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Global equity investing: An efficient frontier approach

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Abstract

The goal of this paper is to test empirically whether emerging-market portfolios appear on the mean-variance efficient frontier, investigate whether particular markets provide better diversification benefits, and to ascertain if these relationships are time-invariant. Countries that are more economically independent from the United States (as measured by relatively low correlations of their stock markets to the United States, or intuitively as being markets whose real and monetary shocks are seemingly independent of the United States) provide better diversification for US investors. Though these relationships are time-dependent, Mexico and China appear to be the most important diversifiers. We also compare the results of a mean-variance framework versus a mean-VaR (value-at-risk) framework that may be more applicable when return distributions are non-normal, for the period May 1988–2018, and find that there are no significant differences.

1 | INTRODUCTION

International portfolio diversification has been increasing in importance among US institutional and private investors since the early 1970s (Solnik & McLeavey, 2009). According to Solnik and McLeavey (2009), 'In 1974, the New York Stock Exchange was the only significant market in the world, representing 60 percent of world market capitalization of less than $1 trillion. The size of the world market multiplied by a factor of 50 in the next 32 years, and the share of U.S. equity moved from 60 percent to less than 30 percent in 1988 and back to 40 percent by the end of 2006'.

Theoretically speaking, international diversification allows investors to reduce the total risk of their portfolios, given a return expectation; or increase their return expectation, given a risk (standard deviation of returns) expectation. This theoretical assertion exists because international stocks are not perfectly correlated. Markowitz (1952), the father of modern portfolio theory, posits that diversification benefits are higher when there is a low correlation among the portfolio's assets. Further studies have extended this research by exploring the positive diversification impact of international securities on a portfolio due to the domestic and international positions' low correlations (Grubel, 1968; Levy & Sarnat, 1970; Solnik, 1974). Naturally, international returns will also need to be adjusted for exchange-rate movements.

As stated in De Fusco, McLeavey, and Runkle (2007), a portfolio is mean-variance efficient if it has the highest level of expected return for a given level of risk. The set of all efficient portfolios is called the efficient frontier.

The benefits from diversifying internationally have been decreasing due to the increasing correlations among stock markets, which may be the result of global capital markets becoming more integrated (Longin & Solnik, 1995). Bekaert, Hodrick, and Zhang (2008) explain that events such as the implementation of the euro and the integration of European Union countries and NAFTA have probably created regionally integrated markets. Other factors such as independence of national economies, fiscal and monetary policies, varying regulatory frameworks, and national factor endowments may cause less than perfect correlations among national economies and stock markets, suggesting that international diversification enhances the domestic efficient frontier.

Emerging market economies, in particular, have become more attractive to investors in the late 1990s when these markets were reformed following events such as the 1997 Asian financial crisis and the 1998 Russian debt crisis. Additionally, these markets may provide better returns for US investors because emerging markets often have a low correlation with the US stock market.

The literature suggests that compared with developed markets, emerging markets exhibit higher volatility than developed markets, with asymmetric return distributions and increasing return correlations in times of crisis, but they also exhibit higher return opportunities because of early growth stages of their economies.

While investing internationally in general, and in emerging markets in particular, may pose additional risks (volatility, liquidity, political risk, foreign-exchange risk) and costs, the general consensus among academics and practitioners is that international diversification pays off. Stated differently, academics have long maintained that international diversification provides an efficient frontier that dominates the domestic-only efficient frontier because domestic returns are not perfectly correlated with international returns. The goal of this paper is to determine empirically which emerging market portfolios will appear on the efficient frontier.

Our tests use indexes built in discrete increments for the time period 1990–2014 to find the efficient frontier. By utilizing indexes, the applicability of these findings extends to individual investors who can easily and at a low cost invest in exchange-traded funds (Jacobs, Müller, & Weber, 2013). The results show that the efficient frontier does benefit from the inclusion of emerging markets, but there is also the need to analyse macroeconomic conditions prior to investment.

We create efficient frontiers with portfolios of specific markets built in discrete increments for the time period 1990–2014 by utilizing seven country indexes. As we would expect, the findings point to a better diversification of benefits from countries which are economically independent from the United States. Both sets of tests are performed multiple times utilizing different time periods to see the impact of timing on the returns. The various time periods include long spans of time, shorter time periods, and before and after the 2000 and 2007 crises. These results, though, are not time-invariant in that investors should keep an eye on macroeconomic developments.

Using historical data, and armed with good computational hardware, software, and skills, we determine the efficient frontier for an array of international investments. Trying to determine the efficient frontier for the future, however, is more of an art than a science and may require economic forecasting skills as well.

1.1 | Economic independence from the United States

Though we introduce this concept intuitively, there may be several ways of measuring it. The simplest way is to state that countries whose stock markets have relatively low correlations to the US market are relatively independent from the United States (we do report these correlations in the body of the text). Intuitively, we can posit that economies are driven by monetary and real shocks. If so, it is more likely that the developed economies of the United States, Europe, and Japan are driven by similar monetary (central banks coordinate) and real shocks, whereas emerging markets may experience uncorrelated idiosyncratic shocks. A further exploration of this interesting topic is beyond the scope of this paper.

