การศึกษาผลกระทบของปัจจัยความไม่แน่นอนทางด้านนโยบายเศรษฐกิจที่มีต่อกลยุทธ์การลงทุนในตลาดเงินตราระหว่างประเทศแบบ Carry Trade

นางสาวถิรนันท์ สงวนจีน

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาเศรษฐศาสตรมหาบัณฑิต
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Economic Policy Uncertainty and Carry Trade Strategy

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ถิรนันท์ สงวนจีน : การศึกษาผลกระทบของปัจจัยความไม่แน่นอนทางด้านนโยบายเศรษฐกิจที่มีต่อกลยุทธ์การลงทุนในตลาดเงินตราระหว่างประเทศแบบ Carry Trade (Economic Policy Uncertainty and Carry Trade Strategy) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ผศ. ดร. พงศ์ศักดิ์ เหลืองอร่าม, 103 หน้า.

การศึกษาผลกระทบของปัจจัยความไม่แน่นอนทางด้านนโยบายเศรษฐกิจที่มีต่อกลยุทธ์การลงทุนในตลาดเงินตราระหว่างประเทศแบบ Carry Trade อยู่ภายใต้กรอบแนวคิดความเชื่อว่า การดำเนินนโยบายทางเศรษฐกิจในแต่ละประเทศย่อมสามารถส่งผลโดยตรงต่อตลาดเงินระหว่างประเทศ โดยทั่วไปแล้ว การทำกลยุทธ์การลงทุนแบบ Carry Trade ในตลาดเงินตราระหว่างประเทศสามารถทำได้หลายวิธีขึ้นอยู่กับดุลยพินิจของนักลงทุน ดังนั้น งานวิจัยนี้เกิดขึ้นเพื่อศึกษาว่า ความไม่แน่นอนของในเชิงนโยบายจะส่งผลต่อผลตอบแทนจากพอร์ตการลงทุนในตลาดเงินตราระหว่างประเทศแบบ Carry Trade แตกต่างกันหรือไม่ หากพอร์ตการลงทุนถูกสร้างด้วยวิธีที่แตกต่างกัน

ในการศึกษานี้ถือเป็นการศึกษาที่ครอบคลุมผลกระทบของความไม่แน่นอนเชิงนโยบายเศรษฐกิจที่มีต่อกลยุทธ์การลงทุนแบบ Carry Trade โดยพอร์ตการลงทุนจะครอบคลุมสกุลเงินทั้งกลุ่มประเทศที่พัฒนาแล้วและกลุ่มประเทศเกิดใหม่ รวมถึงมีการนำกลยุทธ์การกำหนดน้ำหนักให้แต่ละสกุลเงินในพอร์ตการลงทุน และวิธีการคัดเลือกสกุลเงินที่เหมาะสมที่สุดที่หลากหลายวิธีเข้ามาร่วมพิจารณาด้วย โดยในการประเมินความสัมพันธ์ระหว่างความไม่แน่นอนเชิงนโยบายเศรษฐกิจและผลตอบแทนจากการลงทุน ผู้วิจัยเลือกใช้แบบจำลอง Vector Autoregressive Model (VARs) ในการประมาณการความสัมพันธ์ระหว่างสองตัวแปร และใช้ Impulse Response Function ในการอภิปรายผลการประมาณการแบบจำลอง ซึ่งจากการศึกษา พบว่า ความไม่แน่นอนในเชิงนโยบายเศรษฐกิจจากประเทศญี่ปุ่น และสหรัฐอเมริกามีผลต่อผลตอบแทนจากการลงทุนแบบ Carry Trade มากที่สุดเมื่อเปรียบเทียบกับความไม่แน่นอนเชิงนโยบายเศรษฐกิจของโลก และการตอบสนองมีโอกาสเป็นได้ทั้งทางบวกและทางลบ ขึ้นอยู่กับลักษณะของพอร์ตการลงทุนว่าเป็นแบบใด ซึ่งแตกต่างจากงานศึกษาในอดีตที่ผ่านมา นอกจากนี้ในการศึกษานี้ยังพบเพิ่มเติมว่า การลงทุนในกลุ่มประเทศเกิดใหม่มีความอ่อนไหวต่อความไม่แน่นอนเชิงนโยบายทางเศรษฐกิจน้อยกว่าการลงทุนในกลุ่มประเทศพัฒนาแล้ว

สาขาวิชา เศรษฐศาสตร์	ลายมือชื่อนิสิต ....
ปีการศึกษา 2560	ลายมือชื่อ อ.ที่ปรึกษาหลัก ....

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TIRANAN SANGUANJEEN: Economic Policy Uncertainty and Carry Trade Strategy. ADVISOR: ASST. PROF. PONGSAK LUANGARAM, Ph.D., 103 pp.

This study provides a comprehensive analysis of the impact of economic policy uncertainty on carry trade. Based on 24 countries (both emerging and developed markets) during the past 17 years, the paper considers five strategies of carry trade investment (i.e. positive carry, carry to risk, yield slope, policy change and valuation), three methods of portfolio constructions (equal weight, risk parity and mean variance optimization), and four types of economic policy uncertainties (US, Japan, EU and Global). Based on vector autoregressive model, it is found that US and Japan economic policy uncertainties have most impact on carry trade return. However, direction of such impact is ambiguous, depending on how carry trade portfolio have been formed. This is in contrast with the literature. Interestingly, the paper finds that carry trade strategy that focuses on emerging markets appears to be less sensitive to policy uncertainty shocks.

Field of Study:	Economics	Student's Signature	....
Academic Year:	2017	Advisor's Signature	....

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CHAPTER I: INTRODUCTION

1.1 Importance of Currency Carry Trade and Economic Policy Uncertainty

The differential in interest rates between two any countries should be equal to the expectation of change in exchange rates between those countries' currencies, Uncovered Interest Parity (UIP) said that. The non-existing of the parity create an opportunity to investors in order to make a profit whereby a high-yielding currency funds the trade with a low-yielding currency. The low-yield-currency is expected to depreciate against high-yield-currency. There are only limited evidences to support UIP but many literatures found the conflicting evidence[1].

Over 30 years past, articles continue to find that high yielding currency tends to appreciate relative to low yielding currency, on average (Clarida, Davis, & Pedersen, 2009). The direct implication of this stylized fact is that investors can make systematic profits by shorting the low yielding currency and longing the high yielding currency. This become a popular investment strategy in foreign exchange market well-known as carry trade, which has enhanced investors' profitability

Basically, carry trade strategy is an investment strategy whereby an investor invests in a high yielding currency funded by low yielding currency. The safe haven currency has been used to be a funding currency, for example Japanese Yen (JPY), Swiss Franc (CHF) (McCauley and McGuire, 2009).

Carry trade has been becoming to be a major area of interest for market participants and policymakers alike. From the perspective of FX market participants, diversified carry-trade portfolios have been shown to generate attractive risk-adjusted returns over long periods of time. As a result, many global fund managers today devote at least a portion of their portfolios to carry-trade-related strategies.

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[1] See Meese & Rogoff, 1983, Hansen & Hodrick, 1980, Cumby & Obstfeld, 1981, and Fama, 1984 for reviewing of the huge literatures which documenting the failure of uncovered interest parity.

Figure 1 plots the long-run cumulative return that could have been earned on a simulated diversified G-10[2] (purple line) & Emerging Country (EM)[3] (orange line) carry trade strategy. The two portfolios are constructed by opened long positions in the three highest yielding G-10 currencies and short positions in the three lowest yielding G-10 currencies. Each currency was assigned equal weight and held over the 1996 – 2017 period (22 years), while EM currencies were held between 2005 – 2017 (13 years, due to data available). This simple carry trade strategy would have generated an interesting performance. Table 1 reports performance of G-10 & Emerging 3x3 Portfolio between 1996 – 2007,compare to S & P 500 Index. It can be seen that G-10 portfolio had, annual excess return of 3.74 percent and 7.07 percent in EM portfolio, under an annualized volatility of return of 9.34 percent and 10.05 percent respectively. The estimated Sharpe's ratio of them are likely high at 0.4 for 22-year portfolio and 0.6 for 13-year portfolio. To compare with S&P 500 index (dot line), Carry Trade is more attractive, especially EM portfolio.

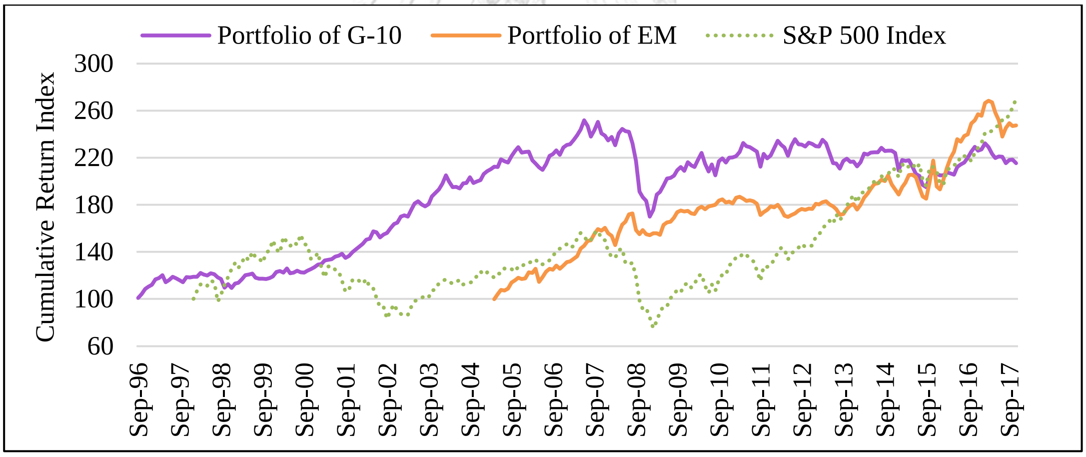

Figure 1: Illustration of cumulative return index of G-10 & emerging country 3x3 portfolio between 1996 - 2017, compares with S&P index 500

Source: Bloomberg

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[2] G-10 country includes Australia, Canada, Denmark, Eurozone, New Zealand, Norway, Sweden, Switzerland, Sweden, United Kingdom and United State

[3] Emerging Country includes Argentina, Brazil, Bulgaria, Chile, China, Columbia, Czech Republic, Hong Kong, Hungary, India, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russia, Singapore, South Africa, South Korea, Taiwan, Thailand, and Turkey

Profitability of carry trade seems to be sweet desserts to investors, unfortunately, the investors are eating them on a glass bridge not a metal platform. Table 1 shows that carry trade has a negatively skewness in both portfolios which means that the excess returns on carry trades have been significantly positive overtime, carry trade is prone to crash from time to time. Therefore, carry trade still profitable to investor unless the interest rate differential in two any countries cannot offset the depreciation of high-yield currency.

Rafferty, 2012 revealed that the reason for the large negative skew on the carry trade strategy is that a strategy long in negatively skewed currencies and short positively skewed currencies will tend to be doubly exposed to the downside when disaster strikes. That is, both the long position in high-yield currencies and the short position in low-yield currencies tend to decline in value at the same time when carry trades are exposed to a major downside event. Because both sides of the carry trade suffer at the same time, the large negative skew in the distribution of carry-trade returns cannot be diversified away.

Table 1: Performance of G-10 & Emerging 3x3 Portfolio between 1996 – 2007, compare to S & P 500 Index

	G-10 3x3 Portfolio	EM 3x3 Portfolio
Annualized Return (percent)	3.74	7.07
Standard Deviation	9.34	10.05
Sharpe’s ratio	0.40	0.70
Skewness	-0.34	-0.53
Kurtosis	3.02	2.71

Source: Bloomberg

From the perspective of policymakers, the stability of exchange rate is both explicit and implicit central bank’s objective in many countries, for example, Singapore that adopted a Monitoring Band, in which the Singapore dollar is allowed to float (within an undisclosed bandwidth of a central parity) but closely monitored by the Monetary Authority of Singapore (MAS) against a concealed basket of currencies of Singapore's major trading partners and competitors. This, in theory, allows the Singaporean government to have more control over imported inflation and to ensure that Singapore's exports remain competitive. Even in countries with managed floating and floating exchange rate regime, they still monitor the exchange rate movement closely. ("Singapore dollar,")

The dramatic unwinding of the global FX carry trade during the 2008-09 Global Financial Crisis followed the script of previous major carry-trade unwinds. Financial conditions started to deteriorate in 2007 and then collapsed when the global financial markets melted down in the fall of 2008. With liquidity conditions turning less favourable, highly leveraged investors found that their access to funding liquidity had dried up, which forced them to unwind their carry-trade positions in favor of safe-haven currencies such as the U.S. dollar. Figure 2, which comes from a BIS study, reveals that countries with the highest short-term interest rates saw their currencies depreciate the most versus the U.S. dollar in 2008. Thus, the currencies that rode the carry-trade boom in 2002-07, fell the hardest in 2008.

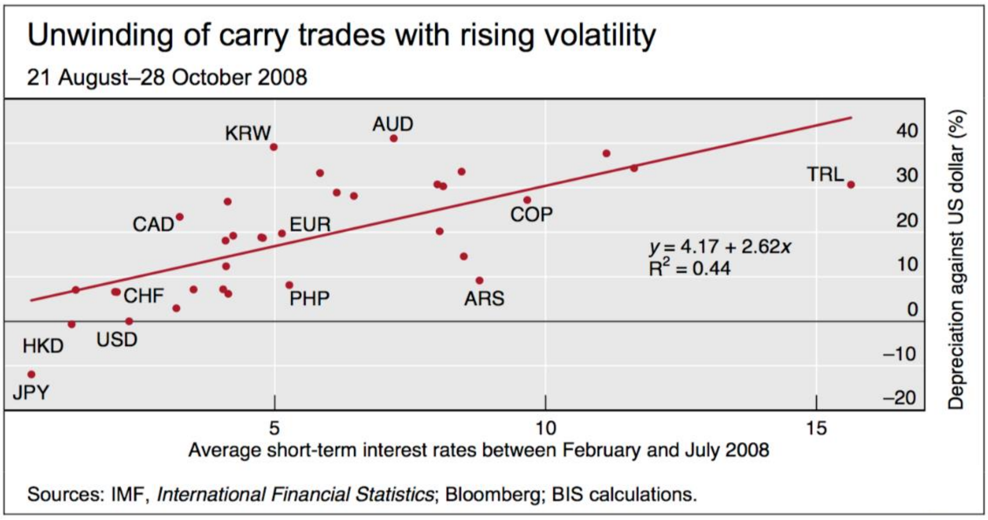

Figure 2: The Impact of Increased Market Volatility on Low-Yield and High Yield Currencies Depreciation of Currencies against the U.S. Dollar from August-October 2008

Source: McCauley & McGuire, 2009

There is a clear concern that carry-trade activities might be playing a major role in generating exchange-rate misalignments and financial bubbles around the world. As carry-trade activities have become a more important part of the FX landscape, there exists a risk that a global search for yield could drive high-yield currencies deep into overvalued territory, which could have serious negative consequences for economic activity in such markets. In that environment, monetary authorities in high-yield markets might feel compelled to resort to capital controls to stem the inflow of foreign capital into their markets to prevent an undesired appreciate on of their currencies or a rise in domestic asset prices in general.

In case of Thailand, since the author educated in carry trade, found that in 18 of the 20 quarters through the second quarter of 1997, carry trade was profitable, the pegged exchange rate ruling out large exchange rate surprises. Notwithstanding the stability of the Thai baht, a growing number of investors began to worry that the period of financial stability might be drawing to a close. The first episode of pressure on the currency as in July 1996, following the collapse of the Bangkok Bank of Commerce and the central's bank injection of liquidity to support the financial system. The second episode was in early 1997, following the release in January of disappointing fiscal and export performance. International investors who were important players in the carry trade began closing out their positions. At this stage, the liquidation of long positions in Thai securities by domestic corporates and banks, proprietary trading desks of commercial and investment banks, treasuries and foreign exchange desks of the major money center banks. Mutual funds, hedge funds, and retail investors was probably more important that short sales in weakening the baht.[4]

There is a linkage between exchange rate markets and monetary policy, the policy is involved with the currency that can affect to foreign exchange market return. Thus, it is reasonable to conjecture that economic policy risk affect currency carry trade portfolio excess return. Policy uncertainty, nowadays, becomes an importance issue to many central bankers and researchers, the Federal Open Market Committee (2009) and the IMF (2012, 2013) suggest that uncertainty in the U.S. economy and policy in Eurozone including fiscal, regulatory, and monetary policies associated with the decline in the economy during 2008-2009, and represents a slow recovery afterward. Mark Carney (2016), Governor of the Bank of England, said that in the last few years economic uncertainty has been elevated because of the instability of the financial system and the debt to the private sector. The central bank's monetary policy are become more challenging in order to balance the savings and investment of the global economy. Veerathai Santiprabhob – Chairman of Bank of Thailand, though, suggested that we are all standing on *VUCA planet*, V is highly volatility, U is highly uncertainty, c is highly complexity and A is highly ambiguity. Without question, why policy uncertainty should be studied.

All as mentioned above leads to this thesis topic “Economic Policy Uncertainty and Carry Trade Strategy”. By and large, the innumerable of academic literatures have focused on using differentials in interest rate levels and forward premium/discount commonly known as positive carry, to screen currency and predict carry trade behavior. Only one criterion with one portfolio, however, is not enough to make a conclusion to the carry trade strategies, the most powerful investment strategy. The author strongly believes that if carry trade portfolio is constructed in different method, impact of economic policy shock must be different. Consequently, this thesis

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[4] See Jansen et al., 1998 for more detail about carry trade activity in emerging market.

investigates that whether economic policy uncertainty affect carry trade portfolio excess return differently, if carry trade portfolios are constructed in different way and the author is going to use economic policy uncertainty (EPU) to capture uncertainty about *who* will make economic and monetary policy decisions, *what* economic policy actions will be undertaken and *when* the economic effects of policy actions (or inaction) – including uncertainties related to the economic ramifications of "non-economic" policy matters (Baker, Bloom, & Davis, 2016).

1.2 Research Objective

This study aims to study the relationship between economic policy uncertainty and return on investment in the international currency market, carry trade strategy. In fact, carry trade can be done in several ways, depends on the perspective of each investor. The author strongly believes that carry trade excess return responds to economic policy uncertainty differently, depends on how the portfolios are built and type of EPU[5]. Thus, the purposes are as follow; Whether the economic policy uncertainty affects carry trade portfolio excess return differently, if carry trade portfolios are constructed in different way.

1.3 Research Question

There is a research questions in this study: How does economic policy uncertainty affect to currency carry trade strategy and whether the carry-trade portfolio construction matter to the strategy.

[5] Type of uncertainty, the country originates policy uncertainty.

CHAPTER 2: THEORY AND LITERATURE REVIEW

2.1 Theory

There are many concepts and theories, using in this research. The author studied the theory of economics related to the presentation of the thesis. This section is divided into 3 subsections:

- International Parity Condition
  - Purchasing Power Parity (PPP)
  - Covered Interest Parity (CIP)
  - Uncovered Interest Parity (UIP)
- Modern Portfolio Theory (Markowitz, 1952)
- Measuring Efficiency of Portfolio

2.1.1 International Parity Condition

2.1.1.1 Purchasing Power Parity (PPP) and Big Mac Index[6]

The first original reference of PPP Theory was made by David Ricardo. However, Gustav Cassel popularized this theory in 1918. The concept of purchasing power parity allows one to estimate what the exchange rate between two currencies would have to be in order for the exchange to be at par with the purchasing power of the two countries' currencies. Using that PPP rate for hypothetical currency conversions, a given amount of one currency thus has the same purchasing power whether used directly to purchase a market basket of goods or used to convert at the PPP rate to the other currency and then purchase the market basket using that currency. The deviations of the exchange rate from purchasing power parity are measured by deviations of the real exchange rate from its PPP value.

[6] Purchasing power parity. Retrieved from https://en.wikipedia.org/wiki/Purchasing_power_parity

Law of One Price applies to individual commodities whereas PPP applies to the general price level. The existing of Law of one price, the existing of purchasing. When discussing the validity of PPP, some argue that the law of one price does not need to be true exactly for PPP to be valid. If the law of one price is not true for a certain commodity, the price levels will not differ enough from the level predicted by PPP. Law of One Price can be shown in mathematical manner as follow;

$$s \times P^{*} = P \qquad (1)$$

where s = Spot Exchange Rate[7]

P^{*} = Price level of the product in term of foreign currency unit

P = Price level of the product in term of domestic currency unit.

Another example of one measure of the law of one price, which underlies purchasing power parity, is the Big Mac Index, popularized by The Economist, which compares the prices of a Big Mac burger in McDonald's restaurants in different countries. The Big Mac Index is presumably useful because although it is based on a single consumer product that may not be typical, it is a relatively standardized product that includes input costs from a wide range of sectors in the local economy, such as agricultural commodities (beef, bread, lettuce, cheese), labor (blue and white collar), advertising, rent and real estate costs, transportation, etc. The Economist publishes Big Mac index on their website, it shows the under and over valuation of the local currency against the U.S. dollar in percent term.

2.1.1.2 Covered Interest Parity[8]

When the no-arbitrage condition is satisfied with the use of a forward contract to hedge against exposure to exchange rate risk, interest rate parity is said to be covered. Investors will still be indifferent among the available interest rates in two countries because the forward exchange rate sustains equilibrium such that the dollar return on dollar deposits is equal to the dollar return on foreign deposit, thereby

[7] Exchange rate is in term of domestic currency units per foreign currency unit.

