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Does it pay to diversify? U.S. vs. international ETFs

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Abstract

Individual investors seek diversification in their portfolios using a number of approaches. One approach that is commonly used is to diversify globally. This article evaluates the performance and diversification benefits of international ETFs for U.S. investors during and after the recent financial crisis. Our results show that U.S. ETFs outperform all categories of international ETFs for the period of our study (January 2008 – June 2013); they have higher average monthly returns, lower risk (standard deviation of returns), higher risk-adjusted performance (Sharpe, Sortino, and Treynor ratios) and the highest cumulative returns over the entire period. When we form equally weighted portfolios of each ETF category and compute their risk-adjusted performance, we again find that U.S. ETF portfolios had the best performance for the entire period. We also find that U.S. ETFs have the lowest tracking error during the entire period. Most of these ETFs passively track the benchmark and do not manage for positive α. Previous research has questioned the diversification benefits of international investing during times of financial distress. We find that international ETFs are highly dependent on major U.S. indices during the period of our analysis, and therefore, offered limited diversification benefits for U.S. investors.

JEL classification: G11; G12; G15

Keywords: International ETFs; Diversification; Portfolio; Risk-adjusted performance

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1. Introduction

U. S. investors can achieve global diversification in a number of ways. They can purchase individual securities directly in foreign capital markets or in U.S. markets through American depository receipts (ADRs). Other investors attain international diversification by indirect investments such as mutual funds, closed-end funds, or exchange traded funds (ETFs). Earlier research (e.g., Adler and Dumas, 1983; Black, 1974; Heston and Rouwenhorst,1994; Levy and Sarnat, 1970; Stulz, 1981) supports the importance to investors to allocate some of their funds into foreign investments as a means of reducing portfolio risk because of low correlations among markets or market segmentation that results in barriers to international investment. However, more recent findings bring into question the diversification benefits of international investing especially during times of financial distress. Eun and Shin (1989), King and Wadhwani (1990), and Koch and Koch (1991) show that regional dependencies have increased over time. Longin and Solnik (1995) and Jacquier and Marcus (2001) examine correlations in country portfolio returns during turbulent market conditions and conclude that they increase. Roll (1987) analyzed the crash of October 1987 and reports that all 23 indexes studied declined in a synchronized fashion. Pries, Kenett, Stanley, Helbing, and Ben-Jacob (2012) report that diversification benefits vanish during times of financial distress. Russell (1998) looks at the international diversification benefits of U.S. exchange traded securities such as closed ended funds, ADRs and Multinational Corporation (MNCs) to provide diversification benefits similar to investment in foreign equity. The result indicate that U.S. exchange-listed securities behave more like host exchange than their home exchange. This results suggests exchange-listed securities on average, do not perform an international diversification role for U.S. investors. Johnson et al. (1999) find that diversification benefits of international mutual funds may be less than what previous studies find. They find that during restrictive U.S. monetary policy periods, international mutual fund indexes provide lower excess returns than domestic counterparts. Additionally, the correlations between international mutual funds and domestic mutual funds are higher during restrictive monetary policy periods. This evidence may represent a partial explanation for the home country bias exhibited by United States-based individual and institutional investors. Aiello and Chieffe (1999) compare the performance of international index funds and the S&P 500 from 1989 to 1997 and find that international index funds do not offer superior performance. Ho et al. (1999) find that the United States equity market is a large proportion of the international equity market that is available to individual investors, and United States returns are highly correlated with other markets. Hanna et al. (1999) look at ten years of historical data (January 1988 through December 1997) from the stock markets in the G-7 countries. Across this 10-year period, they find that a portfolio consisting solely of the S&P 500 dominates any portfolio that can be constructed from the S&P 500 and the major market index of the G-7 countries.

The growth in the number of international ETFs has been significant, especially immediately before the "great recession." This growth was in response to investor demand for ETFs that provided an opportunity to diversify globally using low cost options. In this article we look at the performance and diversification benefits of international ETFs for U.S. investors from 2008 through June 2013.[1] Using ETFs that follow Total World, Total World

Ex U.S., Developed markets, and Emerging markets, we compare their performance to U.S. ETFs that follow the major indices. According to Rompotis (2010), investors choose foreign ETFs for a number of reasons: (1) It was difficult to invest in securities listed on foreign exchanges before the emergence of ETFs because many U.S. brokers were unable to process orders on non-U.S. exchanges and the few good international mutual funds that existed had very high expenses. (2) Apart from difficulties of foreign investing, investors choose international ETFs for broad diversification without having to directly purchase stocks in foreign countries. In addition, investors want to take advantage of specific macroeconomic or microeconomic trends, such as rapid growth in a particular economy or region. International ETFs give U.S. investors a cheaper and less complicated method to invest in foreign stocks rather than direct investment. Our article will test whether international ETFs outperform major U.S. ETFs and whether U.S. investors get diversification benefits by investing in foreign ETFs during the financial crisis and subsequent recovery of the U.S. stock market.

2. Data

To be included in the analysis (for an equal comparison), the ETF should have been created on or before January 2008 and have continuous return and trading history from January 2008 through June 2013. These ETFs where created at different points of time with U.S. ETFs created before Total World, Total World Ex U.S., Developed markets, and Emerging markets ETFs. Table 1a provides a list of each ETF used in our study, its inception date, the underlying benchmark index, and the category to which the ETF belongs. The complete list of different categories of ETFs was obtained from Morningstar Direct.

Using data obtained from Morningstar Direct and Bloomberg Terminal we compare the performance of U.S. ETFs following six major U.S. indices (S&P 500, Russell 1000, Russell 3000, Dow Jones Industrial Average, Dow Jones U.S. Total Returns, and NASDAQ 100) to Total World, Total World ex U.S., Emerging markets, and Developed markets ETFs. There are a total of 36 ETFs (6 U.S., 6 Total World, 4 Total World ex U.S., 10 Emerging Markets, and 10 Developed Markets) included in this analysis. We also look at the potential benefits of diversification for American investors from owning international ETFs.

Descriptive data are provided in Table 1b that include the average annual net expense and turnover ratios of each ETF from 2008 to 2013 and assets at the end of June 2013. U.S. ETFs have the lowest expense ratios while Developed market and Emerging market ETFs have the highest expense ratios. All these values have also been taken from Morningstar Direct and Bloomberg Terminal.

3. Performance and risk

Following Rompotis (2009, 2010) and Shin and Soydemir (2010), ETFs are compared based on their average monthly returns for the entire period (January 2008 through June 2013). We rank ETFs in descending order based on their average returns. The risk of ETFs

Table 1a: This table shows the ETF, the benchmark it follows, the inception date and category to which it belongs