1.2 | Quick summary of findings

As our reviewer has pointed out, we have attempted to differentiate international portfolios, including emerging markets, in terms of their roles in the global efficient frontier. As expected, we find that markets more unrelated to the US markets provide better diversification benefits compared to markets more strongly tied to the US markets. Consistent with the literature, we find that US investors can enjoy better diversification by incorporating particular markets into their portfolios; however, this is not a time-invariant pattern. Latin American countries such as Mexico and Brazil provide better diversification than Europe for a US investor, probably because Latin America and the United States' fiscal and monetary policies are relatively independent. In addition, the Hang Seng is also an important diversifier depending on the time period in question. Moreover, we find that the results of a mean-variance versus a mean-VaR (value-at-risk) efficient frontier are not significantly different.

1.3 | This paper is organized as follows

First, we review the literature. Section 3 discusses the data and the empirical method, including the variables that are utilized in the empirical analyses. The empirical method described in section 3 incorporates both a mean-variance efficient frontier approach, and a mean-value-at-risk efficient (VaR) frontier analysis. Section 4 analyses the main empirical results, and section 5 concludes the paper.

2 | LITERATURE REVIEW

By reviewing the existing literature, we find a firm basis in the concept of global diversification, which encompasses many different possible strategies and paths. An in-depth analysis of the estimates of return on equity on cross-border investments since the 1920s is compiled by Jorion and Goetzmann (1996). The authors find that the United States had the highest real return at 4.3%. While investing in the United States may provide investors with the highest real rate of return, the risk of the investment can be reduced though cross-border diversification. As a complement to these findings, Jorion (2003) investigated 30 global markets, including the United States, for the period from 1921 to 1996 and finds

that there is less downside risk from investing in an international stock market index than in one particular market.

Global diversification can also yield good results for individual investors with simple strategies. Jacobs et al. (2013) gauge various diversification strategies for individual investors to counteract their common costly investment mistakes. The authors demonstrate that when individual investors make decisions regarding global equity diversification and asset class allocation, they yield comparable diversification benefits regardless of whether they utilize easy heuristic approaches or more complex portfolio optimization strategies.

The relative importance of country, industry, world market, and currency risk factors for the returns of international equities is studied by Eiling, Gerard, Hillion, and de Roon (2012). The authors find that the main driver of equity returns is currency risk and global industry factors, specifically when they allow volatilities, correlations, and expected return to fluctuate over time.

A history of the world equity market's correlation structure over the past 150 years is compiled by Goetzmann, Li, and Rouwenhorst (2004). They demonstrate that periods of economic and financial integration exhibited high correlations. The authors create two components to reflect the advantages of international diversification. The first component gauges the changes across markets of the average correlation. The second component evaluates the changes in the investment opportunity set. In recent years, investments in emerging markets have been a big factor in the benefits of cross-border diversification. This analysis makes it clear that while there is an upside for international investors in periods of globalization trends, there is also a downside. Additionally, Pukthuanthong and Roll (2009) demonstrate that cross-market correlation is a weak measure of integration, documenting that, though there has been a marked increase in measured integration, this is not indicated by correlations among country indexes.

The types of investments when investing internationally may also impact the benefits of diversification. Huang, Eun, and Lai (2008) show that the benefits from global diversification are reduced for large cap stock market returns due to their tendency to move together because of global factors. Moreover, a more efficient strategy for global diversification is small-cap funds as a result of their low correlation with large-cap funds.

Ackermann, Pohl, and Schmedders (2016) examine mean variance analysis with carry trades. They find that due to the capacity of mean variance analysis to recognize the most beneficial risk return trade-offs, a diversified portfolio, regardless of crash or boom scenarios, will achieve good returns.

Previous literature has also explored the benefits of diversification by investing in frontier markets. Berger, Pukthuanthong, and Yang (2011) find that there are low levels of integration in frontier markets that do not seem to grow over time by implementing principal component analysis. As a result, frontier markets present substantial diversification advantages to investors as opposed to developed and emerging markets. Sukumaran, Gupta, and Jithendranathan (2015) investigate the benefits of investing in frontier markets for investors in developed countries. They find that higher returns can be achieved without incurring a significant increase in risk.

There have been numerous studies which focus on emerging markets. Christoffersen, Errunza, Jacobs, and Jin (2010) utilize weekly returns for emerging and developed markets to study correlation patterns and trends over time during the period 1973–2009. The results show that implementing diversification in emerging markets is still advantageous but the benefits of diversification may have been reduced for developing markets, especially when we begin to integrate tail risk. Furthermore, Caglayan and Ulutas (2014) study emerging market and global macro hedge funds and find that there is a significant positive relation between hedge funds' exposure to emerging market equities and their returns while controlling for typical hedge funds' biases and characteristics. In addition, the literature finds that hedge fund managers monitor market conditions and the state of financial markets by timing

their exposures to emerging markets accordingly (Bali, Brown, & Caglayan, 2011, 2012, 2014; Caglayan & Ulutas, 2014).

In particular, Bali et al. (2014) argue that macroeconomic risk is a powerful determinant of cross-sectional differences in hedge fund returns, while Bali et al. (2011) investigate hedge funds' exposures to various financial and macroeconomic risk factors through alternative measures of factor betas and examine their performance in predicting the cross-sectional variation in hedge fund returns. Moreover, Bali et al. (2012) investigate the extent to which market risk, residual risk, and tail risk explain the cross-sectional dispersion in hedge fund returns. In synchrony with this approach, our paper will explore differences in the efficient frontier using a mean-variance approach versus a mean-VaR approach.