[8] Interest rate parity. Retrieved from https://en.wikipedia.org/wiki?curid=2406246

eliminating the potential for covered interest arbitrage profits. Furthermore, covered interest rate parity helps explain the determination of the forward exchange rate. The following equation represents covered interest rate parity.

$$1 + i_{d,t} = \frac{F_t}{S_t}(1 + i_{f,t}) \qquad (2)$$

where i_d = Interest rate in domestic country at time t

i_f = Interest rate in foreign country at time t

F_t = Current spot exchange rate at time t

S_t = Spot exchange rate at time t

2.1.1.3 Uncovered Interest Parity[9]

When the no-arbitrage condition is satisfied without the use of a forward contract to hedge against exposure to exchange rate risk, interest rate parity is said to be uncovered. Risk-neutral investors will be indifferent among the available interest rates in two countries because the exchange rate between those countries is expected to adjust such that the dollar return on dollar deposits is equal to the dollar return on euro deposits, thereby eliminating the potential for uncovered interest arbitrage profits. Uncovered interest rate parity helps explain the determination of the spot exchange rate. The following equation represents uncovered interest rate parity.

$$1 + i_{d,t} = \frac{E(s_{t+1})}{S_t}(1 + i_{f,t}) \qquad (3)$$

where i_d = Interest rate in domestic country at time t

i_f = Interest rate in foreign country at time t

S_t = Current spot exchange rate at time t

$E(s_{t+1})$ = Expectation of future spot exchange rate at time $t + 1$

2.1.2 Modern Portfolio Theory (Markowitz, 1952)[10]

Harry Markowitz is Nobel winner in economics who had introduced Modern Portfolio Theory in 1952. It assumes that an investor wants to maximize a portfolio's expected return contingent on any given amount of risk. For portfolios that

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[9] Interest rate parity. Retrieved from https://en.wikipedia.org/wiki?curid=2406246

[10] Portfolio optimization. Retrieved from https://en.wikipedia.org/wiki/Portfolio_optimization

meet this criterion, known as efficient portfolios, achieving a higher expected return requires taking on more risk, so investors are faced with a trade-off between risk and expected return. This risk-expected return relationship of efficient portfolios is graphically represented by a curve known as the efficient frontier. All efficient portfolios, each represented by a point on the efficient frontier, are well-diversified. While ignoring higher moments can lead to significant over-investment in risky securities, especially when volatility is high, the optimization of portfolios when return distributions are non-Gaussian is mathematically challenging.

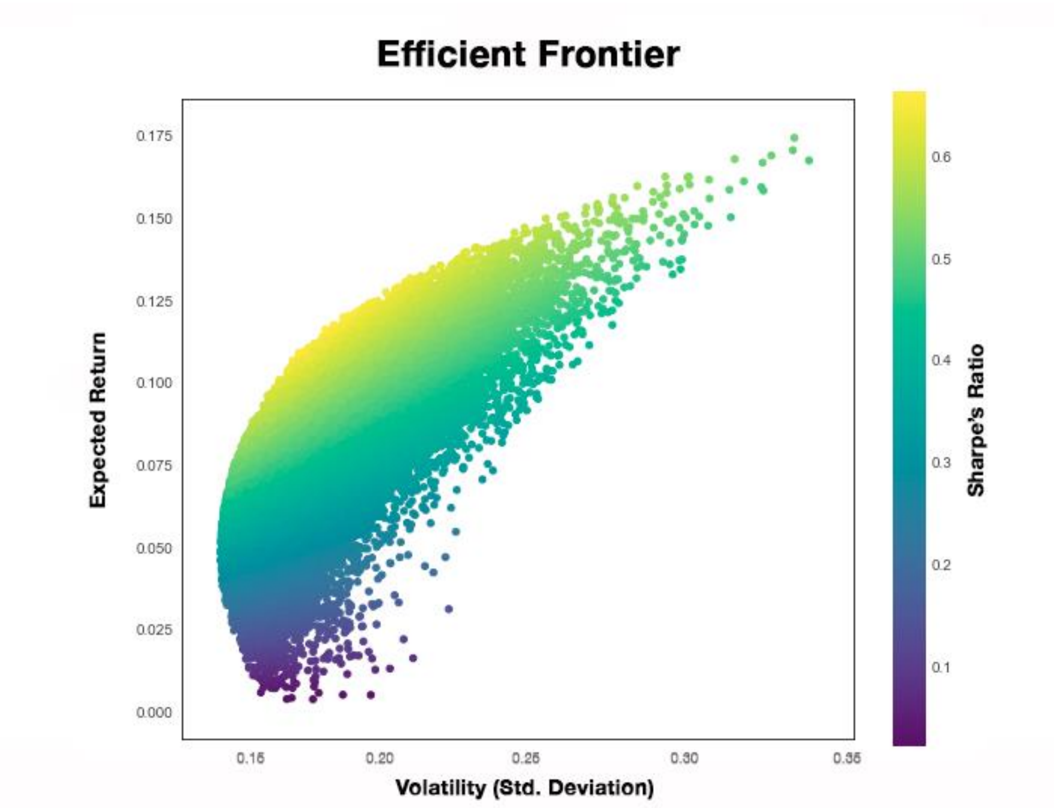

Figure 3: Markowitz's Efficient Frontier

Figure 3 shows Markowitz's Efficient Frontier in which expected return (vertical axis) versus standard deviation (horizontal axis). This is called the "risk-expected return space" that show all possible combination of risky assets and all possible portfolios. The upper edge of this hyperbola curve is so called as the *efficient frontier* in which represent the combination offering the best possible expected return (including no holdings of the risk-free asset) for a given level of risk. The tangent to the hyperbola at the tangency point indicates the best possible capital allocation line (CAL), given risk appetite of any investors.

The calculations of the efficient frontier usually uses the matrices to make it easier to understand; the efficient frontier is found by minimizing the variance of portfolio that can be written as the following manner:

$$\min_{w_t} \quad w^T V w \qquad (4)$$

$$\text{s.t.} \quad R^T w = z$$

$$\sum_i^N w_i = 1$$

$$w_i \geq 0$$

where w = Vector of portfolio weights

V = Covariance matrix for the returns on the assets in the portfolio

R^T = Vector of expected returns on each asset

Z = Expected return on the portfolio

$w^T V w$ = Variance of portfolio return

2.1.3 Measuring Efficiency of Portfolio

The Sharpe ratio is developed by William F. Sharp. There are many common names of the ratio, i.e. the Sharpe index, the Sharpe measure, and the reward-to-variability ratio. In finance and economic finance, the ratio is commonly used as a measure of the performance of an investment strategy in which adjusting for its risk. The ratio measures the excess return from risk free rate (so called as risk premium) per unit of volatility in an investment or a trading strategy. The Sharpe ratio is defined as in equation (5):

$$S_p = \frac{E[R_p - R_f]}{\sigma_p} = \frac{E[R_p - R_f]}{\sqrt{\sigma^2_{[R_p - R_f]}}} \qquad (5)$$

where S_p = Sharpe's ratio of the portfolio

R_p = Return on the portfolio

R_f = Return of risk free asset

σ_p = Volatility or standard deviation of the portfolio return

$E[R_p - R_f]$ = Expected value of the excess return of the portfolio over the benchmark

$\sigma^2_{[R_p - R_f]}$ = Variance of the excess return of the portfolio over the benchmark

2.2 Literature Review

The failure of uncovered interest parity (UIP) become the enduring puzzle in international finance research that researcher, academician and economist would have been placing the importance. UIP said that "In the risk neutral world, the interest rate differential should be offset by the depreciation of high-yielding currency". The implication of this theory is that investors could not have an arbitrage opportunity. Countless studied, however, found that UIP does not exist in the world included Meese & Rogoff, (1981), Hansen & Hodrick, (1981), Cumby & Obstfeld, (1981) and most famous Fama (1984). In addition, Froot et al., (1992) and Burnside et al., (2006) tested Fama Regression and confirmed the failure of non-existing theory

There are many literatures found that interest rate differential between two any countries cannot completely offset by the depreciation of high-yielding currency. Consequently, investor can be going short in low-yield currency and taking long in high-yield currency. Clarida et al., (2009) found that there is a large violation of UIP during low volatility episodes and large profits to the carry trade, as a result of the high yielding currency tends to appreciate that contrast to the theory. On the other hand, the low yielding currency tends to appreciate much more than implied by UIP, causing carry-trade investors faced up with the large negative returns in high volatility environments. This empirical result is consistent with Brunnermeier, Nagel & Pedersen, (2008)

Uncertainty is one kind of risk, consequently, it is impossible to not mention about risk and carry trade. There is a surge of literatures that tried to explore the relationship between carry trade and risk. There have been two groups of risk factor, traditional risk factors[11] and currency risk factors[12], which researcher used to educate. In Burnside, (2011), the result from the former model suggests that the traditional risk factors use to price the stock market, do not price currency returns. While the latter, less traditional risk factors, are more powerful in influencing currency returns.

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[11] Traditional risk factor is risk factor that was derived from capital market such as Fama & French stock pricing model (excess return of capital market, small minus big and high minus low)

[12] Currency risk factor is risk factor that was derived from foreign exchange market such as dollar risk factor, global currency volatility, global currency skewness and high minus low in FX

There is a little evidence in literatures that talk about the dealing between carry trade and uncertainty. Husted, Rogers, & Sun, (2017), they first used the monetary policy sub index of Economic Policy Uncertainty (EPU) constructed in Baker, Bloom, & Davis, (2016). They provided strong evidence that carry-trade investors require a higher profit from the strategy when uncertainty in the U.S. real economy or financial markets strike. Baker, Bloom, & Davis, (2016) constructs an economic policy uncertainty index both overall and local. They used text-mining in news articles by searching the digital archives of each paper from January 1985 to 2009. They monthly count news-articles that contains the all triple terms in economic, uncertainty and policy.[13] They standardized the raw count to obtain the index.

Constructing carry trade portfolio is main key point of this thesis. There are many ways to pursue carry-trade strategies in the FX markets. In practice, an investor could either select a specific currency to be long and a currency to be short or else choose to construct a diversified portfolio of long and short baskets of currencies from a sample of G-10, emerging market, or regional currencies or from the entire universe of tradable currencies. In constructing diversified long and short carry-trade baskets, an investor will choose to go long the x-highest yielding currencies and short the y-lowest yielding currencies, with the x and y allocations not necessarily the same number. With no leverage, the weights must sum to 100 percent in each basket. Simply and basically, many of researches chose to construct by using naïve portfolio which every currency in portfolio are assigned the same weight (equally-weighted) and using positive carry (interest rate differential) to be a criterion, for example, Brunnermeier et al., (2008), Clarida et al., (2009), and Husted et al., (2017). Portfolios were constructed by using the interest rate differential criteria. The first consists of the x lowest interest rate countries, the second portfolio for the next x lowest interest rate currencies, and so on. Portfolios are rebalanced every period in a way that maintains the order criteria. While Lustig & Verdelhan, (2007), Burnside et al., (20011), Jylha & Suominen, (2009), and Menkhoff et al., (2012) construct several portfolios, by

[13] “economic” or “economy”; “uncertain” or “uncertainty”; and one of the following policy terms: “congress”, “deficit”, “Federal Reserve”, “legislation”, “regulation” or “White House” (including variants like ‘uncertainties’, ‘regulatory’ or ‘the Fed’).

sorting currencies according to their forward discount/premium against the U.S. dollar (USD). The sorting is also done period by period and each portfolio is equally weighted..

There are a huge of literatures found that although carry trade seem to be attractive in pre-financial-crisis with moderately impressive Sharpe’s ratio, the strategies, however, often came with negative third moments or high negatively skewness. It commonly appeared through the occasional tendency of target currencies, or conversely funding currencies to suddenly appreciate in financial crisis or fragile event. Rafferty, (2012) explain the reason for large negative skew on the carry trade basket that a strategy that the strategy long negatively skewed currencies and short positively skewed currencies which tend to be doubly exposed to the downside if and when disaster strikes.

There are many criterions for selecting currency to go long and short. Beyond interest rate differential and forward discount criterion, Ang and Chen, (2010) suggested that going long currencies whose central banks have recently raised short-term interest rates and going short currencies whose central banks have recently lowered short-term interest rates has generated positive, risk-adjusted returns overtime. Furthermore, in the same article, Ang and Chen, (2010), discovered that going long currencies that have relatively flat yield curves and going short currencies that have relatively steep yield curves has generated positive risk-adjusted returns overtime. Moreover, investor can use Power Purchasing Parity to be a criterion, called PPP valuation strategy, an investor undertakes long positions in the x-most undervalued currencies according to PPP in the G10 and short positions in the y-most overvalued currencies[14].

Investors, however, can take into account all of these factors—relative yield levels, volatility of returns and correlation of returns—by adopting a mean-variance optimization (MVO) approach to currency asset allocation. The MVO approach to portfolio diversification was first introduced by Nobel Prize winner Harry Markowitz since 1952 and incorporates information on expected returns, volatility of returns, and the cross-correlation of asset returns to derive an optimal asset mix that maximizes

[14] Rosenberg, M. R. (2013). *The Carry Trade - Theory, Strategy & Risk Management*: Bloomberg.

portfolio return, subject to a targeted level of portfolio risk. The Markowitz framework can be applied to the currency market in a similar way by incorporating information on expected returns, currency volatility, and cross-currency correlations to derive an op mal mix of long and short currency positions that maximizes currency portfolio return subject to a predetermined targeted level of portfolio risk. Burnside, Eichenbaum, Kleshchelski, & Rebelo, 2006 had been constructing portfolios by maximizing the Sharpe ratio. Accordingly, they compute the portfolio frontier and calculate the portfolio weights that minimize variance and called "Optimally-Weighted Portfolio"

Lastly, there is another way to assign weight to currency. In portfolio management field, risk parity is claimed to be a more powerful way to manage portfolio used by hedge funds. Maillard, Roncalli, & Roncalli, 2008 suggest that the risk parity approach can be done by using the ratio of the inverse of its volatility with the harmonic average of the volatilities. Follows the instruction, all elements in portfolio are adjusted (leveraged or deleveraged) to the same risk level. The portfolio is able to accomplish a higher Sharpe's ratio and become more effective in order to cope with market downturns than the traditional portfolio as well.

CHAPTER 3: CONCEPTUAL FRAMEWORK

There are many ways to pursue carry trade strategies in the FX markets. An investor could either select a specific currency to be long and short or construct a diversified portfolio of long and short portfolio of currencies from a sample of G-10, Emerging Country, or regional currencies or from the entire universe of tradable currencies. Figure 4 illustrates the conceptual framework of this study – Economic Policy Uncertainty and Currency Carry Trade Strategy. There are three steps for forming carry trade portfolio and one step for estimating the relationship between uncertainty and excess return from carry trade.

To construct portfolio, First and foremost is screen universe process. This step makes it possible to determine which currency is the best for going short and long position. The author separates sample into three groups, only advanced economy sample (called AE), emerging country (called EM) and both advanced economy and emerging country or whole sample (called WS). In each group, there are five criterions for selecting currencies that are interest rate differential or positive carry criteria, carry-to-risk ratio criteria, relative term spreads criteria, change in policy rate criteria and valuation of currency or Purchasing Power Parity criteria. The portfolios that have been using in this research is 3x3 portfolio that consists of long position in 3 highest-yielding currencies (or else criterion) and short position in the 3 lowest- yielding currencies (or else criterion) at any given point in time. This step reveals 15 sets of currencies. Second, portfolio constructing, the selected currencies in first step will be assigned weight in different ways, viz., equally-weighted, risk parity and optimization process. After weight assigning mechanism, there are 45 carry trade portfolios in total. Third, the previous step allows the author to compute carry trade excess return.

Lastly, Vector Autoregressive Model is applied in this study to explore the relationship between carry trade excess return and economic policy uncertainty. In this study, the author uses impulse response function to summarize the structural analysis of VARs.

All of these steps will be thoroughly mentioned in CHEPTER 4: DATA AND METHODOLOGY.

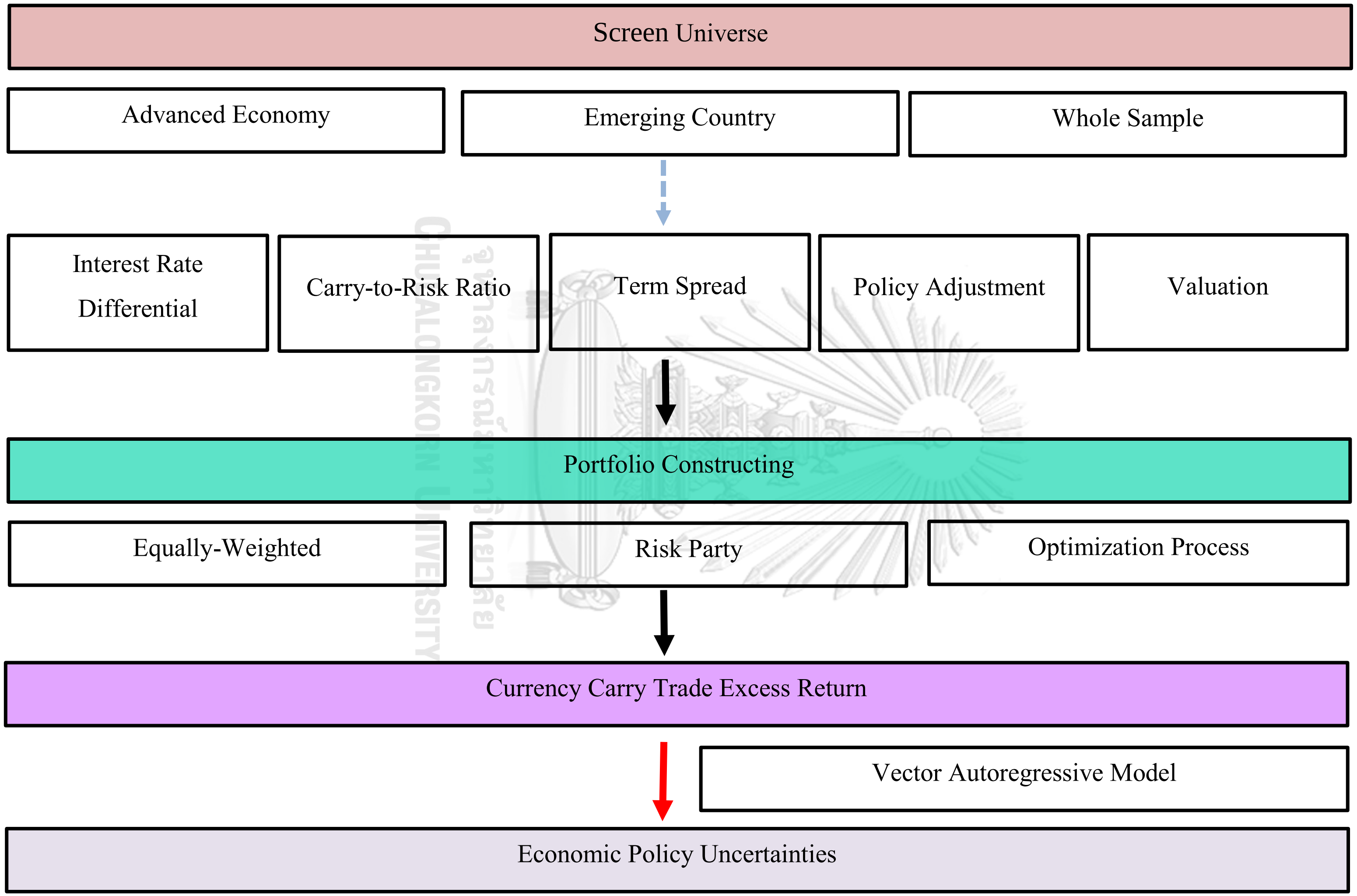

Figure 4: Illustration of Research's Conceptual Framework

CHEPTER 4: DATA AND METHODOLOGY

The structure of this chapter is the following: 4.1 Portfolio Rebalancing and Screen Universe, 4.2 Weighting Strategies, 4.3 Return to Currency Carry Trade, 4.4 Estimation of Impact of Economic Policy Uncertainty, and 4.5 Interpretation of Estimated Model.

4.1 Portfolio Rebalancing and Screen Universe

There are many ways to pursue carry-trade strategies in the FX markets. An investor could either select a specific currency to be long and a currency to be short or else choose to construct a diversified portfolio of long and short portfolio of currencies from a sample of G10, EM, or regional currencies or from the entire universe of tradable currencies. The sample in this research consist of 24 countries that are 14 advanced economies: Australia, Canada, Czech Republic, Denmark, Eurozone, Hong Kong, Japan, New Zealand, Norway, Singapore, South Korea, Sweden, Switzerland, United Kingdom and 10 emerging countries: Hungary, India, Indonesia, Malaysia, Mexico, Philippines, Poland, South Africa, Taiwan and Thailand.

Single-paired carry trades — long one high-yield currency and short one low-yield currency — have tended to generate Sharpe ratios that are not very high relative to other risky trading strategies. Most studies, for example Brunnermeier, Nagel, & Pedersen, 2009 and Clarida, Davis, & Pedersen, 2009, find that a multi-currency approach to carry trades can generate attractive risk-adjusted returns. Consequently, the portfolio that have been using in this research is 3x3 portfolio that consists of long position in 3 highest-yielding currencies (or else criterion) and short position in the 3 lowest-yielding currencies (or else criterion) at any given point in time.

There are differrent portfolios due to the author believes that if the portfolios are constructed differently, uncertainty can generate different impacts to carry trade. Accordingly, portfolios are constructed variously as follow this explaining: There five screen universe processes that are mentioned below. Moreover, there are 3 subdivision in each form of selection that are emerging-countries portfolio which consists only emerging country currency (refers as EM), advanced-economy portfolio which consists only advanced economy currency (refers as AE) and whole-sample portfolio which the elements in portfolio are selecting from the both AE and EM (refers as WS).

Currency traders refer to such extreme patterns as "going up by the stairs and coming down in the elevator" (Breedon, 2001), as the case in Global Financial Crisis (2008) that drove the returns on most risky assets and strategies into negative territory. To help minimize the magnitude of the losses when large downside moves occur, crash protection indicators that have had some success in helping investors cope with major carry-trade unwinds[15].

This section is organized in order to show five screen universe procedures. Portfolios in this study are rebalanced every three months (quarter) in a way that maintains the ascending or descending order criterions throughout the sample period — since December 1999 – December 2017. The dataset that have been used in screen universe process is from Bloomberg, Federal Reserve Economic Data (FRED) and CEIC Data.

4.1.1 Interest Rate Differential or Positive Carry Criteria

This criterion is ranking currencies on the basis of positive carry alone that is normally done by comparing relative yield spreads in the one-to-three-month maturity ranges, but there is no specific reason why another maturity selecting could not be chosen. This study, however, chooses three-month maturity range (three-month deposit rate) because most carry trades tend to be short-term, so comparing 3-month rates or shorter should be representative of the profits involved, that is similarly to Curcuru, Vega, & Hoek, 2010

[15] Rosenberg, M. R. (2013). *The Carry Trade - Theory, Strategy & Risk Management*: Bloomberg.

$$\Delta i_t = i^*_{m,t} - i_{us,t} \qquad (6)$$

where Δi_t = Interest rate differential of foreign currency relative to U.S.

$i^*_{m,t}$ = Currency m three-month deposit rate at time t

$i_{us,t}$ = U.S. three-month deposit rate at time t.

The author constructs portfolio sorted in increasing order of Δi_t , then, long in three highest Δi_t currencies and short in three lowest Δi_t currencies.