ETF	Name	Benchmark	Inception	Category
IVV	iShares Core S&P 500 ETF	S&P 500 TR USD	5/15/2000	U.S.
IWB	iShares Russell 1000 Index	Russell 1000 TR USD	5/15/2000	U.S.
IWV	iShares Russell 3000 Index	Russell 3000 TR USD	5/22/2000	U.S.
DIA	SPDR Dow Jones Industrial Average	DJ Industrial Average TR USD	1/13/1998	U.S.
IYY	iShares Dow Jones U.S. Index	DJ US TR USD	6/12/2000	U.S.
QQQ	PowerShares QQQ	NASDAQ 100 TR USD	3/10/1999	U.S.
DEW	WisdomTree Global Equity Income	WisdomTree Global Equity Income TR USD	6/16/2006	Total World
DGT	SPDR Global Dow ETF	DJ Global TR USD	9/25/2000	Total World
IOO	iShares S&P Global 100 Index	S&P Global 100 TR	12/5/2000	Total World
FGD	First Trust DJ Global Select Dividend	DJ Global Select Dividend TR USD	11/21/2007	Total World
LVL	Guggenheim S&P Global Dividend Opps Idx	S&P Global Dividend Opport NR USD	6/25/2007	Total World
TOK	iShares MSCI Kokusai	MSCI Kokusai TR USD	12/10/2007	Total World
CWI	SPDR MSCI ACWI (ex-US)	MSCI ACWI Ex USA GR USD	1/10/2007	Total World Ex US
DNL	WisdomTree Global ex-US Growth	WisdomTree Global Ex Us Growth TR USD	6/16/2006	Total World Ex U.S.
GWL	SPDR S&P World ex-US	S&P Developed Ex US BMI TR USD	4/20/2007	Total World Ex U.S.
VEU	Vanguard FTSE All-World ex-US ETF	FTSE AW Ex US TR USD	3/2/2007	Total World Ex U.S.
ADRD	BLDRS Developed Markets 100 ADR Index	BONY Developed Markets 100 ADR TR USD	11/13/2002	Developed
DOL	WisdomTree International LargeCap Div	WisdomTree Intl LargeCap Dividend TR USD	6/16/2006	Developed
DOO	WisdomTree International Div ex-Finncls	WisdomTree Intl Dividend Ex Fincl TR USD	6/16/2006	Developed
DTH	WisdomTree DEFA Equity Income	WisdomTree DEFA Equity Income TR USD	6/16/2006	Developed
DWM	WisdomTree DEFA	WisdomTree DEFA TR USD	6/16/2006	Developed
EFA	iShares MSCI EAFE	MSCI EAFE NR USD	8/14/2001	Developed
IDV	iShares Dow Jones Intl Select Div Idx	DJ EPAC Select Dividend TR USD	6/11/2007	Developed
PIZ	PowerShares DWA Dev Mkts Technical Ldrs	Dorsey Wright Dev Mrkt Tech Ldrs NR USD	12/28/2007	Developed
PXF	PowerShares FTSE RAFI Dev Mkts ex-US	FTSE RAFI Dvlp ex US 1000 TR USD	6/25/2007	Developed
VEA	Vanguard FTSE Developed Markets ETF	FTSE Developed ex North America NR USD	7/20/2007	Developed
ADRE	BLDRS Emerging Markets 50 ADR Index	BONY Emerging Markets 50 ADR TR USD	11/13/2002	Emerging
BIK	SPDR S&P BRIC 40	S&P BRIC 40 TR	6/19/2007	Emerging
BKF	iShares MSCI BRIC	MSCI BRIC NR USD	11/12/2007	Emerging
DEM	WisdomTree Emerging Markets Equity Inc	WisdomTree EM Equity Income TR USD	7/13/2007	Emerging
EEB	Guggenheim BRIC	BNY/Mellon BRIC TR USD	9/21/2006	Emerging
EEM	iShares MSCI Emerging Markets	MSCI EM NR USD	4/7/2003	Emerging
GMM	SPDR S&P Emerging Markets	S&P Emerging BMI TR USD	3/19/2007	Emerging
PIE	PowerShares DWA Em Mkts Technical Ldrs	Dorsey Wright Em Mrkt Tech Ldrs NR USD	12/28/2007	Emerging
PXH	PowerShares FTSE RAFI Emerging Markets	FTSE RAFI Emerging TR USD	9/27/2007	Emerging
VWO	Vanguard FTSE Emerging Markets ETF	FTSE Emerging TR USD	3/4/2005	Emerging

is estimated as the standard deviation of returns. As shown in Table 2, on average, U.S. ETFs and indices have the highest average monthly returns, whereas Emerging (ADRE, EEB, and BKF) markets ETFs and benchmarks have the lowest returns over the entire period. Similarly, U.S. ETFs and indices (with the exception of QQQ and its benchmark Nasdaq 100) have the lowest standard deviation of returns over the entire period, whereas Emerging markets ETFs have the highest standard deviation of returns over the entire period.

3.1. Sharpe, Sortino, and Treynor ratios

An ETF could have higher returns, but it could have done so by assuming higher risk. To compare risk adjusted returns of ETFs over the same period, Sharpe, Sortino, and Treynor ratios are used. These measures have been widely used in the literature (e.g., Harper, Madura, and Schnusenberg, 2006; Rompotis, 2009, 2010) to compare ETF performance. ETFs are ranked in descending order (from best to worst based on these ratios) for the entire period (January 2008 through June 2013).

Table 1b: Shows average annual net expense and turnover ratios from 2008 to 2013 and assets at the end of June 2013

ETF	Average annual net expense ratio 2008–2013	Average annual turnover ratio 2008–2013	Assets $ (June 2013)	Category
IVV	0.09%	5.33%	42,573,234,908	U.S.
IWB	0.15%	6.67%	7,686,737,763	U.S.
IWV	0.20%	6.33%	4,287,062,577	U.S.
IYY	0.20%	5.67%	715,567,400	U.S.
DIA	0.17%	6.72%	12,568,816,144	U.S.
QQQ	0.20%	12.19%	33,645,121,238	U.S.
DEW	0.53%	42.33%	98,284,717	Total World
DGT	0.51%	27.17%	88,219,982	Total World
IOO	0.40%	5.67%	1,256,399,204	Total World
FGD	0.60%	36.83%	311,450,253	Total World
LVL	0.80%	82.67%	72,989,199	Total World
TOK	0.25%	5.67%	576,636,913	Total World
CWI	0.34%	6.17%	416,858,949	Total World Ex U.S.
DNL	0.58%	54.00%	76,210,727	Total World Ex U.S.
GWL	0.35%	5.83%	572,349,639	Total World Ex U.S.
VEU	0.19%	7.00%	9,041,860,844	Total World Ex U.S.
ADRD	0.28%	10.10%	45,196,595	Developed
DOL	0.48%	22.50%	209,073,220	Developed
DOO	0.58%	46.33%	322,821,722	Developed
DTH	0.58%	31.50%	212,323,318	Developed
DWM	0.43%	35.67%	438,785,622	Developed
EFA	0.34%	6.33%	40,201,315,518	Developed
IDV	0.50%	42.67%	1,969,620,635	Developed
PIZ	0.80%	128.17%	246,498,810	Developed
PXF	0.71%	21.83%	536,149,000	Developed
VEA	0.12%	8.60%	13,152,279,035	Developed
ADRE	0.27%	12.04%	235,859,904	Emerging
BIK	0.49%	12.33%	226,925,818	Emerging
BKF	0.34%	13.33%	491,577,033	Emerging
DEM	0.63%	38.50%	4,848,791,521	Emerging
EEB	0.63%	11.00%	224,304,688	Emerging
EEM	0.69%	14.33%	34,620,518,926	Emerging
GMM	0.59%	10.50%	180,418,744	Emerging
PIE	0.90%	171.00%	354,721,563	Emerging
PXH	0.80%	36.50%	333,461,873	Emerging
VWO	0.20%	14.67%	49,355,444,391	Emerging

Sharpe ratio is calculated as:

$$SR = (R_{ETF} - R_f)/\sigma_{ETF} \quad (1)$$

where

R_{ETF} denotes the monthly returns on the ETF,
R_f is the monthly risk free rate,
σ_{ETF} is the standard deviation of monthly ETF returns.