More specifically, past research explores the connection between the United States and Latin America. Conover, Jensen, and Johnson (2012) examine how emerging markets affect the efficient frontier using a cross-country analysis as opposed to a broad market index. In particular, they find there is a low correlation with Latin American markets and the United States. Also, López-Herrera, Santillán-Salgado, and Ortiz (2014) examine the correlation of NAFTA markets and find that while there is increasing integration, there are times when events thwart this integration, such as during crises. In addition, Caporale and Girardi (2016) examine the business cycle impact on the four largest economies and the Latin American bloc. The study finds that Latin America is strongly impacted by external factors.

Bekaert et al. (2008) use base portfolios of country-style and industry to explore international stock return co-movements. The only stock market in which they find evidence of an upward trend in return correlations is Europe. Furthermore, their results show that country factor correlations with returns surpass industry factors in driving returns. The authors find support for the high value of country-specific factors, which further confirms the advantages of diversification utilizing international securities.

Our paper extends this work in an important new dimension regarding the efficient frontier. Given the aforementioned array of previous literature, the objective of this paper is to empirically investigate which emerging market portfolios lie on the efficient frontier. Then, extending the topic further, we explore whether certain markets provide better diversification alternatives, and if such relationships are time-invariant. Researchers and investors will appreciate this empirical method as it is thorough, yet easy to comprehend. In addition, when applying modern portfolio analysis, as defined in the efficient-frontier approach, investors should also incorporate a well-thought-out scenario analysis of future macroeconomic and stock market developments.

Because, equity returns are not normally distributed as we show in Table 1, we extend our work to follow Bali, Demirtas, and Levy (2009), who introduce a theoretical framework in which expected

TABLE 1 Summary statistics with *p* values, investing using country indexes, May 1988–2018

Indexes	Skew	*z*-score	*p*-value	Kurtosis	*z*-score	*p*-value
ASX	−0.73	−5.10	0.000	4.90	4.22	0.000
BOVESPA	−1.39	−8.26	0.000	14.37	8.76	0.000
EUROSTOXX	−0.73	−5.04	0.000	4.55	3.74	0.000
Hang Seng	−0.33	−2.44	0.015	5.45	4.84	0.000
MEX BOL	−1.29	−7.84	0.000	7.97	6.67	0.000
NIKKEI	−0.12	−0.91	0.365	3.95	2.72	0.007
S&P	−0.77	−5.32	0.000	4.82	4.11	0.000

return is a positive function of downside risk proxied by Var. For the period May 1988–2018, we show that our main findings remain intact when standard deviation is replaced by VaR.

As our reviewer points out, 'the mean-VaR efficient frontier is justified during extremely large falls and rises of the market, i.e. when the empirical return distributions exhibit significant departures from normality. It is well known that the empirical distribution of index returns is typically skewed, peaked around the mode and has fat tails, implying that extreme returns occur much more frequently than predicted by the normal distribution. Therefore, the traditional measures of risk (e.g. variance or standard deviation) are not appropriate to approximate maximum likely loss of the market, especially under highly volatile periods'.

3 | METHODOLOGY: DATA AND EMPIRICAL METHOD

3.1 | Data

This paper explores global efficient frontier equity investment strategies, mostly for the period 1990–2014, and its various sub-periods. The data set, reported by Bloomberg, encompasses monthly stock market indexes for seven countries (except Euro Stoxx, which is regional): S&P 500 (United States), SX5E- Euro Stoxx 50 (Euro Zone), ASX (Australia), IBOV (Brazilian Ibovespa), HSI (Hong Kong's Hang Seng), MEX BOL (Mexican Bolsa), and NIKKEI (Japanese Nikkei). The stock market indexes are taken with reinvestment of dividends, where the necessary information is available. All returns are in US dollars. The returns are always annualized and are calculated on a continuously compounded basis. Our sample spans over 24 years from March 1990 to 2014.

We have also extended our analysis to include the May 1988–2018 period, wherein we compare the mean-variance versus the mean-VaR efficient frontiers.

3.2 | Empirical method

We use stock market indexes from seven countries (except Euro Stoxx, which is regional). The experiments consist of building portfolios in 14.29% increments, as there are seven indexes. Calculations are based on monthly, annualized US dollar returns, and on a continuously compounded basis. Depending on data availability, dividends may or may not be included in the analysis. This set of tests is run multiple times using different time periods. Initially, the tests are run using a long-period from 1990 to 2014. Next the same tests are run using shorter time periods such as 1990–2007, 2001–2014, and 2009–2014. This difference in time periods is incorporated to see if the results are time-invariant, and, in particular, to see how the corresponding crises would impact the results. Additionally, the testing time periods incorporate dividend yields and dividend reinvestment where the data are available. As a result of this experiment, we will attempt to answer the question as to which combinations of country stock market indexes are on the efficient frontier.

As described above, we also use data to include the May 1988–2018 period so that we can compare the mean-variance versus the mean-VaR efficient frontiers.

4 | FINDINGS: ANALYSIS OF RESULTS

4.1 | Using seven country indexes, mean-variance efficient frontiers

Our data set is based on the following seven US dollar-adjusted country indexes, which include S&P 500 (United States), SX5E- Euro Stoxx 50 (Euro Zone), ASX (Australia), IBOV (Brazil), HSI (Hong

Kong), MEX BOL (Mexico), and NIKKEI (Japan). The returns are continuously compounded and annualized.