4.1.2 Carry-to-Risk Ratios Criteria

Unfortunately, ranking currencies on the basis of positive carry alone does have its disadvantages. Simply overweighting currencies that offer the highest yield does not guarantee that you are overweighting currencies that offer the highest risk-adjusted yield. Two currencies might offer the same positive carry relative to the U.S., but if one of those currencies exhibits a much higher level of volatility than the other versus the U.S. dollar, a risk-averse investor would tend to prefer investing in the currency exhibiting the lower level of volatility.

$$CTR_{m,t} = \frac{i^*_{m,t} - i_{us,t}}{\sigma_{m,t}} \qquad (7)$$

where $CTR_{m,t}$ = Carry-to-risk ratio of currency m at time t

$\sigma_{m,t}$ = Implied volatility of three-month at-the-money Option of currency m at time t

The author constructs portfolio sorted in increasing order of $CTR_{m,t}$ then long in three highest $CTR_{m,t}$ currencies and short in three lowest $\Delta CTR_{m,t}$ currencies.

4.1.3 Relative Yield-Curve Slopes or Relative Term Spreads Criteria

Relative yield-curve slopes capture the market's expectations of the future course of short-term interest-rate spreads in competing markets, as well as relative term premia, has also been an important driver of exchange-rate changes as well. Regarding the relative steepness of yield-curve slopes as a driver of currency returns, previous studies find that countries with relatively flat or inverted yield curves tend to see their currencies appreciate in value, while countries with relatively steep yield curves tend to see their currencies depreciate in value. The reason for this effect of the yield-curve slope on currency values owes to the fact that relatively flat or inverted yield curves are normally associated with tight monetary policies, which should be positive for a currency's value, and vice versa.

This criterion ranks currencies by using term spreads between 10-year and 3-month money market rate in each currency. The portfolio is going long currencies that have relatively flat yield curves (or lowest term spreads) and going short currencies that have relatively steep yield curves (or highest term spreads). This method is similarly to Ang & Chen, 2010 that said it has generated positive risk-adjusted returns overtime.

$$TS_{m,t} = MM_{m,t}^{10y} - MM_{m,t}^{3m} \quad (8)$$

where $TS_{m,t}$ = Term spread between 10-year and 3-month money market rate of country m at time t

$MM_{m,t}^{10y}$ = 10-year money market rate of country m at time t

$MM_{m,t}^{3m}$ = 3-month money market rate of country m at time t.

The author constructs portfolio sorted in descending order of $TS_{m,t}$ then long in three lowest $TS_{m,t}$currencies and short in three highest $TS_{m,t}$ currencies.

4.1.4 Change in Policy Rate Criteria

Research by Ang & Chen, 2010 found that ranking currencies by the change in short-term interest rates captures the impact of policy-rate adjustments on exchange-rate changes. They find that equally-weighted portfolio that going long currencies whose central banks have recently raised short-term interest rates and going short currencies whose central banks have recently lowered short-term interest rates has generated positive, risk-adjusted returns overtime. The author conducts this method to check that the result still the same as Ang & Chen, 2010, If the portfolios are constructed differently such as risk parity portfolio.

Two issues may occur among screening universe process by using policy rate adjusted. Firstly, there are some period that central bank in several countries adjust policy rate in the same magnitude such as in June 2002, Switzerland and Czech Republic decreased policy rate by 0.5 percent and 0.5 percent that is 3rd lowest policy-rate-adjusting, so that among two countries, the author combines level-consideration to the process that is Czech Republic's policy rate is 2.75 while Switzerland's policy rate is 1.25 so that Swiss Franc is suddenly opened short position. Secondly, policy rate level and policy rate adjusted are equally among each currency, I include money market rate to the process such as 3-month deposit rate.

$$PC_{m,t} = PR_{m,t} - \mathrm{PR}_{\mathrm{m,t-1}} \qquad (9)$$

where $PC_{m,t}$ = Policy change of country m at time t

$PR_{m,t}$ = Policy rate of country m at time t [16]

$PR_{m,t-1}$ = Three-month money market rate of country m at time $\mathrm{t}-1$

The author constructs portfolio sorted in ascending order of $\mathrm{PC}_{\mathrm{m,t}}$ then long in three highest $\mathrm{PC}_{\mathrm{m,t}}$ currencies and short in three lowest $\mathrm{PC}_{\mathrm{m,t}}$ currencies.

4.1.5 Valuation of currency or Purchasing Power Parity Criteria

The Purchasing Power Parity (PPP) theory of exchange rate determination asserts that the long-run trend in exchange rates is determined by cumulative differences in national inflation rates. In a PPP valuation strategy, an investor undertakes long positions in the most undervalued currencies and short positions in the most overvalued currencies[17].

PPP estimates are based on the price changes of comparable baskets of goods in each country. This is the case for the Organization for Economic Cooperation and Development's (OECD) annual PPP estimates, or on the price of a single good common to both countries, such as The Economist magazine's famous Big Mac PPP estimates. These are based on the relative prices of a Big Mac (McDonald's ubiquitous sandwich treat) among the various countries. So that, this criterion is using Big Mac Index from The Economist. The portfolio is going to long in most undervalued currencies and short in most overvalued currencies.

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[16] Period t means a period that portfolio rebalancing (next three months since period $t-1$)

[17] Rosenberg, M. R. (2013). *The Carry Trade - Theory, Strategy & Risk Management*: Bloomberg.

4.2 Weighting Strategies

In each portfolio, the author normalizes the size of the bet to 1 U.S. dollar. The only thing required in order for the carry trade to be fully funded is that the dollar amount allocated to the long and short positions must be equal.

4.2.1 Equally-Weighted Portfolio

Equal weight is typically assigned to each of the three currencies in the long and short baskets in previous studies — one-third weights are assigned to the three currencies in each basket—and no effort is made to allocate more weight to the highest or lowest yielding currencies that make up the long and short baskets. Furthermore, neither volatility nor cross-currency correlation considerations are taken into account in selecting the currency composition of the long and short baskets. This type of portfolio is denoted as EW. EW's is defined as;

$$w_{m,t}^{\mathrm{EW}} = \frac{1}{\mathrm{N}} \tag{10}$$

where $w_{m,t}^{\mathrm{EW}}$ = Optimal weight from equally-weighted approach

N = Number of currencies in portfolio

4.2.2 Risk Parity Portfolio

Investors, however, can assign different weight to each currency on their portfolio. In portfolio management field, risk parity is claimed to be a more powerful way to manage portfolio used by hedge funds. Maillard, Roncalli, & Roncalli, 2008 suggest that the risk parity approach can be done by using the ratio of the inverse of its volatility with the harmonic average of the volatilities. Follows the instruction, all elements in portfolio are adjusted (leveraged or deleveraged) to the same risk level. The portfolio is able to accomplish a higher Sharpe's ratio and become more effective in order to cope with market downturns than the traditional portfolio as well.

This type of portfolio is denoted as RP. RP's weight is defined as;

$$w_{m,t}^{\text{RP}} = \frac{\sigma_{m,t}^{-1}}{\sum_{n=1}^{N} \sigma_{j,t}^{-1}} \tag{11}$$

where $w_{m,t}^{\text{RP}}$ = Optimal weight from risk-parity approach

N = Number of currencies in portfolio

$\sigma_{m,t}^{-1}$ = Inverse volatility (standard deviation) of return of currency m at time t

$\sum_{n=1}^{N} \sigma_{j,t}^{-1}$ = Harmonic average of the volatilities

4.2.3 Optimization Portfolio

More effectively allocate investment portfolio, optimization portfolio is conducted in this research. The Markowitz framework can be applied to the currency market in a similar way by incorporating information on expected returns, currency volatility, and cross-currency correlations to derive an optimal mix of long and short currency positions that minimize portfolio risk subject to expected currency portfolio return. This portfolio is denoted as OP. The portfolio optimization problem can be written as

$$\min_{w_t} \quad w^T V w \tag{12}$$

$$\text{s.t.} \quad r^T w = R$$

$$\sum_{i}^{N} w_i = 1 \quad , \quad 0 \le w_i \le 1$$

where w = Vector of portfolio weights

V = Covariance matrix of the currency return in the portfolio

r^T = Vector of return of each currency

R = Return on the currency-portfolio

$w^T V w$ = Variance of currency-portfolio return

Readers might be question that why the author use currency portfolio in optimization process instead of carry trade portfolio. The reason is that the estimation of covariance matrix for the carry trade returns, is limited, because of data of three month deposit rate. Thus, the author uses optimization process for minimizing variance of currency return instead. This is still considered appropriate because one of the main determinants of the return of carry trade strategy is a change in currency value.

4.3 Return to Currency Carry Trade

In this research, each carry trade portfolio consists of 6 elements which take long position in 3 highest-yield currencies and short position in 3 lowest-yield currencies, called 3x3 portfolio. The carry trade return (or the excess return) equals the return on the long (high- yield) investments less the cost of borrowing in the short (low-yield) currencies, all in U.S. dollar terms (denoted as z_t^a: a refers to portfolio a) as follow:

$$z_t^a = LONG_t^a - SHORT_t^a \tag{13}$$

$$LONG_t^a = \left[\sum_{m=1}^{3} w_m \left(1 + \left(\frac{i_{m,t}}{4}\right)\right)\left(\frac{s_{m,t}}{s_{m,t-1}}\right)\right] - 1 \tag{14}$$

$$SHORT_t^a = \left[\sum_{n=1}^{3} w_n \left(1 + \left(\frac{i_{n,t}}{4}\right)\right)\left(\frac{s_{n,t}}{s_{n,t-1}}\right)\right] - 1 \tag{15}$$

Equation (14) and (15) are mathematical manner of the return on investing and cost of borrowing of portfolio a at time t, denoted as $LONG_t^a$ and $SHORT_t^a$: that equals to the weighted average of the interest-rate earned on denominated assets of the three highest-yield currencies times that change in each currency's value where i_m and i_n are three-month deposit rate of currency m and n at time t respectively[18] and $\left(\frac{s_{m,t}}{s_{m,t-1}}\right)$ and $\left(\frac{s_{n,t}}{s_{n,t-1}}\right)$ are the chage of spot exchange rates (4 p.m. closing quotes) of currency m and n respectively, against U.S. Dollar. All data of measuring the returns to carry trade are from Bloomberg.

[18] This study is using 3-month deposit due to the data of T-bill is limited in some country.

4.4 Estimation of Impact of Economic Policy Uncertainty

Christopher A. Sims (Sims, 1986) suggested using econometric policymaking models, problems can arise from the use of improper econometric processes. Vector Autoregressive has its advantage in order to reduce the problem, especially endogeneity problem and the model allows the uncertainties to be measured. Sims concludes by demonstrating a method for identifying a small macroeconomic in VAR model so that it can be used to analyze monetary policy. Sim's suggestion is constantly tested and VARs model becomes the most powerful time series econometric model that play an important role in evaluating alternative models until today.

Vector autoregression (VAR) is a random process model used to capture linear dependencies between multiple time series in which related systematically. The VAR model generally uses as the univariate autoregression model (AR model), more than one evolving variable incorporated to the model. Each variable has its evolutionary equation, depending on its own lag, the lag of the other variables, and error term. Modeling a VARs does not require much of background knowledge or theoretically relationship among the variable as do in structural models with simultaneous equations. Only requirement in VARs model is a list of variables can be hypothesized to affect each other intertemporally.

This paper examines the ability of Vector Autoregressive Models (VARs) to properly identify the influencing of economic policy uncertainty to carry trade excess return. Eichenbaum & Evans, 1995, for axample, used VARs model to identify that there is a persistancy and significant appreciations in nominal and real exchange rates of U.S. dollar and U. S. interest rates persistently deviate from uncovered interest rate after the contraction of U.S. monetary policy. While Jääskelä & Jennings 2011 applied VARs model to estimate the influence of monetary policy to macroeconomic variables to. Moreover, Brunnermeier, Nagel, & Pedersen, 2009 use VARs model for finding empirical result of shock of interest rate differential to the carry trade activity and the cumulative excess returns on carry trades as well. No doubt about it, this study conducts VARs model to estimate the response of EPU to carry trade excess return.

$$z_t^a = c_1 + A_1 z_{t-1}^a + \cdots + A_p z_{t-p}^a + B_1 EPU_{t-1}^m + \cdots +$$
$$B_p EPU_{t-p}^m + D_1 VIX_{t-1} + \cdots + D_p VIX_{t-p} +$$
$$E_0 \ln[WGDP_t] + e_{1t} \quad (16)$$
$$EPU_t^m = c_2 + F_1 z_{t-1}^a + \cdots + F_p z_{t-p}^a + G_1 EPU_{t-1}^m + \cdots +$$
$$G_p EPU_{t-p}^m + H_1 VIX_{t-1} + \cdots + H_p VIX_{t-p} +$$
$$E_1 \ln[WGDP_t] + e_{2t} \quad (17)$$

Equation (16) and (17) represent a p^{th} order VAR, denoted as $VAR(p)$ that has been used in this study where z_{t-p}^a is p -period lag of portfolio a's return, EPU_{t-p}^m is p -period lag of country m's EPU. The author adds the VIX index as an explanatory variable, VIX_{t-p}, for control global risk aversion $WGDP_t$ is a year over year, YoY, change on world gross domestic product (World GDP)[19]. This variable is used as an economic activity indicator, which is an exogeneous variable for this model. The optimal lag selection, Bayesian information criterion (BIC) or Schwarz criterion (also SBC, SBIC) is a criterion for selecting the optimality of variable lags among a finite set of models; the model with the lowest BIC is preferred.

Due to vector autoregression regularly include the estimation of numerous parameters. Generously, the parameters will bring down the degrees of freedom of the regression (the number of observations minus the number of). This can hurt the precision of the parameter assessments and subsequently of the expectation given by the model. Consequently, assessing the impact of EPU to return is done by 1-1 format[20].

The data of economic policy uncertainty index is from Baker, Bloom, & Davis, (2016). They construct an economic policy uncertainty index both overall and local. They used text-mining in news articles by searching the digital archives of each paper from January 1985 to 2009. They monthly count news-articles that contains the

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[19] Data is from Bloomberg, International Financial Statistics (IFS), IMF.

[20] For estimating impact of EPU to U.S., the author estimates VARs of equation (16) and (17) only EPU of U.S. and do the same process in other country.

all triple terms in economic, uncertainty and policy.[21] They standardized the raw count to obtain the index. Criteria is an article must contain terms in all three categories pertaining to uncertainty, the economy, and policy. They keep updating EPU on www.policyuncertainty.com. Now 22 countries' EPU indexes are contained in their website including Global EPU index.

4.5 Interpretation of Estimated Model

Interpretationof VARs is usually summarized using Impulse Response Function, structural analysis. The impulse response function (IRF) is its output when presented with a brief input signal, called an impulse. More generally, an impulse response is the reaction of any dynamic system in response to some external change. In both cases, the impulse response describes the reaction of the system as a function of time (or possibly as a function of some other independent variable that parameterizes the dynamic behavior of the system).

[21] "economic" or "economy"; "uncertain" or "uncertainty"; and one of the following policy terms: "congress", "deficit", "Federal Reserve", "legislation", "regulation" or "White House" (including variants like 'uncertainties', 'regulatory' or 'the Fed').

CHAPTER 5: EMPIRICAL RESULT

This chapter is organized by 5.1 The Performance of 45 Carry Trade Portfolios, 5.2 Vector Autoregressive Models: Specification of the model, 5.3 Economic Policy Uncertainties and Construction of Carry Trade Portfolio

5.1 The Performance of 45 Carry Trade Portfolios

In this section, the author has visualized the performance of carry trade portfolios. There are 45 portfolios from five screen universe processes, three subdivisions in sample and three weight strategies. To avoid confusing, portfolios are named precisely, refer to screen universe process, type of element in portfolio and weight methods as well. For example, *Yield Slope – RP – EM* represents a portfolio constructed by yield curve slope (term spread) criteria, consists only emerging market currency and risk parity conducted. This study calls *Positive Carry – EW – WS* as Benchmark Portfolio, a standard portfolio that many researches have been used to study the behavior of carry trade, whether Brunnermeier, Nagel et al. 2008, Clarida, Davis et al. 2009, Burnside, Eichenbaum et al. 2011and Husted, Rogers et al. 2017.

Figure 5 visualized Standard Deviation vs. Sharpe’s ratio of 45 carry trade portfolio. Color and size of the bubble show details about Annualized Return. The marks are labeled by Portfolio. *Positive Carry – OP – EM* has the most impressive performance with Sharpe’s ratio 0.88, Annualized Return 8.77 and Standard Deviation 9.93. Compared to the Benchmark Portfolio, MVO approach and investment in Emerging Country in carry trade quite successful. Surprisingly, the Risk Parity, more powerful way to manage portfolio used by hedge funds, may be not always yield satisfactory results in terms of managing the volatility of portfolios. *Positive Carry – RP – WS*, for example, comes with the highest standard deviation,13.61, and relative to Benchmark, they both are similar but only weight strategy is different, but the Benchmark offers a lower S.D., 11.124. For *Valuation - RP – AE*, Standard Deviation is as high as 9.083, but if compared to *Valuation - EW – AE*, Equally-Weighted offers higher Sharpe's Ratio, higher annualized return and lower Standard Deviation that definitely touching more than Risk Parity

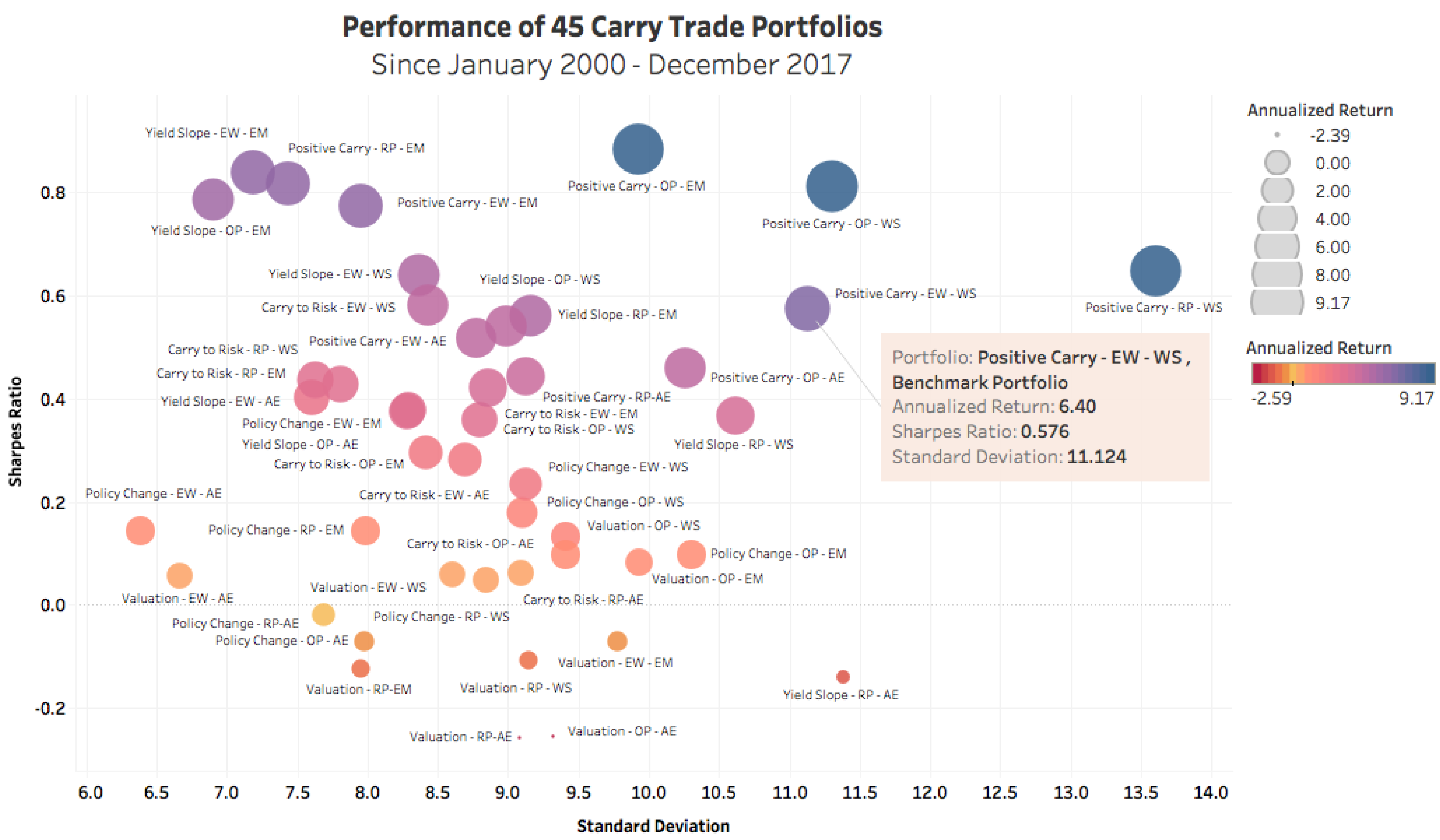


Figure 5: Performance of 45 Carry Trade Portfolios since January 2000 – December 2017

5.2 Vector Autoregressive Models: Specification of the model

This part is going to compare the results from Vector Autoregressive Model between two difference models in which included and excluded VIX index.

The VIX index is widely used as a barometer of global risk appetite and academic studies generally find that carry trades tend to perform poorly in periods when the VIX index is rising. Figure 6 is the illustration of the VIX index and cumulative return to carry trade on Benchmark Portfolio. It can be confirmed that in low volatility periods, the return should have been positive for carry-trade performance or vice versa.