Table 2 Shows average monthly returns and standard deviation of returns (in %) from January 2008 through June 2013

Rank	ETF	No. of obs	Avg. monthly ETF return	ETF *SD*	Avg. monthly index return	Index *SD*	Category
1	QQQ	66 months	0.7561%	6.1599%	0.7705%	6.1401%	US
2	DIA	66 months	0.5148%	4.8122%	0.5279%	4.8237%	US
3	IYY	66 months	0.4949%	5.4340%	0.5107%	5.4480%	US
4	IWV	66 months	0.4949%	5.4871%	0.5059%	5.5027%	US
5	IWB	66 months	0.4810%	5.4020%	0.4896%	5.4150%	US
6	IVV	66 months	0.4590%	5.2919%	0.4633%	5.3017%	US
7	DEM	66 months	0.4407%	6.7076%	0.5276%	6.7266%	Emerging
8	FGD	66 months	0.2923%	7.1894%	0.2776%	7.0462%	Total World
9	TOK	66 months	0.2521%	5.9550%	0.2301%	5.9868%	Total World
10	DNL	66 months	0.2345%	5.5904%	0.2910%	5.5820%	Total World Ex US
11	IDV	66 months	0.1843%	7.6042%	0.1920%	7.7109%	Developed
12	PIZ	66 months	0.1534%	7.3502%	0.2334%	7.3026%	Developed
13	GMM	66 months	0.1441%	7.8320%	0.1644%	8.0012%	Emerging
14	IOO	66 months	0.1387%	5.6871%	−0.2219%	6.8277%	Total World
15	VWO	66 months	0.0989%	8.1487%	0.1627%	8.0327%	Emerging
16	LVL	66 months	0.0824%	7.5689%	−0.0142%	7.4818%	Total World
17	EEM	66 months	0.0765%	7.9182%	0.1079%	8.0415%	Emerging
18	VEU	66 months	0.0473%	6.9711%	0.0683%	6.8047%	Total World Ex US
19	VEA	66 months	0.0311%	6.7140%	0.0172%	6.6193%	Developed
20	GWL	66 months	0.0252%	6.4864%	0.0837%	6.6414%	Total World Ex US
21	CWI	66 months	0.0236%	6.6716%	0.0482%	6.7425%	Total World Ex US
22	PXF	66 months	0.0137%	7.4310%	0.1014%	7.3730%	Developed
23	PXH	66 months	0.0077%	7.9612%	0.1705%	8.0847%	Emerging
24	DGT	66 months	−0.0661%	5.5120%	0.2421%	6.0017%	Total World
25	DEW	66 months	−0.0166%	6.5695%	0.0027%	6.5988%	Total World
26	EFA	66 months	−0.0112%	6.5123%	−0.0064%	6.5437%	Developed
27	PIE	66 months	−0.0389%	8.4288%	0.3117%	8.1988%	Emerging
28	ADRD	66 months	−0.0451%	6.7941%	−0.0625%	6.8151%	Developed
29	DWM	66 months	−0.0617%	6.4940%	−0.0130%	6.5679%	Developed
30	DTH	66 months	−0.0930%	6.8944%	−0.0602%	6.9748%	Developed
31	DOL	66 months	−0.0943%	6.4759%	−0.0814%	6.5380%	Developed
32	BIK	66 months	−0.0999%	8.5527%	−0.0542%	8.5939%	Emerging
33	DOO	66 months	−0.1272%	6.9165%	−0.1335%	6.9606%	Developed
34	ADRE	66 months	−0.1960%	7.7663%	−0.1874%	7.7789%	Emerging
35	EEB	66 months	−0.2289%	8.7484%	−0.1896%	8.7991%	Emerging
36	BKF	66 months	−0.2402%	8.9804%	−0.2082%	8.9795%	Emerging

ETFs are ranked in descending order based on average monthly returns.

The Sharpe ratio evaluates how well an ETF compensates its investor for each unit of risk they incur. The higher the Sharpe ratio, the better is the performance of the ETF.

The second measure of risk-adjusted performance is the Sortino ratio expressed as:

$$\text{Sortino} = (R_{ETF} - R_f)/\sigma_d \tag{2}$$

where

R_{ETF} and R_f are described as above;
σ_d is the standard deviation of ETF's negative returns.

The Sortino ratio differentiates between good and bad volatility in the Sharpe ratio. The differentiation of upward and downward volatility allows the calculation of the risk-adjusted return to provide a performance measure of an ETF without penalizing it for positive returns. A large Sortino ratio indicates low risk of large losses occurring. Similar to the Sharpe ratio, the higher the Sortino ratio, the better is the performance of an ETF.

The third measure we use is the Treynor ratio that is expressed as:

$$\text{Treynor} = (R_{ETF} - R_f)/\beta_{ETF} \tag{3}$$

where

R_{ETF} and R_f are defined as above,
β_{ETF} is the systematic risk of the ETF.

Similarly to Sharpe and Sortino ratios, the higher the Treynor ratio, the better is the performance of the ETF.

The results shown in Table 3a indicate again that U.S. ETFs have the highest Sharpe and Sortino ratios (the first six ranks are occupied by U.S. ETFs with QQQ and DIA having the best performance out of all ETFs), whereas Emerging (ADRE, BKE, and EEB) and Developed (DTH, DOO, and DOL) market ETFs have the lowest Sharpe and Sortino ratios.

The Treynor ratio again indicates that U.S. ETFS had the best performance for the entire period as shown in Table 3b.

As a robustness test, Sharpe, Sortino, and Treynor ratios were computed using the three month Interbank Libor rate instead of three month T-Bill rate as many of these ETFs buy international stocks. The results as shown in Tables 3a and b did not change (U.S. ETFs again occupied the first six ranks).

4. Cumulative returns and cumulative wealth index

Cumulative returns of ETFs for the entire period have been computed. Following Woolridge (2004) we also compute the cumulative wealth index (CWI) for each ETF. The CWI measures the outcome of investing $1,000 in each ETF at the beginning of January 2008, presuming reinvestment of dividends. ETFs are ranked in descending order based on cumulative returns and CWI. U.S. ETFs occupy the top six ranks as shown in Table 4. For example, $1,000 invested in QQQ and DIA in January 2008 would have returned $1,451.14 and $1,300.23 by June 2013, respectively.

5. Tracking error

It is important to consider tracking error when analyzing ETF performance. The greater the tracking error the less closely the ETF follows the benchmark. If an investor is considering using an ETF for international diversification and the ETF has a high tracking

Table 3a: Sharpe and Sortino ratios calculated using three month T-Bill and three month LIBOR rates

Rank (T-Bill)	ETF	Sharpe ratio	Sortino ratio	Category	Rank (libor)	ETF	Sharpe ratio	Sortino ratio	Category
1	QQQ	0.1176	0.1684	U.S.	1	QQQ	0.1163	0.1663	US
2	DIA	0.1004	0.1403	U.S.	2	DIA	0.0989	0.1380	US
3	IYY	0.0853	0.1175	U.S.	3	IYY	0.0841	0.1155	US
4	IWV	0.0845	0.1161	U.S.	4	IWV	0.0833	0.1142	US
5	IWB	0.0832	0.1144	U.S.	5	IWB	0.0820	0.1125	US
6	IVV	0.0808	0.1111	U.S.	6	IVV	0.0796	0.1092	US
7	TOK	0.0372	0.0505	Total World	7	DEM	0.0603	0.0860	Emerging
8	DNL	0.0365	0.0516	Total World Ex U.S.	8	DNL	0.0356	0.0502	Total World Ex US
9	FGD	0.0364	0.0514	Total World	9	FGD	0.0356	0.0501	Total World
10	IDV	0.0202	0.0278	Developed	10	TOK	0.0363	0.0492	Total World
11	IOO	0.0191	0.0261	Total World	11	IDV	0.0196	0.0268	Developed
12	PIZ	0.0168	0.0224	Developed	12	IOO	0.0182	0.0248	Total World
13	GMM	0.0145	0.0201	Emerging	13	PIZ	0.0161	0.0214	Developed
14	VWO	0.0084	0.0118	Emerging	14	GMM	0.0139	0.0192	Emerging
15	LVL	0.0069	0.0094	Total World	15	VWO	0.0078	0.0109	Emerging
16	DEM	0.0611	0.0874	Emerging	16	LVL	0.0061	0.0083	Total World
17	EEM	0.0059	0.0082	Emerging	17	EEM	0.0053	0.0073	Emerging
18	VEU	0.0025	0.0034	Total World Ex U.S.	18	VEU	0.0018	0.0024	Total World Ex US
19	VEA	0.0002	0.0002	Developed	19	VEA	−0.0005	−0.0007	Developed
20	GWL	−0.0007	−0.0010	Total World Ex U.S.	20	GWL	−0.0015	−0.0020	Total World Ex US
21	CWI	−0.0010	−0.0013	Total World Ex U.S.	21	CWI	−0.0017	−0.0023	Total World Ex US
22	PXF	−0.0022	−0.0031	Developed	22	PXF	−0.0028	−0.0040	Developed
23	PXH	−0.0028	−0.0040	Emerging	23	PXH	−0.0034	−0.0048	Emerging
24	EFA	−0.0063	−0.0084	Developed	24	EFA	−0.0070	−0.0093	Developed
25	DEW	−0.0071	−0.0093	Total World	25	DEW	−0.0078	−0.0102	Total World
26	PIE	−0.0082	−0.0103	Emerging	26	PIE	−0.0087	−0.0110	Emerging
27	ADRD	−0.0110	−0.0151	Developed	27	ADRD	−0.0117	−0.0159	Developed
28	DWM	−0.0141	−0.0187	Developed	28	DWM	−0.0148	−0.0195	Developed
29	BIK	−0.0152	−0.0207	Emerging	29	BIK	−0.0157	−0.0213	Emerging
30	DGT	−0.0174	−0.0231	Total World	30	DGT	−0.0182	−0.0240	Total World
31	DTH	−0.0178	−0.0236	Developed	31	DTH	−0.0184	−0.0244	Developed
32	DOL	−0.0191	−0.0253	Developed	32	DOL	−0.0198	−0.0261	Developed
33	DOO	−0.0227	−0.0298	Developed	33	DOO	−0.0233	−0.0305	Developed
34	ADRE	−0.0291	−0.0396	Emerging	34	ADRE	−0.0296	−0.0403	Emerging
35	EEB	−0.0295	−0.0408	Emerging	35	EEB	−0.0300	−0.0414	Emerging
36	BKF	−0.0300	−0.0410	Emerging	36	BKF	−0.0305	−0.0415	Emerging

