DIVERSIFICATION EFFECTS OF U.S. BONDS AND GLOBAL EQUITIES

by

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Abstract

The purpose of this paper is to study and compare the diversification effects of the investment in the foreign equity market and the U.S. bond market during the U.S. expansion and recession periods. The concept and test methodology are based on the CJJ paper, but expands to a broader area which covers fixed income, further supported with portfolio optimization test. This paper can provide U.S. investors with insights on the ways to diversify their equity portfolio, especially during the U.S. stock market recession periods.

Results show that both foreign equities and the U.S. bonds can diversify U.S. equity assets. However, the effect of diversification of the foreign equity market experienced a decrease and is also lower than that of the U.S. fixed-income assets. This result also rationalizes the investing behaviour of "flight to quality".

Keywords: diversification benefits, U.S. Treasury notes; U.S. and global equity market; expansive and restrictive monetary policy; economic cycle; asset allocation; flight to quality

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1: Introduction

As non-systematic risk can be eliminated through a sufficiently diversified portfolio, investments outside the domestic market is considered to lower the systematic risk during economic recessions and financial crises. The previous works of literature generally focus on the diversification benefits of the global equity market, especially with the expanding emerging market. This paper further supports the perspective that U.S. investors can invest in the foreign equity markets as a tool to diversify the U.S. equity holdings to combat domestic market recessions, even the currency exchange rate fluctuations might intensify the volatility of international investments.

However, besides the currency exchange rate instability, the impact of globalization also raises concerns on the diversification capacity of global equity, regarding the increasing correlations among the economies of different countries. This concern promotes to explore an investment instrument that maintains low volatility, as well as low or even negative correlation with the U.S. equity market during the U.S recession periods. This diverts the attention to investigate the diversification effect of the domestic fixed-income assets for U.S. investors. The investment behavior of moving from the riskier stock market to the less risky assets such as bonds and gold is recognized as “flight to quality”, which is generally considered to be driven by the increasing fear for risk during the market recessions. The increase of demand in “safe assets” drives up the price and thus lowers the return. Moreover, the expansive monetary policy also raises concerns over the interest rate returns during economic recessions. This paper will study the performances of the bond market during the expansions and recessions will generate insights whether the investment in fixed income during the U.S. stock market recessions can create diversification benefits or is caused merely by fear for risk.

2: Literature Review

2.1 Relationship between Monetary Conditions and the Global Stock Returns

Many investors have believed that the government monetary policy can have a significant influence on the financial market. Rozeff (1975) suggested that stock returns not only reflect the just published money supply data but also anticipate future monetary growth. Jensen, Mercer, and Johnson (1996) further studied the impact of monetary policy on the drivers of U.S. stock and bond returns, and observed that the stocks and bond returns were extremely higher in the expansive monetary policy periods than in the restrictive monetary periods. Based on these previous findings, Conover, Jensen, and Johnson (CJJ,1996) processed research to examine the impact of monetary policy on international investments. Since stock returns tend to be lower during the U.S. restrictive monetary periods, this study discusses whether investing in international equities can lead to diversification benefits to the U.S. investors during U.S. restrictive monetary periods.

2.2 International Diversification Benefits

The international investment is generally considered as a tool to achieve diversification benefits, which allows investors to gain the same rate of return at a lower risk level, against the systematic risk of the U.S. stock market. Studies are done to investigate the diversification capacity of international investments. Sinquefield (1996) concludes that international equity does not have higher expected returns nor substantially diversify U.S. portfolios, based on both empirical evidence from 1970 to 1994 and the asset pricing theory regarding the same risk factors applied to the U.S. and

international market. CJJ (1996) disagrees with Sinquefield's conclusion and suggested that U.S. investors can obtain diversification benefits by investing globally both in the past and in the recent. U.S. investors should analyze and forecast the international monetary policy besides the U.S. monetary policy for better diversification benefits through international investments.

In their study, CJJ first collected stock indices monthly returns of 16 countries from January 1956 to December 1995 (total of 480 months). All of these countries selected are developed countries with matured equity market, including Austria, Belgium, Canada, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, South Africa, Sweden, Switzerland, the U.K., and the U.S. By comparing the volatilities (standard deviations) and mean monthly returns after currency exchange rates adjustments, CJJ (1996) observed that among the 16 countries, the ones with the highest mean monthly returns do not necessarily show the highest volatilities. CJJ also conducted unequal variance t-test on the correlations between the foreign equity returns with domestic expansive and restrictive monetary periods, as well as the correlations between the foreign equity returns with the U.S expansive and restrictive monetary periods respectively. The test results suggest that the stock returns of most foreign markets are significantly related to the domestic and U.S. monetary environments, where the highest returns can be generated when the local and U.S. market are both under expansive monetary environments. CJJ also compared the returns and volatilities between five portfolios under different foreign local and U.S. monetary environments. The results further supported the findings from the correlation test and indicate that diversification benefits can be achieved through international investments.

However, there are limitations to the diversification effects of international investments. Based on CJJ (1996), not all foreign countries are favourable, since the higher risks do not necessarily lead to higher returns. Moreover, the globalization trend has enhanced the correlation between the U.S. and global markets, which leads to a higher probability that both markets are in restrictive environments. Therefore, the international diversification benefits might be even lower during the periods when the return of the U.S. market is low.

2.3 Bond Market Diversification Benefits

Besides international investments, the bond market should also be considered for its diversification capacity against the U.S. equity market. Marsh and Pfleiderer (2013) studied the effectiveness of tactical asset allocation of U.S. equities, developed-market equities, emerging market equities, bonds, and cash in the 2008 financial crisis. They tested the optimal portfolio allocation under different levels of risk tolerance, by assuming a 40% loss on the value of equities and 10% loss on the value bonds. The paper concludes that the portfolio allocation in response to the financial crisis depends on individual investor's risk tolerance level relative to the social average, and the market equilibrium of assets as a result of "flee to quality". It observed that investors with risk tolerance levels higher than the social average generally increase their holdings of risky assets, and the ones with risk tolerance lower than the average increase holdings of safe assets, which rebalances the market. Another key observation of Marsh and Pfleiderer is that it is only appropriate for the extremely risk-averse or risk-tolerant investors to substantially change their asset allocations (less than 4% appropriate adjustment turnover

for 80% investors). These findings indicate that shifting portfolio allocation to the U.S. bond market does not generate diversification benefits to most of the U.S. investors.