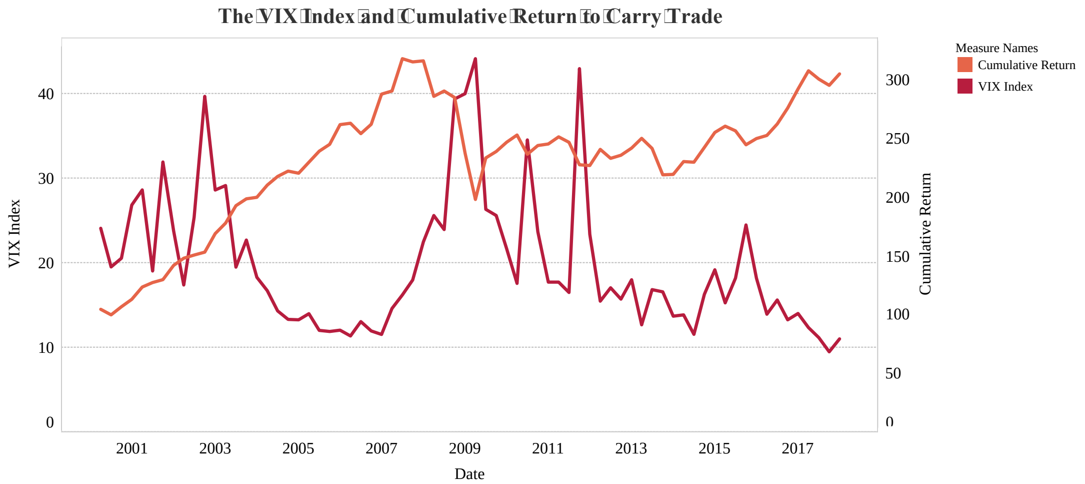


Figure 6: The VIX index and Cumulative Return to Carry Trade

To yield results, the author starts by fitting a basic VARs to quarterly data of Global, U.S., Eurozone and Japan economic policy uncertainty from March 2000 to December 2017. This study uses a Cholesky decomposition with the following ordering: the carry trade return, VIX index, the EPU index and uses the World GDP, an economic activity indicator, as an exogeneous variable. VAR specification includes one period lag of the carry trade return, VIX index and EPU index. All data using in this study are stationary, thus, the results obtained may not be spurious.[22]

[22] See the result for Unit Root and Granger Causality Test are in Appendix Table A-1 – A17

Figure 7 is the illustration of impulse response function from VARs for shocks to Benchmark Portfolio. It is clear that the basic character of the impulse response functions is robust to the modification of the specification, includes and excludes the VIX. Before controlling volatility in the U.S. Equity Market (VIX), return to carry trade tends to response positively to all four economic policy uncertainty shocks. After controlling global risk aversion, the results are in line with the previous one – the direction of the policy shock impact remains positive, just slightly shrink. This means that part of carry trade return volatility could be captured by VIX index – stocks market expectation.

Furthermore, the results suggest that the effect of policy uncertainty varies according to the originate of policy uncertainty. This study finds that the local policy shock is matter to carry trade than overall, especially in Japan and the United States. As a result of Japan and the United States are the world's major economic powers. The economic situation in the US and Japan has had a huge impact on other countries around the world. In addition, the result yields that Japan policy shock generates the most positive effect to the Benchmark Portfolio in both case. Owing to be that Japanese yen is used to be a funding currency in portfolio virtually the most.

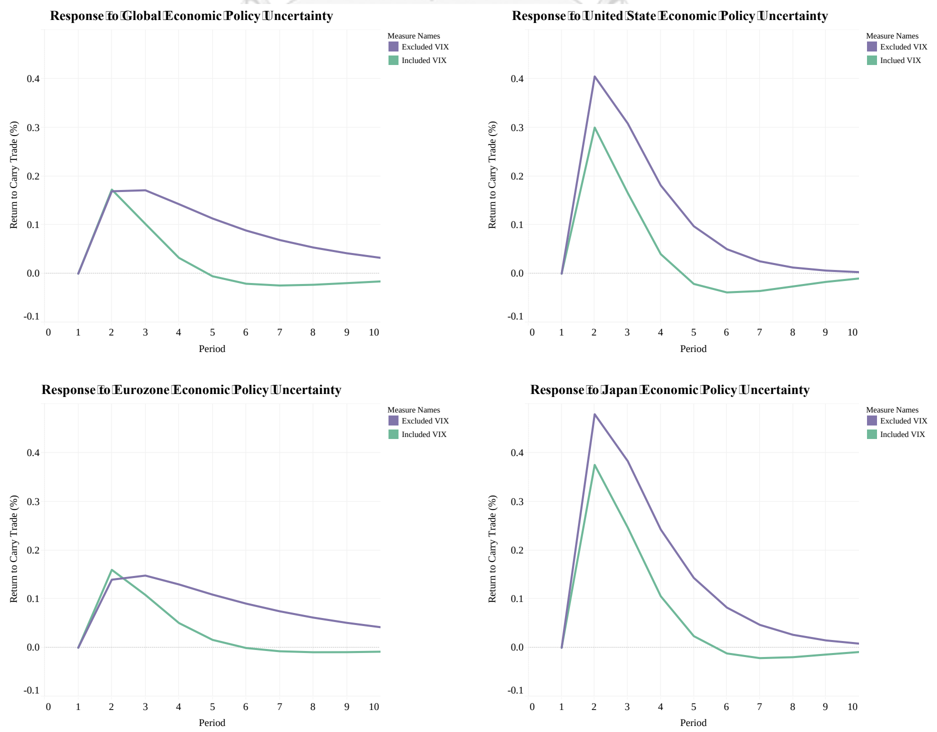


Figure 7: Impulse Response Function from VARs for shocks to Benchmark Portfolio

Figure 8 reports portfolio allocation of Benchmark Portfolio, finds that the Japanese yen is the main currency in portfolio flagrantly with exactly 59 times from all over 71 periods.

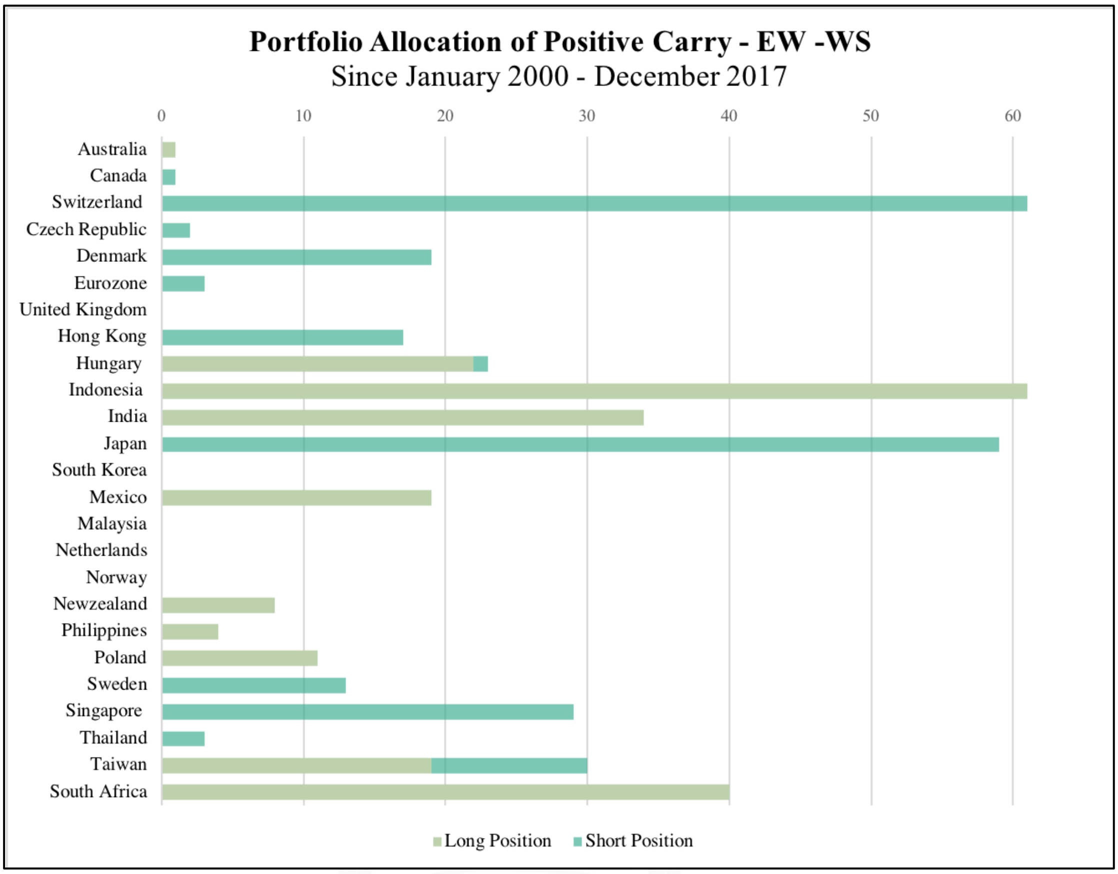


Figure 8: Portfolio Allocation of Positive Carry - EW -WS since January 2000 - December 2017

In Baker et al., 2016 shows a strong evident suggests that the innovation of an upward EPU or unexpected policy uncertainties, causes the worsening of real options effects, cost-of-capital effects or other mechanisms which capture macroeconomic performance. Besides, policy uncertainty catches the terrible news about the standpoint of economy that is not completely caught by alternate factors, and that awful news triggers an ascent in EPU that affects the economy. Consequently, if the fundamentals of any country are not conducive to economic activity thus it may result in the worsen in their currency. Clearly speaking that Japan EPU may cause a depreciation in yen.

The depreciation of short currency causes the return to carry trade increases. No doubtedly, why carry trade tends to yield another excess return after Japan policy shock occurs.

Noticeably, the responses of the carry trade excess return to Global and the Eurozone policy uncertainty are similar. Partly, as a result of the close relationship between these two uncertainties. The GEPU Index is a GDP- weighted average of national EPU indices for 19 countries: Australia, Brazil, Canada, Chile, China, *France*, *Germany*, India, Ireland, *Italy*, Japan, Mexico, the Netherlands, Russia, South Korea, *Spain*, Sweden, the *United Kingdom*, and the United States. The GEPU covered 5 European countries which may cause a highly correlation the two uncertainty-factors. Table 2 shows the correlations between economic policy uncertainties since January 2000 – December 2017. Global and Eurozone policy uncertainty is highly correlated over 0.9 even after Global Financial Crisis episode the correlation is still almost 1.

Table 2: The correlations between each of economic policy uncertainty since January 2000 – December 2017

Measure	Period	Uncertainty			
		Global	U.S.	EU	Japan
Global	Whole	1			
	After GFC	1			
U.S.	Whole	0.7673	1		
	After GFC	0.6017	1		
EU	Whole	0.9333	0.6948	1	
	After GFC	0.9044	0.5348	1	
Japan	Whole	0.6471	0.7284	0.5885	1
	After GFC	0.4238	0.5207	0.4312	1

* After Global Financial Crisis period is between January 2009 – December 2017

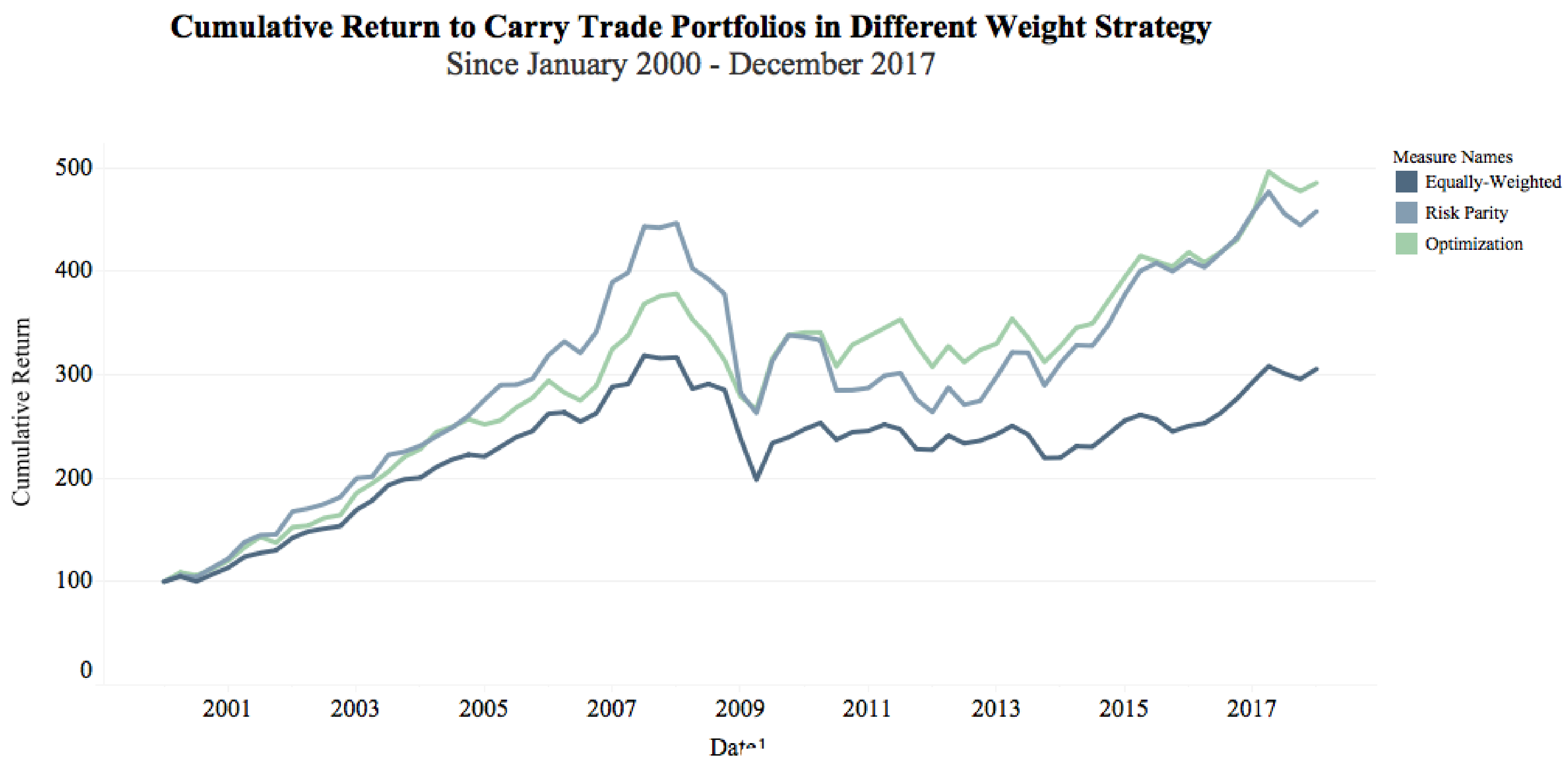
5.3 Economic Policy Uncertainties and Construction of Carry Trade Portfolio

There are numerous ways that investors can pursue carry-trade strategies in the FX market. The important hypothesis in this study is that economic policy uncertainty can generate different impacts to carry trade, depends on how investors construct portfolio. This section presents that the responses of carry trade excess return to policy shock vary according to portfolio constructing strategies. This section shows three possible differences. First, responding to economic policy uncertainty of carry trade return is different. Either If the portfolios adopt a weight strategy to determine the weight of each currency. Second, the response to the economic policy uncertainty of the return to carry trade varies, if the portfolios are made up from currencies that are in different countries, Advanced Economy, Emerging Country or both. Third, the response to economic policy uncertainty of return to carry trade are differ if the portfolios are made up by crash-protection indicators to help investors in order to manage risk.

This section is organized as follow; 1) Weight Strategies, Carry Trade and Economic Policy Uncertainty, 2) Sample Selection, Carry Trade and Economic Policy Uncertainty 3) Five Criterions, Carry Trade and Economic Policy Uncertainty

5.3.1 Weight Strategy, Carry Trade and Policy Uncertainty

This subsection presents a study of the effects of policy uncertainty on a carry trade strategy where weight strategy is used to determine the weight of the element in portfolio instead of equally-weighted. There are two weight strategies added: Risk Parity and Markowitz's Framework – Modern Portfolio Theory, (Markowitz, 1952). Figure 9 illustrates cumulative return to carry-trade portfolios in different weight strategies since January 2000 – December 2017. It is the evident that the use of weight strategy in carry trade can enhance the profitability of investors. The cumulative return to equally-weighted portfolio obviously lies below both risk parity and MVO approach. Risk parity looked even better since 2000 - 2007 than it did after Global Financial Crisis. Although, it is the best performance compared to the Benchmark Portfolio and Optimization Portfolio in pre-GFC, but it generates the most volatility, 13.61 (Table 3), and has a sharp drawdown approximately 25 percent of period return in GFC (2008). After GFC Mean-Variance-Optimization is quite successful in carry-trade, the Sharpe's ratio of the optimally-weighted portfolio strategy is substantially higher than the equally-weighted portfolio strategy, 0.81 (Table 3). Table 4 reports the correlation between 3 carry trade portfolios since January 2000 – December 2017.



The cumulative return of 3 carry trade portfolios since January 2000 - December 2017. Each portfolio using different weight strategies as follow;Equally-Weighted, Risk Parity and MVO Approach (Color assigned represents type of portfolio).

Figure 9: Cumulative Return to Carry-Trade Portfolios in Different Weight Strategy since January 2000 – December 2017

Table 3: Summary Statistics for 3 Carry-Trade Portfolios since January 2000 – December 2017

	Equally-Weighted	Risk Parity	MVO Approach
Annualized Return	6.40	8.82	9.17
Standard Deviation	11.12	13.61	11.30
Skewness	-0.82	-0.94	-0.07
Kurtosis	2.77	3.41	0.17
Sharpe's Ratio*	0.58	0.65	0.81

*Sharpe's ratio significant test reports in Table A-19 & A-20

Table 4: Correlations between 3 Carry Trade Portfolios since January 2000 – December 2017

Measure	Period	Portfolio		
		Equally-Weighted	Risk Parity	MVO
Equally-Weighted	Whole	1.00		
	After GFC*	1.00		
Risk Parity	Whole	0.86	1.00	
	After GFC	0.77	1.00	
MVO	Whole	0.85	0.88	1.00
	After GFC	0.84	0.86	1.00

* After Global Financial Crisis period is between January 2009 – December 2017

Figure 10 depicts the model-implied responses of three carry-trade return to an upward EPU and rely on a Cholesky decomposition to identify shocks. The result in this subsection suggests that there is an unclear mechanism for how policy uncertainty operates through the carry trade strategy. The basic character of the impulse response functions is still robust to two modifications of the specification, including and excluding VIX index (Figure A-1), only the responding of MVO approach to the U.S. EPU and is exception. Based on Vector Autoregressive Model, the direction of responding may different up to the originate of policy uncertainty and weight strategy. After using weight strategies, policy uncertainty seems to play a minor role on the carry-trade portfolio in which MVO Portfolio tend to be more sensitive than RP. Consequently, the introduction of a weight strategy into a carry trade not only increase investor profitability but portfolios also become more effective in order to cope with economic policy uncertainty, compares to Benchmark portfolio.

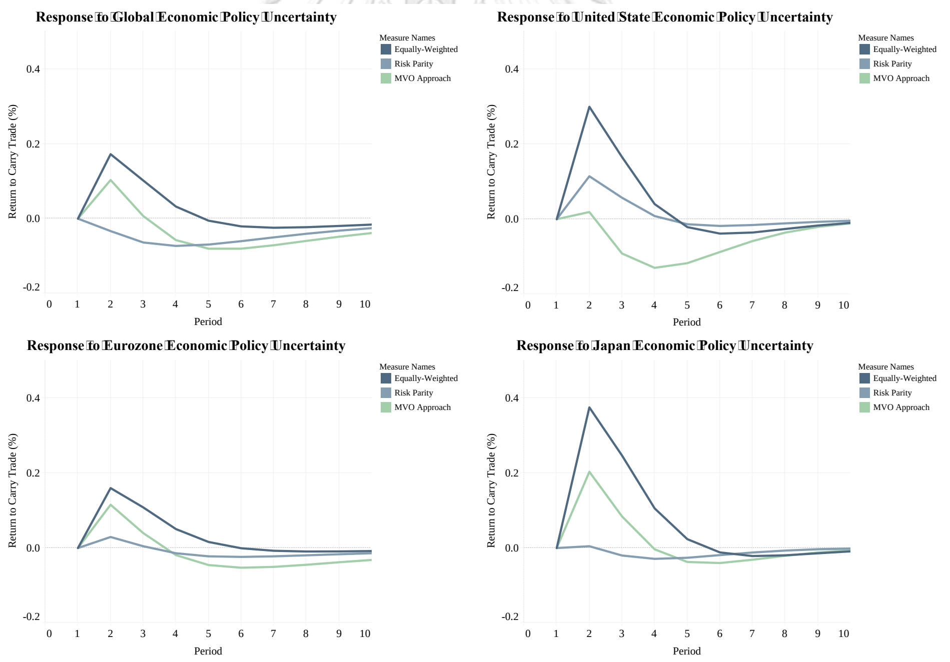
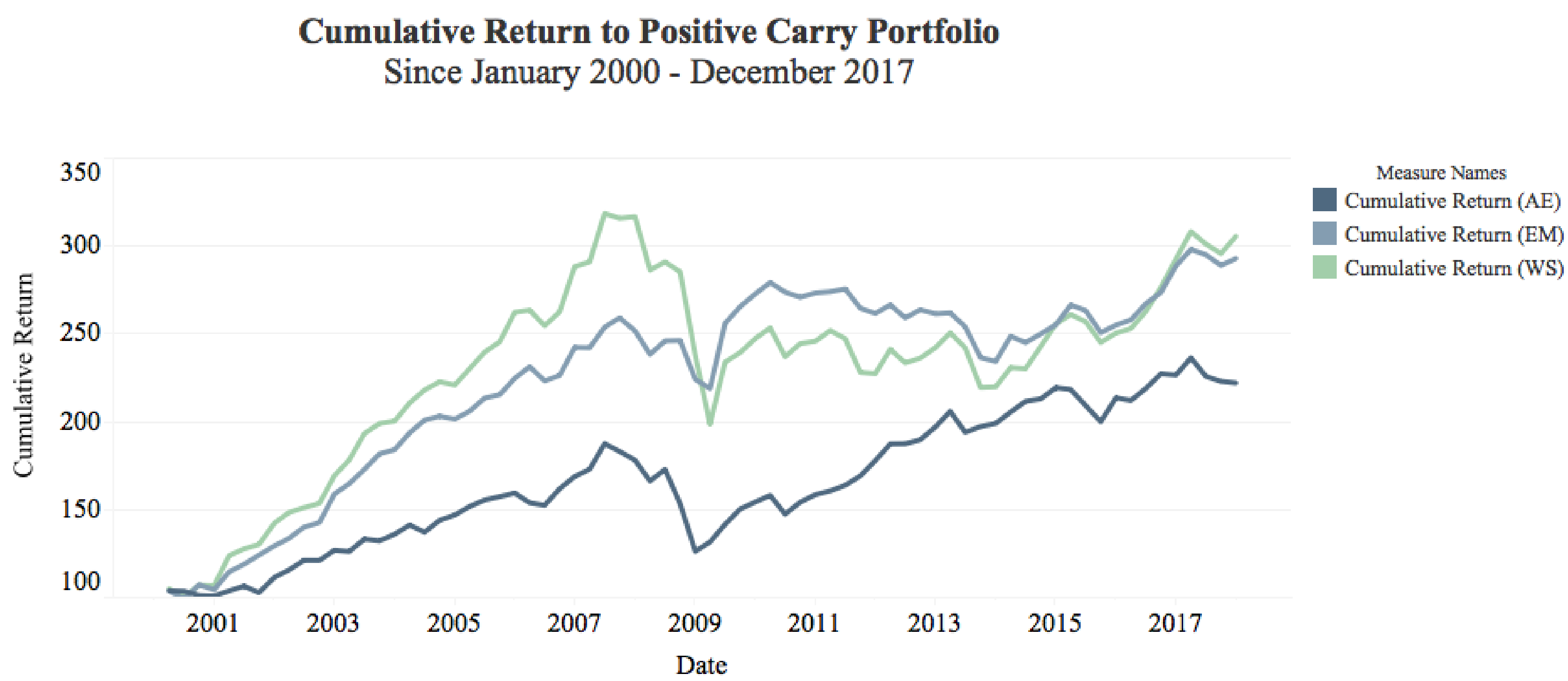


Figure 10: Impulse Response Function from VAR for shocks to Positive Carry Portfolio (EW, RP, OP)

5.3.2 Sample Selection, Carry Trade and Policy Uncertainty

This subsection turns to investigate the effects of policy uncertainty on a carry trade strategy where the portfolios are distinguished by type of currencies in portfolio. Motivate question for this part is how carry trade excess return responses to policy uncertainty, if the portfolios are made up from currencies that are in different countries, Advanced Economy, Emerging Country or both.

