Frontier Market Diversification and Transaction Costs

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Abstract

Frontier markets, sometimes referred to as "emerging emerging markets," have high transaction costs, but these do not subsume the diversification benefits of these countries. We form comprehensive measures of transaction costs using tick data for 19 frontier markets that are readily accessible to foreign investors. The average cost of trading is over three times that in the US, but the low correlations of these markets allow for diversification benefits that, on average, outweigh transaction costs from 2002 to 2010. However, frontier market diversification benefits disappeared during the global financial crisis.

JEL Classification: G11, G15
Keywords: Frontier market, liquidity, transaction cost, diversification

First Version: February 5, 2011
This Version: October 26, 2011

Acknowledgments: We thank Henk Berkman, Dimitri Margaritis, and seminar participants at the University of Auckland and Massey University for valuable comments. All errors are our own.

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Frontier markets, sometimes referred to as “emerging emerging markets,” have high transaction costs, but these do not subsume the diversification benefits of these countries. We form comprehensive measures of transaction costs using tick data for 19 frontier markets that are readily accessible to foreign investors. The average cost of trading is over three times that in the US, but the low correlations of these markets allow for diversification benefits that, on average, outweigh transaction costs from 2002 to 2010. However, frontier market diversification benefits disappeared during the global financial crisis.

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1. Introduction

Frontier market stock returns have relatively low correlations with developed and emerging market stock returns. However, frontier markets have relatively high transaction costs so it is important to account for these before reaching a conclusion on the diversification benefits international investors in these markets can receive. Frontier markets, which are sometimes referred to as "emerging emerging markets", (Quisenberry (2010, p. 40))[1] have become increasingly popular with investors. Standard & Poor's (S&P) and Morgan Stanley both calculate indices for these markets. In a recent paper, Berger, Pukthuanthong, and Yang (2011, p. 227) find these markets have "low integration with the world market and thereby offer significant diversification benefits."

Our paper contributes to the literature as follows: First, we document the cost of trading in frontier markets. Our analysis is based on tick data so we are able to calculate high-frequency measures of the cost of trading, such as effective spread, quoted spread, and price impact. A recent paper by Fong, Holden, and Trzcinka (2011) documents the cost of trading in over 40 developed and emerging country exchanges, but little is known about frontier market transaction costs. Second, we report the net (post-transaction cost) benefits of frontier market diversification. Previous frontier market diversification studies use returns from country indices or a frontier market index formed from country indices.[2] However, Bekaert and Urias (1996) show, using emerging market data, that results based on uninvestable indices can lead to diversification benefits being overstated. Moreover, transaction costs are an important consideration for investors. De Roon, Nijman, and Werker (2001) show that, while emerging markets appear to provide

[1] Quisenberry (2010) attributes this term to Merrill Lynch.
[2] Berger, Pukthuanthong, and Yang (2011) also consider a frontier market ETF, but they only have data for an 18-month period so their diversification benefit analysis is limited.

diversification benefits, these disappear once transaction costs are considered. Balduzzi and Lynch (1999) find investors who ignore transaction costs in the asset allocation process can face a utility of wealth loss of as much as 16.9%. Unlike previous frontier market studies, we calculate returns for individual stocks, measure each stock's transaction costs monthly, and then deduct these from the frontier market investors' returns.

Fowler (2010) notes the term *frontier market* dates back to 1992, to Farida Khambata of the International Finance Corporation. By 1999 when S&P acquired the Emerging Markets Database from the International Finance Corporation, only 19 countries were labeled frontier markets (AllBusiness.com (1999)). It was not until 2007 when Morgan Stanley and S&P each launched frontier market indices that the use of the term became more widespread. This means that some countries that are now generally accepted as frontier markets were previously denoted emerging markets by researchers (e.g., Giannetti and Ongena (2009)). Other frontier market countries have not been studied much.

When evaluating a country for inclusion in its Frontier Markets Index, MSCI (2011, p. 54) "starts by considering all equity markets not included in the MSCI Emerging Markets Index, that demonstrate a relative openness to and accessibility for foreign investors." It checks that the country is "generally not considered as part of the developed markets universe" and does "not belong to countries undergoing a period of extreme economic (e.g., hyperinflation) or political instability (e.g., civil war)" (MSCI (2011), p. 54). It then verifies that the country has at least two companies eligible for inclusion in its index. As noted by S&P (2007, p. 7), "frontier markets have become increasingly accessible to foreign investors, to the point where dedicating a significant investment to this space is feasible."

Investors wishing to obtain frontier market exposure can do so by using an ETF or a fund. However, these are relatively illiquid compared to the frontier markets themselves. For instance,

the Guggenheim Frontier Markets[3] ETF, traded on the New York Stock Exchange (NYSE) Arca, has had an average monthly value traded of less than US$20 million since its inception in 2008 through the end of 2010. In contrast, the stocks included in our study had a total monthly average value traded in excess of US$4 billion. Institutional investors who want anything other than a modest exposure to frontier markets need to invest directly. Achieving diversified frontier market exposure via American Depositary Receipts is not viable. Only 37 frontier market companies had American Depositary Receipts listed in the US at the end of 2010.

We determine diversification benefits prior to transaction costs. Sharpe ratios are statistically significantly larger when the frontier market indices we create are added to an international portfolio comprising US, developed market, and emerging market exposures and a US-only portfolio. However, transacting in frontier market stocks is costly. Country value-weighted effective spreads range are as large as 7.4% (Ukraine), and the overall frontier market value-weighted effective spread is approximately three times larger than US transaction costs. Given the magnitude of these costs and the findings of De Roon, Nijman, and Werker's (2001), where diversification benefits (from emerging markets in their case) disappear once even small transaction costs are accounted for, we suggest our results are somewhat surprising. We find that the diversification benefits of frontier markets for US investors withstand even the most conservative transaction cost estimates. We first show the benefits exist after accounting for each stock's average monthly transaction costs and then demonstrate the benefits survive the maximum of such transaction costs, as measured by effective spread.

Our analysis is based on 19 countries for which we have matched return and transaction cost data. Data for six countries are available in 2002, the start of our sample period. Data for the others are available at various intervals after this date. These 19 countries represent over 80% of

[3] Previously called the Claymore/BNY Frontier Markets ETF.

the market capitalization of all frontier markets included in the MSCI Frontier Market Index in March 2011, and the value-weighted frontier market index we generate from individual stocks within each country has a monthly return correlation of 0.85 with the MSCI Frontier Market Index.[4] We also verify our conclusions by showing our results are qualitatively identical when the MSCI Frontier Market Index is used in place of the two frontier markets indices we construct. Moreover, our findings about diversification benefits prior to transaction costs for frontier market investors are consistent with those of Berger, Pukthuanthong, and Yang (2011), who include 24 countries, and Cheng, Jahan-Parvar, and Rothman (2010) and Jayasuriya and Shambora (2009), who each study four countries.[5]

Eight of the 19 frontier markets we analyze were recognized as frontier markets back in 2002. We find that diversification benefits are present in this subset and the subset of 11 countries added as frontier markets since this point.[6] These findings, together with the fact that Morgan Stanley did not remove frontier market status from any countries during our sample period, confirm that our results are not driven by a focus on the frontier markets that survive. Diversification benefits exist when the portfolios of the largest, smallest, most-liquid, and least-liquid frontier markets are created. The difference in benefit magnitude across these portfolios is rarely statistically significant. The 19 markets frontier markets in our sample include countries that are highly segmented based on the measure of Bekaert, Harvey, Lundblad, and Siegel (2011), such as Bulgaria, and countries that are far less segmented, such as Bahrain. We find evidence of diversification gains in both subsets. Frontier market diversification benefits are not driven by small, illiquid markets, which may be more difficult for investors to access.

[4] Average market capitalization is calculated for 2005–2009 using *S&P Global Stock Markets Factbook* data.
[5] Each study includes additional countries. The number of frontier markets provided is based on countries that were in the MSCI Frontier Market index in March 2011. Speidell and Krohne (2007) also document low correlations between frontier markets and both emerging markets and the S&P 500.
[6] This conclusion is based on data for the eight and 11 countries from when it becomes available in the databases we use rather than the point at which each country is designated as a "frontier market."

We also show that both frontier markets indices we calculate are, based on standard measures, less risky than the MSCI Emerging Market Index. The standard deviation of the returns of the frontier market indices are lower and have less downside risk (less negative 5% value at risk returns and minimum monthly returns).[7] While frontier markets were less risky and provided strong diversification benefits for US investors from 2002 to 2010 on average, they underperformed during the global financial crisis. During this period, US-only portfolios had slightly larger Sharpe ratios than those with frontier market exposure.

The remainder of this paper is organized as follows: Section 2 describes the data and methodology. Section 3 presents the results, and Section 4 concludes the paper.