There are a few limitations to Marsh and Pfleiderer's study. Firstly, the study period only covers the 2008 financial crisis (2007-2009), so the findings from the limited observations cannot be applied to other cases. Additionally, this study only considers the impact of market rebalance and relative risk tolerance of individual investors. Other subgroup motivations for adjustments, such as liquidity and tax benefits are not considered.

3: Data Collection

3.1 Research Period

The entire research period ranges from January 1995 to December 2018, covering the 24 years (288 months) after the CJJ research, which provides 288 value observations, and thus 287 return observations for each asset respectively. It also covers the periods of the 2008 financial crisis, which is studied by Marsh and Pfleiderer. This time period is chosen with the purpose to firstly test whether the conclusion about the international diversification effect from the CJJ study still applies to the current capital market; secondly, identify whether globalization diminishes the international diversification effect compared to the remote periods, and thus makes fixed income a more favorable asset for diversification.

The entire research period is separated into five sub-periods based on the economic cycle of the U.S. equity market, including three expansion periods and two recession periods, as shown in *Figure 2.1*. In total, there are 238 observations for the expansion periods and 49 observations for the recession periods. Dividing the periods into expansion and recession categories allows the comparison between the periods within and cross categories for the diversification benefits at different economic stages. In the CJJ study, periods are categorized based on expansive and restrictive U.S. monetary environments, but in this study, the sub-periods are determined by both the historical events and the S&P 500 index (SPX) return performance to better adapt the objective of this study. The periods with generally positive U.S. equity returns are recognized under expansion, the ones with generally negative U.S. equity returns are recognized under recession.

Period 1: the first expansion period (E1) starts from January 1995 to August 2000, which covers 68 months and 67 observations for each asset. During this period, the SPX increased by 223% from 470 to 1,518 in total.

Periods 2: the first recession period (R1) starts from September 1995 to March 2003, which covers 31 months and observations for each asset. During this period, the SPX decreased by 41% from 1,437 to 848. The corresponding event is the dot-com bubble crash, and an expansionary monetary policy is implemented to combat the recession.

Periods 3: the second expansion period (E2) starts from April 2003 to September 2007, which covers 54 months and observations for each asset. During this period, the SPX increased by 67% from 916 to 1,527, and the monetary policy is restrictive.

Periods 4: the second recession period (R2) starts from October 2007 to March 2009, which covers 18 months and observations for each asset. During this period, the SPX reduced by 49% from 1,549 to 798. This recession starts with the 2008 subprime-mortgage crisis, since when the U.S. Fed implemented the quantitative easing monetary policy, which substantially drove down the interest rates. This is also the period that Marsh and Pfleiderer focused on.

Periods 5: the third recession period (E3) starts from April 2009 to December 2018, which covers 117 months and observations for each asset. During this period, the SPX grew by 187% from 873 to 2,507, but the Fed kept expansionary monetary policy by maintaining consistently low interest rates until 2017.

3.2 Portfolio Construction

The comprehensive portfolio contains three types of assets: U.S. equities, global equities, and U.S. bonds. In order to smooth out the impact of company-specific risks, the portfolio for this study is assumed to be an efficient portfolio with a passive investment strategy, which means the equities are fully diversified in the U.S. and global markets respectively. Therefore, stock market indices are used for the test instead of individual stocks.

SPX is used to represent the performance of the U.S. equity market performance. SPX is weighted by float-adjusted market capitalization, containing 500 companies from the large-cap segment with sector balance (S&P Dow Jones Indices 2019). This index is generally used as a proxy of the U.S. market equities, and thus also used in this study. A natural logarithm is taken between the months for continuously compounding monthly returns.

For the global equity market, a global market index is created in this study based on the 15 foreign countries (besides the U.S.) which are also used in the CJJ paper, as shown in *Table 3.1*. For each country, the most representative index is used as a proxy of the market performance. Since the historical values of the indices in Ireland, Italy, New Zealand, and South Africa are not sufficient for the entire study period, the total share prices (standardized at index 2015 = 1000) are used for these markets. Currency exchange rates fluctuate significantly at different stages of economic cycles. Especially during the recession periods, they are impacted by the change of interest rates according to monetary policy adjustments. Therefore, it necessary to consider the exchange rate impact on the returns of foreign investments. For the foreign equity markets that are not

trading at U.S. dollars, the month-end index values are individually adjusted by the currency exchange rates of the corresponding countries and periods, and continuously compounding monthly returns are taken by applying natural logarithm. The returns from the 15 countries are equally-weighted to compose the global index.

2-year and 10-year U.S. Treasury notes are considered for the bond assets of the portfolio. It is assumed that bonds are held till maturity, and the returns are determined by constant maturity rates only. The maturity rates of bonds are also adjusted to continuously compounding monthly returns. Backed by the U.S. government, Treasury bonds have the lowest credit risk, which exempts company-specific risks. Shown in *Figure3.3*, the return of 2-year Treasury note fluctuates more dramatically than the 10-year one, since the U.S. Federal Reserve generally adjust the 2-year rates as a monetary policy tool to combat recessions. The 10-year Treasury rate remains relatively stable at a higher level, which usually reflects the investor confidence level, and the spread between the 2-year and 10-year yields can be an indicator of the economic outlook. The two bonds are compared with the foreign equity market individually as well as compositely to smooth out the monetary policy and investor confidence impact.