Figure 11 illustrates cumulative return to 3 *Positive Carry – EW* since January 2000 – December 2017. It can be seen that in a period of 2000 - 2007 carry trade in whole sample is relatively robust positive carry-trade. Moreover, diversified EM carry trades have only come into vogue in the past decade. Prior to that, many EM countries had experienced periodic crises involving currency crashes, debt defaults, and inflation spikes, which evidently discouraged investors in developed markets from actively pursuing carry-related strategies in EM currencies (Rosenberg, 2013). In 2008, well-known as the crash in carry-trade returns during the Global Financial Crisis – GFC, WS portfolio seems to be the most vulnerable to disaster while EM is impressive, a slight decline and higher rebound. Table 5 shows Summary Statistics for Positive Carry – EW since January 2000 – December 2017. Investment in EM is profitable for investors, which has generated an average annual excess return of 6.15 percent over this 17-year period, with an annualized volatility of return of 7.95 and an estimated Sharpe's ratio 0.77. Table 6 displays correlations between 3 carry trade portfolios since January 2000 – December 2017



The cumulative return of positive carry portfolio in different universe, Advanced Economy (AE), Emerginf Country (EM) and Both (WS) . Color assigned represents type of portfolio. Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the order criterions.

Figure 11: Cumulative Return to 3 Equally-Weighted Positive Carry Portfolios since January 2000 – December 2017

Table 5 : Summary Statistics for Positive Carry – EW since January 2000 – December 2017

	Whole Sample	Advanced Economy	Emerging Country
Annualized Return	6.40	4.53	6.15
Standard Deviation	11.12	8.77	7.95
Skewness	-0.82	-1.53	0.49
Kurtosis	2.77	4.26	2.77
Sharpe's Ratio*	0.58	0.52	0.77

*Sharpe's ratio significant test reports in Table A-21 & A-22

Table 6: Correlations between 3 carry trade portfolios since January 2000 – December 2017

Measure	Period	Portfolio		
		Advanced Economy	Emerging Country	Whole Sample
Advanced Economy	Whole	1		
	After GFC*	1		
Emerging Country	Whole	0.4781	1	
	After GFC	0.4355	1	
Whole Sample	Whole	0.5702	0.8597	1
	After GFC	0.4030	0.8297	1

* After Global Financial Crisis period is between January 2009 – December 2017

To yield the results, the author also considers VARs that include the VIX index to endogenize global risk aversion and EPU into the model and use the same type of Cholesky decomposition to identify shocks. Figure 12 depicts impulse response function from VARs for shocks to Positive Carry Portfolio (AE, EM, WS). The result shows that the responding of carry trade returns is different, depends on the type of element in portfolio and the originate of policy uncertainty. Carry trade strategy that focuses on emerging markets appears to be less sensitive to policy uncertainty shocks than advanced economy that may due to foreign exchange market intervention of EM's central banks.

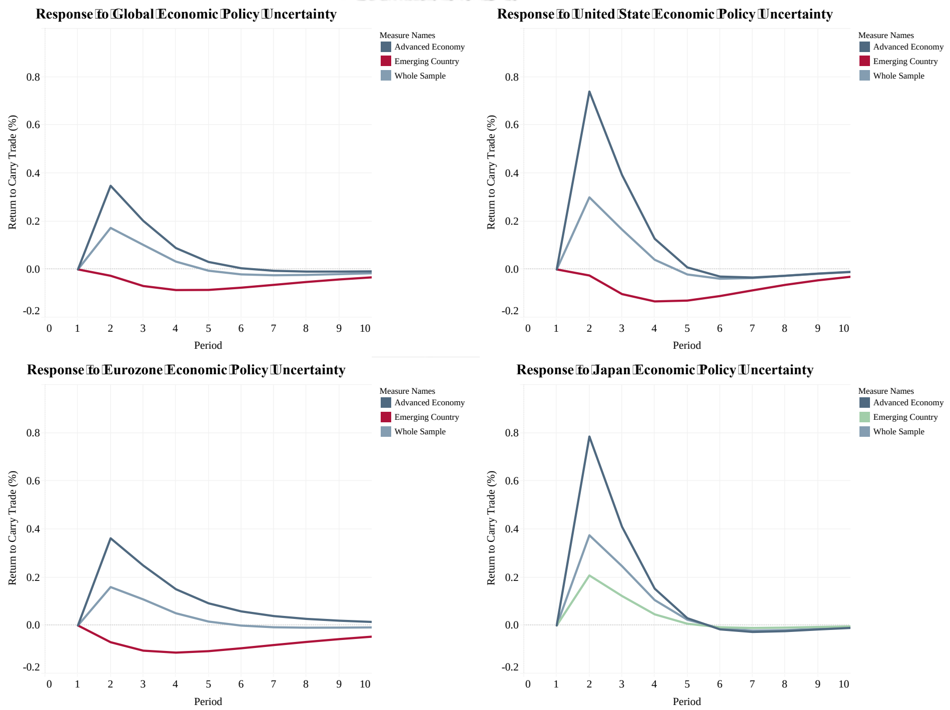


Figure 12: Impulse Response Function from VARs for shocks to Positive Carry Portfolio (AE, EM, WS)

A potential question is to what extent that carry trade return drives by changing in exchange rate and interest rate differential. Figure 13 and 14 shows period return decomposition of Advanced Economy and Emerging Country Portfolio. It can be seen that in both portfolio period returns and return from exchange rate are co-move along the period. Apparently, although the return on investment from carry trade is speculation on the spread of interest rates, but the fluctuations in returns come mainly from exchange rate movements. Data show that the exchange rate fluctuation of the Advanced Economy Portfolio is about 4.38 percent, while the port of Emerging Country is approximately 3.74 percent which are significantly different at the 90 percent confidence level. One of the motive reasons for the behavior is that in emerging country, central bankers jump into foreign exchange market to intervene their currencies more often than advanced economy.

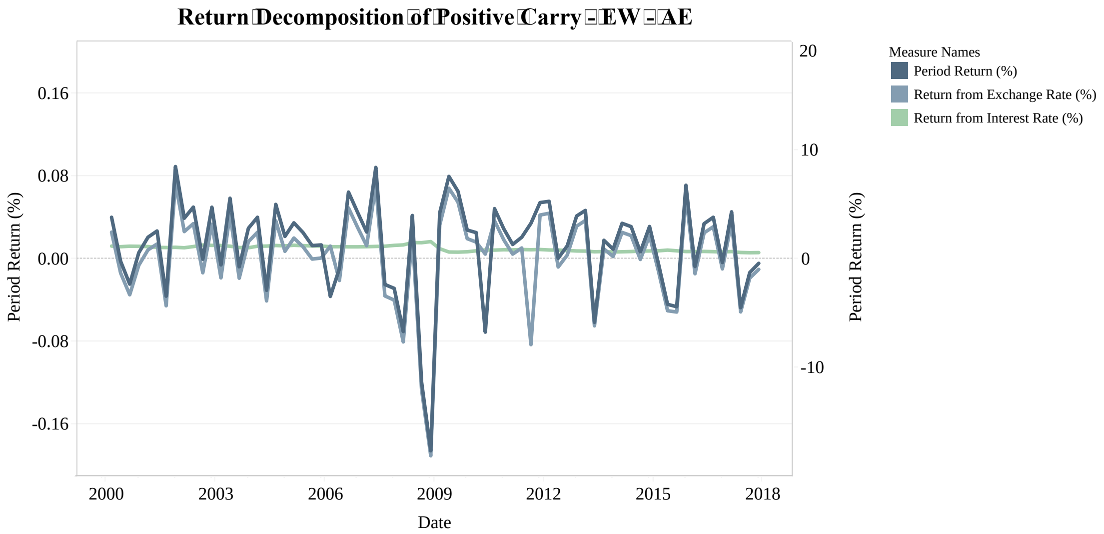


Figure 13 : Period Return Decomposition of Advanced Economy Portfolio

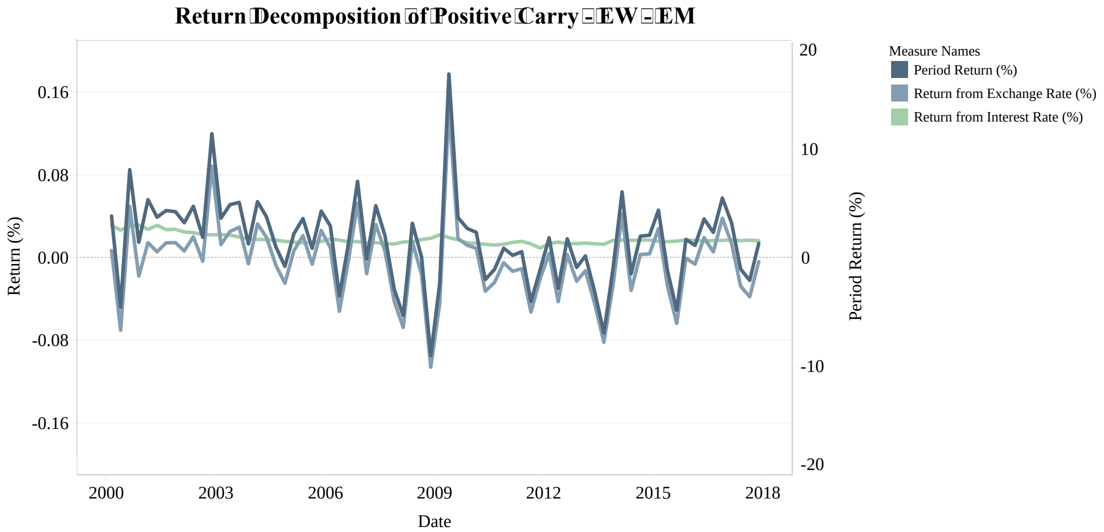


Figure 14 : Period Return Decomposition of Emerging Country Portfolio

Table 7 shows exchange rate classification over 2000 – 2017 on each country. Ilzetzki, Reinhart, & Rogoff, 2017 provides a comprehensive history of anchor or reference currencies, exchange rate arrangements, and peerform a new algorithm for jointly determining a country's anchor currency and its degree of exchange rate flexibility. The currencies selected in the table are the most used to construct portfolios (Figure A-2 and A-3). It is obvious that central banks in emerging country try to stabilize the exchagnge rate more than the advanced economy does. Perhaps this result, invest in EM currencies less sensitive to policy uncertainty, is unsurprising. The more central intervene, the less volatilie of exchange rate or vice versa.

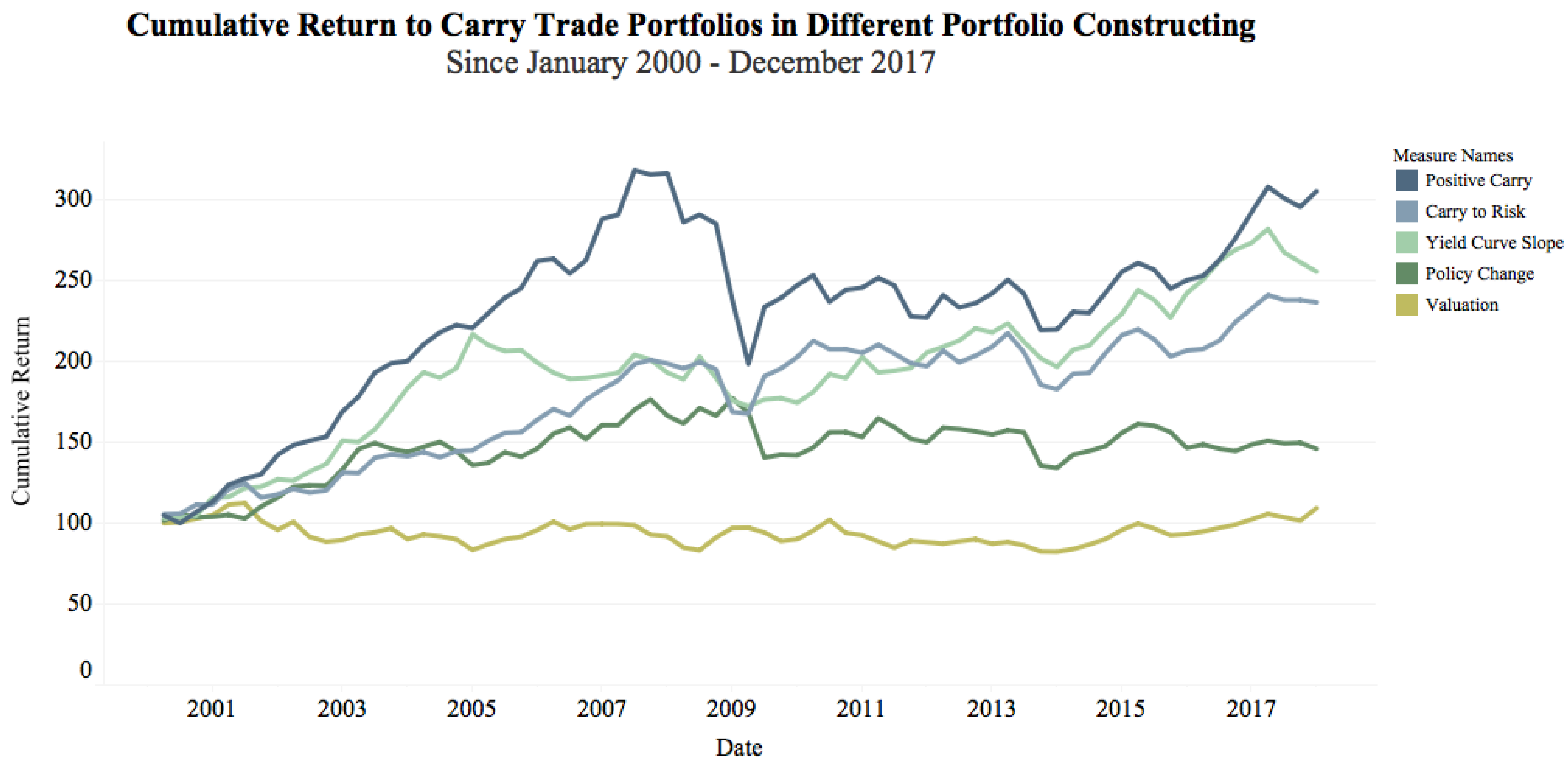
Table 7: Exchange Rate Classification (Ilzetzki, Reinhart, & Rogoff, 2017)

Advanced Economy	**De Facto (2000 - 2017)**
Japan	Freely floating
Australia	Freely floating
United Kingdom	Moving band Managed floating Freely floating
Emerging Country	**De Facto (2000 - 2017)**
India	Crawling band Managed floating
South Africa	De facto moving band +/-5% Managed floating
Thailand	Moving band that is narrower than or equal to +/-2% (i.e., allows for both appreciation and depreciation over time)

5.3.3 Five Criteria, Carry Trade and Policy Uncertainty

Husted, Rogers et al. 2017 using Benchmark Portfolio to study correlation between carry trade excess return and uncertainty. Their result suggested that an increase in uncertainty regarding the U.S. economy increases investors' risk aversion, which in turn, drives up the expected returns in the FX market. Beyond to their study, only positive carry applied, this study, the author adds four more approaches to be a criterion in order to screen universe, 1. Carry-to-Risk, 2. Yield Slope, 3. Policy Change and 4. Valuation, to see whether carry trade return responds to policy shock differently if the portfolio is constructed with risk-management indicators.

Figure 15 depicts the cumulative return of 5 carry trade portfolios and Table 8 represents summary statistic for each portfolio. Each portfolio is constructed differently follow Positive Carry, carry-to-risk, Yield Slope, Policy Change and Valuation criterions (Color assigned represents type of portfolio). Each portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the ascending or descending order criterions. Overall, it can be seen that although investors could have earned a risk premium or positive excess return overtime, that positive excess return would only have been earned if investors had the capital, patience, and risk tolerance to re-enter carry-trades after suffering a large loss for gaining a final profit. Risk-Management system seems to help investors to manage volatility of their portfolio, for example, screening an element base on a carry-to-risk ratio *(Carry to Risk – EW – WS)*, comparing to Benchmark Portfolio, has had some success in reducing both the volatility of return on carry-trade portfolios and the negative skew in the distribution of carry-trade returns, also increasing the size of Sharpe's ratio. Although the Benchmark Portfolio gains the highest Annualized Return but in the same time it has got the highest portfolio volatility as well.



The cumulative return of 5 carry trade portfolios. Each portfolio is constructed differently follow Positive Carry, Carry to Risk, Yield Slope, Policy Change and Valuation criterions (Color assigned represents type of portfolio). Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the ascending or descending order criterions.

Figure 15: Cumulative Return to Carry-Trade Portfolios in Different Portfolio Constructing since January 2000 – December 2017

From Table 8, clearly speaking that the distribution of global carry-trade returns does not conform to a normal distribution, but rather tends to be more peaked at the center with fatter tails that are negatively skewed. The negative skew and fat tails indicate that carry trades have tended to experience more frequent and larger losses than would have occurred had the distribution of returns been normal. The more peaked distribution at the center or around the mean return implies that carry trades have typically generated a larger than normal amount of trades that have resulted in small gains. *Policy Change – EW – WS* perform almost the worsen performance with a heavily negative skew which reflect the tendency for portfolio to experience periodic crashes, apparently in GFC that contradict with Ang & Chen, 2010, which suggest that going long currencies whose central banks have recently raised short-term interest rates and going short currencies whose central banks have recently lowered short-term interest rates has generated positive, risk-adjusted returns overtime. Thus, risk-management system does not guarantee that investors always earn a higher Sharpe's ratio.

Yield *Slope – EW – WS* seems to be the best performance, in this case, which perform the best with 0.64 Sharpe's ratio, less Standard Deviation 8.37 and heavily skew to the right, positive skew that consistent with Ang & Chen, 2010 suggested yield slope strategy results in portfolio strategies with high Sharpe's ratio, and returns that are less negatively skewed (positively skew in this study). *Valuation – EW – WS* seems to have the worst performance compared to other crash-protection indicators. Over GFC, however, it was hardly affected, so overall the port would not be attractive to investors but the port still doing well in disaster.

Table 8: Summary Statistics for 5 Carry-Trade Portfolios since January 2000 – December 2017

	Positive Carry	Carry to Risk	Yield Slope	Policy Change	Valuation
Annualized Return	6.40	4.91	5.36	2.13	0.51
Standard Deviation	11.12	8.43	8.37	9.12	8.60
Skewness	-0.82	-0.48	0.17	-0.90	-0.31
Kurtosis	2.77	2.27	-0.44	2.40	-0.42
Sharpe's Ratio	0.575	0.582	0.64	0.23	0.06

*Sharpe’s ratio significant test reports in Table A-23 - 26

The result in this subsection is from Vector Autoregressive Model again. Figure 16 represents impulse response function from VARs for shocks to 5 carry-trade portfolios. The result in this part clearly confirms that relationship between economic policy uncertainty and currency carry trade is ambiguous, depends on portfolio constructing. The author cannot conclude only one conclusion on the relationship of these two factors.

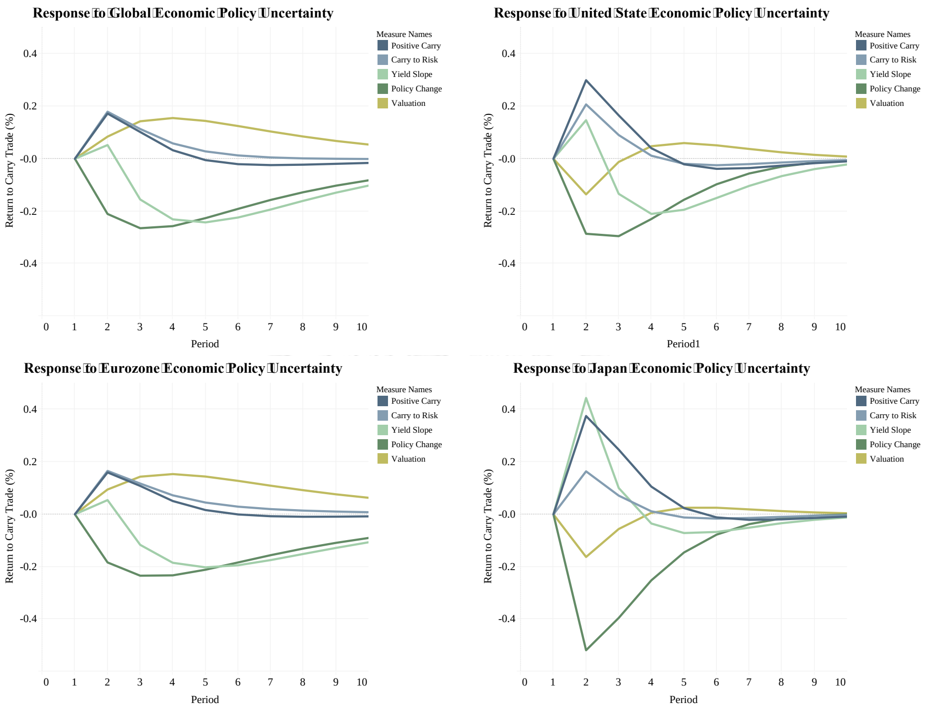


Figure 16: Impulse Response Function from VARs for shocks to 5 Carry-Trade Portfolios

The reason for the twofold of the effect of policy uncertainty to carry trade strategy can be explained by the correlation coefficient between variables. Table 9 – Table 11, report the correlations between all of carry trade excess returns in five risk-management portfolio and four economic policy uncertainty measures since January 2000 – December 2017 Portfolio, after Global Financial Crisis period is between January 2009 – December 2017. There are both decreasing and increasing in correlation coefficients between all of carry trade return and between portfolio return and economic policy uncertainty after the Global Financial Crisis, while the correlation coefficients between policy uncertainty fell noticeably after Global Financial Crisis. Thus, the author does not cover an equivocally clear mechanism for how economic policy uncertainty works through the carry trade strategy. The result consists with Husted, Rogers, & Sun, 2017. Although, they found that economic policy uncertainty from the United States can enhanced the profitability of carry-trade investor, but they also found the effects of U.S. policy shock is small and less significant during zero-lowered-bound episode compared to the whole period. As a result of among the ZLB era, the correlations between all uncertainty measures (financial uncertainty, macroeconomic uncertainty and monetary policy uncertainty) drop noticeably. Thus, they also could not conclude a clear relationship between monetary policy uncertainty and carry trade strategy.