2. Data and Methodology

2.1. Data and Transaction Cost Measurement

This paper uses data for 19 frontier markets: Argentina, Bahrain, Bulgaria, Croatia, Estonia, Jordan, Kuwait, Lebanon, Lithuania, Oman, Pakistan, Qatar, Romania, Serbia, Slovenia, Sri Lanka, the United Arab Emirates (UAE), Ukraine, and Vietnam.[8] Each of these countries was included in the MSCI Frontier Markets Index in March 2011. When deciding whether a country should be classified as a frontier market, "openness to and accessibility for foreign investors" are a key consideration (MSCI (2011), p. 54). As noted by S&P (2007), frontier markets are accessible to foreign investors. Referring to 11 frontier markets back in 1997, S&P (2007, p. 7) states "these

[7] It is important to note that less developed countries often have non-normal returns and higher contagion risk (Erb, Harvey, and Viskanta, 1998); so, to the extent that these risks differ across emerging and frontier markets, traditional risk measure comparisons may lack accuracy.
[8] Argentina, Jordan, and Pakistan were previously classified as emerging markets by MSCI.

markets have comparable ... foreign investment ceilings to larger emerging markets," regulations that allow for "easy capital entry and exit," no prohibitive tax laws, more than enough liquidity, and settlement procedures that are similar to emerging markets. The 2003 *S&P Global Stock Markets Factbook* (2003, p. 341) records information for 14 of the 19 markets we study and states these had "free entry" and "free repatriation" of capital and income as at the end of 2002[9]: A total of 12 of these countries had a "foreign investment ceiling" of "100% in general," and the other two had a ceiling of 49%. Other countries in our sample were recorded as being "free" or "relatively free" and investable in subsequent editions of the *S&P Global Stock Markets Factbook*. All had this designation in the 2010 *S&P Global Stock Markets Factbook.*

Our analysis starts in June 2002 and concludes in December 2010. The start point is chosen for two reasons: It coincides with the commencement of the MSCI Frontier Markets Index data, which allows us to check that the frontier markets indices we construct are representative of that index. Second, we have data for six countries at this point. If we start one year earlier, we would have data for only three countries.

For a stock to be included in our sample each month, we require sufficient data to calculate its transaction costs and return that month. Our transaction cost calculations are based on high-frequency data from the Thomson Reuters Tick History (TRTH), which we access via the Securities Industry Research Centre of Asia Pacific (SIRCA). The TRTH provides "millisecond-time-stamped data ... from the Reuters Integrated Data Network which obtains feeds directly from exchanges" (Fong, Holden, and Trzcinka, 2011, p. 9). We require a stock to have at least one quote and trade on the same day for that stock month to be a candidate for inclusion in our final sample. We then check there is a monthly return and market capitalization. We generate a frontier

[9] The *2003 S&P Global Stock Markets Factbook* defines *free entry* as "no significant restrictions to purchasing stocks" and *free repatriation* as "repatriation done routinely (p. 340).

market index for each country by value-weighting (based on market capitalization) each stock within that country each month. We then use these value-weighted country indices to form two overall frontier market indices. The first is value weighted and determined by weighting each country's index by its market capitalization each month. The equal-weight frontier market index is calculated as the simple average of each country's value-weighted index each month.

We take a number of steps to ensure our data selection process does not lead to conclusions driven by survivorship bias. Since MSCI did not remove frontier market status from any country in the period studied, the countries included in the MSCI Frontier Market Index at the end of our sample period are not just survivors. Nevertheless, we run our results on the eight countries that were referred to as frontier markets at the start of our sample and find that our key conclusions are unchanged.[10] Moreover, any stock that has valid data for one month is included; we do not impose a data length criterion in our selection. Finally, as noted by Harvey (1995, p. 781), the imposition of liquidity or size criteria in sample selection may "implicitly reveal information about the past history of the company." We do not apply any such criteria.

Summary statistics for each of our frontier market indices are presented in Table 1 from June 2002 to December 2010. These are presented alongside value-weighted statistics for the MSCI Emerging Market Index, the MSCI Developed Market Index (both obtained from Thomson Reuters Datastream), and the Center for Research in Security Prices (CRSP). All index returns are total returns in US dollars. It is clear that, contrary to popular perception, frontier markets are less—not more—risky than emerging markets. The standard deviations of the value- and equal-weighted frontier market series are 6.16% and 5.63%, respectively, compared to 7.12% for the MSCI Emerging Market Index. The fifth percentile return (5% value at risk) is less negative for

[10] These results, which are available from the authors upon request, are based on a start date for each frontier market that is determined by data availability rather than the date it was deemed to be a "frontier market".

both frontier market indices than for the MSCI Emerging Market Index, and the frontier market minimum returns are also less negative than those in emerging markets. Both these metrics suggest the downside risk in frontier markets is lower than that in emerging markets.[11] Frontier markets have larger (mean and median) returns than emerging markets. Average frontier market returns are up to three times greater than those in developed markets and the US in the period studied.

[Insert Table 1 Here]

The value-weighted and equal-weighted series calculated are both representative of the MSCI Frontier Market Index. As shown in Appendix A, the value-weighted series has a correlation of 0.85 and the equal-weighted index has a correlation of 0.79. Each of the country series we generate are also a good match for the equivalent MSCI country index.[12] The average correlation across the 19 countries is 0.83. All except for three country correlations are in excess of 0.7, and the lowest is 0.48.

Three monthly measures of transaction costs are also generated for each country. The first is the effective spread:

$$\text{Effective Spread} = 2 \cdot |\ln(P_k) - \ln(M_k)|, \quad (1)$$

[11] The following caveat should be added to this result: Erb, Harvey, and Viskanta (1998) note that emerging market returns are often non-normal and emerging markets are more likely to suffer from contagion risk than developed markets. Differences in either of these risk factors across frontier and emerging markets weaken the risk comparison we provide.

[12] We matched transaction costs and return data for Tunisia, but the correlation between our constructed Tunisian return series and the MSCI Tunisia series is negative, so we omit Tunisia from our analysis.

where P_k is the price of the *k*th trade and M_k is the midpoint of the bid and ask quotes at the time of the *k*th trade. In accordance with Goyenko, Holden, and Trzcinka (2009), intraday effective spreads are then weighted by dollar volume to generate a monthly average.

The second transaction cost measure we adopt is the quoted spread, which is calculated as:

$$\text{Quoted Spread} = (A_k - B_k)/M_k, \tag{2}$$

where A_k is the ask price, B_k is the bid price, and M_k is midpoint of these two prices. We then calculate the monthly average quoted spread as the time-weighted average of intraday spreads according to Fong, Holden, and Trzcinka (2011).

Our final transaction cost measure is the five-minute price impact, measured as:

$$\text{Price Impact} = \begin{cases} 2 \cdot \left(\ln(M_{k+5mins}) - \ln(M_k)\right) \text{ when the } k^{th} \text{ trade is a buy,} \\ 2 \cdot \left(\ln(M_k) - \ln(M_{k+5mins})\right) \text{ when the } k^{th} \text{ trade is a sell,} \end{cases} \tag{3}$$

where $M_{k+5mins}$ and M_k are, respectively, the midpoints five minutes after and at the time of the *k*th trade. Trades are classified according to Lee and Ready (1991) and monthly measures are calculated by dollar volume weighting intra-month observations.

Different countries have different trading protocols, with some having a pre-market session, a market session, and a post-market session. We only calculate transaction costs in the market session to ensure consistency across markets. Once the monthly transaction cost is calculated for each stock that has the required low-frequency data from Thomson Reuters Datastream, we calculate an overall transaction cost for each country. This is computed by value-weighting all individual stock transaction costs according to their US dollar market capitalizations.

We then calculate two overall frontier market transaction cost measures for each month: The first is a value-weighted measure that involves calculating the value-weighted average of each country's transaction cost and return based on market capitalizations. The second is an equally weighted measure across each country.

We also calculate the volume traded, US dollar volume traded, number of trades, and US dollar depth for each stock each month, and a monthly country average is then computed based on individual stock market capitalizations. Overall equal- and value-weighted frontier market averages are calculated in the same manner as for spreads.

2.2. Portfolio Formation and Diversification Measurement

Markowitz's (1952) derivation of the optimal portfolio for investors who are only concerned about portfolio means and variances has been an important building block in finance theory. However, as Tu and Zhou (2011, p. 204) note "..the true model parameters are unknown and have to be estimated from the data, resulting in the well-known parameter uncertainty or estimation error problem – the estimated optimal portfolio rule is subject to random errors and can thus be substantially different from the true optimal rule."

De Miguel, Garlappi, and Uppal (2009, p. 1916) point out that the Markowitz (1952) model is "…notorious for producing extreme weights that fluctuate substantially over time and perform poorly out of sample." An alternative approach to allocating wealth to different investments, suggested by Duchin and Levy (2009), dates back 1,500 years to the Babylonian Talmud: the 1/*N* rule. According to this rule, which is often referred to as naïve diversification, wealth should be invested equally between N available assets. Frankfurter, Philips, and Seagle (1971) find that the large sampling error in Markowitz (1952) portfolios results in portfolios that

are no more likely to be efficient than those formed using "random" weights. More recently, De Miguel, Garlappi, and Uppal (2009) evaluate the Markowitz (1952) model and 14 extensions and find that none of these rules consistently outperforms the 1/N rule "in terms of Sharpe ratio, certainty-equivalent return, or turnover" (p. 1918). Moreover, Benartzi and Thaler (2001) find the 1/*N* rule is used in practice by investors.

We use the 1/*N* rule to form portfolios. We do not take a position on whether the Markowitz (1952) or any other portfolio allocation approach could be used to generate superior diversification in frontier markets. However, it is worth pointing out that if this is possible, then our conclusions regarding the benefits of frontier market diversification would only be strengthened. This 1/*N* rule has some added advantages in our setting. We are constrained to a period of eight and a half years due to data availability, so a method such as Markowitz's (1952), which requires an in-sample estimation period, substantially reduces the period during which we can assess the diversification ability, or lack thereof, of frontier markets. Applying the 1/*N* rule means that short positions are not included. This is also appropriate in our setting, since short selling is either not permitted, not widely practiced, or expensive in many markets outside the US (Bris, Goetzmann, and Zhu (2007)).