4: Methodology

This test for diversification benefits contains two steps. The first step compares the returns, volatilities, and correlations of the foreign equity market, 2-year, and 10-year U.S. Treasury notes with the U.S. market, to identify whether fixed-income and international investments can create diversification benefits. The second step compares the optimal asset allocation and maximum utilities for portfolios with different asset composites. This can indicate to what extent diversification benefits can be generated by fixed income assets under different periods and risk aversion levels.

4.1 Correlation Test

The comparison of returns and volatilities between different foreign markets show that the higher risks do not necessarily lead to higher returns. Therefore, in order to understand whether the performances of the global equity market, 2-year, and 10-year U.S. Treasury notes have statistical relationships with the performance of the U.S. stock market, unequal variance t-test, which is also known as Aspin-Welch test (Welch,1938), is conducted by applying the formulas below:

Unequal variance t-test:

$$T - value = \frac{mean1 - mean2}{\sqrt{\frac{var1^2}{n1} + \frac{var2^2}{n2}}}$$

And,

$$Degree\ of\ Freedon = \frac{\left(\frac{var1^2}{n1} + \frac{var2^2}{n2}\right)^2}{\frac{\left(\frac{var1^2}{n1}\right)^2}{n1-1} + \frac{\left(\frac{var2^2}{n2}\right)^2}{n2-1}}$$

where:

mean1 (mean 2) = monthly mean return in the expansion (recession) period of each sample set

var1(var2) = variance in the expansion (recession) period of each sample set

*n*1 and *n*2 = Number of observations in the expansion (recession) period of each sample set

If the absolute value of t-stats is larger than the t-critical value, the null hypothesis that there is no difference between the returns of expansion and recession periods can be rejected. Therefore, it is reasonable to conclude that the returns of assets do have a statistic relationship with U.S. monetary environments.

4.2 Portfolio Optimization Test

For the second step, portfolio optimizations are processed through the MatLab portfolio function, to compare the optimized asset allocations under different composites and risk aversion levels. The portfolio is long-only, and the optimized portfolio is defined by the maximum utility under CAPM assumptions.

The utility is calculated as shown below:

$$u = r - An \times \sigma^2$$

Where:

r = continuously compounding monthly return

An = risk aversion level (range from 1 to 6)

σ = standard deviation

Four portfolio combinations are considered for each time period, and each combination is optimized under three risk aversion levels, which in total generates 60 optimized asset allocation results. The four portfolio combinations include one control group which is a two-asset portfolio with the U.S. and foreign equities only, two three-asset portfolios with additional 2-year and 10-year Treasury notes respectively besides the equity portion, and one inclusive four-asset portfolio. The optimal allocation results of the three-asset and four-asset portfolios are compared to the control group to test the impact of adding bonds into the portfolio on the optimized asset allocation and maximized utilities. Three levels of risk aversion are considered for each portfolio, including An = 1, 3, and 6. Risk aversion of 1 represents the highest level of risk tolerance, and 6 represents the lowest level of risk tolerance.

5: Findings from Test Results

5.1 Findings from Correlation Test

As shown in Table 5.1, the observation samples show different levels of diversification benefits with respect to stock market performance. The mean monthly returns of Germany, Finland, Canada, and Switzerland are the highest (0.41%~0.58%), while Japan, Italy, and Sweden have the lowest mean monthly returns (0.10%~0.19%). The standard deviations are highest for Finland, Germany, and South Africa (0.0658~0.0692), and lowest for Switzerland, the United Kingdom, and Canada (0.0283~0.0252). The Canadian market can provide the largest diversification benefit among the global markets with the highest level of return and lowest volatility. However, some foreign markets, for example South Africa and Sweden, can lead to negative diversification benefits with higher volatility and lower return compared with the U.S. stock market.

According to *Table 5.2*, the U.S. stock index, global index, and 2-year U.S. Treasury notes have higher returns in the U.S. expansion periods than in U.S. recession periods. However, the 10-year U.S. Treasury note shows an opposite result, for which the returns are slightly higher during the recession periods (0.36%) than during the expansion periods (0.33%).

In U.S. expansion periods, investors can observe positive economic data. They will invest more money into the equity market than the fixed income market. Hence, in the expansion periods, the returns of securities and bonds will be higher compare with returns in the recession periods.

The t-test results show that the global index is significant at both 1% and 5% significance level, 10-year U.S. Treasury note is only statistically significant at 5% level, and the 2-year Treasury note is neither significant at 1% nor 5% level. This result leads to a rejection of the null hypothesis that there is no difference between the means. The returns of the global equity and 10-year U.S. Treasury note have statistically significant relationships with the U.S. equity market. The statistical insignificance of the 2-year Treasury note with the U.S. equity can be partially interpreted by the forward-looking approach that the Federal Reserve implements in order to compensate for the time lag of the impact that monetary policy can make to the economy (Federal Reserve 2018).

According to *Table 5.3*, the global market index shows a higher correlation with the US market during U.S. recession periods than during expansion periods. The average correlation of the two recession periods is 0.907, and the average correlation of the three expansion periods is 0.786. The correlation also increases from the first to the second recession periods, as well as the second to the third expansion periods respectively. At the same economic stage, the chronologically upward trend of the correlation is an unfavourable signal for the effectiveness of diversification that the global market can make, especially during the U.S. recession periods.

The 2-year Treasury note shows a slightly negative correlation for expansion periods and the first recession period, but a positive correlation for the second recession period. The negative correlation for most of the periods suggests that the 2-year Treasury note has a better diversification effect than the foreign equity market. However, the statistically insignificant feature of 2-year Treasury note with the U.S. equity market weakens the soundness of this finding.

As being statistically significant at 5% significance level, the 10-year Treasury note shows positive correlations with the U.S equity market for the periods R1and E3, and negative correlations for the rest of periods. The 10-year Treasury note also has correlations closer to 0 than both the global equity and 2-year Treasury note (except for comparing with 2-year Treasury note in the period E2). The closer-to-zero correlation with the U.S. equity market allows 10-year Treasury note to diversify the U.S. equity investments more effectively than the foreign equities in both expansion and recession periods.