Table 9: The correlations between each of economic policy uncertainty since January 2000 – December 2017

Measure	Period	Uncertainty			
		Global	U.S.	EU	Japan
Global	Whole	1			
	After GFC	1			
U.S.	Whole	0.7673	1		
	After GFC	0.6017	1		
EU	Whole	0.9333	0.6948	1	
	After GFC	0.9044	0.5348	1	
Japan	Whole	0.6471	0.7284	0.5885	1
	After GFC	0.4238	0.5207	0.4312	1

* After Global Financial Crisis period is between January 2009 – December 2017

Table 10: The correlations between each of carry-trade portfolio (only in case of risk-management portfolio) since January 2000 – December 2017

Measure	Period	Portfolio				
		Positive Carry	Carry to Risk	Yield Slope	Policy change	Valuation
Positive Carry	Whole	1				
	After GFC*	1				
Carry to Risk	Whole	0.7875	1			
	After GFC	0.8184	1			
Yield Slope	Whole	0.3997	0.3916	1		
	After GFC	0.3613	0.4589	1		
Policy change	Whole	0.1588	0.0744	0.0735	1	
	After GFC	0.0836	0.1386	0.2199	1	
Valuation	Whole	0.0911	0.2411	-0.0215	0.203	1
	After GFC	0.0679	0.2299	0.5202	0.3261	1

* After Global Financial Crisis period is between January 2009 – December 2017

Table 11: The correlations between each of carry-trade portfolio (only in case of risk-management portfolio) and economic policy uncertainty since January 2000 – December 2017

Measure		Period	Portfolio				
			Positive Carry	Carry to Risk	Yield Slope	Policy change	Valuation
Policy Uncertainty	Global	Whole	-0.173	-0.178	-0.05	-0.0373	0.1146
		After GFC*	0.0093	0.0011	0.0464	0.022	0.2109
	U.S.	Whole	-0.2752	-0.3023	-0.055	-0.0424	-0.0067
		After GFC	-0.3353	-0.2303	-0.1143	-0.1541	-0.0452
	EU	Whole	-0.1298	-0.1601	-0.0083	-0.0527	0.0812
		After GFC	0.0424	-0.0619	0.113	0.0652	0.2361
	Japan	Whole	-0.2737	-0.19	0.0143	0.0101	0.0579
		After GFC	-0.1641	-0.0269	0.2118	-0.0286	0.0424

* After Global Financial Crisis period is between January 2009 – December 2017

In addition, the Policy Change Portfolio gives only one conclusion that is regardless of whether the portfolios are distinguished by any sample groups or any weight strategies or any originates of uncertainty the response of the return is always negative (Figure 17) because policy uncertainty is closely related in terms of policy changes. Therefore, the selection of the risk management indicator in the screen universe process must be very specific, depends on the purpose and perspective of the investor in order to prevent the risk.

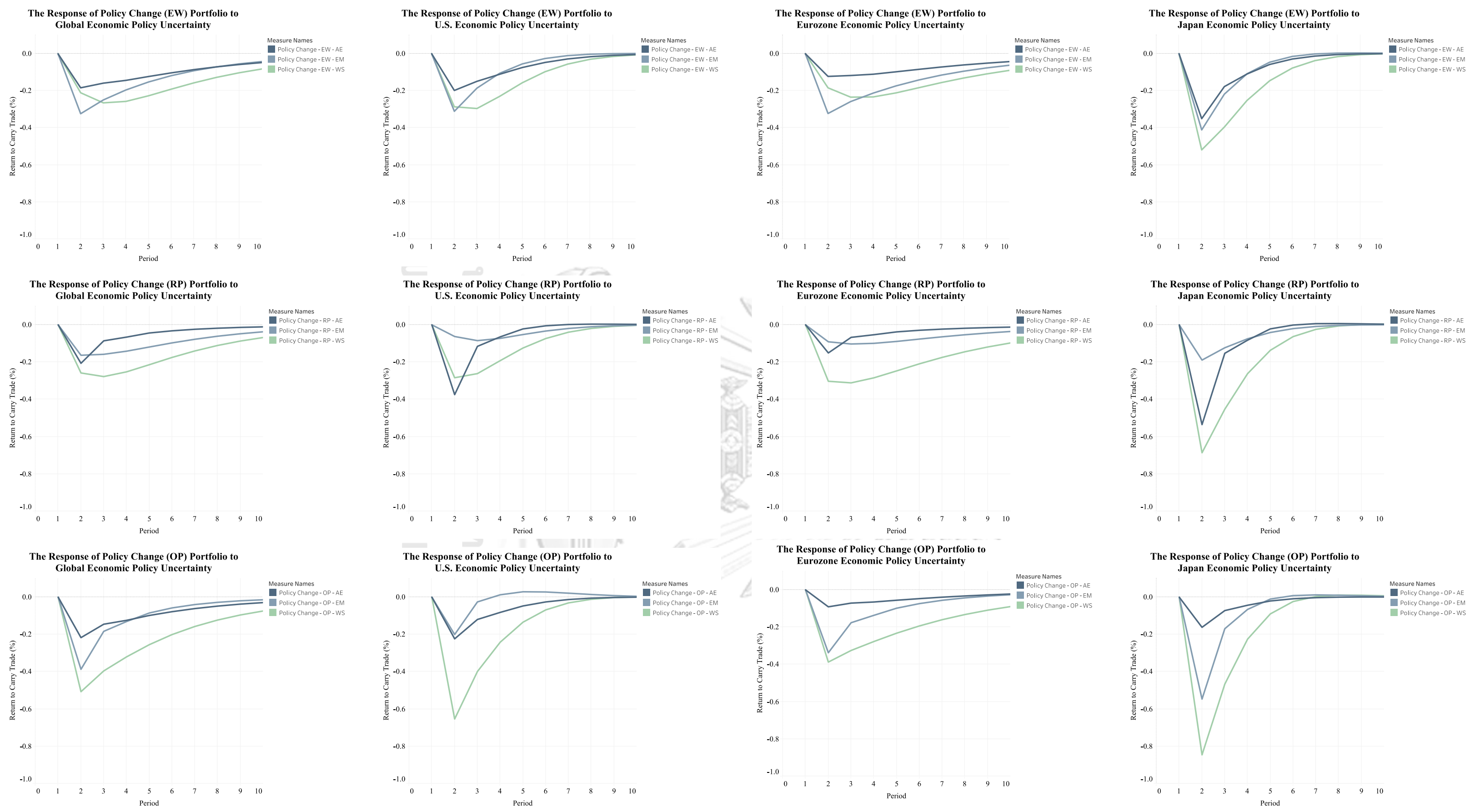


Figure 17: Impulse Response Function from VARs for shocks to Policy Change Portfolios

CHAPTER 6: CONCLUSION

In this article, the author has demonstrated that whether the economic policy uncertainty affects carry trade excess return differently, if carry trade portfolios are constructed in different way. The Vector Autoregressive Model (VARs) is used to find the words, impulse response function has been used to interpret VARs model. In this study, the three main themes are: 1) The response to the economic policy uncertainty of the return to carry trade varies, if the portfolios are made up from currencies that are in different countries, Advanced Economy, Emerging Country or both. 2) Responding to economic policy uncertainty of carry trade return is different. Either If the portfolios adopt a weight strategy to determine the weight of each currency, 3) Does the response to economic policy uncertainty of return to carry trade differ if the portfolios are made up by crash-protection indicators to help investors in order to manage risk.

As illustrated, all the results offer potential assessing the role of policy uncertainty to carry trade excess return, at least as perceived by contemporary observers. Based on vector autoregressive model, it is found that US and Japan economic policy uncertainties have most impact on carry trade return. However, direction of such impact is ambiguous, depending on how carry trade portfolio has been formed. This is in contrast with the literature. Interestingly, the paper finds that carry trade strategy that focuses on emerging markets appears to be less sensitive to policy uncertainty shocks. The author also explores that the volatility to carry trade return is driven by volatility of exchange rate return.

There is a clear concern that carry-trade activities might be playing a major role in generating exchange-rate misalignments and financial bubbles around the world. As carry-trade activities have become a more important part of the FX landscape, there exists a risk that a global search for yield could drive high-yield currencies deep into overvalued territory, which could have serious negative consequences for economic activity in such markets. In that environment, monetary authorities in high-yield markets might feel compelled to resort to capital controls to stem the inflow of foreign capital into their markets to prevent an undesired appreciate on of their currencies or a rise in domestic asset prices in general.

In case of Thailand, since the author educated in carry trade, found that in 18 of the 20 quarters through the second quarter of 1997, carry trade was profitable, the pegged exchange rate ruling out large exchange rate surprises. Notwithstanding the stability of the Thai baht, a growing number of investors began to worry that the period of financial stability might be drawing to a close. The first episode of pressure on the currency as in July 1996, following the collapse of the Bangkok Bank of Commerce and the central's bank injection of liquidity to support the financial system. The second episode was in early 1997, following the release in January of disappointing fiscal and export performance. International investors who were important players in the carry trade began closing out their positions. At this stage, the liquidation of long positions in Thai securities by domestic corporates and banks, proprietary trading desks of commercial and investment banks, treasuries and foreign exchange desks of the major money center banks. Mutual funds, hedge funds, and retail investors was probably more important that short sales in weakening the baht.[23]

By and large, foreign interventions objective is to construct a preferable state to the societies from the standpoint of central bankers. Sometimes, it might not possibly line up with what those in the outside society see as a favored situation. Apart of this study, the author conjectures that foreign intervention drive return to carry trade in emerging country become the best perform. EM currencies offer higher Sharpe's ratio with positive skewness, lower kurtosis and less response to policy uncertainties. Thus, for the perspective of FX market participants, EM currencies may become such an attractive choice to invest because they do not have to worry as much about exchange rate risk. If so, should policymakers still interfere in foreign exchange market while the carry-trade activity still dancing? This is a good research question for researching in the future.

[23] See Jansen et al., 1998 for more detail about carry trade activity in emerging market.

REFERENCES

Ang, A., & Chen, J. (2010). Yield Curve Predictors of Foreign Exchange Returns. from SSRN

Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring Economic Policy Uncertainty. *The Quarterly Journal of Economics, 131*(4), 1593–1636.

BIS Quarterly Review. (2009). Retrieved from Bank of International Settlements:

Brunnermeier, M. K., Nagel, S., & Pedersen, L. H. (2008). Carry trades and currency crashes. *NBER Macroeconomics Annual, 23*(1), 313-348.

Burnside, C. (2012). Carry Trades and Risk. In J. James, I. W. Marsh, & L. Sarno (Eds.), *Handbook of Exchange Rates*. Hoboken: Wiley.

Burnside, C., Eichenbaum, M., Kleshchelski, I., & Rebelo, S. (2006). The Returns to Currency Speculation. Retrieved from

Burnside, C., Eichenbaum, M., & Rebel, S. (2011). Carry Trade and Momentum in Currency Markets *Annual Review of Financial Economics, 3*, 511-535.

Burnside, C., Eichenbaum, M., & Rebelo, S. (2007). The Returns to Currency Speculation in Emerging Markets. *American Economic Review, 97*(2), 333-338.

CARRY TRADES AND EXCHANGE RATES. (2010). Retrieved from European Central Bank:

Clarida, R., Davis, J., & Pedersen, N. (2009). Currency carry trade regimes: Beyond the Fama regression. *Journal of International Money and Finance, 28*(8), 1375-1389.

Cooper, W. H. (2014). *U.S.-Japan Economic Relations: Significance, Prospects, and Policy Options*. Retrieved from

Cumby, R. E., & Obstfeld, M. (1981). A note on exchange-rate expectations and nominal interest differentials: A test of the Fisher hypothesis. *The journal of finance, 36*(3), 697-703.

Curcuru, S., Vega, C., & Hoek, J. (2010). Measuring Carry Trade Activity. *IFC Bulletin, 25*, 436.

DeMiguel, V., Garlappi, L., & Uppal, R. (2007). Optimal Versus Naive Diversification: How Inefficient is the 1/N Portfolio Strategy? *The Review of Financial Studies, 22*(5), 1915-1953.

Eichenbaum, M., & Evans, C. L. (1995). Some Empirical Evidence on the Effects of Shocks to Monetary Policy on Exchange Rates. *The Quarterly Journal of Economics, 110*(4), 975–1009.

Fama, E. F. (1984). Forward and spot exchange rates. *Journal of monetary economics, 14*(3), 319-338.

Froot, K. A., Scharfstein, D. S., & Stein, J. C. (1992). Herd on the Street: Informational Inefficiencies in a Market with Short-Term Speculation. *The journal of finance, 47*(4), 1461-1484.

Hansen, L. P., & Hodrick, R. J. (1980). Forward exchange rates as optimal predictors of future spot rates: An econometric analysis. *Journal of Political Economy, 88*(5), 829-853.

Husted, L., Rogers, J., & Sun, B. (2016). Measuring monetary policy uncertainty: the federal reserve, January 1985-January 2016. from Board of Governors of the Federal Reserve System (US)

Husted, L., Rogers, J., & Sun, B. (2017). Uncertainty, currency excess returns, and risk reversals. *Journal of International Money and Finance*.

Ilzetzki, E., Reinhart, C. M., & Rogoff, K. S. (2017). *THE COUNTRY CHRONOLOGIES TO EXCHANGE RATE ARRANGEMENTS INTO THE 21ST CENTURY: WILL THE ANCHOR CURRENCY HOLD?* NBER WORKING PAPER SERIES.

Interest rate parity. Retrieved from https://en.wikipedia.org/wiki?curid=2406246

Jääskelä, J. P., & Jennings, D. (2011). Monetary policy and the exchange rate: Evaluation of VAR models. *Journal of International Money and Finance, 30*(7), 1358-1374.

Jansen, A., Mathieson, D. J., Eichengreen, B. J., Kodres, L. E., Chadha, B., & Sharma, S. (1998). *Hedge Funds and Financial Market Dynamics* International Monetary Fund.

Jobson, J. D., & Korkie, B. M. (1981). Performance Hypothesis Testing with the Sharpe and Treynor Measures. *The journal of finance, 36*(4), 889-908.

Jurado, K., Ludvigson, S. C., & Ng, S. (2015). Measuring Uncertainty. *American Economic Review, 105*(3), 1177-1216.

Lustig, H., Roussanov, N., & Verdelhan, A. (2011). Common Risk Factors in Currency Markets. *The Review of Financial Studies, 24*(11), 3731–3777.

Maillard, S., Roncalli, T., & Roncalli, T. (2008). On the Properties of Equally-Weighted Risk Contributions Portfolios. *The Journal of Portfolio Management, 36*(4), 60-70.

Markowitz, H. (1952). PORTFOLIO SELECTION. *The journal of finance, 7*(1), 77-91.

McCauley, R. N., & McGuire, P. (2009). Dollar appreciation in 2008: safe haven, carry trades, dollar shortage and overhedging. *BIS Quarterly Review*, 88.

Meese, R. A., & Rogoff, K. (1983). Empirical exchange rate models of the seventies: Do they fit out of sample ? *Journal of International Economics*, *14*(1-2), 3-24.

Menkhoff, L., Sarno, L., Schmeling, M., & Schrimpf, A. (2012). Carry trades and global foreign exchange volatility. *The journal of finance, 67*(2), 681-718.

Portfolio optimization. Retrieved from https://en.wikipedia.org/wiki/Portfolio_optimization

Purchasing power parity. Retrieved from https://en.wikipedia.org/wiki/Purchasing_power_parity

Rafferty, B. (2012). Currency Returns, Skewness and Crash Risk. Retrieved from https://ssrn.com/abstract=2022920

Rosenberg, M. R. (2013). *The Carry Trade - Theory, Strategy & Risk Management*: Bloomberg.

Sharpe, W. F. (1966). Mutual fund performance. *The Journal of business, 39*(1), 119-138.

Sims, C. A. (1986). Are forecasting models usable for policy analysis? *Federal Reserve Bank of Minneapolis Quarterly Review, Winter*, 2-16.

Singapore dollar. Retrieved from https://www.tititudorancea.com/z/singapore_dollar_04.htm

APPENDIX

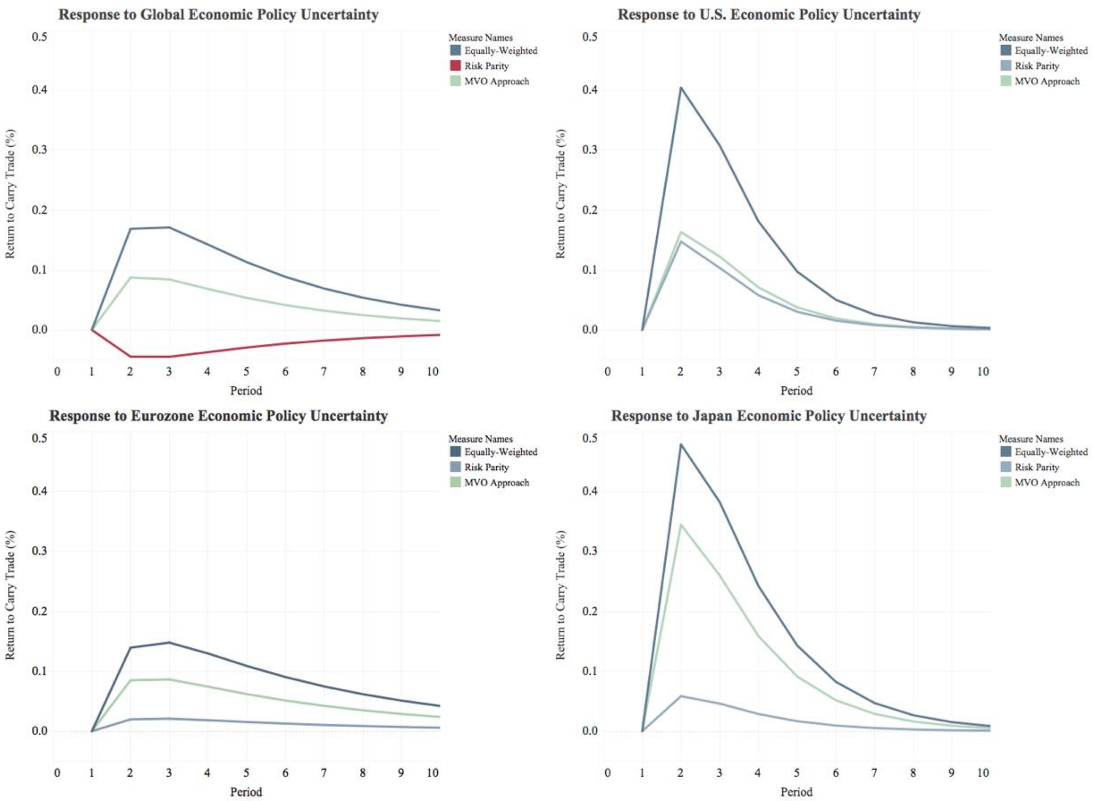


Figure A-1: Impulse Response Function, excluding VIX index, from VARs for Shocks to Positive Carry Portfolio (EW, RP, OP)

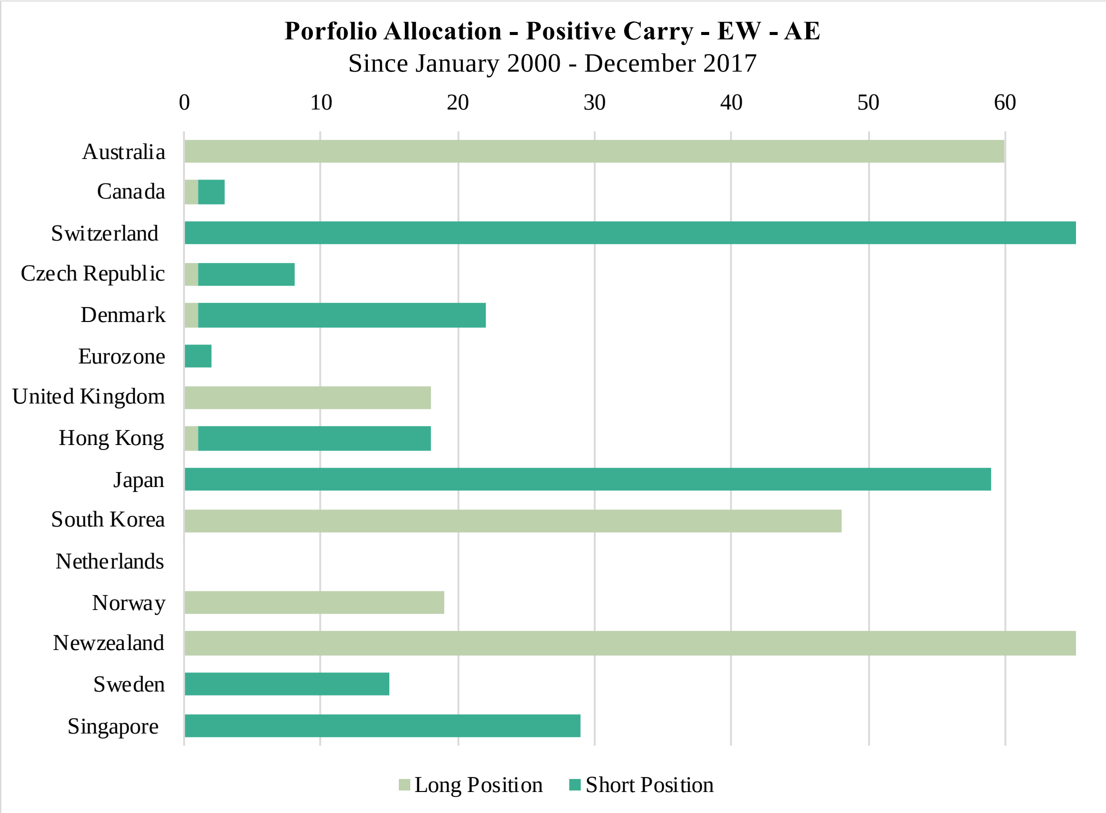


Figure A-2: Portfolio Allocation of *Positive Carry* - *EW -AE* since January 2000 - December 2017