Like many other researchers, such as Biais, Bossaerts, and Spatt (2010), we use overlapping observations. Each month we assume the purchase of a benchmark portfolio that excludes frontier market exposure and one that includes frontier markets. In the base case, we assume each of these is then held for 12 months. Robustness checks include holding for 24 and 36 months. Sharpe ratios are then calculated for each period for both portfolios to determine if portfolios that with frontier markets exposure have risk and return properties that are statistically significantly superior to those without such exposure.

An advantage of this approach is that gives insight from multiple portfolio start points. However, the inclusion of overlapping observations can introduce bias into the parameters of the covariance matrix of the test statistics. We account for this using the popular block bootstrap methodology discussed in Politis and Romano (1994) and Hall and Jing (1996) and applied to dependant financial time series by Sullivan, Timmerman, and White (1999). We calculate the difference between the Sharpe ratio[13] of the frontier market portfolio and benchmark at each point in time. We then determine the optimal block length from this series using the method of Patton, Politis, and White (1999). Let us assume the optimal block length and Sharpe difference series length are *n* and *z*, respectively. We sample (with replacement) *n* continuous observations from the *z* observations, and repeat this process *z*/*n* times. We then calculate the average of this series, which we call *b1*. This process is then repeated 1,000 times to generate *b1*, *b2*, ..., *b1000*. The number of negative values in *b1*, *b2*, ..., *b1000* is then counted. If there are 50 negatives and 950 positives, the *p*-value is 50/1000, or 0.05.

3. Results

3.1. Correlations

Movements in global equity markets generally become more highly correlated in times of crisis. Dooley and Hutchison (2009) show that correlations between the returns of a range of emerging equity markets and the S&P 500 increased as the global financial crisis intensified. We therefore consider two periods: The first is the period before the global financial crisis and the

[13] We use the 1994 version of the Sharpe ratio (Sharpe (1994)), which, unlike the 1966 version (Sharpe (1966)), calculates the variance of excess returns.

second period includes the global financial crisis. Griffiths, Kotomin, and Winters (2010) suggest the global financial crisis started in August 2007; others focus on the collapse of Lehman Brothers in September 2008 as signaling the start of the crisis. We assume the latter start point and define a pre-crisis period from June 2002 to August 2008. Our conclusions are strengthened if we start the pre-crisis period in August 2007. The second period, which includes all our data, runs from June 2002 to December 2010.

The results in Panel A of Table 2 show that both frontier market indices have relatively low correlations with the US, developed market, and emerging market indices in the pre-crisis period. The monthly correlations of the value-weighted frontier market index with these indices range from 0.153 to 0.341, while the correlations of the equal-weighted frontier market index range from 0.304 to 0.573. In contrast, emerging markets, which are often promoted for their diversification benefits, have correlations of 0.846 and 0.779 with developed markets and the US, respectively. Developed markets and the US have a correlation of 0.972. The full-period results presented in Panel B of Table 2 show that all correlations increased during the global financial crisis. The value-weighted frontier market correlations range from 0.530 to 0.571, and the equal-weighted frontier market correlations range from 0.623 to 0.715. However, these correlations are still considerably smaller than the emerging market equivalents. The correlation between the emerging market index and the developed market index is 0.902, and that with the US market is 0.859. In Appendix B we calculate rolling 52-week correlations of frontier market and emerging market indices versus the US index. These confirm that frontier markets had lower correlations with the US throughout the entire sample period and declined by over 50% from a global financial crisis peak to their September 2011 level.

[Insert Table 2 Here]

3.2. Diversification Benefits Prior to Transaction Costs

The results in Table 3 document the diversification benefits of frontier markets exposure before transaction costs are considered: The results in Panel A are based on a benchmark portfolio with developed market, emerging market, or US exposure, according to Berger, Pukthuanthong, and Yang (2011). The benchmark in Panel B of Table 3 is a US portfolio. Portfolios are constructed each month and held for 12 months. The 1/*N* rule is applied in each instance, with each portfolio being rebalanced monthly. A Sharpe ratio is calculated for each portfolio at the end of the 12-month holding period, and summary statistics are calculated on these Sharpe ratios. The adjusted Politis–Romano (1994) block bootstrap approach is used to generate *p*-values that take into account overlapping observation bias.

Adding either the value- or equal-weighted frontier market indices to a portfolio with developed market, emerging market, and US exposure in the pre-crisis period leads to higher Sharpe ratios. The mean Sharpe ratio increases by over 30% in each instance, which is highly statistically significant. All Sharpe ratios are lower for the full period due to the global financial crisis, but the benefits of including frontier market exposure remain evident. All portfolios including frontier markets have Sharpe ratios that are statistically significantly greater than those of the benchmark. Our results are consistent with those of Berger, Pukthuanthong, and Yang (2011), who show using the Markowitz (1952) approach from 1989 to 2009, that adding frontier market exposure to a developed market, emerging market, or US portfolio leads to increased Sharpe ratios. The results in Panel B of Table 3 show the results are qualitatively identical when a US portfolio is used as the benchmark. Sharpe ratios increase when either the value- or equal-weighted frontier market index is added. Panels C and D of Table 3 show the results for 24- and 36-month holding periods. Portfolios that include frontier markets have statistically significantly

larger Sharpe ratios then the benchmark in each instance. This result is consistent with Bekaert and Harvey (2000), who find that correlations with the world market return increase after countries liberalize their capital markets, but this increase does not offset diversification benefits.[14]

We already show that the frontier market indices we construct from individual stock returns are representative of the MSCI Frontier Market Index. As a further robustness check, therefore, we re-run our tests using this MSCI index instead. These results, which are available on request, are qualitatively identical to the results in this paper, which confirms that our conclusions relate to frontier markets in general.

[Insert Table 3 Here]

Following Biais, Bossaerts, and Spatt (2010), we now consider Sharpe ratio differences over time. We calculate 12-month Sharpe ratios from the 12th month in our sample (May 2005) onward for the benchmark portfolio and the portfolio including frontier market exposure. We then calculate the difference in Sharpe ratios between the frontier market portfolio and the US benchmark portfolio and plot these in Figure 1. This reveals that the benefits of diversifying into frontier markets were completely lost during the global financial crisis. The Sharpe ratio differences between both value- and equal-weighted portfolios including frontier markets and the US benchmark portfolio became negative in 2008.[15] This result is consistent with Erb, Harvey, and Viskanta (1998), who find that emerging markets provide better diversification when the world market is increasing than when it is declining.

[14] Bekaert, Harvey, and Lundblad (2005) find that equity market liberalizations lead to a 1% increase in real economic growth, on average.
[15] We obtain similar results when the developed market, emerging market, and US benchmark portfolio are used.

Frontier market diversification also led to underperformance versus the benchmark in 2006. This is evident in portfolios including the equal-weighted frontier market index and especially more pronounced in portfolios including the value-weighted frontier market index. Closer examination reveals this is due to the sharp falls in many Middle Eastern equity markets. Qatar, the UAE, and Jordan—the second-, third-, and fifth-largest markets in our sample, respectively—fell 30–43% from November 2005 to October 2006,[16] so these declines had a larger impact on the value-weighted series.

[Insert Figure 1 Here]

3.3. Frontier Market Liquidity and Transaction Costs

We document transaction cost and liquidity measures in Table 4. As mentioned in Section 2, the individual stock transaction cost and liquidity variables are value weighted based on market capitalization for each country each month. Time series averages for each country are then calculated and presented. Overall frontier market simple and value-weighted averages are then computed. The frontier market equal- and value-weighted effective spreads are 2.6% and 1.9%, respectively. By way of comparison, the global average effective spread in Fong, Holden, and Trzcinka (2011) for developed and emerging markets from 1996 to 2007 is 2.3%. The simple and value-weighted frontier market quoted spreads are 3.6% and 2.6%, respectively, and the global average from Fong, Holden, and Trzcinka (2011) is 2.9%.

[16] These declines in the indices we construct for each country are consistent with those in the countries' MSCI indices. The MSCI country indices declined 33–44%.

At first glance, it appears as if the frontier market transaction costs are not as large, relative to other markets, as one might expect; however, this is not the case. We calculate market capitalization weighted average spreads within each country so each country's transaction cost number is relevant to an investor who allocates money to stocks within that country based on company size. This ensures our transaction cost numbers for each country are consistent with our returns calculations. Fong, Holden, and Trzcinka (2011), on the other hand, calculate simple weighted country spreads and simple weighted averages across all countries. This method is most appropriate for their purpose, which is to determine the accuracy of various liquidity proxies. Appendix C reports the frontier market spreads calculated according to Fong, Holden, and Trzcinka (2011). The average quoted spread is 7.0% and the average effective spread is 4.8%, 143% and 110% greater, respectively, than the developed and emerging market numbers in Fong, Holden, and Trzcinka (2011).