For the sake of completeness, we have analysed the correlations of local currency returns versus the appreciation or depreciation of the local currency. For most markets, as the local currency depreciates, the local stock market declines. Assuming that such a correlation is positive, we observe the following correlations for the period May 1988–2018: Hong Kong (0.11), Mexico (0.37), United States (0.18), Australia (0.38), Brazil (0.66). The exceptions to the above stylized facts are as follows: Euro (−0.06) and Japan (−0.22). We suspect that the above results depend on the nature of the shocks facing each economy. Nonetheless, a full exploration of these relationships is beyond the scope of this paper.

Figure 1 displays the efficient frontier for the seven country indexes including Euro Stoxx for the time period 1990–2014. During this period, the efficient frontier is bounded at the low-risk end by the S&P 500, and at the high-risk end by the Mexican Bolsa and the Brazilian Bovespa. The interim points largely consist of the S&P 500 and the Mexican Bolsa with intermittent appearances of the Brazilian Bovespa, the Australian ASX, and the Hong Kong Hang Seng. This result is in line with academic literature such as Conover et al. (2012), which documents the low correlation between the United States and Latin American markets. We also observe that a portfolio which is equally weighted of all the indexes is quite far from the frontier as are all of the individual index portfolios as expected.

Eurostoxx makes no appearance on the efficient frontier which is logical due to its high correlation, shown in Table 2, with the majority of the indexes. Eurostoxx's absence can also be explained by its low return with a fairly high standard deviation, which is highlighted in the summary statistics in Table 3. The United States is at the low end of the efficient frontier as mentioned above and this can be explained by yielding the fourth highest return while its standard deviation is the lowest in the group. The upper end of the efficient frontier includes the Mexican Bolsa, Brazilian Bovespa, and Hang Seng which all have the top three mean and median returns. With this set of data, all of the country indexes exhibit a negative skew along with positive excess kurtosis.

While the results are not presented in this paper, the efficient frontier is also calculated with a pre-credit crisis mindset by utilizing the time period 1990–2007. We are interested in this period to eliminate any effect the global credit crisis may have had on the efficient frontier. The efficient

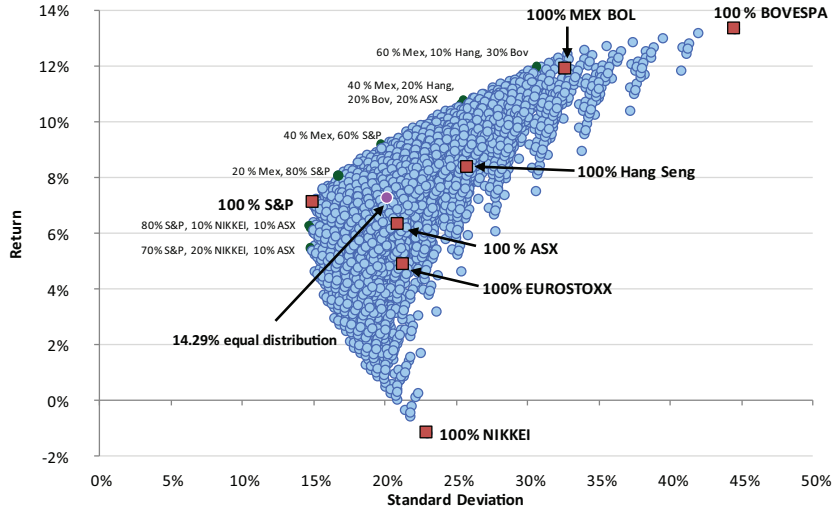

FIGURE 1 Investing using country indexes, March 1990–2014

TABLE 2 Correlation matrix, investing using country indexes, March 1990–2014

Correlation	ASX	BOVESPA	EUROSTOXX	Hang Seng	MEX BOL	NIKKEI	S&P
ASX	1						
BOVESPA	0.49	1					
EUROSTOXX	0.70	0.41	1				
Hang Seng	0.64	0.42	0.61	1			
MEX BOL	0.55	0.47	0.50	0.56	1		
NIKKEI	0.51	0.33	0.48	0.42	0.37	1	
S&P	0.68	0.45	0.78	0.62	0.60	0.48	1

frontier's composition is somewhat similar to the longer period, with strong cameo appearances by the Australian ASX and the Hong Kong Hang Seng. Such cameo appearances should not be surprising given the high correlation of the Australian economy with China's in the pre-crisis period. The appearance of the Australian index on this efficient frontier is explained by its high mean return during this time span.

The next period we analyse is shown in Figure 2 and it displays a crisis to crisis time period between 2001 and 2007. As in Figure 2, this test displays the efficient frontier between the dotcom bubble crisis and the credit crisis. Now the efficient frontier is book-ended by a 100% S&P 500 portfolio at the low end and a 100% Mexican Bolsa portfolio at the high end. Between these two points are portfolios comprised of a mixture of the S&P 500, Mexican Bolsa, Australian ASX, and Japanese Nikkei. Quite far from the efficient frontier is the equally weighted portfolio of Asia, Europe, Japan, Latin America, and the United States.