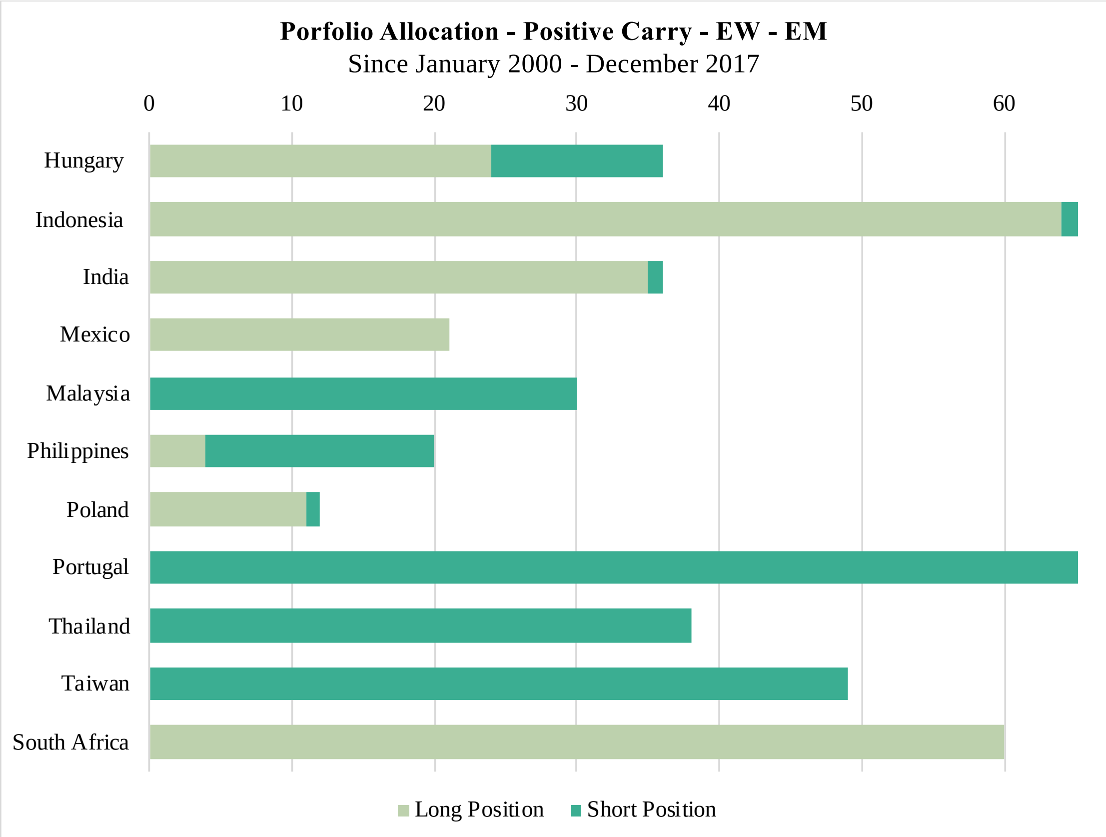
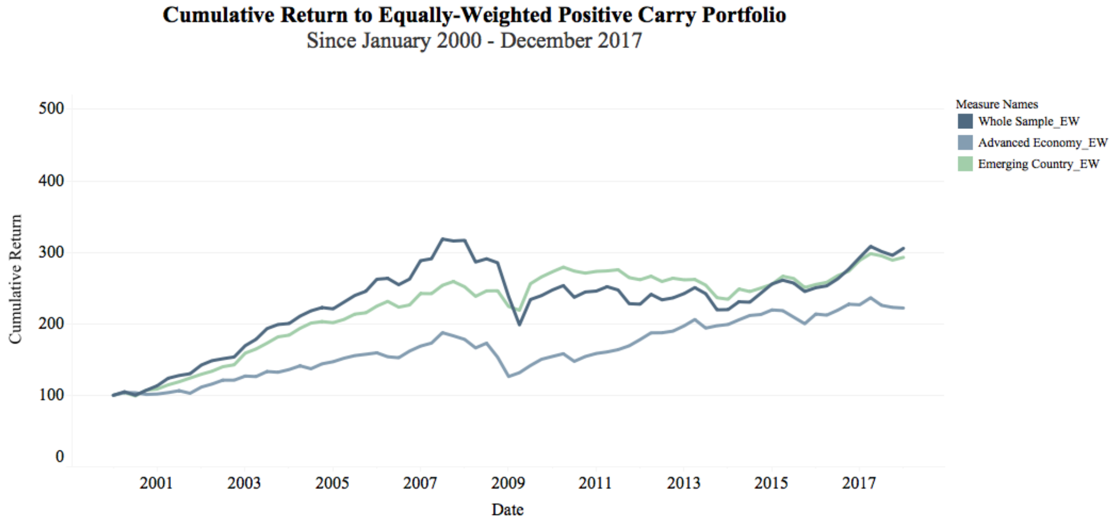
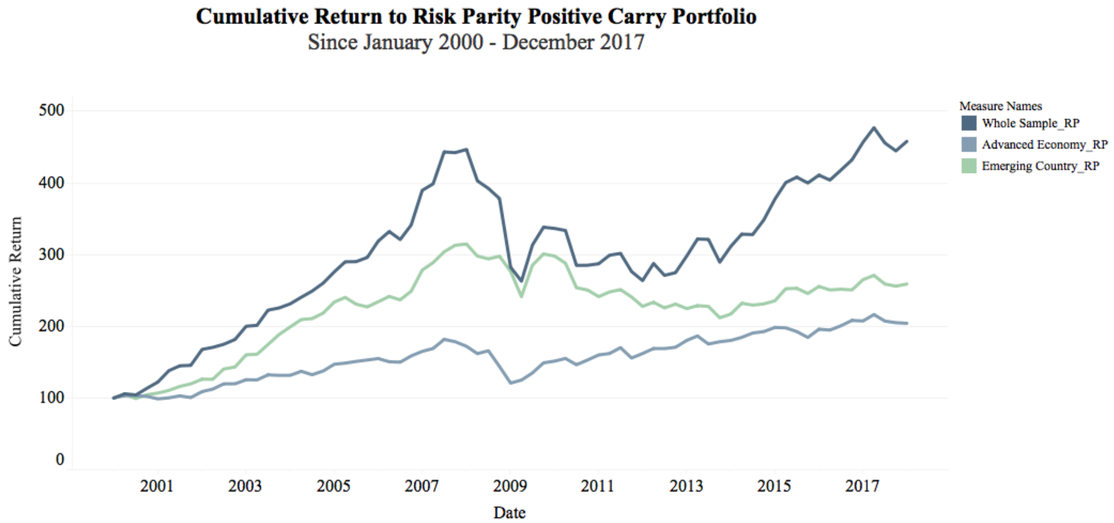


Figure A-3: Portfolio Allocation of *Positive Carry - EW -EM* since January 2000 - December 2017



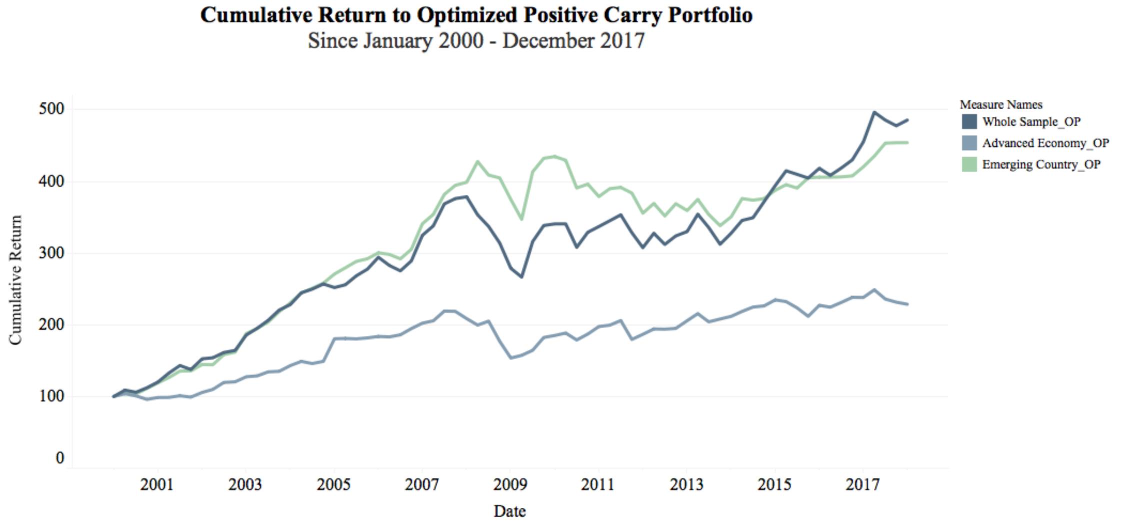
The cumulative return of equally-weighted portfolios. The portfolio is constructed positive carry criterion. Color assigned represents type of currencies. Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the order criterions.

Figure A-4: Illustration of Cumulative Return to Equally-Weighted Positive Carry Portfolio since January 2000 – December 2017



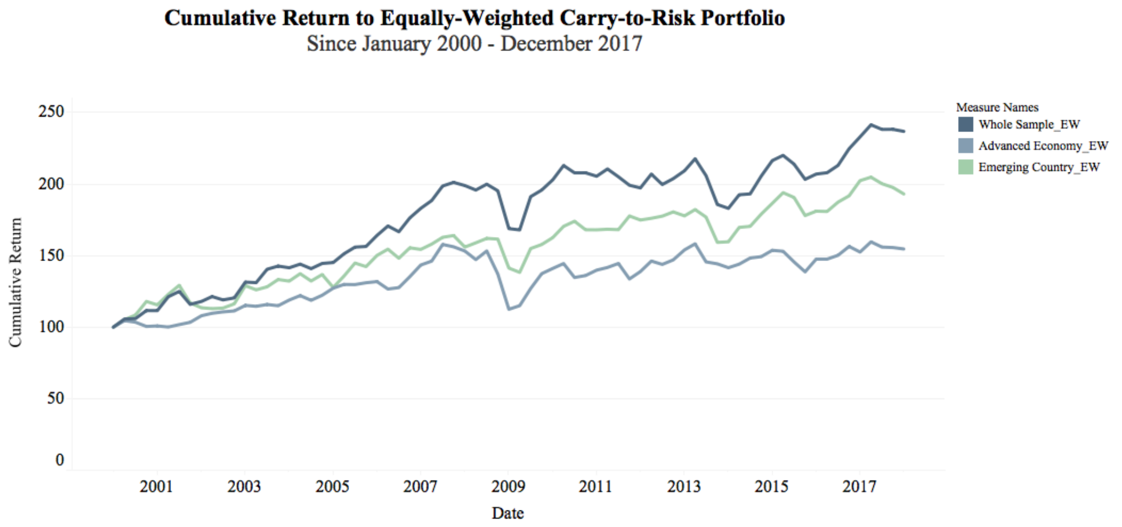
The cumulative return of risk parity portfolios. The portfolio is constructed positive carry criterion. Color assigned represents type of currencies. Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the order criterions.

Figure A-5: Illustration of Cumulative Return to Risk Parity Positive Carry Portfolio since January 2000 – December 2017



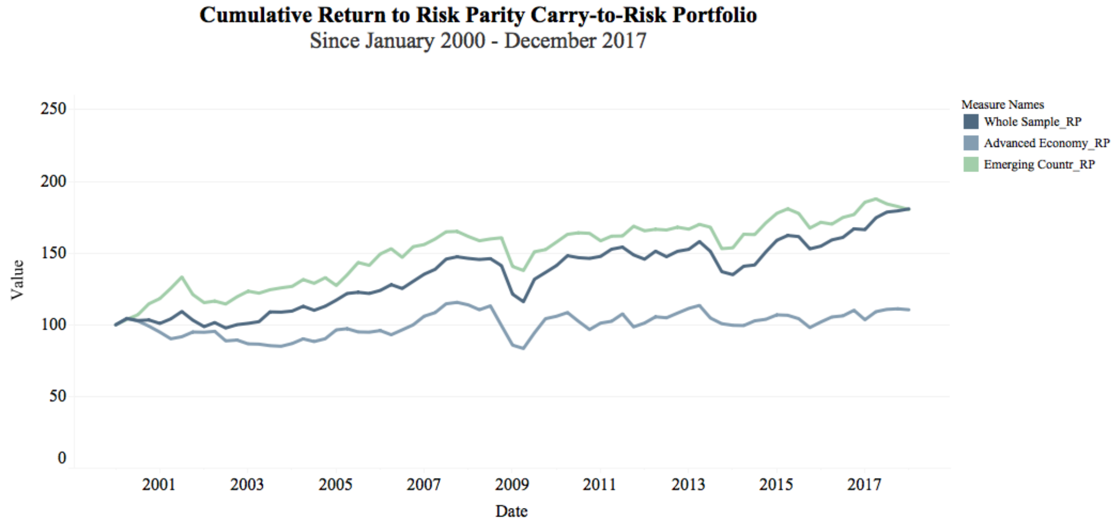
The cumulative return of optimized portfolios. The portfolio is constructed positive carry criterion. Color assigned represents type of currencies. Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the order criterions.

Figure A-6: Illustration of Cumulative Return to Optimized Positive Carry Portfolio since January 2000 – December 2017



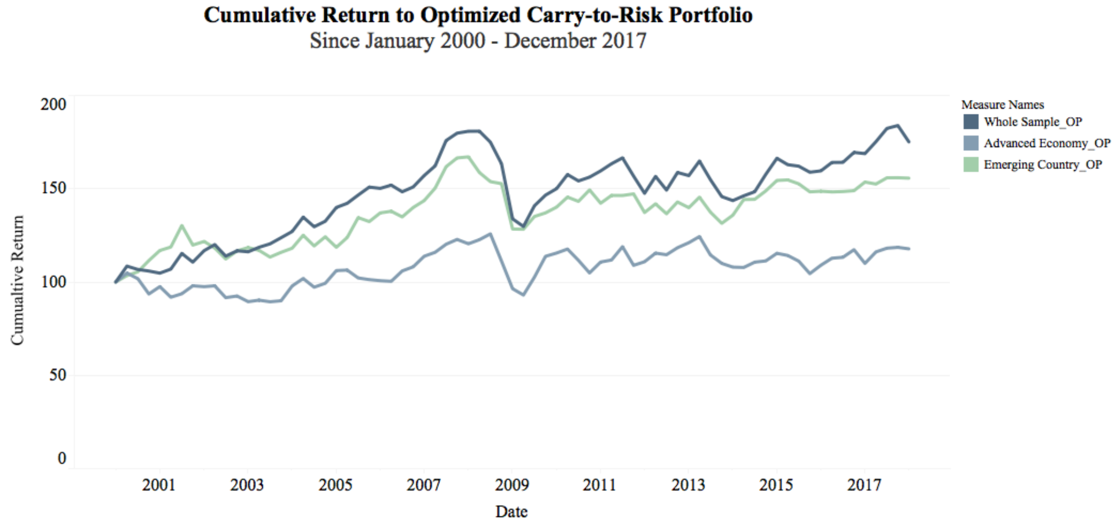
The cumulative return of equally-weighted portfolios. The portfolio is constructed carry-to-risk criterion (Color assigned represents type of currencies). Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the order criterions.

Figure A-7: Illustration of Cumulative Equally-Weighted Carry-to-Risk Portfolio since January 2000 - December 2017



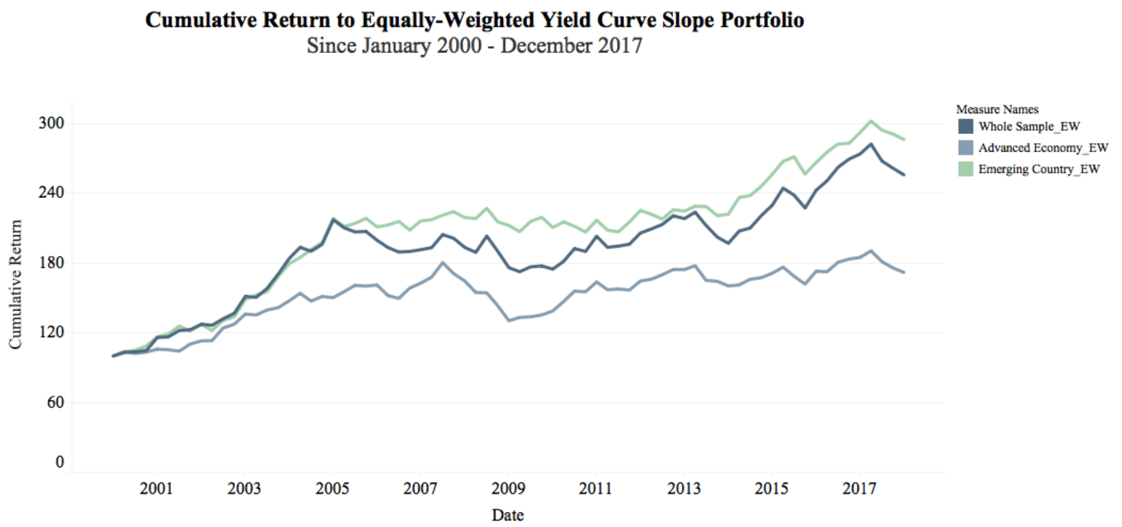
The cumulative return of risk parity portfolios. The portfolio is constructed carry-to-risk criterion (Color assigned represents type of currencies). Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the order criterions.

Figure A-8: Illustration of Cumulative Risk Parity Carry-to-Risk Portfolio since January 2000 - December 2017



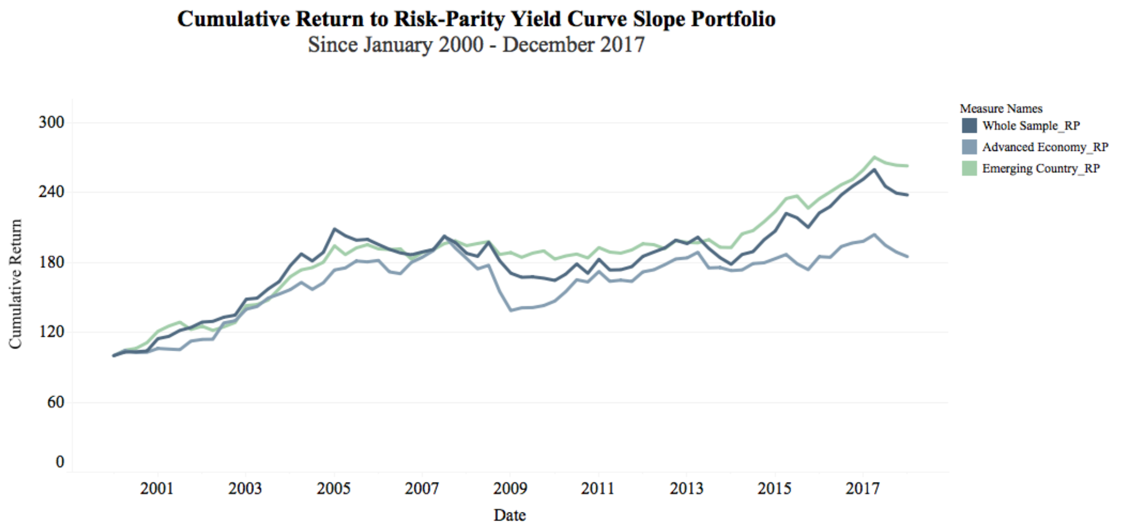
The cumulative return of optimized portfolios. The portfolio is constructed carry-to-risk criterion (Color assigned represents type of currencies). Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the order criterions.

Figure A-9: Illustration of Cumulative Optimized Carry-to-Risk Portfolio since January 2000 - December 2017



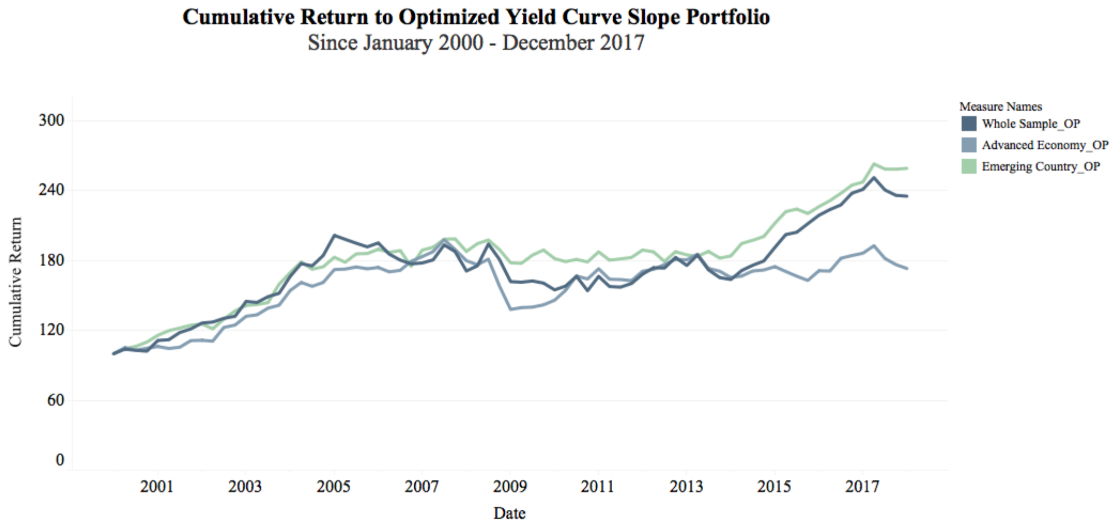
The cumulative return of equally-weighted portfolios. The portfolio is constructed yield curve slope criterion. Color assigned represents type of currencies. Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the order criterions.