To calculate the returns after transaction costs to a US-only benchmark portfolio and the US–frontier market portfolio, we require a measure of US transaction costs. We calculate US transaction costs using the Corwin–Schultz (2011) high–low measure, which is calculated monthly based on NYSE, AMEX, and NASDAQ common stocks in the CRSP database.[17] An overall US market measure is then calculated by weighting stock measures by their market capitalization. Figure 2 plots the frontier market effective spread based on equal- and value-weighting individual country spreads against the Corwin–Schultz (2011) US spread. The average US spread over our sample period is 0.72%. Corwin and Schultz (2011) report a mean spread (based on their high–low measure) of 2.10% from 1993 to 2006. However, this is a simple average across all stocks, so it is unsurprising that our value-weighted measure is lower. While US spreads are less volatile than

[17] Following Corwin and Schultz (2011, p. 10), we "set all negative two-day spreads to zero before calculating monthly averages."

their frontier market equivalents, both US and frontier market spreads increased dramatically in late 2008 as the global financial crisis intensified. For example, US spreads increased from approximately 0.5% in the last quarter of 2006 to over 2% in the last quarter of 2008, while value-weighted frontier market spreads increased from approximately 1.5% to over 6.5% during the same period.

[Insert Figure 2 Here]

Based on value-weighted measures of transaction costs, the Ukraine is the most expensive market in which to trade, and it has the largest average quoted spread (12.4%) and effective spread (7.4%). Bulgaria is the second most expensive, with quoted and effective spreads of 7.6% and 6.9%, respectively. Qatar and Pakistan have the lowest transaction costs, with quoted and effective spreads in the 0.7–1.0% range. The relative liquidity of the frontier market countries differs, depending on whether the volume, US dollar volume, number of trades, or depth measure is used. However, several patterns emerge: Pakistan, Qatar, Kuwait, Jordan, and Estonia consistently feature among the most-liquid countries, while Bulgaria, Lebanon, and Lithuania are consistently the least-liquid countries.

The sum of the average monthly US dollar volume traded in each market is over US$4.4 billion, which is many times larger than the value of trading in any frontier market ETF or fund. By way of comparison, the Guggenheim Frontier Markets ETF had an average monthly value traded of less than US$20 million from 2008 to 2010. This emphasizes that investors who want anything other than small exposure to frontier markets need to invest directly. The total market capitalization of stocks in our sample is in excess of US$416 billion, on average, during our sample period.

[Insert Table 4 Here]

Figure 3 shows the US percentile that the average stock dollar volume from each frontier market equates to, which is calculated as follows: The US percentile is calculated by determining the dollar volume traded for each NYSE, NASDAQ, and AMEX stock in 2010. For each frontier market, the 2010 dollar volume is divided by the number of stocks to arrive at the average dollar volume per stock for that market. The 2010 average dollar volume per stock in Kuwait equates to the 70th percentile US stock. Nine other countries have average dollar volumes above the 25th US percentile and just two countries have average dollar volumes that equate to less than the 10th US percentile. These results suggest that, while typically less liquid than US stocks, frontier markets have sufficient liquidity to be attractive to US investors.

[Insert Figure 3 Here]

3.4. Diversification Benefits after Transaction Costs

Our base one-way transaction cost measure is half the spreads depicted in Figure 2. These are incorporated into the Sharpe ratio calculations described in Section 2.2, as follows. For the US benchmark portfolio, which is a buy and hold portfolio, the prevailing one-way US transaction cost is deducted from the pre-transaction cost US return at the beginning and end of each 12-, 24-, and 36-month holding period. For the US–frontier market portfolio, which is 50% invested in each, the average US and frontier market transaction cost is subtracted from the portfolio return at the beginning and end of the portfolio holding period. Transaction costs are incurred each month

as the portfolio is rebalanced to 1/N weights (50% in each). The net portfolio returns after this rebalancing are calculated as follows:

$$Net\ TC\ Return_{Portfolio} = 0.5 \times Net\ TC\ Return_{US} + 0.5 \times Net\ TC\ Return_{FM}, \quad (4)$$

where the net of transaction cost (*TC*) returns for the US and frontier market component of the portfolio are:

$$Net\ TC\ Return_{US} = RET_{US} - \left|RET_{US} - \frac{RET_{US}+RET_{FM}}{2}\right| \times TC_{US}, \quad (5)$$

$$Net\ TC\ Return_{FM} = RET_{FM} - \left|RET_{FM} - \frac{RET_{US}+RET_{FM}}{2}\right| \times TC_{FM}. \quad (6)$$

The second component in the right-hand side of equations (5) and (6) is the transaction cost of rebalancing. This is calculated by multiplying the transaction cost by the absolute deviation of an individual asset return from the average of asset returns in the portfolio, which is the portion of the portfolio that needs to be rebalanced.

The results in Table 5 show that each Sharpe ratio is lower than the pre-transaction cost equivalent in Table 3. However, as in Table 3, each of the Sharpe ratios that include the frontier market is higher than the benchmark, and these differences are all statistically significant. Like Table 3, equal-weighted portfolios that include the frontier market have larger Sharpe ratios than their value-weighted equivalents. The mean Sharpe ratios in Table 5 are 1.2 to 3.8 basis points lower than their Table 3 equivalents. Frontier market value-weighted effective spreads vary through time, but half-spreads average 0.93% during our sample. One-way US transaction costs

average 0.36%. This means that, on average, a portfolio that is half invested in the US and half invested in frontier markets costs 0.645% to open (0.5×0.96% + 0.5×0.36%) and 0.645% to close. This cost gets deducted from the average returns over the holding period. Therefore, assuming a 12-month holding period, the reduction in Sharpe ratio from the opening to the closing positions is (0.645%/12)/volatility. Volatility averages approximately 4% and does not change much when returns are calculated pre- or post-transaction costs, so the reduction in Sharpe is (0.645%/12)/4%, or 1.3 basis points. The final component of transaction costs relates to costs incurred when the portfolio is rebalanced each month back to 50% US and 50% frontier markets. These costs, which are calculated using equations (5) and (6), are typically lower than the portfolio opening and closing transaction costs.[18]

[Insert Table 5 Here]

Quisenberry (2010) notes that the commissions incurred in trade execution are substantially larger than those in the US. The author estimates these averaged 1.09% in 2007.[19] In contrast, Jones (2002) estimates that commissions in the US had fallen to approximately 0.10% by 2000. As a robustness check, we assume that those wishing to diversify into frontier markets incur the transaction costs incorporated in Table 5 and these commissions each time they trade. As the results in Appendix D show, the benefits to frontier market diversification remain after these

[18] The incurring of additional transaction costs is implicit in the assumption of an equally weighted frontier market portfolio as rebalancing of the frontier markets is required each month to achieve this. We do not include this transaction cost in our calculations, but we do verify that this number is sufficiently small that its inclusion would not alter any of our conclusions.

[19] Quisenberry (2010) notes these estimates are based on Elkins/McSherry data and his own estimates.

commissions. The only Sharpe ratio that loses significance is that which relates to the value-weighted portfolio for a 12-month horizon for the full time period.[20]

We next determine if more conservative transaction cost estimates would swamp frontier market diversification benefits. Rather than calculate the dollar volume weighted average effective spread for each stock each month, we calculate the maximum effective spread for each stock each month. We then weight these by individual stock market capitalization to form a country average maximum spread each month. Equal- and value-weighted frontier market effective spreads are then calculated. Figure 4 shows that changes in the maximum value-weighted effective spread are positively correlated with changes in the average value-weighted effective spread (correlation = 0.67). The maximum effective spread series averages 6.02%, which is over three times larger than the average effective spread.

[Insert Figure 4 Here]

The results in Table 6 show that frontier market portfolio Sharpe ratios are up to 17% lower when maximum rather than average transaction costs are accounted for. The impact is more severe on portfolios held for 12 months, and least severe on portfolios held for 36 months. However, there are still benefits to frontier market diversification, even under this conservative transaction cost assumption. The only change from Table 6 is that the larger Sharpe ratio from the value-weighted portfolio including the frontier market is no longer statistically significantly different from the benchmark during the entire period for a 12-month holding period. Statistically significantly larger frontier market portfolio Sharpe ratios are evident for all holding periods in the

[20] Investors in frontier markets would also incur transaction costs on currency transactions, but these appear relatively small compared to the transaction costs we incorporate and, are therefore, unlikely to affect our key conclusions.

pre-financial crisis period and for 24- and 36-month holding periods in the entire period. As shown in Appendix E, the diversification benefits of frontier markets remain after applying maximum transaction costs and Quisenberry's (2010) commissions for investors with an equal-weighted frontier market portfolio for a 12- to 36-month holding period and for those with a value-weighted frontier market portfolio and a 36-month horizon.

[Insert Table 6 Here]

As a final test, we consider differences in diversification benefits provided by relatively large and small markets, relatively liquid and illiquid markets, and countries with relatively strong (weak) segmentation. We determine the 10 (nine) countries with the largest (smallest) market capitalization from Table 4 and label these "big" ("small"). We also determine the 10 (nine) most-liquid (illiquid) countries based on the monthly market dollar volume from Table 4 and label these "liquid" ("illiquid"). Bekaert, Harvey, Lundblad, and Siegel (2011) develop a novel measure of market segmentation based on valuations, which they use to rank 69 countries. Thirteen of the countries in our sample are included in their rankings, so we assign each of these countries to a high (low) segmentation according to the segmentation rank from 2001 to 2005 from Table 1 in Bekaert, Harvey, Lundblad, and Siegel (2011)). The high-segmentation portfolio has seven countries, ranging from Bulgaria with a rank of 1 (out of 65) to Argentina with a rank of 16 (low numbers represent more segmentation). The low-segmentation portfolio has six countries, ranging from Sri Lanka with a rank of 25 to Bahrain with a rank of 54.