The Mexican Bolsa, which is at the upper end of the efficient frontier, displays the highest mean and median return for this period in Table 4. The lower end of the efficient frontier notes a US portfolio which is supported by its low return and low standard error. Table 5 displays the correlation matrix for the crisis to crisis time period. The excess kurtosis in this period is positive for all indexes except for Japan. The skewness is negative for all indexes. Looking at the results, we see that barbells on the efficient frontier of the S&P 500 and Mexican Bolsa are explained by the high correlation between the two indexes.

In Table 4, we see that the Mexican Bolsa has the highest mean and median return for this period with dividends incorporated. Once again, we see that the US portfolio maintains the lowest return and

TABLE 3 Summary statistics, investing using country indexes, March 1990–2014

Indexes	Mean	Median	Standard error	Skewness	Kurtosis
ASX	0.0050	0.0079	0.0603	−0.7737	2.0675
BOVESPA	0.0072	0.0149	0.1440	−1.5772	13.5462
EUROSTOXX	0.0043	0.0093	0.0613	−0.8047	1.5221
Hang Seng	0.0070	0.0123	0.0742	−0.3068	2.4783
MEX BOL	0.0100	0.0207	0.0941	−1.3335	4.6865
NIKKEI	−0.0017	0.0018	0.0670	−0.0892	0.7417
S&P	0.0060	0.0110	0.0430	−0.8107	1.7110

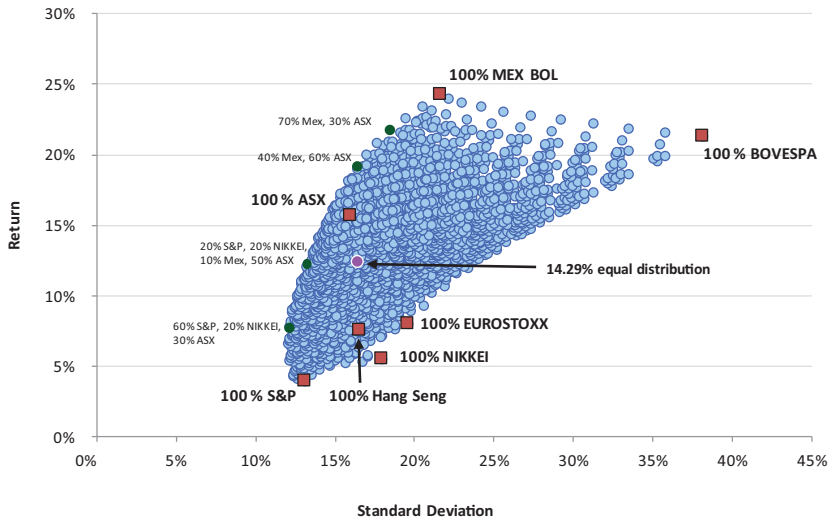

FIGURE 2 Investing using country indexes, crisis to crisis, March 2001–2007

lowest standard error. The skewness and excess kurtosis also mirror the results above with a negative skew for all indexes and positive excess kurtosis for all indexes except Japan.

If the impact of dividend yields and dividend reinvestment, where the information is available, are factored into the efficient frontier during the crisis to crisis period of 2001–2007, the returns are, of course, increased in comparison to Figure 2 with this addition of dividends. Also, the portfolios on the efficient frontier are virtually identical to Figure 6 with the exception of an upward shift in returns as we would expect.

Further tests are run utilizing a medium-term perspective during the period 2001–2014 in Figure 3. This particular period will show the efficient frontier incorporating the impact of the crisis through the recovery period. As we have seen in the crisis to crisis investing efficient frontier, there is a mixture of portfolios containing the Australian ASX, S&P 500, Japanese Nikkei, and Mexican Bolsa. Once again at the high end of the frontier, we have a 100% Mexican Bolsa portfolio but now the low end notes a portfolio of 70% S&P 500 and 30% Japanese Nikkei.

The upper and lower portions of the efficient frontier can, again, be explained by the summary statistics (Table 6). The Mexican Bolsa displays the highest mean and median return while

TABLE 4 Summary statistics, investing using country indexes, crisis to crisis, March 2001–2007

Indexes	Mean	Median	Standard error	Skewness	Kurtosis
ASX	0.0139	0.0203	0.0472	−0.8686	1.4456
BOVESPA	0.0152	0.0216	0.1114	−0.9170	2.1001
EUROSTOXX	0.0046	0.0102	0.0568	−0.7415	2.6936
Hang Seng	0.0040	0.0102	0.0510	−0.6842	0.3643
MEX BOL	0.0196	0.0314	0.0627	−0.8835	0.8959
NIKKEI	0.0040	0.0018	0.0522	−0.0503	−0.8841
S&P	0.0019	0.0075	0.0383	−0.5794	0.9900

TABLE 5 Correlation matrix, investing using country indexes, crisis to crisis, March 2001–2007

Correlation	ASX	BOVESPA	EUROSTOXX	Hang Seng	MEX BOL	NIKKEI	S&P
ASX	1						
BOVESPA	0.70	1					
EUROSTOXX	0.73	0.75	1				
Hang Seng	0.69	0.57	0.67	1			
MEX BOL	0.69	0.65	0.64	0.59	1		
NIKKEI	0.52	0.37	0.42	0.51	0.37	1	
S&P	0.72	0.70	0.88	0.74	0.72	0.44	1

the United States notes the lowest standard deviation. All indexes exhibit a negative skew and positive excess kurtosis. The correlation matrix in Table 7 gives us insight into the appearance of the Japanese index due to its relatively lower correlation.