5.2 Findings from Portfolio Optimization Test

5.2.1 Control Group

Comparing the results of the two-asset portfolio within different time periods in *Table 5.4*, it shows that the weights are fully allocated to the U.S. equity market for all risk aversion levels except for the periods R1 and E2, as the SPX index generates higher returns at lower volatilities than the global index. This result indicates that the global investment can be a diversification tool to the U.S. equity market for the periods R1 and E3, but not for R2 and the other expansion periods. The reduced weight allocated to the foreign market from period R1 to R2 aligns with the concept that the foreign equity market is experiencing diminishing diversification benefits to the U.S. market, and this is probably a result of globalization.

5.2.2 Control Group vs. Three-Asset Portfolios:

According to *Table 5.5* and *Table 5.6*, in the three-asset portfolios, the 2-year and 10-year Treasury notes play their roles to optimize portfolios during the expansion periods only when the risk aversion level is high enough, due to their lower return levels compared with the equity market. While the weights shift from the equity to bond assets, the maximum utility increases at the same risk aversion level. For example, the maximum utility for the two-asset portfolio is 0.006 in the period E1 with a risk aversion level of 6, which increases to 0.008 by including the 2-year treasury note, and to 0.0081 by including the 5-year treasury note for the same period and same risk aversion. For the period E3, the increase in maximum utility is even more significant, which more than doubled from 0.0012 in the two-assets portfolio to 0.0029 by including the 2-year treasury bond, and tripled to 0.0036 by including the 10-year treasury bond. This concludes that bonds can generate diversification benefits with higher maximum utilities during the expansion periods for highly risk aversive investors.

For both recession periods, the optimized three-asset portfolios are fully allocated to the bond assets. In addition, the control group shows negative maximum utilities from -0.0253 to -0.0208 for the period R1, and from -0.0639 to -0.0425 for the period R2 due to the negative returns of the equity markets (utility decreases as risk aversion increases). The maximum utility increased significantly for corresponding periods in both three-assets portfolios, which reaches 0.0027 (with 2-year Treasury note) and 0.004 (with 10-year treasury note) for R1, and 0.0016(with 2-year Treasury note) and 0.003 for R2 (with 10-year treasury note). The allocation shifting from the equity market to the bond market with increased maximum utility indicates that bonds are creating better diversification benefits than the global equity market during the recession. This conclusion also

rationalizes the behavior of "flight to quality" during the recessions with economic reasons.

5.2.3 Control Group vs. Four-Asset Portfolio:

The optimized allocations shift the weights fully to the 10-year Treasury bond for both recession periods as shown in *Table 5.7*, as well as the first and third expansion periods under high risk aversion levels. This leads to the results of asset allocation and maximum utilities in the four-assets portfolio the roughly same as those in the three-asset portfolio with the 10-year bond, which suggests that the 10-year Treasury note provides better diversification benefits than the 2-year Treasury note does. This result also aligns with the findings by comparing the two three-asset portfolios: as asset weights shift to the bond market, the portfolio with a 10-year Treasury note generates higher maximum utilities than the one with a 2-year Treasury note, holding other factors constant.

This finding can be interpreted by the higher return and lower volatility of the 10-year Treasury note compared to the 2-year one, as shown in *Figure 3.3*. The bonds with longer maturity generally have higher yields to compensate for the time-associated credit risk, which leads to an upward trending term structure for economic expansionary periods. As the equity market lags the bond market, the 2-10 spread is greater during the first half of the expansion periods and shrinks when approaching recessions.

As a monetary policy tool, 2-year Treasury note rates fluctuate more dramatically than 10-year note rates, especially during the period from 2000 to 2009. Overall, the 2-year Treasury note may have higher interest rates at the late expansion periods, where the inverse term structure indicates an economic recession, but the impact of monetary policy

and normally higher yields of long-term bonds make the 10-year Treasury note a more effective diversification instrument for both expansion and recession periods.

6: Conclusion

6.1 Diversification Effects of Bonds and International Investments

Both the correlation and portfolio optimization tests support the conclusion that from 1995 to 2018, the foreign equity market had weakening diversification effect to the U.S. equity market during the recession periods, and the U.S. bonds display better diversification benefits than global equities, even with the impact of the U.S. monetary policy.

According to the correlation test, in the U.S. expansive periods, it is favorable for U.S. investors to invest in global equities to diversify their portfolios. The diversification benefit will allow them to gain the same level returns with significantly lower volatilities compared with their original portfolios, which agrees with the CJJ's conclusion. In terms of fixed-income assets, the 10-year Treasury note allows investors to gain higher diversification benefits during the U.S. recession periods due to its higher rates of return and similar to slightly lower level of correlation compared with the 2-year Treasury note.

According to the portfolio optimization test, the optimized asset weights move from the equity market to the bonds during recession periods for all three levels of risk aversion, and higher maximum utilities can be reached by the portfolios with bond assets. This concludes that the investment in the bond market allows investors to achieve more diversification benefits than investment in foreign equity markets. At each constant level of the risk aversion, the significantly larger weight allocated to the bond market than to the equity market also rationalizes the behavior of "flight to quality". This result disagrees with the Marsh and Pfleiderer's conclusion reached that it is only appropriate for the extremely risk-averse or risk tolerant investors to significantly change their asset

allocations during the financial crisis. It suggests that investors within an extensive risk aversion range can generate higher utilities and thus diversification benefits through heavily investing in bonds. However, during expansion periods, it is concluded that only highly risk-averse investors will find it appropriate to shift their asset allocations to the bond market.

Additionally, as a result of the impact of U.S. monetary policy, the 2-year Treasury note shows higher volatility and the interest rates are cut down more dramatically than the 10-year Treasury note, especially during the recession periods. The 2-year Treasury note is more favorable for diversification compared with the global equity market and generates less diversification benefit compared with the 10-year Treasury note.