Table 7, which relates to a 12-month holding period, uses an asterisk to denote Sharpe ratios that are statistically significantly different from the benchmark and gives *p*-values for the null hypothesis that the big and small, liquid and illiquid, and high- and low-segmentation

equivalent Sharpe ratios are the same. The results, which relate to both pre- and post-transaction costs, show there is generally no statistically significant difference between the diversification benefits provided by big and small or liquid and illiquid portfolios. The only exception to this is for the equal-weighted small and big portfolios after transaction costs. Diversification benefits exist in both the value- and equal-weighted portfolios of the high- and low-segmentation countries in the pre-global financial crisis period. There is no difference between the benefits when value-weighted portfolios are used, but countries with higher segmentation provide better diversification when equal-weighted portfolios are used. More highly segmented countries provide better diversification benefits in the full period, but this difference is not statistically significant. These results prove that the diversification benefits are not limited to small illiquid markets, which may be difficult for foreigners to access.

[Insert Table 7 Here]

Of course, as with any empirical study, our results are based on a historical period. Frontier market investment has resulted in diversification benefits for US investors in the past, but this does not guarantee that these benefits will continue in the future. Increased foreign investment may increase the correlation of frontier market stock returns with international stock returns. However, increased international investment should increase the liquidity and reduce the transaction costs of frontier market investment.

4. Conclusions

Frontier markets, which are countries that are less developed than emerging markets, are attracting increasing attention from the investment community. These countries have relatively

low correlations with international stock returns and are accessible to foreign investors, which makes them attractive candidates for those seeking diversification benefits. Using high-frequency tick data covering 19 frontier markets, we show that frontier markets have transactions costs around three times larger than those in the US from 2002 to 2010.

However, these transaction costs do not subsume the diversification benefits investors receive from allocating capital to their markets. Introducing frontier market exposure to developed markets, emerging markets, and the US or just US portfolios results in a marked increase in Sharpe ratios prior to transaction costs. This is particularly noticeable for the pre-financial crisis period from 2002 to 2008, but is also evident in the entire period from 2002 to 2010. Frontier market diversification also benefits US portfolios after transaction costs are considered. Our findings are robust. The conclusions on the benefits of frontier market hold even when the largest, rather than the average, transaction cost recorded for each stock each month is deducted from returns. However, frontier markets did under-perform during the global financial crisis.

Future research in this area can focus on the sources of the frontier market diversification benefits we document. Maybe the benefits are driven by frontier market economies having, on average, different exposures to commodities such as crude oil than developed markets. Many frontier markets are oil exporters who benefit from oil price increases, while most developed countries are net oil importers, such that oil price increases reduce their economic performance. Another possibility is that frontier markets stocks have not yet experienced sufficient foreign investment to make their returns as highly correlated with global returns as those of developed markets.

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Table 1
Return Summary Statistics

	Frontier VW	Frontier EW	MSCI Emerging VW	MSCI Developed VW	CRSP VW
Minimum	-17.07	-18.63	-27.35	-18.93	-18.41
5th Percentile	-9.20	-8.13	-9.93	-8.70	-8.09
Mean	1.71	1.94	1.66	0.60	0.59
Median	2.15	2.41	1.88	1.45	1.31
Maximum	17.44	16.86	17.14	11.32	11.06
Std. Dev.	6.16	5.63	7.12	4.97	4.86

Summary statistics are in percent and relate to the period from June 2002 to December 2010. Here VW refers to value weighted and EW refers to equal weighted.

Table 2
Return Correlations

	Frontier VW	Frontier EW	MSCI Emerging VW	MSCI Developed VW
Panel A: Pre-Financial Crisis (June 2002 to August 2008)				
Frontier Market EW	0.799			
MSCI Emerging VW	0.341	0.573		
MSCI Developed VW	0.229	0.384	0.846	
CRSP VW	0.153	0.304	0.779	0.972
Panel B: Entire Period (June 2002 to December 2010)				
Frontier Market EW	0.884			
MSCI Emerging VW	0.573	0.715		
MSCI Developed VW	0.571	0.673	0.902	
CRSP VW	0.530	0.623	0.859	0.980

This table shows the correlations for the pre-financial crisis period and from June 2002 to December 2010. Here VW refers to value weighted and EW refers to equal weighted.

Table 3
Diversification Benefits before Transaction Costs

	Bench-mark	Incl. Frontier Market VW	Incl. Frontier Market EW	Bench-mark	Incl. Frontier Market VW	Incl. Frontier Market EW
	June 2002 to August 2008			June 2002 to December 2010		
Panel A: Developed Market, Emerging Market, and US Benchmark—12-Month Holding Period						
Mean	0.454	0.595	0.605	0.329	0.411	0.427
Median	0.397	0.588	0.549	0.350	0.441	0.463
p-Value		0.001	0.000		0.036	0.001
Panel B: US Benchmark—12-Month Holding Period						
Mean	0.319	0.576	0.688	0.230	0.377	0.472
Median	0.334	0.709	0.731	0.272	0.403	0.504
p-Value		0.001	0.000		0.073	0.000
Panel C: US Benchmark—24-Month Holding Period						
Mean	0.309	0.546	0.637	0.160	0.298	0.370
Median	0.312	0.469	0.599	0.254	0.253	0.453
p-Value		0.000	0.000		0.021	0.000
Panel D: US Benchmark—36-Month Holding Period						
Mean	0.305	0.550	0.641	0.137	0.271	0.342
Median	0.340	0.521	0.656	0.145	0.274	0.384
p-Value		0.000	0.000		0.000	0.000

This table shows the mean and median Sharpe ratios prior to transaction costs. These are calculated using rolling overlapping windows. The *p*-values relate to the statistical significance of mean differences based on a block bootstrap, which accounts for overlapping observations. Here VW refers to value weighted and EW refers to equal weighted.

Table 4
Transaction Costs and Liquidity

	Start Date	N Stock Months	Quoted Spread	Effective Spread	Price Impact	Volume (000)	$Volume (000)	No. Trades	$Depth (000)	M $ Vol. (000)	M Cap (000)
Argentina	200206	6,026	2.5%	1.4%	0.9%	2,161	3,604	746	23	60,946	16,180,195
Bahrain	200401	1,986	3.5%	2.2%	0.8%	1,902	2,442	115	113	26,998	15,680,982
Bulgaria	200507	9,315	7.6%	6.9%	1.7%	98	530	160	11	20,453	7,860,444
Croatia	200209	1,696	3.8%	3.1%	0.7%	60	4,880	760	113	23,943	11,678,088
Estonia	200206	1,256	1.4%	1.2%	0.5%	1,028	5,997	379	31	31,870	2,861,053
Jordan	200511	10,090	1.4%	1.2%	0.9%	1,674	11,258	2,294	55	402,031	31,587,412
Kuwait	200309	9,157	2.2%	1.5%	1.1%	27,862	69,350	853	144	2,551,099	101,505,134
Lebanon	200206	406	4.5%	3.3%	0.9%	200	1,164	45	106	3,773	1,772,887
Lithuania	200305	2,731	4.3%	3.0%	1.3%	688	844	223	10	19,427	4,784,657
Oman	200407	2,974	2.4%	1.5%	1.0%	101	408	32	42	6,724	11,328,830
Pakistan	200206	14,975	0.9%	0.9%	0.6%	11,224	15,954	4,224	26	542,667	33,952,611
Qatar	200401	2,464	1.0%	0.7%	0.8%	481	14,125	376	231	159,082	64,497,577
Romania	200206	5,982	1.3%	1.0%	0.8%	24,152	6,757	2,094	52	91,662	15,336,489
Serbia	200905	1,309	6.1%	3.4%	1.4%	20	718	317	11	9,654	2,686,251
Slovenia	200602	2,349	2.9%	4.3%	1.1%	54	3,825	586	18	35,303	11,793,805
Sri Lanka	200206	18,657	4.6%	3.6%	1.3%	401	115	140	12	6,230	6,110,929
UAE	200407	2,017	3.5%	2.2%	1.2%	10,745	26,584	413	275	476,549	43,363,917
Ukraine	200604	1,658	12.4%	7.4%	1.4%	1,639	918	304	18	15,751	29,634,561
Vietnam	200706	1,642	1.4%	1.3%	1.0%	175	504	114	50	7,105	4,324,719
EW Average		-	3.6%	2.6%	1.0%	4,456	8,946	746	71	236,383	21,944,239
VW Average		-	2.6%	1.9%	0.9%	11,070	25,721	1,234	114	-	-
Total		96,690	-	-	-	-	-	-	-	4,491,268	416,940,540

This table shows the transaction costs and liquidity measures for each frontier market. Spreads, price impact, volume, dollar volume, number of trades, and depth are calculated for each stock and then weighted by market capitalization to form market averages. This table shows time series averages. M dollar volume and market capitalization are the average monthly numbers for all stocks in each country. Here VW refers to value weighted and EW refers to equal weighted.

