frac{1}{T}\left[2\sigma_n^2\sigma_O^2 - 2\sigma_n\sigma_{nO} + \frac{1}{2}\,\mu_n^2\sigma_O^2 + \frac{1}{2}\,\mu_O^2\sigma_n^2 - \frac{\mu_n\mu_O}{\sigma_n\sigma_O}\,\sigma_{nO}^2\right]$$

where T is the number of observations, σ_{nO} is the covariance, and σ_n, σ_O, μ_n, and μ_O are the standard deviation and excess returns of the new portfolio and the original portfolio, respectively.
6. In addition to optimal portfolios, we also performed the Memmel test for portfolios based on market capitalizations. The results are consistent with those presented in Table 6 and are available from the authors upon request.
7. We also calculate the breakeven cost for the portfolio with 20%, 40%, 60%, 80% U.S. fixed equity weights, as well as a portfolio based on market capitalizations. The calculated annual breakeven costs for investing in the UAs versus the ADRs are $5,668, $4,836, $3,536, $1,872, and $3,380, respectively.

Appendix A

Panel A: ETFs

VBLTX	SPY	AU	GE	FR	JP	UK	HK	Mean	SD	Sharpe	
55.3%	0.0%	0.0%	0.0%	0.0%	44.7%	0.0%	0.0%	0.100%	1.50%	0.0157	
71.0%	1.5%	0.0%	0.0%	0.0%	26.5%	0.0%	1.0%	0.120%	1.16%	0.0375	
72.7%	9.0%	0.0%	0.0%	0.0%	11.6%	3.6%	3.0%	0.140%	1.02%	0.0625	
71.1%	7.2%	3.7%	0.0%	0.0%	6.5%	9.5%	1.9%	0.153%	1.00%	0.0765	MV
70.1%	6.3%	7.2%	0.0%	0.0%	4.3%	10.9%	1.2%	0.160%	1.00%	0.0832	
67.2%	0.1%	15.6%	0.3%	7.3%	0.0%	9.5%	0.0%	0.180%	1.05%	0.0985	
56.6%	0.0%	26.5%	0.0%	16.9%	0.0%	0.0%	0.0%	0.196%	1.17%	0.1027	OPT
53.4%	0.0%	28.8%	0.0%	17.9%	0.0%	0.0%	0.0%	0.200%	1.20%	0.1025	
35.4%	0.0%	41.2%	0.0%	23.4%	0.0%	0.0%	0.0%	0.220%	1.48%	0.0973	
17.5%	0.0%	53.7%	0.0%	28.9%	0.0%	0.0%	0.0%	0.240%	1.82%	0.0899	
0.0%	0.0%	76.7%	0.0%	23.3%	0.0%	0.0%	0.0%	0.260%	2.22%	0.0828	

Panel B: ADRs

VBLTX	SPY	AU	GE	FR	JP	UK	HK	Mean	SD	Sharpe	
65.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	34.4%	0.140%	1.55%	0.0409	
74.1%	7.1%	2.5%	0.0%	0.0%	7.6%	7.6%	1.1%	0.160%	1.00%	0.0833	
71.4%	3.7%	4.8%	0.0%	0.0%	7.0%	13.1%	0.0%	0.166%	1.00%	0.09	MV
63.8%	0.0%	9.0%	0.0%	5.3%	3.3%	18.6%	0.0%	0.180%	1.04%	0.0999	
56.9%	0.0%	11.8%	0.0%	12.9%	0.0%	18.4%	0.0%	0.192%	1.13%	0.1022	OPT
50.3%	0.0%	13.0%	0.0%	18.5%	0.0%	18.1%	0.0%	0.200%	1.22%	0.1012	
34.5%	0.0%	16.0%	0.0%	32.2%	0.0%	17.2%	0.0%	0.220%	1.52%	0.0943	
18.7%	0.0%	19.1%	0.0%	45.8%	0.0%	16.4%	0.0%	0.240%	1.89%	0.0865	
2.9%	0.0%	22.1%	0.0%	59.4%	0.0%	15.6%	0.0%	0.260%	2.29%	0.0801	

Panel C: UAs

VBLTX	SPY	AU	GE	FR	JP	UK	HK	Mean	SD	Sharpe	
31.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	68.1%	0.140%	2.76%	0.023	
73.9%	10.3%	4.4%	0.0%	0.0%	5.1%	4.1%	2.1%	0.160%	1.01%	0.0827	
71.0%	7.6%	6.4%	0.2%	0.0%	4.6%	9.6%	0.5%	0.167%	1.00%	0.0904	MV
67.2%	0.5%	9.1%	1.7%	3.3%	2.8%	15.4%	0.0%	0.180%	1.03%	0.1009	
55.2%	0.0%	12.9%	0.0%	15.9%	0.0%	16.1%	0.0%	0.200%	1.15%	0.1076	
54.8%	0.0%	12.9%	0.0%	16.2%	0.0%	16.1%	0.0%	0.200%	1.15%	0.1076	OPT
40.7%	0.0%	15.6%	0.0%	27.6%	0.0%	16.1%	0.0%	0.220%	1.38%	0.104	
26.3%	0.0%	18.2%	0.0%	39.3%	0.0%	16.2%	0.0%	0.240%	1.68%	0.0974	
11.8%	0.0%	20.9%	0.0%	51.1%	0.0%	16.2%	0.0%	0.260%	2.02%	0.091	

This table shows the portfolio allocation (weights), returns, standard deviations, and Sharpe ratios of the Vanguard U.S. long-term bonds mutual fund (VLTBX) and the S&P 500 Index SPDR Exchange Traded Fund (SPY) with the other international investment vehicles under consideration. MV indicates the minimum variance portfolio and OPT, the optimal portfolio.

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