ETFs are ranked in descending order based on Sharpe and Sortino ratios.

error, the benefit of diversification relative to the benchmark will be lessened. Tracking error is the difference in the performance of ETF and its benchmark. Ideally, the tracking error of an ETF should be zero. However, this is not possible because of expenses; dividends payments arising from stocks of an index; as well as size and timing of index rebalancing (Frino and Gallagher, 2001). Following Frino and Gallagher (2001), tracking error is measured using three different methods.

TE1–The first method of estimating tracking error is computed as the average absolute differences between the return on the ETF and its benchmark index. The equation is given as:

$$\mathrm{TE1} = \sum_{t=1}^{N} Abs\ (Return\ on\ ETF\ -\ Return\ on\ the\ Benchmark\ Index)/n \qquad (4)$$

TE2–The second method to estimate tracking error is to use standard errors from the regression analysis using monthly returns on each ETF and its benchmark index. The model is:

Table 3b: Treynor ratios calculated using three month T-Bill and three month LIBOR rates

Rank (T-Bill)	ETF	Treynor ratio	Category	Rank (libor)	ETF	Treynor ratio	Category
1	QQQ	0.7246	US	1	QQQ	0.7199	US
2	DIA	0.4859	US	2	DIA	0.4812	US
3	IWV	0.4662	US	3	IWV	0.4615	US
4	IYY	0.4661	US	4	IYY	0.4614	US
5	IWB	0.4521	US	5	IWB	0.4474	US
6	IVV	0.4299	US	6	IVV	0.4252	US
7	DEM	0.4120	Emerging	7	DEM	0.4073	Emerging
8	FGD	0.2581	Total World	8	FGD	0.2535	Total World
9	TOK	0.2238	Total World	9	TOK	0.1616	Total World
10	DNL	0.2048	Total World Ex US	10	IDV	0.1520	Developed
11	IDV	0.1568	Developed	11	DNL	0.1430	Total World Ex US
12	PIZ	0.1228	Developed	12	PIZ	0.1181	Developed
13	GMM	0.1168	Emerging	13	GMM	0.1120	Emerging
14	IOO	0.1096	Total World	14	IOO	0.1048	Total World
15	VWO	0.0684	Emerging	15	VWO	0.0638	Emerging
16	LVL	0.0532	Total World	16	EEM	0.0426	Emerging
17	EEM	0.0474	Emerging	17	VEU	0.0124	Total World Ex US
18	VEU	0.0170	Total World Ex US	18	VEA	−0.0036	Developed
19	VEA	0.0010	Developed	19	CWI	−0.0113	Developed
20	GWL	−0.0050	Total World Ex US	20	LVL	−0.0091	Total World
21	CWI	−0.0066	Total World Ex US	21	GWL	−0.0098	Total World Ex US
22	PXF	−0.0162	Developed	22	PXF	−0.0209	Developed
23	PXH	−0.0230	Emerging	23	PXH	−0.0278	Emerging
24	EFA	−0.0415	Developed	24	EFA	−0.0462	Developed
25	DEW	−0.0452	Total World	25	DEW	−0.0497	Total World
26	PIE	−0.0675	Emerging	26	PIE	−0.0721	Emerging
27	ADRD	−0.0753	Developed	27	ADRD	−0.0800	Developed
28	DWM	−0.0928	Developed	28	DWM	−0.0975	Developed
29	DGT	−0.1080	Total World	29	DGT	−0.1133	Total World
30	DTH	−0.1247	Developed	30	DTH	−0.1294	Developed
31	BIK	−0.1305	Emerging	31	DOL	−0.1302	Developed
32	DOL	−0.1255	Developed	32	BIK	−0.1352	Emerging
33	DOO	−0.1578	Developed	33	DOO	−0.2201	Developed
34	ADRE	−0.2264	Emerging	34	ADRE	−0.2311	Emerging
35	EEB	−0.2599	Emerging	35	BKF	−0.2755	Emerging
36	BKF	−0.2708	Emerging	36	EEB	−0.3221	Emerging

ETFs are ranked in descending order based on Treynor ratios.

$$\mathrm{ETF}_{\mathrm{i.t}} = \alpha_i + \beta_i{*}\mathrm{BR}_{\mathrm{i.t}} + \varepsilon_{\mathrm{i,t}} \tag{5}$$

where

$\mathrm{ETF}_{\mathrm{i.t}}$ and $\mathrm{BR}_{\mathrm{i.t}}$ are monthly ETF and benchmark returns, respectively.

In this model the standard errors from regressions proxy tracking errors. If the ETF perfectly follows its benchmark, then the standard deviation of residuals from the regression must be zero.

TE3–The third method estimates tracking error as the standard deviation of the return difference between an ETF and its benchmark index. This method is the one that is most

Table 4 Shows cumulative returns and Cumulative Wealth Index (CWI) over the entire period for each ETF where the CWI measures the outcome of investing $1000 in each ETF at the beginning of January 2008, presuming reinvestment of dividends