Table 5
Diversification Benefits after Average Transaction Costs

	Bench-mark	Incl. Frontier Market VW	Incl. Frontier Market EW	Bench-mark	Incl. Frontier Market VW	Incl. Frontier Market EW
	June 2002 to August 2008			June 2002 to December 2010		
Panel A: 12-Month Holding Period						
Mean	0.300	0.538	0.635	0.213	0.342	0.426
Median	0.315	0.669	0.659	0.259	0.357	0.442
p-Value		0.000	0.000		0.091	0.000
Panel B: 24-Month Holding Period						
Mean	0.299	0.526	0.611	0.151	0.281	0.252
Median	0.302	0.456	0.572	0.243	0.231	0.341
p-Value		0.000	0.000		0.034	0.000
Panel C: 36-Month Holding Period						
Mean	0.298	0.535	0.622	0.132	0.258	0.327
Median	0.332	0.509	0.636	0.138	0.259	0.367
p-Value		0.000	0.000		0.000	0.000

Each statistic is similar to those in Table 3, except for the fact that the Sharpe ratios are calculated after the deduction of average monthly transaction costs (half effective spread) for each stock. Here VW refers to value weighted and EW refers to equal weighted.

Table 6
Diversification Benefits after Maximum Transaction Costs

	Bench-mark	Incl. Frontier Market VW	Incl. Frontier Market EW	Bench-mark	Incl. Frontier Market VW	Incl. Frontier Market EW
	June 2002 to August 2008			June 2002 to August 2010		
Panel A: 12-Month Holding Period						
Mean	0.300	0.466	0.546	0.213	0.283	0.353
Median	0.315	0.589	0.560	0.259	0.267	0.334
p-Value		0.020	0.000		0.247	0.023
Panel B: 24-Month Holding Period						
Mean	0.299	0.488	0.565	0.151	0.250	0.191
Median	0.302	0.423	0.536	0.243	0.201	0.281
p-Value		0.003	0.000		0.074	0.000
Panel C: 36-Month Holding Period						
Mean	0.298	0.506	0.588	0.132	0.236	0.301
Median	0.332	0.486	0.606	0.138	0.237	0.333
p-Value		0.000	0.000		0.003	0.000

Each statistic is similar to those in Table 3, except for the fact that the Sharpe ratios are calculated after the deduction of the maximum monthly transaction cost (half effective spread) for each stock. Here VW refers to value weighted and EW refers to equal weighted.

Table 7
Diversification Benefits in Large and Small Market Capitalization Countries and Liquid and Illiquid Countries

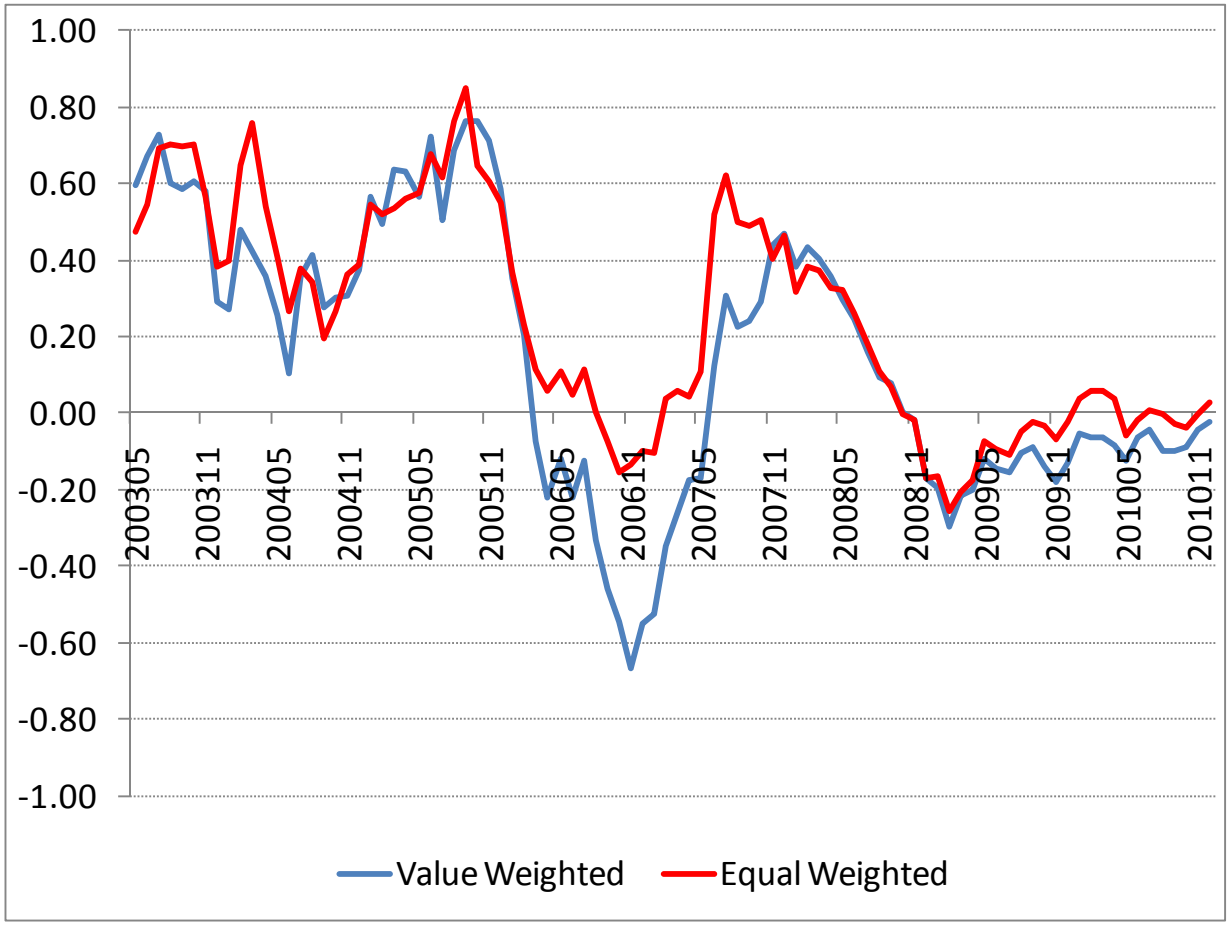
	Bench -mark	Incl. Frontier Market VW	Incl. Frontier Market EW	Bench -mark	Incl. Frontier Market VW	Incl. Frontier Market EW
	June 2002 to August 2008			June 2002 to December 2010		
Panel A: Big versus Small, before Transaction Costs						
Big	0.319	0.562***	0.681***	0.230	0.364	0.460***
Small		0.529***	0.582***		0.374	0.405
p-Value		0.345	0.109		0.573	0.261
Panel B: Big versus Small, after Transaction Costs						
Big	0.300	0.530**	0.643***	0.213	0.334	0.425**
Small		0.466***	0.526***		0.318***	0.356***
p-Value		0.226	0.077		0.436	0.211
Panel C: Liquid versus Illiquid, before Transaction Costs						
Liquid	0.319	0.558**	0.670**	0.230	0.361*	0.456***
Illiquid		0.487***	0.583***		0.344**	0.404***
p-Value		0.256	0.20		0.463	0.281
Panel D: Liquid versus Illiquid, after Transaction Costs						
Liquid	0.300	0.526**	0.634***	0.213	0.334	0.425***
Illiquid		0.414*	0.517***		0.277	0.345***
p-Value		0.164	0.129		0.249	0.152
Panel E: High Segmentation versus Low Segmentation, before Transaction Costs						
High Seg	0.319	0.518***	0.639***	0.230	0.352***	0.439***
Low Seg		0.498**	0.495***		0.340	0.355**
p-Value		0.460	0.043		0.434	0.147

Panel F: High Segmentation versus Low Segmentation, after Transaction Costs

High Seg	0.300	0.485***	0.594***	0.213	0.316**	0.397***
Low Seg		0.447*	0.439***		0.297	0.307*
p-Value		0.351	0.012		0.407	0.120

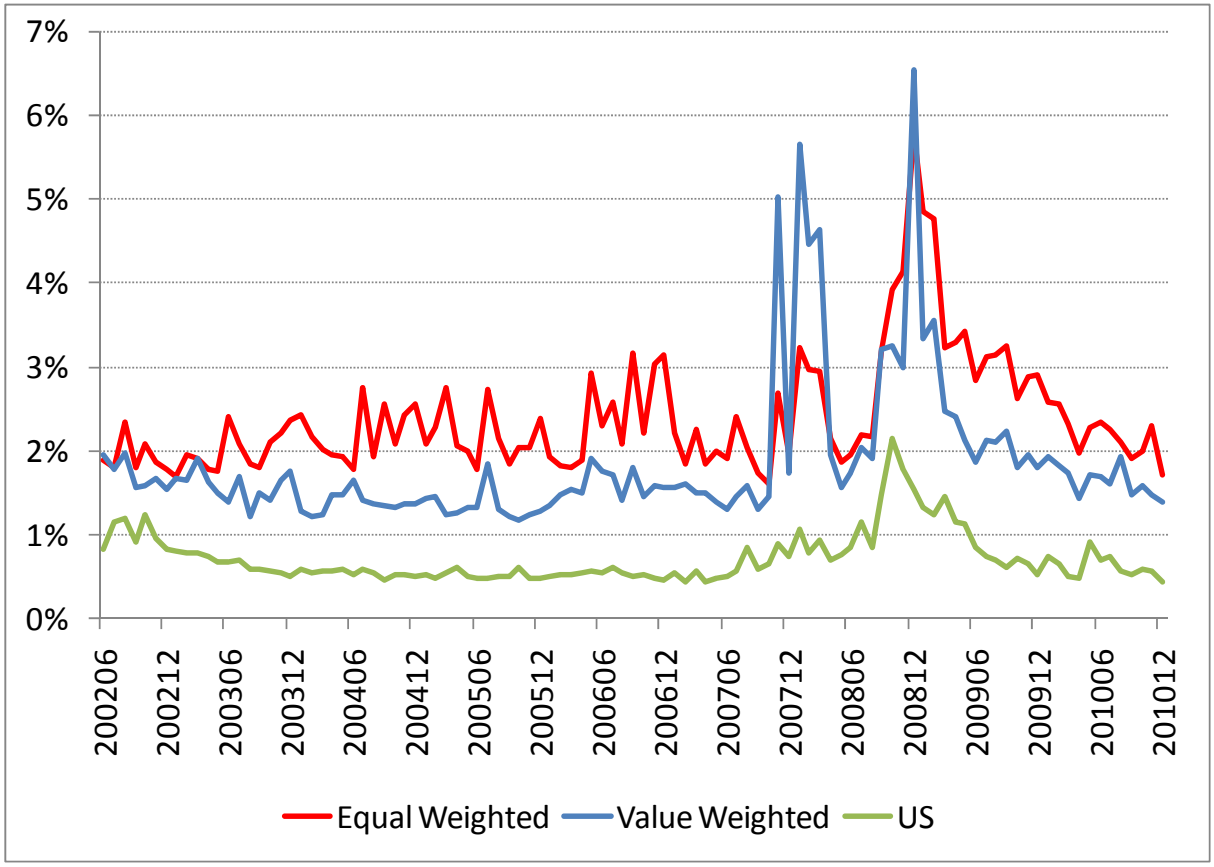
This table shows the 12-month Sharpe ratios for the portfolios of the largest (smallest) countries based on the market capitalization in Table IV, the most (least) liquid countries based on the monthly dollar values traded in Table IV, and the countries with the highest (lowest) segmentation based on the numbers in Table 1 of Bekaert, Harvey, Lundblad, and Siegel (2011). The superscripts *, **, and *** denote Sharpe ratios that are statistically significantly higher than the benchmark at the 10%, 5%, and 1% levels, respectively. The *p*-value shows that the big versus small, liquid versus illiquid, and highly segmented versus less segmented country Sharpe ratios are not different from each other. Here VW refers to value weighted and EW refers to equal weighted.