Dividend yields and reinvestment, when available, are incorporated using this medium-term outlook from 2001 to 2014. Again we can see the efficient frontier yields identical results except for the upward shift in returns. In addition, the United States displays the lowest standard deviation, while the Mexican Bolsa notes the highest mean and median return.

Tests are also run using a post-crisis time period of 2009–2014. These results are similarly book-ended by the S&P 500 and the Brazilian Bovespa but now the order is reversed. The 100% S&P 500 portfolio yields a high return and a low standard deviation while the opposite is true for the Brazilian Bovespa portfolio. Also, the 100% Japanese Nikkei portfolio moves closer to the efficient frontier. In between the two book-ends are a mixture of portfolios with the S&P 500 and Japanese Nikkei.

At the upper end of the efficient frontier there are portfolios with a mix of S&P 500 and the Japanese index. This observation is supported by their mean returns being in the higher end while maintaining the lowest standard errors in Table 8. For the Brazilian index there is a positive skew, while the rest

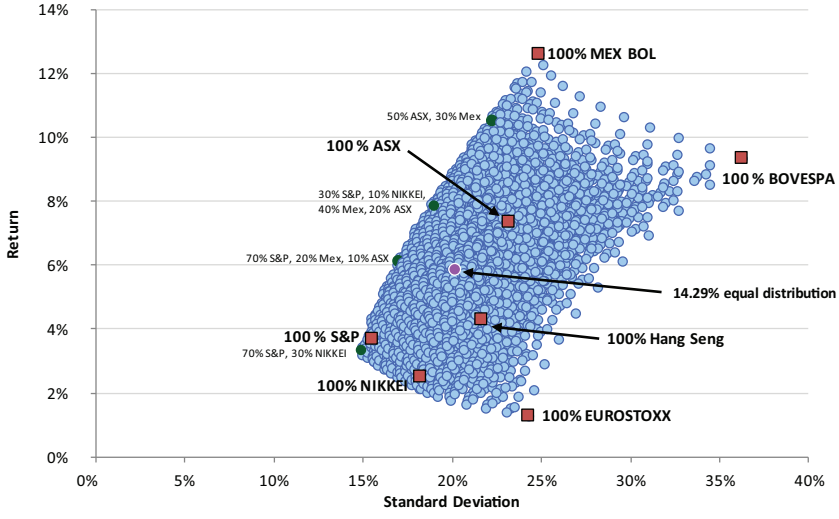

FIGURE 3 Investing using country indexes, post 9/11 and TMT crash, March 2001–2014

TABLE 6 Summary statistics, investing using country indexes, post 9/11 and TMT crash, March 2001–2014

Indexes	Mean	Median	Standard error	Skewness	Kurtosis
ASX	0.0068	0.0185	0.0671	−1.0059	2.4017
BOVESPA	0.0069	0.0097	0.1049	−0.7925	2.0010
EUROSTOXX	0.0006	0.0052	0.0702	−0.7399	1.0214
Hang Seng	0.0026	0.0104	0.0634	−0.6663	1.5740
MEX BOL	0.0102	0.0200	0.0716	−1.1296	3.5941
NIKKEI	0.0017	0.0083	0.0527	−0.5176	0.5424
S&P	0.0026	0.0099	0.0448	−0.8443	1.6679

have a negative skew. Excess kurtosis for the indexes is negative with the exception of Europe. There is also a low correlation between the two indexes, which we see in Table 9.

Additional tests were run for this period incorporating dividend yields and reinvestment onto the efficient frontier and, as before, the results mirror the efficient frontier in Figure 4 but with an upward shift in the curve to reflect greater returns. In addition, Japan and the United States maintain a correlation at the lower end of this index set's spectrum, while both indexes also have the highest mean returns and lowest standard errors.

This analysis results in different conclusions depending on the time periods utilized. Regardless of the period, though, we can see that a US-based portfolio is enhanced with the addition of foreign investments (Grubel, 1968; Levy & Sarnat, 1970; Markowitz, 1952; Solnik, 1974). Like Jacobs et al. (2013), we utilize simple low-cost investment vehicles and indexes to ensure applicability to individual investors.

One interesting conclusion is that the character of the efficient frontier may adjust according to the region's underlying macroeconomic state. During the period tested, there are some underlying macroeconomic occurrences that help us better understand our results. Another interesting point to note is the near absence of Europe on our efficient frontiers. Though European economies are well integrated with the United States, the European problems of the recent several years may explain why Europe is largely non-existent in the efficient frontiers (Goetzmann et al., 2004). By contrast, both Japan and the United States feature largely in the efficient frontiers after the crisis. In particular, we see this with Figure 4; during these post-crisis recovery period tests, both the United States and Japan feature heavily on the efficient frontier. This is probably because the US and Japanese stock markets did relatively well in this period, possibly due to their expansionary monetary policies. Also, in line

TABLE 7 Correlation matrix, investing using country indexes, post 9/11 and TMT crash, March 2001–2014

Correlation	ASX	BOVESPA	EUROSTOXX	Hang Seng	MEX BOL	NIKKEI	S&P
ASX	1						
BOVESPA	0.77	1					
EUROSTOXX	0.81	0.72	1				
Hang Seng	0.78	0.70	0.74	1			
MEX BOL	0.77	0.70	0.73	0.67	1		
NIKKEI	0.64	0.50	0.62	0.61	0.59	1	
S&P	0.79	0.70	0.87	0.73	0.79	0.63	1