Recommendations on trading strategies can be provided to the U.S. domestic equity investors based on the study results. Without considering other motivations such as tax benefit or liquidity requirements, during the market expansion time, risk-seeking and risk-neutral investors are recommended to hold portfolios heavily allocated to equities, as long as the equity holdings are sufficiently diversified, due to the significantly higher return of equity market than that of the bond market. Highly risk-averse investors are suggested to hold a portion of U.S. sovereign bonds (generally around 50%), which allows them to achieve higher maximized economic utilities than fully investing in equities. For the recession periods, investors with different risk tolerance levels are all suggested to substantially adjust their portfolio allocations to U.S. treasury bonds to maintain positive returns and maximized utilities. Regardless of liquidity needs, sovereign bonds with longer maturities (eg. 10-year Treasury note) are more favorable

than the shorter-term ones (eg. 2-year Treasury note) to all the investors in both expansion and recession periods.

6.2 Methodology Evaluation

The effect and accuracy of this study are evaluated, and the following drawbacks should be considered.

Firstly, this study does not cover the time period in the CJJ paper, and only tests on the period after 1995. Although the focus on a more recent time period makes the findings more updated and applicable to the current capital market, this leads to a lack of comparison between the periods of 1965-1995 and 1995-2019. Thus, the findings of the bond market might not be applicable to the period in the CJJ paper, and the insight on the trend of diversification effect for a longer period of time cannot be reached either.

Secondly, regarding the distribution of sub-periods, more than 80% of the observations are categorized into the expansion periods, and only less than 20% is for the recession periods. The great difference in the number of observations between the two sub-periods might lead to biases in the test results. Additionally, there are only two recession periods during the entire time period tested for this study. The lack of sample recession periods weakens the solidity of the results reached.

Thirdly, this study only compares the diversification benefits of two types of assets, which cannot provide any implication whether the diminished diversification effect of the foreign equity market is caused by globalization or other non-systematic random factors. Therefore, it cannot be determined whether the trend will continue, nor whether the same strategy will apply for the future.

Lastly, due to the nature of fixed income, the 10-year and 2-year Treasury notes show significantly low returns and volatilities compared with the equity assets. The impact of adding bonds into the portfolio is limited in the portfolio optimization test, since this test is based on mean-variance analysis which takes only the return and volatility into consideration. The portfolio optimization methodology is not sufficiently effective.

Appendix

Appendix A: Figures and tables mentioned in the paper

Appendix B: Returns and VCV matrices used to support the portfolio optimization test

Appendix A

This appendix contains the tables and figures mentioned in the paper.

Figure 3.1 Research Period

This figure categorizes the research period into expansion and recession periods according to the performance of the U.S. stock market from 1995 to 2018

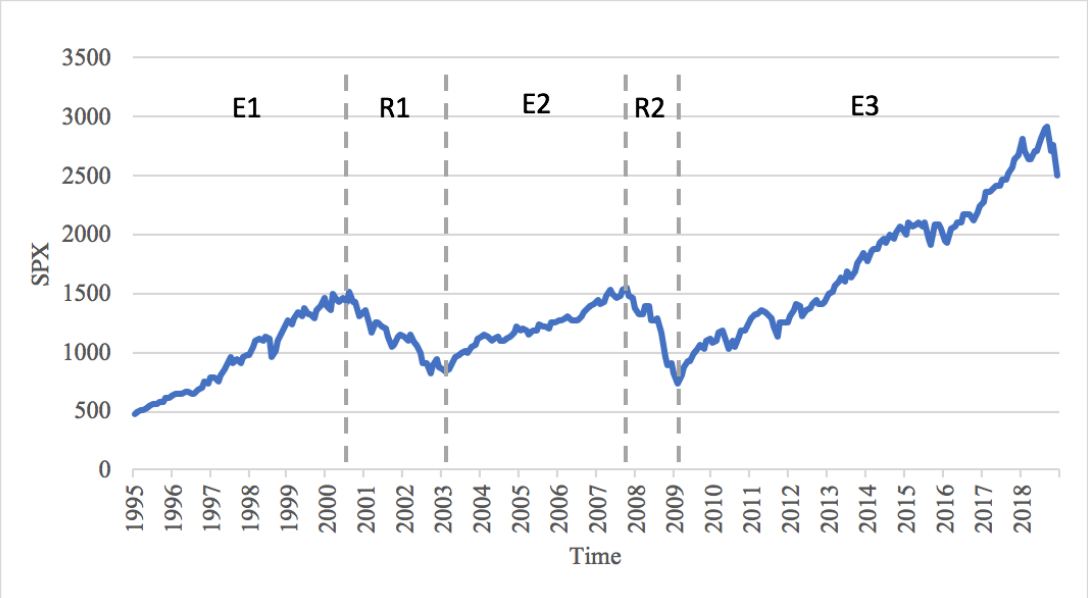

Figure 3.2 Global Equity Market Performance

The figure shows the global equity market return of the corresponding U.S. expansion and recession periods (January 1995 standardized to 100)