Figure 1
Sharpe ratio differences.



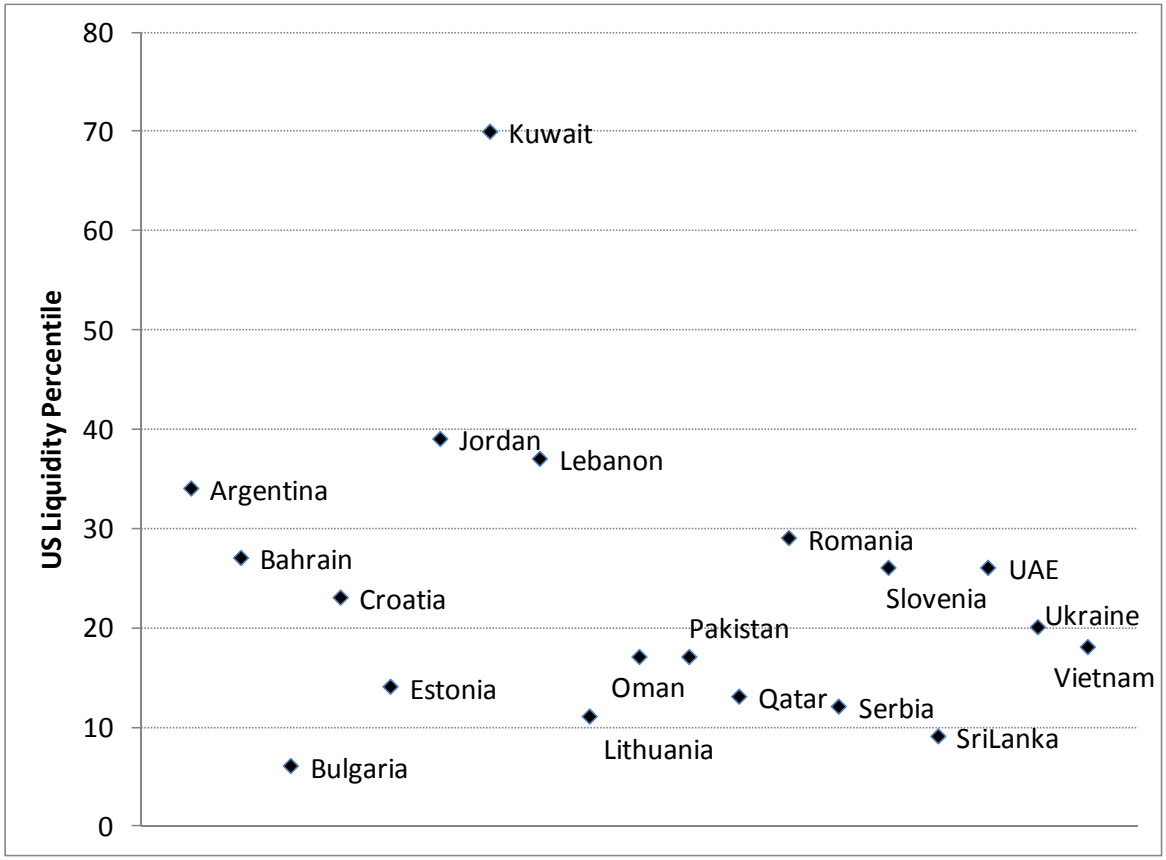
This figure shows the difference between the 12-month holding period Sharpe ratios for portfolios that include the frontier market and the US benchmark portfolio. The equal- and value-weighted frontier market and US portfolio differences are in red and blue, respectively.

Figure 2
Average frontier market effective spreads and Corwin–Schultz (2011) US transaction costs.



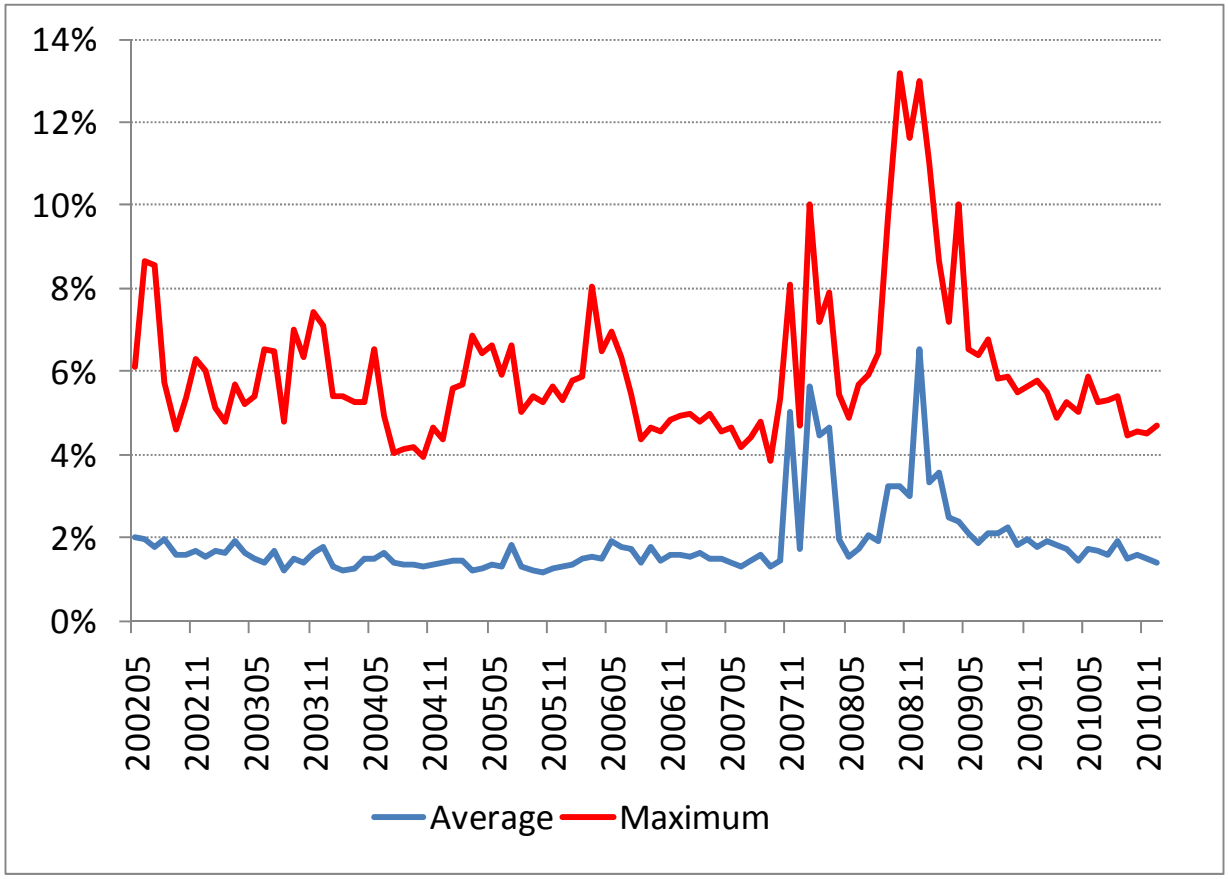
Monthly average effective spreads are calculated for each stock by value-weighting observations. Country monthly spreads are then calculated by market capitalization weighting. Overall frontier market spreads are then calculated by value-weighting and equal-weighting the country spreads. The US transaction costs are calculated using the method of Corwin and Schultz (2011).

Figure 3
US liquidity percentiles for average frontier market stocks.