Rank	ETF	Cumulative returns (January 2008 through June 2013)	Cumulative Wealth in June 2013 ($1000 invested in January 2008)	Category
1	QQQ	45.11%	$1,451.14	U.S.
2	DIA	30.02%	$1,300.23	U.S.
3	IYY	25.60%	$1,256.05	U.S.
4	IWV	25.36%	$1,253.57	U.S.
5	IWB	24.60%	$1,246.02	U.S.
6	IVV	23.31%	$1,233.13	U.S.
7	DEM	15.19%	$1,151.89	Emerging
8	DNL	5.32%	$1,053.16	Total World Ex U.S.
9	TOK	4.92%	$1,049.23	Total World
10	FGD	2.04%	$1,020.42	Total World
11	IOO	−1.52%	$ 984.76	Total World
12	IDV	−7.12%	$ 928.77	Developed
13	PIZ	−7.73%	$ 922.73	Developed
14	GMM	−10.53%	$ 894.72	Emerging
15	GWL	−11.67%	$ 883.34	Total World Ex U.S.
16	VEA	−12.19%	$ 878.09	Developed
17	VEU	−12.30%	$ 876.98	Total World Ex U.S.
18	CWI	−12.45%	$ 875.49	Total World Ex U.S.
19	LVL	−13.24%	$ 867.60	Total World
20	DGT	−13.46%	$ 865.40	Total World
21	EFA	−13.88%	$ 861.15	Developed
22	DEW	−14.50%	$ 854.97	Total World
23	VWO	−14.59%	$ 854.13	Emerging
24	EEM	−14.70%	$ 853.04	Emerging
25	PXF	−15.87%	$ 841.34	Developed
26	DWM	−16.64%	$ 833.63	Developed
27	ADRD	−16.75%	$ 832.47	Developed
28	DOL	−18.34%	$ 816.65	Developed
29	PXH	−18.61%	$ 813.95	Emerging
30	DTH	−19.86%	$ 801.37	Developed
31	DOO	−21.83%	$ 781.67	Developed
32	PIE	−24.14%	$ 758.59	Emerging
33	BIK	−26.84%	$ 731.56	Emerging
34	ADRE	−28.36%	$ 716.44	Emerging
35	EEB	−33.53%	$ 664.67	Emerging
36	BKF	−34.97%	$ 650.33	Emerging

ETFs are ranked in descending order based on cumulative returns and CWI.

commonly used and, according to Pope and Yadav (1994), produces same estimates as Method 1 if β in Method 2 is equal to 1.

$$TE3 = \frac{\sqrt{1}}{n-1}\sum_{t=1}^{N}(R_{i,t} - R_{j,t})^2 \tag{6}$$

where

Table 5a: Shows TE1, TE2, and TE3 by ETF category and the average of TE1, TE2, and TE3

ETF	TE1	TE2	TE3	Average TE	Category
IVV	0.004%	0.016%	0.012%	0.011%	US
IWB	0.009%	0.023%	0.015%	0.016%	US
IWV	0.011%	0.023%	0.018%	0.017%	US
DIA	0.013%	0.031%	0.015%	0.020%	US
QQQ	0.014%	0.544%	0.296%	0.285%	US
IYY	0.016%	0.020%	0.019%	0.018%	US
IOO	0.361%	1.906%	3.350%	1.872%	Total World
LVL	0.097%	2.118%	1.437%	1.217%	Total World
TOK	0.022%	0.126%	0.061%	0.070%	Total World
FGD	0.015%	1.407%	0.678%	0.700%	Total World
DEW	0.019%	0.378%	0.199%	0.199%	Total World
DGT	0.308%	4.015%	1.531%	1.952%	Total World
VEU	0.021%	1.881%	0.891%	0.931%	Total World Ex US
CWI	0.025%	0.880%	0.265%	0.390%	Total World Ex US
DNL	0.057%	0.393%	0.186%	0.212%	Total World Ex US
GWL	0.059%	1.055%	0.334%	0.482%	Total World Ex US
ADRD	0.017%	0.222%	0.088%	0.109%	Developed
DOL	0.014%	0.465%	0.941%	0.473%	Developed
DOO	0.006%	0.388%	0.185%	0.193%	Developed
DTH	0.013%	0.507%	0.215%	0.245%	Developed
DWM	0.033%	0.592%	0.235%	0.286%	Developed
EFA	0.049%	0.138%	0.231%	0.139%	Developed
IDV	0.005%	1.213%	0.067%	0.428%	Developed
PIZ	0.008%	1.021%	0.577%	0.535%	Developed
PXF	0.080%	1.274%	0.403%	0.586%	Developed
VEA	0.088%	2.045%	0.511%	0.881%	Developed
ADRE	0.009%	0.337%	0.090%	0.145%	Emerging
DEM	0.087%	0.405%	0.193%	0.228%	Emerging
GMM	0.020%	1.161%	0.542%	0.575%	Emerging
EEM	0.031%	1.580%	0.763%	0.791%	Emerging
BKF	0.032%	1.035%	0.553%	0.540%	Emerging
EEB	0.039%	0.118%	0.105%	0.087%	Emerging
BIK	0.046%	0.205%	0.125%	0.125%	Emerging
VWO	0.064%	1.577%	0.992%	0.878%	Emerging
PXH	0.163%	1.816%	1.213%	1.064%	Emerging
PIE	0.351%	2.429%	1.018%	1.266%	Emerging

$R_{i,t}$ and $R_{j,t}$ are ETF and benchmark returns during month t.

The total tracking error is computed as the average of TE1, TE2, and TE3.

The results shown in Tables 5a and b indicate that U.S. ETFs (with the exception of QQQ) have the lowest TE among all ETFs. The results show that International ETFs have high tracking errors. This result is not surprising as they face restrictions like time delays or exposure to unsafe market environments, which negatively affects their replication ability (Rompotis, 2009). In addition, international ETFs also have higher expenses compared with U.S. ETFs, which also increases their tracking error as there is a positive relationship between expenses and tracking error (Rompotis, 2009).

Table 5b: Shows average of TE1, TE2, and TE3 ranked in ascending order (smaller Average TE is better)

Rank	ETF	Average TE	Category
1	IVV	0.011%	U.S.
2	IWB	0.016%	U.S.
3	IWV	0.017%	U.S.
4	IYY	0.018%	U.S.
5	DIA	0.020%	U.S.
6	TOK	0.070%	Total World
7	EEB	0.087%	Emerging
8	ADRD	0.109%	Developed
9	BIK	0.125%	Emerging
10	EFA	0.139%	Developed
11	ADRE	0.145%	Emerging
12	DOO	0.193%	Developed
13	DEW	0.199%	Total World
14	DNL	0.212%	Total World Ex U.S.
15	DEM	0.228%	Emerging
16	DTH	0.245%	Developed
17	QQQ	0.285%	U.S.
18	DWM	0.286%	Developed
19	CWI	0.390%	Total World Ex U.S.
20	IDV	0.428%	Developed
21	DOL	0.473%	Developed
22	GWL	0.482%	Total World Ex U.S.
23	PIZ	0.535%	Developed
24	BKF	0.540%	Emerging
25	GMM	0.575%	Emerging
26	PXF	0.586%	Developed
27	FGD	0.700%	Total World
28	EEM	0.791%	Emerging
29	VWO	0.878%	Emerging
30	VEA	0.881%	Developed
31	VEU	0.931%	Total World Ex U.S.
32	PXH	1.064%	Emerging
33	LVL	1.217%	Total World
34	PIE	1.266%	Emerging
35	IOO	1.872%	Total World
36	DGT	1.952%	Total World

6. Alpha and beta

We also test to see if the selections of securities within the ETF provide additional value to investors by computing Jensen (1968) α as follows:

$$(R_{ETF,\,t} - R_{f,\,t}) = \alpha_i + \beta_i{*}(R_{Benchmark,\,t} - R_{f,\,t}) + \varepsilon_{i,t} \quad (7)$$

where

$R_{ETF,\,t}$ and $R_{Benchmark,\,t}$ are monthly returns on the ETF and their benchmark index, respectively.

$R_{f,\,t}$ is the three month T-Bill rate.