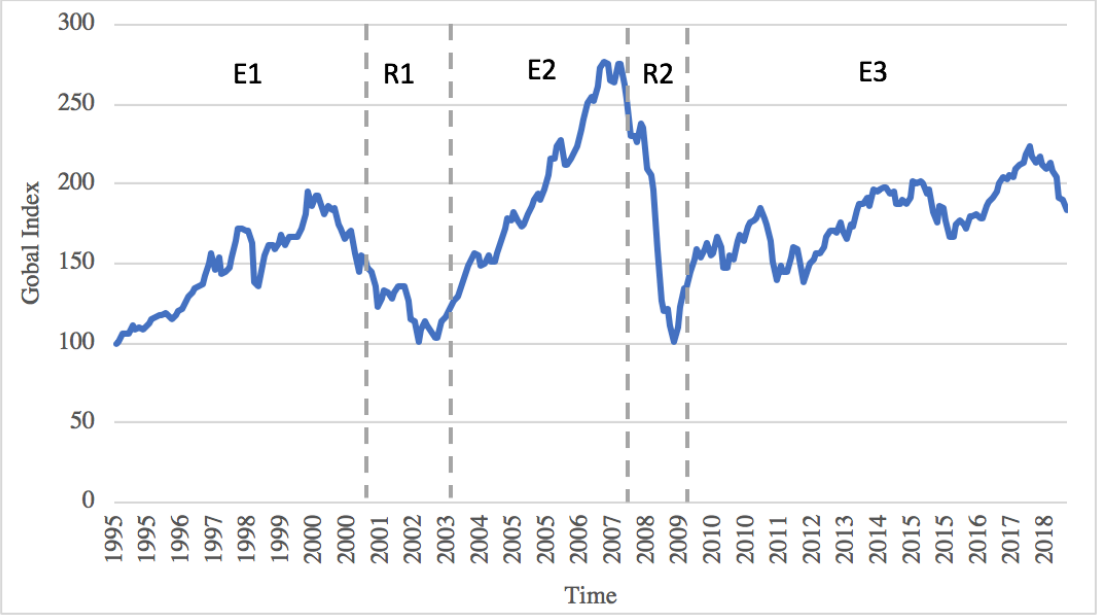

Figure 3.3 U.S. Interest Rates

This figure shows the interest rates of U.S. 2-year and 10-year Treasury notes of the corresponding sub-periods

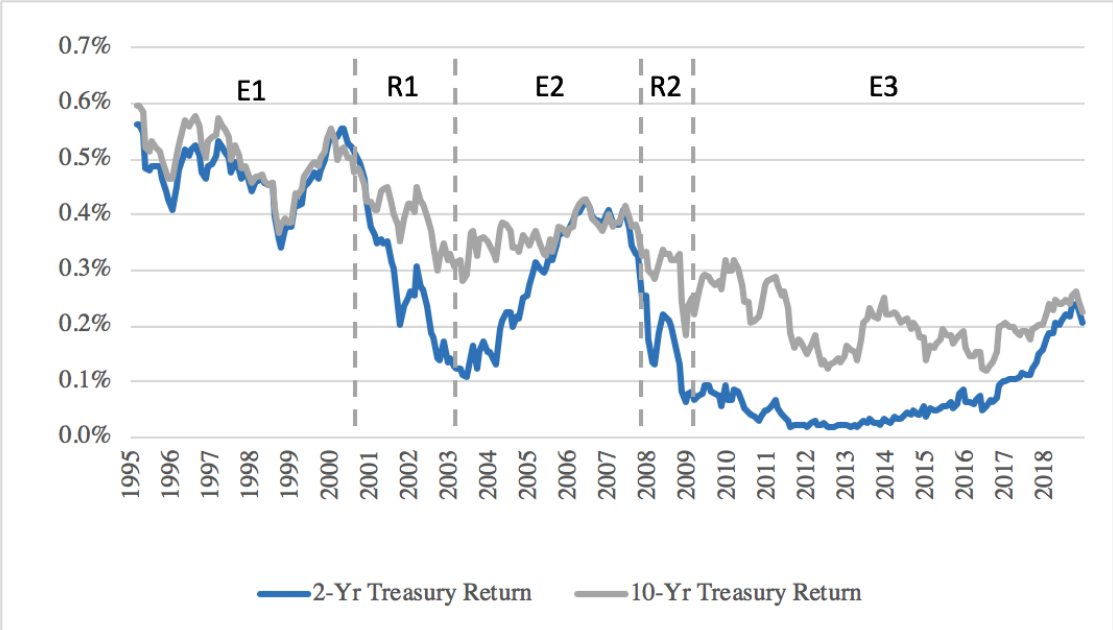

Table 3.4 Index and Currency of the Foreign Market

COUNTRY	INDEX	CURRENCY
AUSTRALIA	ASX 200	AUD
BELGIUM	BEL 20	EUR
CANADA	TSX	CAD
FINLAND	HEX 25	EUR
FRANCE	CAC 40	EUR
GERMANY	DAX	EUR
IRELAND	Total Share Prices for All Shares for Ireland	EUR
ITALY	Total Share Prices for All Shares for Italy	EUR
JAPAN	NKY	JPY
NETHERLAND	AEX	EUR
NEW ZEALAND	Total Share Prices for All Shares for New Zealand	NZD
SOUTH AFRICA	Total Share Prices for All Shares for South Africa	ZAR
SWEDEN	OMX	SEK
SWITZERLAND	SMI	CHF
UNITED KINGDOM	FTSE 350	GBP

Table 5.1 Foreign Equity Market Return and Volatility

This table shows the statistics for exchange rate adjusted monthly stock returns and standard deviations of returns (January 1995–September 2018)

COUNTRY	MEAN MONTHLY RETURN	STANDARD DEVIATION	SAMPLE SIZE
AUSTRIA	0.39%	0.0362	287
BELGIUM	0.32%	0.0288	287
CANADA	0.41%	0.0283	287
FINLAND	0.55%	0.0692	287
FRANCE	0.34%	0.0526	287
GERMANY	0.58%	0.0615	287
IRELAND	0.40%	0.0512	287
ITALY	0.19%	0.0530	287
JAPAN	0.10%	0.0319	287
NETHERLANDS	0.38%	0.0294	287
NEW ZEALAND	0.30%	0.0520	287
SOUTH AFRICA	0.30%	0.0658	287
SWEDEN	0.19%	0.0449	287
SWITZERLAND	0.41%	0.0252	287
UNITED KINGDOM	0.28%	0.0245	287
UNITED STATES	0.40%	0.0329	287

Table 5.2 Correlation Significance Test Result

This table shows the result of the statistical significance test of monthly mean stock returns and standard deviations (s.d.) by U.S. expansion and recession periods (January 1995 - September 2018)