TABLE 8 Summary statistics, investing using country indexes, post crisis, March 2009–2014

Indexes	Mean	Median	Standard error	Skewness	Kurtosis
ASX	0.0137	0.0204	0.0708	−0.5592	0.5151
BOVESPA	0.0051	0.0016	0.0830	0.1080	0.0852
EUROSTOXX	0.0090	0.0220	0.0746	−0.4467	−0.5485
Hang Seng	0.0090	0.0150	0.0595	−0.1553	0.7552
MEX BOL	0.0159	0.0179	0.0652	−0.1349	0.7611
NIKKEI	0.0102	0.0142	0.0444	−0.4525	0.1757
S&P	0.0153	0.0206	0.0407	−0.3642	0.0287

with the literature, we see that the Latin American bloc is strongly impacted by external factors (Caporale & Girardi, 2016) when analysing the high returns of both Mexico and Brazil in the crisis-to-crisis testing.

The idea that macroeconomic factors play a part in the composition of the efficient frontier is also consistent with the literature. Hedge funds can earn positive excess returns by timing their exposures to emerging market securities in response to macroeconomic conditions and the state of financial markets so as to generate a strong link between their returns and their exposures to emerging market securities (see Bali et al., 2011, 2012; Caglayan & Ulutas, 2014).

Additionally, our results indicate that the efficient frontier will be impacted by regions that are more independent from the United States. Grubel (1968), Levy and Sarnat (1970), and Solnik (1974) are supported by these results in particular in Figures 1 and 2. Here the efficient frontier is comprised of portfolios with the United States and Japan or United States and Latin American countries, which are the two regions that exhibited the lowest correlation with the United States. Of all the global regions in the world, Latin America is probably the least correlated with the United States, except for Mexico, due to its idiosyncratic macroeconomic and political regimes. This may help to explain the strong appearance of the Latin American indexes along with the US index and the complete absence of other regions on the efficient frontier in both the longer time period in Figure 1 and shorter time period. In fact, all of the tests had strong appearances of the US index and either the Latin American index or Latin America country indexes. This low correlation between the United States and Latin American markets is consistent with the research of Conover et al. (2012).

As we expand the index universe, indexes such as the Mexican Bolsa, the Brazilian Bovespa, the Japanese Nikkei, and the Australian ASX start playing important roles, depending on the period under investigation. This supports Jorion (2003), who posits that by investing in an international stock market index as opposed to one particular market, we can reduce our risk. We can see the appearance of these other indexes in all of the tests utilizing the seven country indexes such as in Figures 1–4. These results are consistent with the academic literature, which finds a significant positive relation between hedge fund returns and their exposure to both emerging market equities and emerging market currencies (see Aggarwal & Jorion, 2010).

Mexico is also a part of our efficient frontiers during some of the time periods tested. The Mexican economy is closely linked to that of the United States, has cleaned up its act after the Tequila crisis of 1994, and enjoys a risk premium.

Australia's index makes some strong appearances along with the Hang Seng (Hong Kong's index). The US and Chinese economies perform very strongly, with the Australian economy benefiting significantly from Chinese growth due to Australia's strong commodity endowment.

TABLE 9 Correlation matrix, investing using country indexes, post crisis, March 2009–2014

Correlation	ASX	BOVESPA	EUROSTOXX	Hang Seng	MEX BOL	NIKKEI	S&P
ASX	1						
BOVESPA	0.87	1					
EUROSTOXX	0.81	0.77	1				
Hang Seng	0.78	0.82	0.75	1			
MEX BOL	0.80	0.82	0.72	0.77	1		
NIKKEI	0.63	0.58	0.64	0.62	0.63	1	
S&P	0.81	0.77	0.85	0.73	0.82	0.67	1

4.2 | Different measures of risk and non-normal returns: Mean-VaR efficient frontiers

Following Bali et al. (2009), we note that investors may prefer evaluating their risks according to a value-at-risk model, particularly when returns may be non-normal, and this raises the question of whether such a consideration would significantly affect optimal portfolio selection. We chose mean value-at-risk at the 5th percentile of returns for each portfolio as our new measure of risk and examine the corresponding efficient frontier.

We explore whether returns for the pure portfolios are normally distributed, and report the results in Table 1. We examine skew (0 for a normal distribution) and kurtosis (3 for a normal distribution). As the sample sizes are small, we use the components of D'Agostino's K-squared test to assess the significance of the statistics. Indeed, as the *p* values indicate, most of the returns are not normally distributed.

Figures 5 and 6 allow us to compare and contrast the efficient frontier with standard deviation as a measure of risk (Figure 5), versus the efficient frontier with VaR as a measure of risk, for the period May 1988–2018.

Switching to a VaR model does not affect the efficient frontier. Indeed, the relative positions of the flat portfolio and the pure portfolios did not change significantly.

Except for Japan, the returns of pure portfolios appear to exhibit significant leftward skew. All have significant excess kurtosis.