Table 6 Shows α and β for each ETFs

ETF	α	t	β	t	R^2	Category
QQQ	−0.0001592	[−0.48]	1.002071‡	[184.67]	0.9977	US
DIA	−0.0001197‡	[−9.30]	0.9976226‡	[3193.62]	1.0000	US
IYY	−0.000146‡	[−8.58]	0.9974398‡	[4991.90]	1.0000	US
IWV	−0.0000974‡	[−8.63]	0.9971857‡	[4314.20]	1.0000	US
IWB	−0.0000745‡	[−6.93]	0.9976105‡	[4320.09]	1.0000	US
IVV	−0.0000346‡	[−4.37]	0.9981557‡	[6374.79]	1.0000	US
IOO	0.0029214	[0.96]	0.7275802‡	[3.82]	0.7614	Total World
LVL	0.0009631	[0.54]	0.9929058‡	[46.71]	0.9641	Total World
TOK	0.0002312‡	[3.57]	0.994646‡	[793.91]	0.9999	Total World
FGD	0.0001082	[0.13]	1.01569‡	[72.18]	0.9914	Total World
DEW	−0.0001941	[−0.80]	0.9951681‡	[265.80]	0.9991	Total World
DGT	−0.0028468	[−1.65]	0.8893292‡	[22.22]	0.9377	Total World
VEU	−0.0002154	[−0.20]	1.015923‡	[54.09]	0.9840	Total World Ex US
CWI	−0.0002438	[−0.77]	0.9887347‡	[112.71]	0.9986	Total World Ex US
DNL	−0.0005678†	[−2.44]	1.000929‡	[255.82]	0.9989	Total World Ex US
GWL	−0.0005721	[−1.57]	0.9756828‡	[92.78]	0.9980	Total World Ex US
ADRD	0.0001712	[1.63]	0.9968484‡	[450.81]	0.9998	Developed
DOL	0.0001388	[0.12]	1.00407‡	[49.19]	0.9805	Developed
DOO	0.0000518	[0.24]	0.9933894‡	[255.90]	0.9993	Developed
DTH	−0.0001406	[0.24]	0.9900525‡	[212.84]	0.9990	Developed
DWM	−0.000339	[−1.25]	0.9880473‡	[195.63]	0.9990	Developed
EFA	−0.0004915*	[−1.82]	0.9883476‡	[167.06]	0.9989	Developed
IDV	−0.0000502	[−0.69]	0.9951643‡	[723.20]	0.9999	Developed
PIZ	−0.0000505	[−0.07]	0.9835803‡	[81.64]	0.9945	Developed
PXF	−0.0008098	[−1.62]	1.004927‡	[98.55]	0.9970	Developed
VEA	−0.0008811	[−1.40]	1.005444‡	[78.96]	0.9953	Developed
ADRE	−0.00009	[−0.85]	0.9983069‡	[296.77]	0.9999	Emerging
DEM	−0.0008532‡	[−3.53]	0.9967554‡	[247.09]	0.9992	Emerging
GMM	−0.0001712	[−0.27]	0.976705‡	[84.49]	0.9958	Emerging
EEM	−0.0002985	[−0.32]	0.9801021‡	[62.31]	0.9911	Emerging
BKF	−0.0003249	[−0.47]	0.9981108‡	[96.91]	0.9962	Emerging
EEB	−0.0004049	[−3.58]	0.9941872	[847.60]	0.9999	Emerging
BIK	−0.0004605‡	[−3.19]	0.9951161‡	[487.74]	0.9998	Emerging
VWO	−0.0006467	[−0.53]	1.006852‡	[64.07]	0.9853	Emerging
PXH	−0.001591	[−1.08]	0.9734497‡	[53.92]	0.9776	Emerging
PIE	−0.0035638‡	[−2.80]	1.020725‡	[42.07]	0.9859	Emerging

T-stats are heteroskedasticity consistent.

* Significant at 10%.

† Significant at 5%.

‡ Significant at 1%.

Alpha (α_i) represents the return the ETF can achieve above the return of the benchmark. However, as ETFs are passively managed and fully invested in the benchmark index, they are not expected to outperform the benchmark index and generate positive α. On the other hand, ETFs are expected to have slightly negative αs, as they are going to underperform the benchmark by the amount of expenses they charge.

The beta (β_i) coefficient is the measure of systematic risk. If $\beta > 1$, the ETF moves more aggressively than the benchmark index, whereas if $\beta < 1$, the ETF manager is much more conservative than the benchmark index. If $\beta = 1$, it indicates that ETF is very consistent with the benchmark index movements.

Table 7a: Spearman rank correlation tests and their significance between S&P 500 and other major U.S. indices

Major US indicies	S&P 500	Russell 1000	DJIA	Russell 3000	DJ U.S. Total Market Index	Nasdaq 100
S&P 500	1.0000					
Russell 1000	0.9991‡	1.0000				
DJIA	0.9804‡	0.974‡	1.0000			
Russell 3000	0.9981‡	0.9996‡	0.9715‡	1.0000		
DJ US Total Market Index	0.9987‡	0.9999‡	0.9724‡	0.9998‡	1.0000	
Nasdaq 100	0.9232‡	0.9281‡	0.8691‡	0.9283‡	0.9292‡	1.0000

* Significant at 10%.
† Significant at 5%.
‡ Significant at 1%.

Following Rompotis (2009), β is also a measure of ETFs replication strategy. A β of 1 reflects full replication strategy, whereby the ETF invest all its funds in the benchmark index. On the other hand, β that is significantly different than 1 represents a departure from full replication. In such cases, it is assumed that the manager selected stocks anticipating returns better than the benchmark.

As expected and shown in Table 6, most of the ETFs have very small or insignificantly negative αs. U.S. ETFs slightly underperform their benchmark (α is significant, but the magnitude of annualized α is very small with the range being -0.04% to -0.17%), whereas for international ETFs, α is insignificant in most cases. The α is significantly positive only for one Total World ETF (TOK). Even in this case, the magnitude of outperformance is very small (annualized α of 0.2%).

β is positive and significant (at 1%) in all cases. In most cases, β is very close to 1 ($>= 0.98$), which indicates full replication strategy by the ETF manager. This result clearly indicates that most of these ETFs use passive replication strategies and do not manage for positive α.

7. Diversification

We now measure the diversification benefits (if any) of international ETFs for U.S. investors by first computing the average correlation between S&P 500 and other major U.S. indices from January 2008 through June 2013. The Spearman rank correlation test shown in Table 7a indicates that all major U.S. indices are highly correlated with the S&P 500 index. The results are also statistically significant at 1% in all cases. For example, the correlation between S&P 500 and Russell 3000 (that measures the performance of the largest 3,000 U.S. companies representing approximately 98% of the investable U.S. equity market) is 0.9981 (statistically significant at 1%). Similarly, the significance between S&P 500 and DJ U.S. Total Market Index is 0.9987 (again significant at 1%).

Table 7b: Shows Spearman rank correlation between S&P 500 and international ETFs

Total World	S&P 500	DEW	DGT	IOO	FGD	LVL	TOK
S&P 500	1						
DEW	0.9229‡	1					
DGT	0.9569‡	0.9438‡	1				
IOO	0.9596‡	0.9678‡	0.9867‡	1			
FGD	0.9031‡	0.9636‡	0.9202‡	0.933‡	1		
LVL	0.8937‡	0.9372‡	0.8889‡	0.8998‡	0.9587‡	1	
TOK	0.9779‡	0.9699‡	0.9765‡	0.9851‡	0.942‡	0.9212‡	1

Total World Ex U.S.	S&P 500	CWI	DNL	GWL	VEU
S&P 500	1				
CWI	0.9176‡	1			
DNL	0.7824‡	0.8782‡	1		
GWL	0.9222‡	0.9969‡	0.8827‡	1	
VEU	0.918‡	0.9927‡	0.8711‡	0.9899‡	1

Developed Markets	S&P 500	ADRD	DOL	DOO	DTH	DWM	EFA	IDV	PIZ	PXF	VEA
S&P 500	1										
ADRD	0.9189‡	1									
DOL	0.9044‡	0.9865‡	1								
DOO	0.9077‡	0.9735‡	0.9866‡	1							
DTH	0.9022‡	0.9796‡	0.9947‡	0.9928‡	1						
DWM	0.9071‡	0.9853‡	0.998‡	0.987‡	0.9934‡	1					
EFA	0.915‡	0.986‡	0.9911‡	0.9775‡	0.9823‡	0.9957‡	1				
IDV	0.8969‡	0.9528‡	0.9655‡	0.9754‡	0.9729‡	0.9714‡	0.9658‡	1			
PIZ	0.8714‡	0.9256‡	0.9258‡	0.9023‡	0.9031‡	0.934‡	0.9446‡	0.8982‡	1		
PXF	0.9036‡	0.9788‡	0.9768‡	0.9708‡	0.9754‡	0.9817‡	0.9844‡	0.9651‡	0.9187‡	1	
VEA	0.9181‡	0.9915‡	0.986‡	0.9772‡	0.9784‡	0.9886‡	0.991‡	0.9608‡	0.9338‡	0.978‡	1