**: Significant at 5% significance level*
***: Significant at 1% significance level*

U.S. Assets Type	U.S. Expansion	U.S. Recession	T-test for Difference in Means	Critical Value (5%)	Critical Value (1%)	Results
SPX						
Sample size	238	49				Both Significant
Mean	0.44%	-2.68%	3.4125**	2.0000	2.6600	
s.d.	6.09%	5.79%				
Global						
Sample size	238	49	4.4628**	2.0210	2.7040	Both Significant
Mean	0.89%	-3.03%				
s.d.	3.61%	5.93%				
2-Yr Treasury						
Sample size	238	49				Neither Significant
Mean	0.24%	0.23%	0.3238	1.9840	2.6260	
s.d.	0.19%	0.11%				
10-Yr Treasury						
Sample size	238	49				Only Significant at 5%
Mean	0.33%	0.36%	2.4014*	1.9840	2.6260	
s.d.	0.14%	0.07%				

Table 5.3 Correlation between Assets

This table shows the correlation among the U.S. and global equity market, and 2-year and 10-year U.S. Treasury notes

		Global Equity	2-year Treasury Note	10-year Treasury Note
E1	**U.S. Equity**	0.7683	-0.0376	-0.0193
	Global Equity		-0.0081	0.0463
	2-year Treasury Note			0.9563
R1	**U.S. Equity**	0.9032	-0.0747	0.0322
	Global Equity		-0.0319	0.0745
	2-year Treasury Note			0.9102
E2	**U.S. Equity**	0.7593	-0.2346	-0.2473
	Global Equity		-0.3009	-0.3695
	2-year Treasury Note			1.2272
R2	**U.S. Equity**	0.9113	0.2065	-0.0650
	Global Equity		0.0245	-0.2517
	2-year Treasury Note			0.8990
E3	**U.S. Equity**	0.8299	-0.0927	0.0805
	Global Equity		-0.0966	0.0612
	2-year Treasury Note			0.3460

Table 5.4 Portfolio Optimization Result for the Two-Asset Portfolio

					Weights	
	Risk Level	**Volatility**	**Mean Return**	**Utility (Max)**	**SPX**	**Global**
E1	1	0.0417	1.64%	0.0147	100.00%	0.00%
	3	0.0417	1.64%	0.0112	100.00%	0.00%
	6	0.0417	1.64%	0.0060	100.00%	0.00%
R1	1	0.0472	-1.86%	-0.0208	0.00%	100.00%
	3	0.0472	-1.86%	-0.0253	0.00%	100.00%
	6	0.0472	-1.86%	-0.0253	0.00%	100.00%
E2	1	0.0288	1.84%	0.0176	0.00%	100.00%
	3	0.0288	1.84%	0.0159	0.00%	100.00%
	6	0.0288	1.84%	0.0134	0.00%	100.00%
R2	1	0.0654	-3.82%	-0.0425	100.00%	0.00%
	3	0.0654	-3.82%	-0.0510	100.00%	0.00%
	6	0.0654	-3.82%	-0.0639	100.00%	0.00%
E3	1	0.0363	0.91%	0.0078	100.00%	0.00%
	3	0.0363	0.91%	0.0051	100.00%	0.00%
	6	0.0363	0.91%	0.0012	100.00%	0.00%

Table 5.5 Portfolio Optimization Result for the Three-Asset Portfolio with 2-year Treasury note

					WEIGHTS		
	Risk Level	**Volatility**	**Mean Return**	**Utility (Max)**	**SPX**	**Global**	**2-year T-note**
E1	1	0.0417	1.64%	0.0147	100.00%	0.00%	0.00%
	3	0.0417	1.64%	0.0112	100.00%	0.00%	0.00%
	6	0.0232	1.12%	0.0080	55.60%	0.00%	44.40%
R1	1	0.0011	0.27%	0.0027	0.00%	0.00%	100.00%
	3	0.0011	0.27%	0.0027	0.00%	0.00%	100.00%
	6	0.0011	0.27%	0.0027	0.00%	0.00%	100.00%
E2	1	0.0288	1.84%	0.0176	0.00%	100.00%	0.00%
	3	0.0288	1.84%	0.0159	0.00%	100.00%	0.00%
	6	0.0288	1.84%	0.0134	0.00%	100.00%	0.00%
R2	1	0.0007	0.16%	0.0016	0.00%	0.00%	100.00%
	3	0.0007	0.16%	0.0016	0.00%	0.00%	100.00%
	6	0.0007	0.16%	0.0016	0.00%	0.00%	100.00%
E3	1	0.0363	0.91%	0.0078	100.00%	0.00%	0.00%
	3	0.0363	0.91%	0.0051	100.00%	0.00%	0.00%
	6	0.0202	0.54%	0.0029	55.61%	0.00%	44.39%

Table 5.6 Portfolio Optimization Result for the Three-Asset Portfolio with 10-year Treasury note

					WEIGHTS		
	Risk Level	**Volatility**	**Mean Return**	**Utility (Max)**	**SPX**	**Global**	**10-year T-note**
E1	1	0.0417	1.64%	0.0147	100.00%	0.00%	0.00%
	3	0.0417	1.64%	0.0112	100.00%	0.00%	0.00%
	6	0.0232	1.13%	0.0081	55.59%	0.00%	44.41%
R1	1	0.0005	0.40%	0.0040	0.00%	0.00%	100.00%
	3	0.0005	0.40%	0.0040	0.00%	0.00%	100.00%
	6	0.0005	0.40%	0.0040	0.00%	0.00%	100.00%
E2	1	0.0288	1.84%	0.0176	0.00%	100.00%	0.00%
	3	0.0288	1.84%	0.0159	0.00%	100.00%	0.00%
	6	0.0288	1.84%	0.0134	0.00%	100.00%	0.00%
R2	1	0.0005	0.30%	0.0030	0.00%	0.00%	100.00%
	3	0.0005	0.30%	0.0030	0.00%	0.00%	100.00%
	6	0.0005	0.30%	0.0030	0.00%	0.00%	100.00%
E3	1	0.0363	0.91%	0.0078	100.00%	0.00%	0.00%
	3	0.0323	0.83%	0.0052	88.89%	0.00%	11.11%
	6	0.0162	0.52%	0.0036	44.44%	0.00%	55.56%