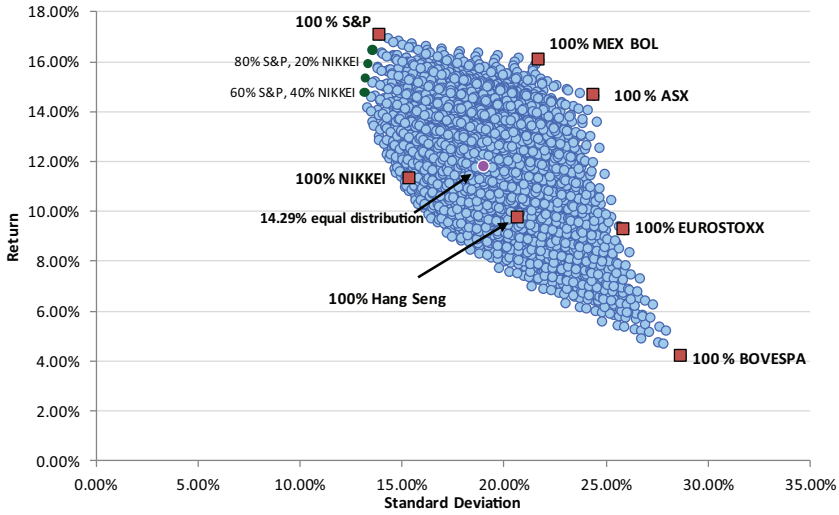

FIGURE 4 Investing using country indexes, post crisis, March 2009–2014

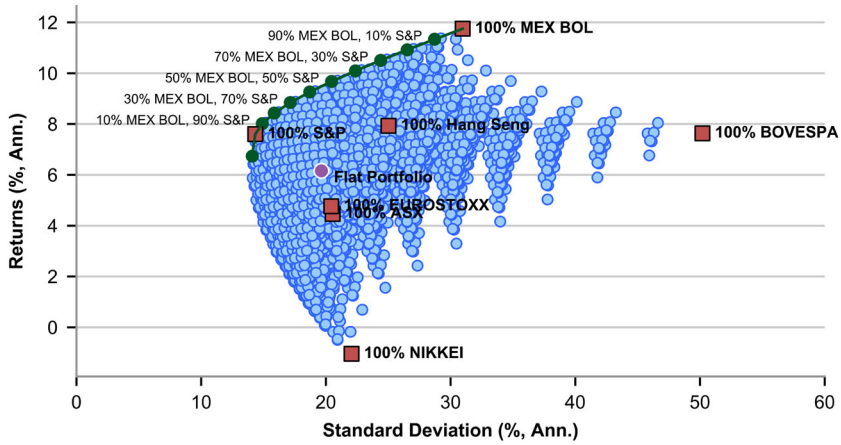

FIGURE 5 Efficient frontier with standard deviation as measure of risk, May 1988–2018

5 | CONCLUSION

Though international portfolio diversification has become increasingly important among US institutional and private investors since the early 1970s, the question remains whether certain markets provide better diversification alternatives than other markets. This paper empirically addresses this question by using up to seven global stock market indexes from all regions of the world and by constructing portfolios that use all combinations of these indexes in discrete increments. By plotting the mean-variance return outcomes, the results then identify the indexes that lie on the efficient frontier.

Consistent with the literature, this research finds that US investors can enjoy better diversification by incorporating particular markets into their portfolios; however, this is not in a time-invariant pattern. As theoretical reasoning suggests, US investors get better diversification from countries that are more economically independent from the United States. Intuitively, we can assume that Latin America would provide better diversification than Europe for a US investor because Latin America and the United States' fiscal and monetary policies are not consistent. We also find that during certain periods the Chinese market also provides better diversification for US investors.

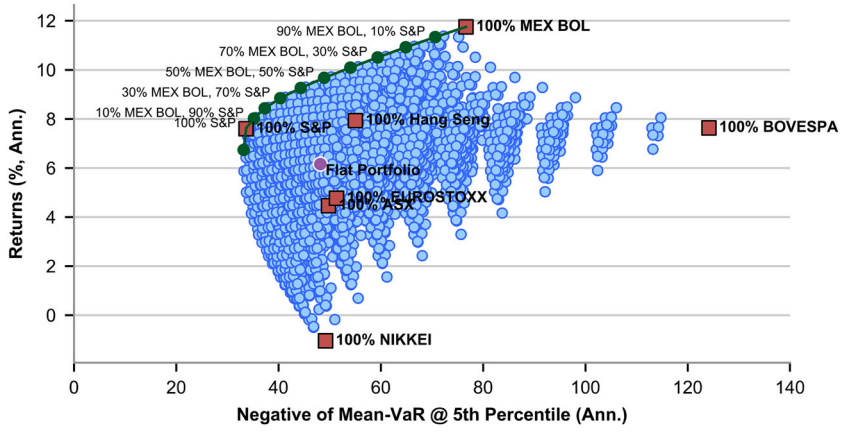

FIGURE 6 Efficient frontier with mean Value-at-Risk as measure of risk, May 1988–2018

Upon further exploration, we find that most of the returns are not normally distributed. As such, we compare the results of a mean-variance efficient frontier versus the results of a mean-VaR efficient frontier, for the period May 1998–2018. However, we do not find that the mean-VaR efficient frontier dominates the mean-variance efficient frontier for the above cited period. Though this conclusion may change for particularly distressful periods, we leave such a study for further exploration.

Researchers and investors would find this paper's approach useful as the empirical method is rigorous, yet easy to understand. When planning forward, investors may want to marry modern portfolio analysis as embodied in the efficient-frontier approach, with careful scenario analysis of future macroeconomic and stock market developments.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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