Emerging Markets	S&P 500	ADRE	BIK	BKF	DEM	EEB	EEM	GMM	PIE	PXH	VWO
S&P 500	1										
ADRE	0.8459‡	1									
BIK	0.7948‡	0.962‡	1								
BKF	0.8041‡	0.971‡	0.9938‡	1							
DEM	0.8394‡	0.9302‡	0.9259‡	0.933‡	1						
EEB	0.8241‡	0.9911‡	0.9731‡	0.9816‡	0.9257‡	1					
EEM	0.8583‡	0.9767‡	0.9639‡	0.9754‡	0.9665‡	0.968‡	1				
GMM	0.8465‡	0.9735‡	0.9786‡	0.984‡	0.9686‡	0.9718‡	0.992‡	1			
PIE	0.8453‡	0.9321‡	0.8994‡	0.9132‡	0.9204‡	0.9164‡	0.9482‡	0.943‡	1		
PXH	0.8575‡	0.9752‡	0.9568‡	0.9657‡	0.9578‡	0.9649‡	0.9903‡	0.9826‡	0.9362‡	1	
VWO	0.8583‡	0.978‡	0.9628‡	0.973‡	0.9632‡	0.9691‡	0.9945‡	0.9916‡	0.9501‡	0.9897‡	1

* Significant at 10%.

† Significant at 5%.

‡ Significant at 1%.

Secondly, we measure the correlation between S&P 500 and international ETFs over the same period. Our results shown in Table 7b indicate that all international ETFs are highly correlated with the S&P 500 (statistically significant at 1% in all cases). For example, for World Ex U.S. ETFs, the correlation varies from 0.7824 to 0.9222 (statistically significant at 1% in all cases). Even in the case of Emerging Market ETFs, correlation with S&P 500 varies from 0.7948 to 0.8583 (significant at 1% in all cases).[2]

Table 8 The regression of monthly international ETF returns on monthly S&P 500 returns for the entire period (January 2008 through June 2013) following Pennathur et al. (2002)

ETF	α	t	S&P 500	t	R^2	Category
DEW	−0.005464*	[−1.75]	1.143574‡	[17.90]	0.8517	Total World
DGT	−0.0052699†	[−2.61]	0.9948454‡	[26.41]	0.9157	Total World
IOO	−0.0033817*	[−1.68]	1.029334‡	[26.76]	0.9208	Total World
FGD	−0.0027508	[−0.73]	1.224583‡	[14.22]	0.8155	Total World
LVL	−0.005087	[−1.19]	1.275853‡	[10.91]	0.7987	Total World
TOK	−0.0025677	[−1.63]	1.098427‡	[38.61]	0.9563	Total World
CWI	−0.0051134	[−1.54]	1.154643‡	[19.73]	0.8419	Total World Ex US
DNL	−0.0014771	[−0.34]	0.8249698‡	[7.41]	0.6121	Total World Ex US
GWL	−0.0049754	[−1.59]	1.12824‡	[20.96]	0.8504	Total World Ex US
VEU	−0.0051187	[−1.49]	1.207013‡	[20.79]	0.8427	Total World Ex US
ADRD	−0.0059064*	[−1.79]	1.177599‡	[21.48]	0.8444	Developed
DOL	−0.0060609*	[−1.77]	1.10468‡	[20.49]	0.8179	Developed
DOO	−0.0067583*	[−1.85]	1.18415‡	[16.39]	0.8239	Developed
DTH	−0.0063656*	[−1.73]	1.173226‡	[18.85]	0.8140	Developed
DWM	−0.0057644*	[−1.70]	1.111143‡	[20.12]	0.8229	Developed
EFA	−0.0053195	[−1.62]	1.123948‡	[20.20]	0.8373	Developed
IDV	−.0041174	[−0.97]	1.286446‡	[12.96]	0.8045	Developed
PIZ	−0.0040626	[−0.87]	1.208036‡	[12.95]	0.7593	Developed
PXF	−0.0057306	[−1.49]	1.266507‡	[17.28]	0.8165	Developed
VEA	−0.0050758	[−1.54]	1.162653‡	[22.44]	0.8429	Developed
ADRE	−0.0077003	[−1.46]	1.239071‡	[11.31]	0.7155	Emerging
BIK	−0.0069385	[−1.05]	1.282092‡	[9.21]	0.6316	Emerging
BKF	−0.0087125	[−1.29]	1.362032‡	[10.18]	0.6466	Emerging
DEM	−0.0005135	[−0.11]	1.061991‡	[12.12]	0.7046	Emerging
EEB	−0.0085882	[−1.37]	1.359787‡	[10.79]	0.6791	Emerging
EEM	−0.0051737	[−1.01]	1.28185‡	[13.43]	0.7366	Emerging
GMM	−0.0043526	[−0.82]	1.250542‡	[10.95]	0.7166	Emerging
PIE	−0.0066144	[−1.12]	1.343829‡	[9.85]	0.7145	Emerging
PXH	−0.005889	[−1.16]	1.287644‡	[13.18]	0.7353	Emerging
VWO	−0.0051226	[−0.97]	1.31925‡	[12.52]	0.7367	Emerging

T-stats are heteroskedasticity consistent.
* Significant at 10%.
† Significant at 5%.
‡ Significant at 1%.

8. Single factor model

Following Pennathur, Delcoure, and Anderson (2002), we use the following single factor model to estimate the diversification benefits of international ETFs for U.S. investors. They used this model to estimate the diversification of international closed-end country funds relative to the S&P 500.

$$R_{ETF,t} = \alpha_i + \beta_i * R_{S\&P\ 500,\ t} + e_{i,\ t} \quad (8)$$

where

$R_{ETF,t}$ and $R_{S\&P\ 500,t}$ are monthly returns for international ETFs and the S&P 500 index, respectively.

Here we regress monthly international ETF returns on monthly S&P 500 returns. A β close to or higher than 1 would indicate that international ETF return mimics the S&P 500, whereas R^2 provides information on tracking effectiveness of the ETFs.

Our results shown in Table 8 indicate that the coefficient for the S&P 500 is close to or greater than 1 and statistically significant at 1% in all cases. For example, for the four Total World Ex U.S. ETFs, the coefficient for the S&P 500 varies from 0.83 to 1.21 (statistically significant at 1% in all cases). The R^2 is also high and varies from 0.6121 to 0.8504. Similarly, for Total World, Developed, and Emerging Market ETFs, coefficient for the S&P 500 is very close to or much greater than 1 in all cases (results are statistically significant at 1% in all cases). R^2 is also high in all cases that indicate that international ETFs closely track the S&P 500. The results are similar for other major U.S. indices (not reported but available upon request). Pennathur et al. (2002) found similar results for international closed end country funds. These results indicate that international ETFs closely follow U.S. indices and there are not many diversification benefits from investing in international ETFs for U.S. investors.

9. Principal component analysis

We also use Principal Component Analysis (PCA) analysis to compute diversification benefits of international ETFs for U.S. investors. This method groups international ETFs and S&P 500 returns into principal components in terms of similarities in their return movement patterns. If international ETFs and the S&P 500 have high factor loadings in the same principal component, they are highly correlated, and, hence, there is limited diversification benefit international ETFs for U.S. investors. If the S&P 500 has low factor loadings in the same principal loadings (than international ETFs), then there are significant benefits of diversification. Therefore, investors should invest in ETFs that have high factor loadings in different principal components than S&P 500 to get benefits of diversification.