Table 5.7 Portfolio Optimization Result for the Four-Asset Portfolio

					WEIGHTS			
	Risk Level	**Volatility**	**Mean Return**	**Utility (Max)**	**SPX**	**Global**	**2-year bond**	**10-year bond**
E1	1	0.0164	4.17%	0.0147	100.00%	0.00%	0.00%	0.00%
	3	0.0164	4.17%	0.0112	100.00%	0.00%	0.00%	0.00%
	6	0.0229	1.12%	0.0081	54.83%	0.00%	0.00%	45.17%
R1	1	0.0005	0.40%	0.0040	0.00%	0.00%	0.00%	100.00%
	3	0.0005	0.40%	0.0040	0.00%	0.00%	0.00%	100.00%
	6	0.0005	0.40%	0.0040	0.00%	0.00%	0.00%	100.00%
E2	1	0.0288	1.84%	0.0176	0.00%	100.00%	0.00%	0.00%
	3	0.0288	1.84%	0.0159	0.00%	100.00%	0.00%	0.00%
	6	0.0288	1.84%	0.0134	0.00%	100.00%	0.00%	0.00%
R2	1	0.0005	0.30%	0.0030	0.00%	0.00%	0.00%	100.00%
	3	0.0005	0.30%	0.0030	0.00%	0.00%	0.00%	100.00%
	6	0.0005	0.30%	0.0030	0.00%	0.00%	0.00%	100.00%
E3	1	0.0363	0.91%	0.0078	100.00%	0.00%	0.00%	0.00%
	3	0.0320	0.83%	0.0052	87.98%	0.00%	0.00%	12.02%
	6	0.0145	0.49%	0.0036	39.92%	0.00%	0.00%	60.08%

Appendix B

This Appendix contains the geometric means and VCV matrices used in the portfolio optimization test.

Table B.1 Geometric mean for the five sub-periods

	SPX Return	***Global Return***	***2-Yr Treasury Return***	***10-Yr Treasury Return***
E1	1.64%	0.90%	0.47%	0.49%
R1	-2.02%	-1.86%	0.27%	0.40%
E2	1.06%	1.84%	0.29%	0.37%
R2	-3.82%	-5.01%	0.16%	0.30%
E3	0.91%	0.44%	0.07%	0.21%

Table B.2 VCV Matrix for Sub-periods

E1				
	SPX	Global Index	2-year T-note	10-year T-note
SPX	0.00173928	0.00117850	-0.00000119	-0.00000064
Global	0.00117850	0.00135292	-0.00000023	0.00000137
2 Yr	-0.00000119	-0.00000023	0.00000058	0.00000058
10 Yr	-0.00000064	0.00000137	0.00000058	0.00000064
R1				
	SPX	Global Index	2-year T-note	10-year T-note
SPX	0.00282305	0.00226304	-0.00000435	0.00000089
Global	0.00226304	0.00222365	-0.00000165	0.00000182
2 Yr	-0.00000435	-0.00000165	0.00000120	0.00000052
10 Yr	0.00000089	0.00000182	0.00000052	0.00000027
E2				
	SPX	Global Index	2-year T-note	10-year T-note
SPX	0.00056764	0.00056433	-0.00000498	-0.00000160
Global	0.00056433	0.00083088	-0.00000698	-0.00000262
2 Yr	-0.00000498	-0.00000698	0.00000108	0.00000025
10 Yr	-0.00000160	-0.00000262	0.00000025	0.00000010
R2				
	SPX	Global Index	2-year T-note	10-year T-note
SPX	0.00427767	0.00438654	0.00001014	-0.00000209
Global	0.00438654	0.00541593	0.00000135	-0.00000910
2 Yr	0.00001014	0.00000135	0.00000056	0.00000033
10 Yr	-0.00000209	-0.00000910	0.00000033	0.00000024
E3				
	SPX	Global Index	2-year T-note	10-year T-note
SPX	0.001320100	0.001143135	-0.000001908	0.000001461
Global	0.001143135	0.001437268	-0.000002074	0.000001159
2 Yr	-0.000001908	-0.000002074	0.000000321	0.000000098
10 Yr	0.000001461	0.000001159	0.000000098	0.000000250

Bibliography

Works Cited

Conover, C. M., Jensen, G. R., & Johnson, R. R. (1999). "Monetary Conditions and International Investing." *Financial Analysts Journal*, vol.*55,* no.4, 2 Jan. 2019, pp. 38-48, doi: 10.2469/faj

Jensen, G., Mercer, J., & Johnson, R. (1996). "Business Conditions, Monetary Policy and Expected Security Returns." *Journal of Financial Economics*, vol.*40,* no.2, Jul. 1995, pp.213-238

Marsh, Terry, and Paul Pfleiderer. "Flight to Quality and Asset Allocation in a Financial Crisis." *Financial Analysts Journal*, vol. 69, no. 4, 2013, pp. 43–57. JStore, https://www.jstor.org/stable/23469535.

Rozeff, M. (1975). "The Money Supply and the Stock Market." *Financial Analysts Journal*, Sep. /Oct. 1975, pp.18

Sinquefield, R. (1996). "Where Are the Gains from International Diversification?" *Financial Analysts Journal*, vol. *52*, no. 1, Jan/Feb 1996, pp. 8-14

Welch, B.L. (1938). "The Significance of the Difference Between Two Means When the Population Variances are Unequal." *Biometrika*, vol. 29, no. 3-4, Feb 1938, pp. 350-362

Database

Bloomberg Terminal Database

"FRED Economic Data." Federal Reserve Bank of St. Louis

Public Documents

"S&P U.S. Indices Methodology." *S&P Dow Jones Indices, July 2019*, https://us.spindices.com/documents/methodologies/methodology-sp-us-indices.pdf.

Websites Reviewed

"Monetary Policy Strategies of Major Central Banks." *Board of Governors of the Federal Reserve System*, 8 Mar. 2018, https://www.federalreserve.gov/monetarypolicy/monetary-policy-strategies-of-major-central-banks.html