This figure shows the US liquidity percentile that the average stock in each frontier market would be in, based on 2010 dollar volumes.

Figure 4
Average and maximum value-weighted effective spreads.



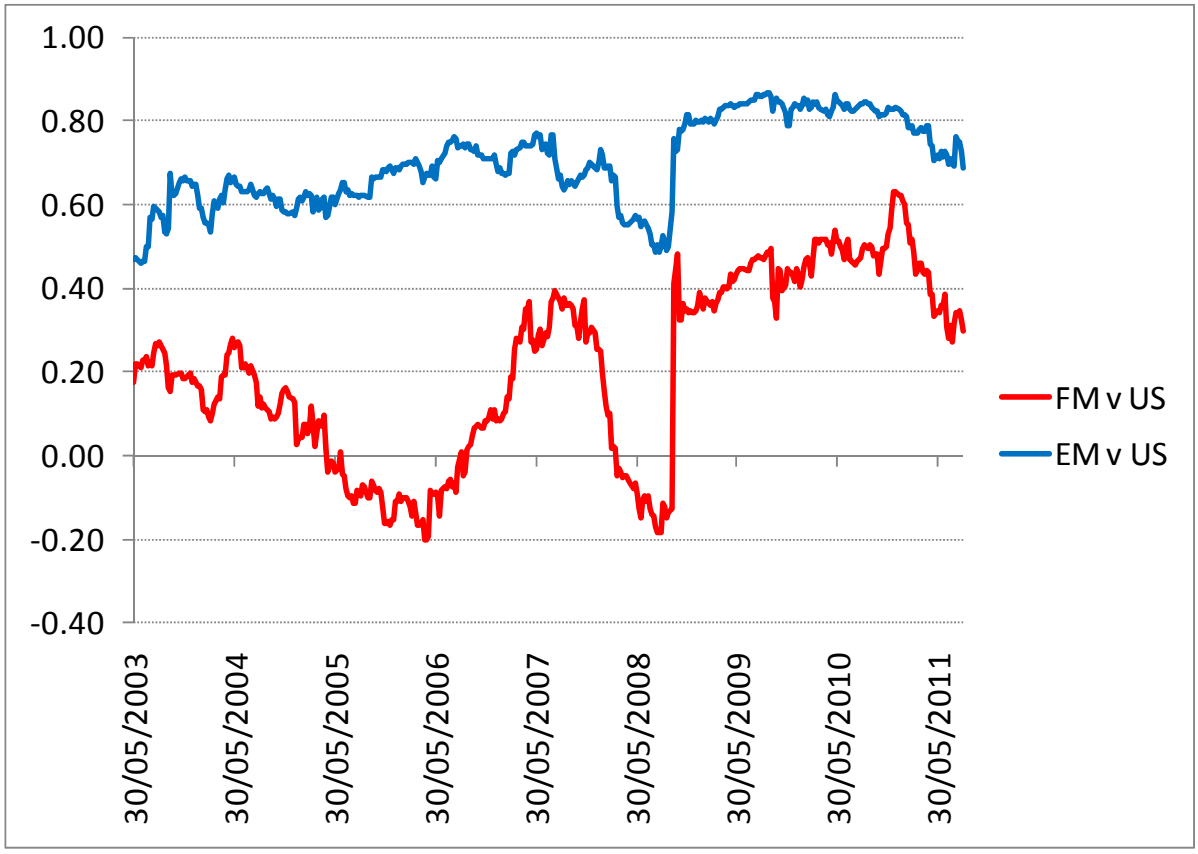
The average value-weighted effective spread is the same as for Figure 2. The maximum value-weighted effective spread is calculated in a similar fashion to the average, except for the first step. The maximum is based on the largest effective spread for each stock for each month, rather than the average.

Appendix A: Correlations with MSCI Series

Frontier Market VW	0.85
Frontier Market EW	0.79
Argentina	0.81
Bahrain	0.83
Bulgaria	0.70
Croatia	0.83
Estonia	0.91
Jordan	0.91
Kuwait	0.84
Lebanon	0.72
Lithuania	0.89
Oman	0.95
Pakistan	0.90
Qatar	0.98
Romania	0.97
Serbia	0.96
Slovenia	0.83
Sri Lanka	0.89
UAE	0.89
Ukraine	0.48
Vietnam	0.51
Country Average	0.83

The table shows the correlations between the value-weighted (VW) and equal-weighted (EW) frontier market indices we form and the MSCI Frontier Markets Index, and the correlations between the individual country indices we construct and the MSCI index for each country.

Appendix B: Time Series Correlations



Appendix B shows the rolling 52-week correlations for the MSCI Frontier Markets (FM) Index versus the US CRSP value-weighted index and for the MSCI Emerging Markets (EM) Index versus the US CRSP value-weighted index.

Appendix C: Equally Weighted Transaction Costs and Liquidity

	Start Date	N Stock Months	Quoted Spread	Effective Spread	Price Impact	Volume (000)	$Volume (000)	No. Trades	$Depth (000)
Argentina	200206	6,026	4.8%	2.4%	1.4%	1,040	1,023	308	9
Bahrain	200401	1,986	4.9%	3.1%	0.9%	1,062	1,155	62	70
Bulgaria	200507	9,315	16.2%	12.7%	2.7%	36	178	89	4
Croatia	200209	1,696	12.3%	8.9%	1.7%	20	1,403	218	33
Estonia	200206	1,256	3.1%	2.5%	1.0%	438	2,482	212	16
Jordan	200511	10,090	3.6%	2.8%	1.5%	726	2,480	473	18
Kuwait	200309	9,157	3.6%	2.5%	1.3%	18,717	26,261	428	20
Lebanon	200206	406	6.4%	4.2%	1.2%	178	863	35	69
Lithuania	200305	2,731	5.3%	3.7%	1.8%	423	506	159	6
Oman	200407	2,974	5.1%	2.9%	1.6%	108	317	29	23
Pakistan	200206	14,975	6.3%	4.8%	1.9%	2,741	2,789	805	5
Qatar	200401	2,464	2.0%	1.3%	1.1%	298	7,232	222	149
Romania	200206	5,982	7.1%	5.7%	1.9%	5,456	1,510	571	14
Serbia	200905	1,309	9.8%	5.0%	2.0%	5	148	59	7
Slovenia	200602	2,349	7.4%	5.6%	1.5%	25	852	150	9
Sri Lanka	200206	18,657	8.8%	6.5%	2.3%	156	34	67	4
UAE	200407	2,017	4.8%	3.2%	1.5%	12,238	20,402	413	212
Ukraine	200604	1,658	20.2%	12.5%	3.0%	1,511	503	179	16
Vietnam	200706	1,642	2.0%	1.7%	1.3%	193	392	103	14
EW Average			7.0%	4.8%	1.7%	2,388	3,712	241	37

The calculations here are the same as in Table 4, except that simple averages are calculated across stocks within each country for each month. Time series averages are then calculated and reported.

Appendix D: Diversification Benefits after Average Transaction Costs and Commissions

	Bench-mark	Incl. Frontier Market VW	Incl. Frontier Market VW	Bench-mark	Incl. Frontier Market VW	Incl. Frontier Market VW
	June 2002 to August 2008			June 2002 to August 2010		
Panel A: 12-Month Holding Period						
Mean	0.294	0.495	0.586	0.208	0.307	0.387
Median	0.308	0.624	0.602	0.254	0.316	0.391
p-Value		0.010	0.000		0.148	0.001
Panel B: 24-Month Holding Period						
Mean	0.296	0.504	0.587	0.149	0.263	0.329
Median	0.299	0.435	0.554	0.239	0.214	0.399
p-Value		0.002	0.000		0.041	0.000
Panel C: 36-Month Holding Period						
Mean	0.296	0.518	0.604	0.130	0.246	0.313
Median	0.329	0.495	0.618	0.136	0.245	0.352
p-Value		0.000	0.000		0.002	0.000

The statistics here are similar to those in Table 3, except for the fact that the Sharpe ratios are calculated after deducting the average monthly transaction cost (half effective spread) for each stock, and an estimate of the commission is incurred each time a stock is traded (Quisenberry (2010)). Here VW refers to value weighted and EW refers to equal weighted.

Appendix E: Diversification Benefits after Maximum Transaction Costs and Commissions

	Bench-mark	Incl. Frontier Market VW	Incl. Frontier Market VW	Bench-mark	Incl. Frontier Market VW	Incl. Frontier Market VW
	June 2002 to August 2008			June 2002 to December 2010		
Panel A: 12-Month Holding Period						
Mean	0.294	0.421	0.496	0.208	0.247	0.312
Median	0.308	0.528	0.494	0.254	0.232	0.285
p-Value		0.070	0.000		0.367	0.056
Panel B: 24-Month Holding Period						
Mean	0.296	0.465	0.538	0.149	0.232	0.291
Median	0.299	0.402	0.502	0.239	0.185	0.350
p-Value		0.008	0.000		0.114	0.000
Panel C: 36-Month Holding Period						
Mean	0.296	0.488	0.568	0.130	0.223	0.286
Median	0.329	0.471	0.584	0.136	0.222	0.317
p-Value		0.000	0.000		0.009	0.000

The statistics are similar to those in Table 3, except for the fact that the Sharpe ratios are calculated after deducting the maximum monthly transaction cost (half effective spread) for each stock, and an estimate of the commission is incurred each time a stock is traded (Quisenberry (2010)). Here VW refers to value weighted and EW refers to equal weighted.