In this method, the correlation matrix of monthly returns for international ETFs and S&P 500 is used as the input for the entire period. The Eigen value reported in Table 9 for only the first common factor is greater than 1 and explains more than 90% of the variation in all cases. Hence, only the first common factor is important and is reported for this analysis (Eigen value 2 and its variation are also shown for comparison purposes. Detailed results are available upon request.) Results again indicate that international ETFs are highly correlated to U.S. markets as the factor loadings of international ETFs for component 1 are very close to factor loadings of the S&P 500 for component 1. These results hold for other U.S. indices too.

10. Risk adjusted performance and CWI of equally weighted portfolios

We form equally weighted portfolios of U.S., Total World, Total World Ex U.S., Developed, and Emerging market ETFs and compute their risk adjusted performance (Sharpe and Sortino ratios) for the entire period. The results from Table 10a indicate that U.S. ETF portfolio has the best performance (both absolute and risk-adjusted performance) for the entire period. Similarly, U.S. ETFs portfolios have the highest cumulative returns and CWI.

Table 9 Eigen values for Component 1 and 2 and the principal factor loadings for component1 for international ETFs and S&P 500

Total World

Entire period	Eigen value	Proportion	Cumulative
Component 1	6.66062	0.9515	0.9515
Component 2	0.187901	0.0268	0.9784
Variable (entire period)			Factor loading Component 1
TOK			0.3844
IOO			0.3821
DEW			0.3805
DGT			0.3788
FGD			0.3756
S&P 500			0.3754
LVL			0.3687

Total World Ex U.S.

Entire period	Eigen value	Proportion	Cumulative
Component 1	4.66593	0.9332	0.9332
Component 2	0.225322	0.0451	0.9783
Variable (entire period)			Factor loading Component 1
GWL			0.4598
CWI			0.4592
VEU			0.4579
S&P 500			0.4354
DNL			0.4224

Developed Markets

Entire period	Eigen value	Proportion	Cumulative
Component 1	10.5741	0.9613	0.9613
Component 2	0.153925	0.014	0.9753
Variable (entire period)			Factor loading Component 1
DWM			0.3064
EFA			0.3061
DOL			0.3057
VEA			0.3053
DTH			0.3045
ADRD			0.3046
DOO			0.3038
PXF			0.3033
IDV			0.3002
PIZ			0.2896
S&P 500			0.2863

(continued on next page)

Table 10b shows the Spearman-rank correlation test between S&P 500 and equally weighted ETF portfolios. Results again indicate that all international ETF portfolios are highly correlated with S&P 500 (all the results are statistically significant at 1%). Results

Table 9 (continued)
Emerging Markets

Entire period	Eigen value	Proportion	Cumulative
Component 1	10.4036	0.9458	0.9458
Component 2	0.284646	0.0259	0.9717

Variable (entire period)	Factor loading Component 1
EEM	0.3084
GMM	0.3084
VWO	0.3083
PXH	0.3067
ADRE	0.3056
BKF	0.3045
EEB	0.3042
BIK	0.3021
DEM	0.2996
PIE	0.2958
S&P 500	0.2711

Because the Eigen value only for Component 1 is greater than 1, only factor loading for Component 1 are reported. If factor loadings for Component 1 are close to each other, there are limited benefits of diversification.

(not reported) are similar when we regress equally weighted portfolio returns on S&P 500 as well as the PCA. These results again indicate that these international ETFs are highly dependent on U.S. indices and there were limited benefits of diversification in these ETFs for U.S. investors during the period of our analysis.

11. Conclusions

Our results indicate that U.S. ETFs outperform international ETFs during the period beginning January 2008 through June 2013. U.S. ETFs have higher average returns and lower risk (standard deviation of returns) than international ETFs. Risk adjusted measures of performances (Sharpe, Sortino, and Treynor ratios) also confirm that U.S. ETFs outperform international ETFs.

Table 10a: Shows equally weighted portfolios of U.S., Total World, Total World Ex U.S., Developed, and Emerging market ETFs and their risk adjusted performance (Sharpe, Sortino and Treynor ratios), cumulative returns, and cumulative wealth index (CWI) the portfolios

Rank	Equally weighted portfolio	Time period (January 2008 through June 2013)	Average monthly return	*SD* of monthly returns	Sharpe ratio	Sortino ratio	Cumulative Returns	Cumulative wealth (initial wealth - $1,000 in January 2008)	Number of ETFs
1	U.S.	66 months	0.53%	5.35%	0.0939	0.1307	29.26%	$1,292.63	6
2	Total World	66 months	0.11%	6.26%	0.0134	0.0182	−5.46%	$ 945.40	6
3	Total World Ex U.S.	66 months	0.08%	6.28%	0.0084	0.0115	−7.36%	$ 926.37	4
4	Emerging	66 months	−0.0036%	7.96%	−0.0042	−0.0057	−19.45%	$ 805.45	10
5	Developed	66 months	−0.005%	6.82%	−0.0051	−0.0068	−14.68%	$ 853.19	10

Table 10b: Shows the Spreaman-rank correlation between equally weighted ETF portfolios and S&P 500 for the period of our study (January 2008-June 2013)

	S&P 500	U.S. ETF portfolio	Total World ETF portfolio	Total World Ex U.S. ETF portfolio	Emerging ETF portfolio	Developed ETF portfolio
S&P 500	1					
U.S. ETF portfolio	0.9968‡	1				
Total World ETF portfolio	0.9408‡	0.9376‡	1			
Total World Ex U.S. ETF portfolio	0.8770‡	0.8791‡	0.9651‡	1		
Developed ETF portfolio	0.8896‡	0.8876‡	0.9790‡	0.9794‡	1	
Emerging ETF portfolio	0.8091‡	0.8183‡	0.8868‡	0.9519‡	0.8999‡	1

* Significant at 10%.
† Significant at 5%.
‡ Significant at 1%.

Jensen's α indicates that most of these ETFs have negative or insignificant αs. These results are expected as these ETFs are passively managed and closely follow their benchmark, but underperform the benchmark by the amount of expenses they charge. Alpha is positive in only one instance (TOK), however, even in cases where ETFs have significantly positive or negative αs, the amount of out or under performance is very small. β is positive and significant (at 1%) in all cases. In most cases, β is very close to 1 ($>= 0.98$), which indicates full replication strategy by the ETF manager. This clearly indicates passive replication instead of active management for positive α.

Diversification benefits of international ETFs-Results indicate that international ETFs are highly correlated with major U.S. indices during the entire period. Spearman rank correlation tests find that all international ETFs are highly correlated with the S&P 500 during the entire period (results are significant at 1%). Results are similar for other major U.S. indices (DJIA, Nasdaq 100, Russell 1000, Russell 3000, and Dow Jones U.S. Total Return index). We find similar results with PCA.

The second model we use (following Pennathur, Delcoure, and Anderson, 2002), where we regress monthly returns of international ETFs against S&P 500 returns indicates that all international ETFs are highly dependent on S&P 500. These results are statistically significant at 1% or 5% in all cases. We find similar results between international ETFs and other major U.S. indices.

In conclusion our results indicate that during the financial crisis and the ensuing recovery, U.S. ETFs provided superior performance relative to international ETFs on both an absolute and risk-adjusted basis. In addition, during this period, international ETFs exhibit high correlation with U.S. markets that eliminates most, if not all, of their global diversification benefits. As such, individual investors should be aware that global diversification using ETFs may not provide them with any benefits especially during times of extreme financial distress.

Notes

1 Over one half of international ETFs were created in 2007 as shown in Table 1a.
2 Results not reported in the article indicate that international ETFs are also very highly (and significantly) correlated with other major U.S. indices over the entire period, and hence there are limited benefits of diversification for the period of our study.

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