Figure A-10: Illustration of Cumulative Equally-Weighted Yield Curve Slope Portfolio since January 2000 - December 2017



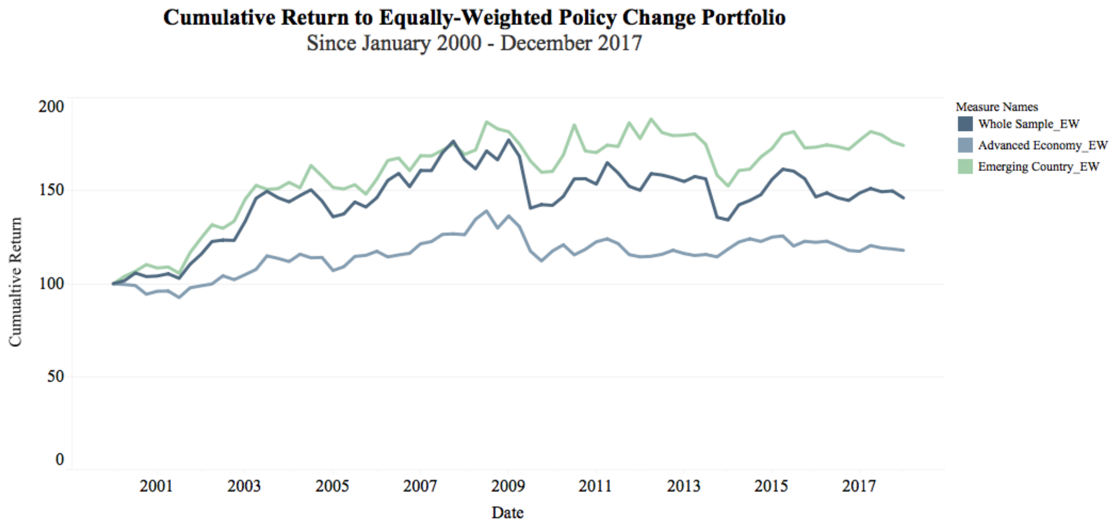
The portfolio is constructed yield curve slope criterion. Color assigned represents type of currencies. Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the order criterions.

Figure A-11: Illustration of Cumulative Risk Parity Yield Curve Slope Portfolio since January 2000 - December 2017



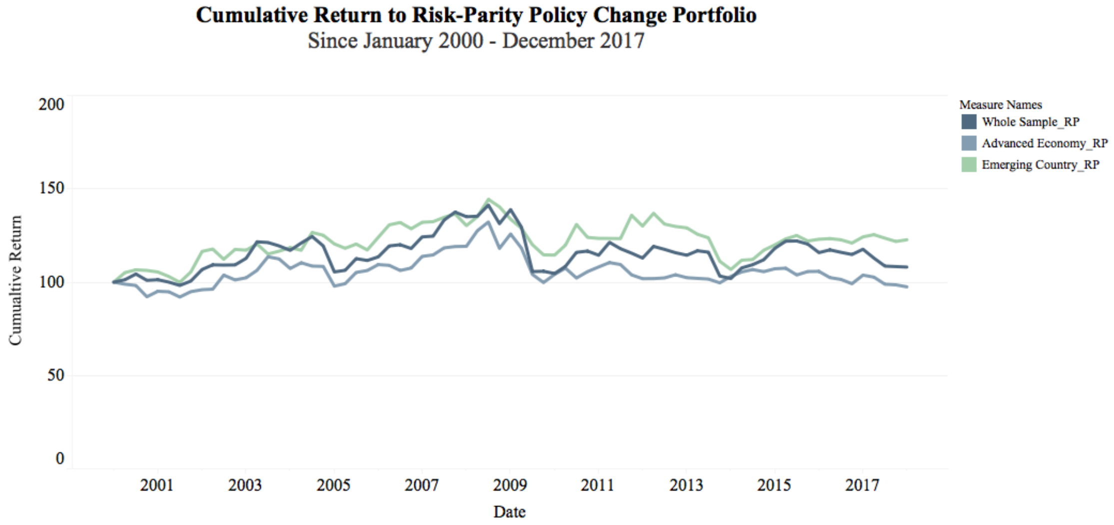
The portfolio is constructed yield curve slope criterion. Color assigned represents type of currencies. Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the order criterions.

Figure A-12: Illustration of Cumulative Optimized Yield Curve Slope Portfolio since January 2000 - December 2017



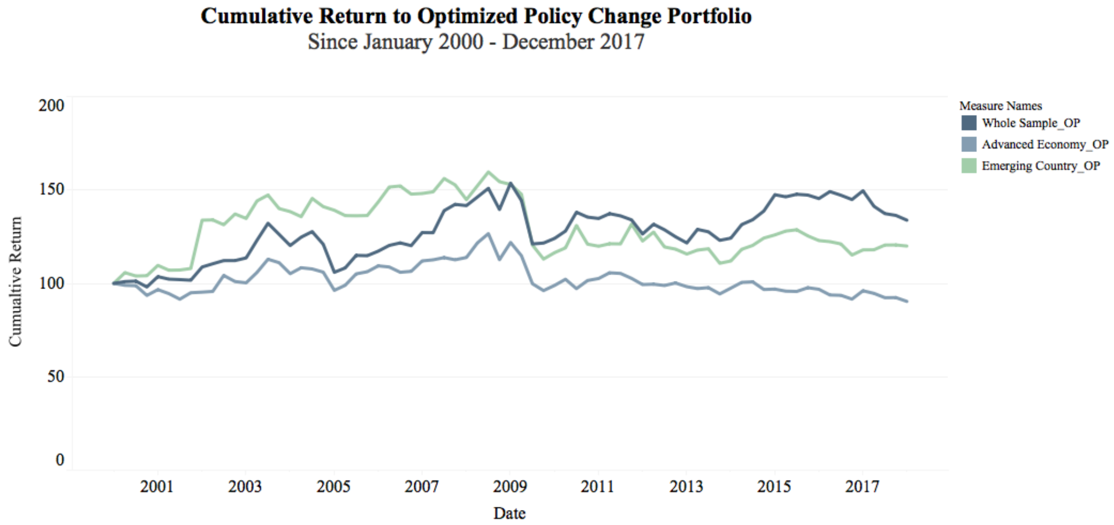
The cumulative return of equally-weighted portfolios. The portfolio is constructed policy change criterion. Color assigned represents type of currencies. Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the ascending order criterions.

Figure A-13: Illustration of Cumulative Equally-Weighted Policy Change Portfolio since January 2000 - December 2017



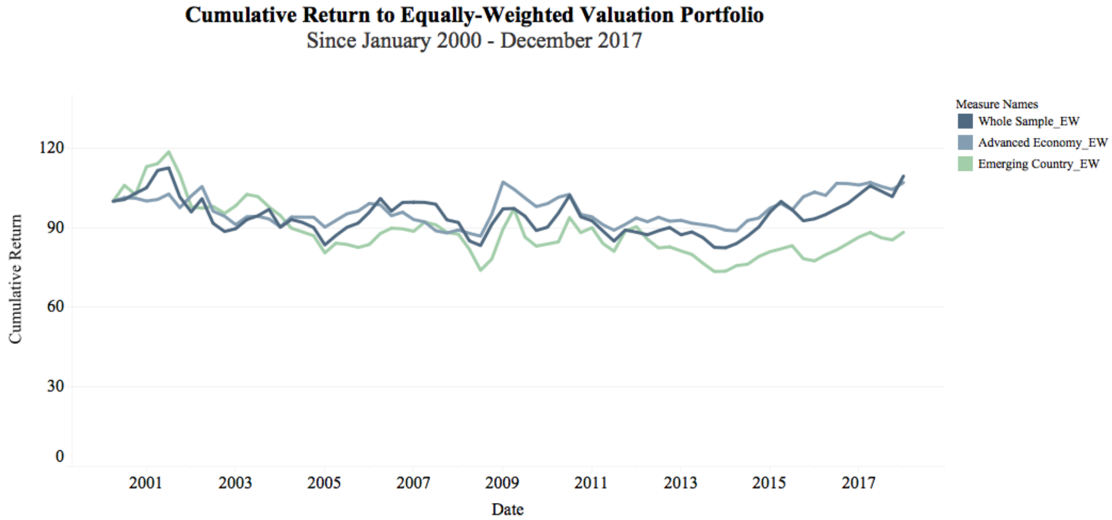
The cumulative return of risk parity portfolios. The portfolio is constructed policy change criterion. Color assigned represents type of currencies. Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the ascending order criterions.

Figure A-14: Illustration of Cumulative Risk Parity Policy Change Portfolio since January 2000 - December 2017



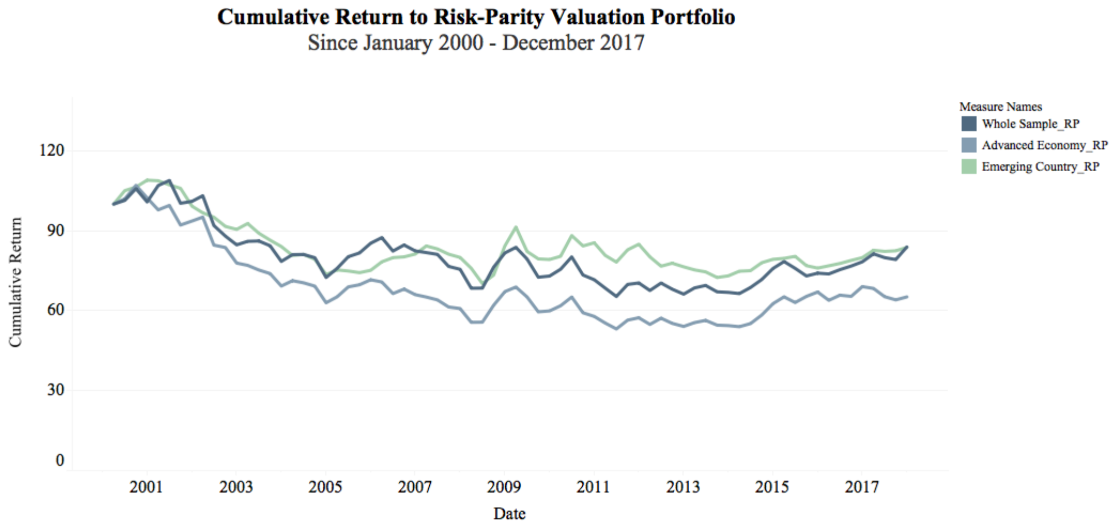
The cumulative return of optimized portfolios. The portfolio is constructed policy change criterion. Color assigned represents type of currencies. Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the ascending order criterions.

Figure A-15: Illustration of Cumulative Optimized Policy Change Portfolio since January 2000 - December 2017



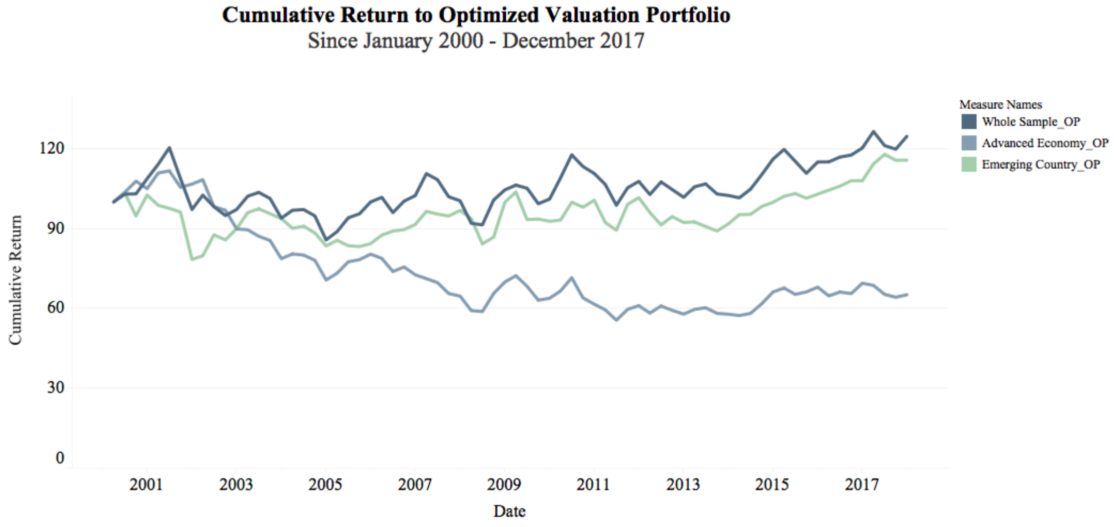
The cumulative return of equally-weighted portfolios. The portfolio is constructed valuation. Color assigned represents type of currencies. Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the order criterions.

Figure A-16: Illustration of Cumulative Equally-Weighted Valuation Portfolio since January 2000 - December 2017



The cumulative return of risk parity portfolios. The portfolio is constructed valuation. Color assigned represents type of currencies. Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the order criterions.

Figure A-17: Illustration of Cumulative Risk Parity Valuation Portfolio since January 2000 - December 2017



The cumulative return of optimized portfolios. The portfolio is constructed valuation. Color assigned represents type of currencies. Portfolio is rebalanced every three months (a quarter) since January 2000 - December 2017 in a way that maintains the order criterions.

Figure A-18: Illustration of Cumulative Optimized Valuation Portfolio since January 2000 - December 2017

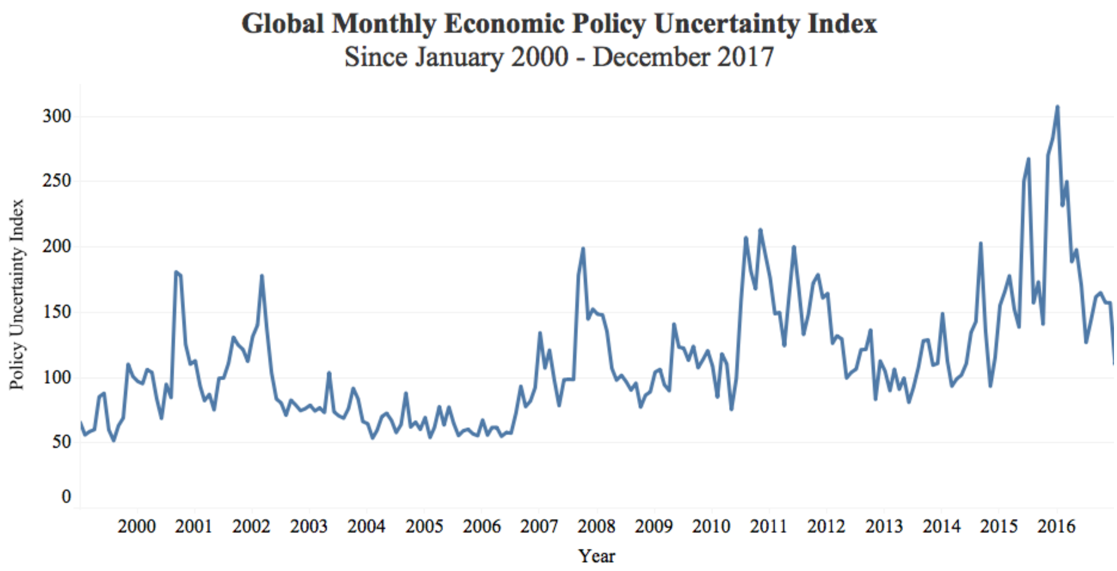


Figure A-19: Illustration of Global Economic Policy Uncertainty Index since January 2000 - December 2017

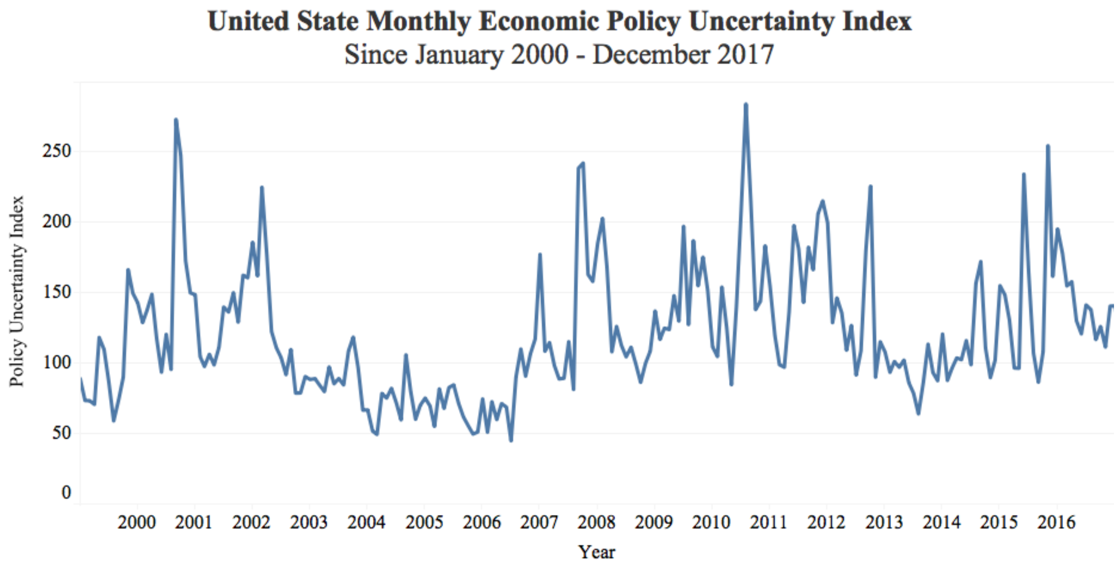


Figure A-20: Illustration of the United State Economic Policy Uncertainty Index since January 2000 - December 2017

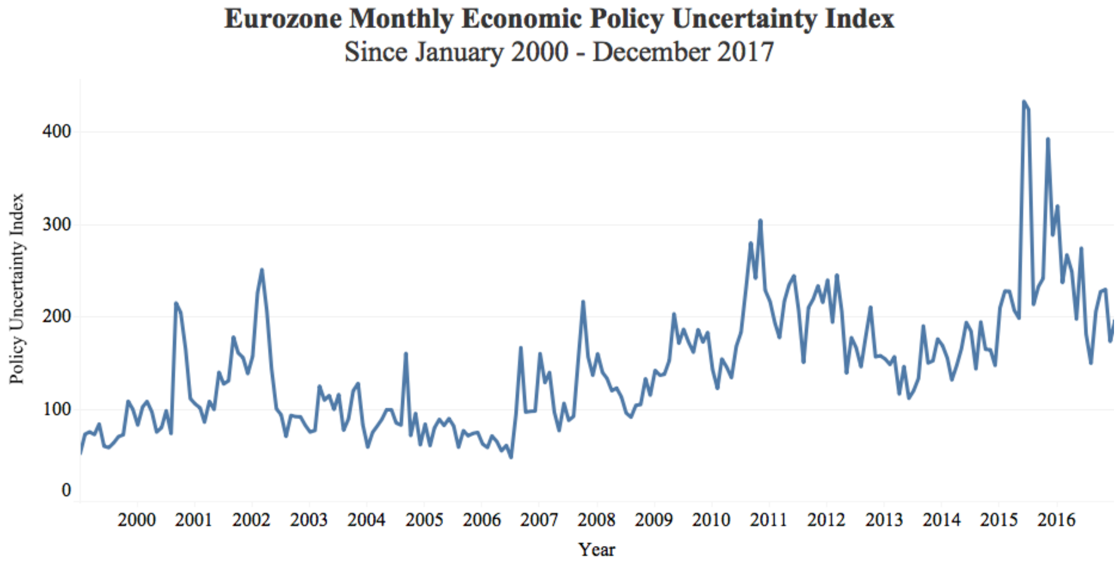


Figure A-21: Illustration of the Eurozone Economic Policy Uncertainty Index since January 2000 - December 2017

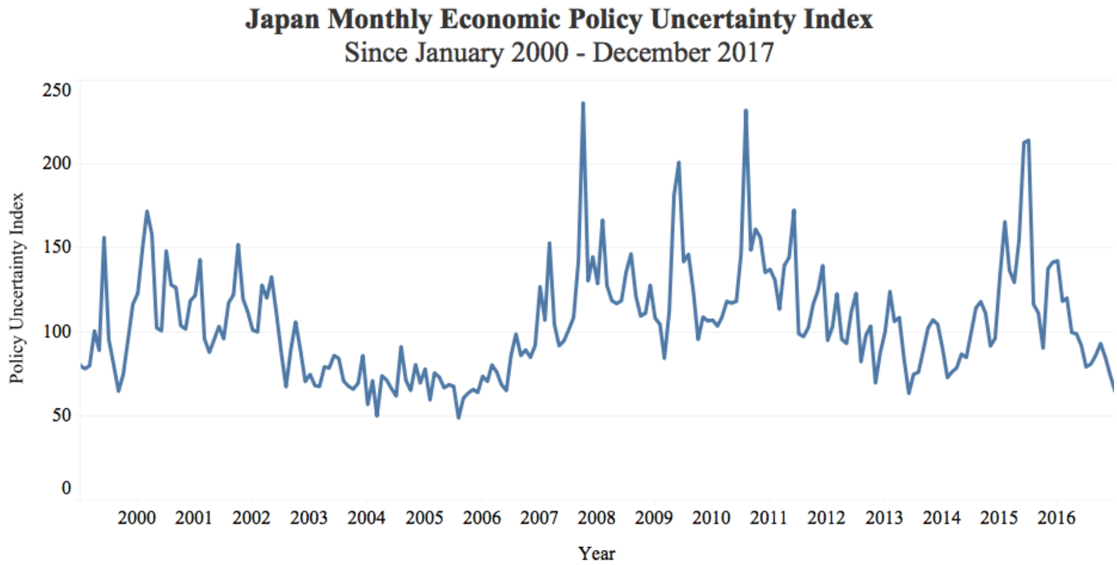


Figure A-22: Illustration of Japan Economic Policy Uncertainty Index since January 2000 - December 2017

Table A-1: Stationarity Test of Global Economic Policy Uncertainty Index

Null Hypothesis: GEPU has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.46442	0.0512
Test critical values:	1% level	-4.09255	
	5% level	-3.47436	
	10% level	-3.1645	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(GEPU)

Method: Least Squares

Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GEPU(-1)	-0.29972	0.086513	-3.46442	0.0009
C	21.52439	8.276985	2.600511	0.0114
@TREND("2000Q1")	0.382349	0.183431	2.084427	0.0409

R-squared	0.150064	Mean dependent var	1.404414
Adjusted R-squared	0.125066	S.D. dependent var	26.6838
S.E. of regression	24.95946	Akaike info criterion	9.313718
Sum squared resid	42362.29	Schwarz criterion	9.409324
Log likelihood	-327.637	Hannan-Quinn criter.	9.351738
F-statistic	6.003017	Durbin-Watson stat	1.90545
Prob(F-statistic)	0.003973		

Table A-2: Stationarity Test of United State Economic Policy Uncertainty Index

Null Hypothesis: US_EPU has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.16088	0.0082
Test critical values:	1% level	-4.09255	
	5% level	-3.47436	
	10% level	-3.1645	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(US_EPU)

Method: Least Squares

Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
US_EPU(-1)	-0.403	0.096855	-4.16088	0.0001
C	43.9713	12.40315	3.545172	0.0007
@TREND("2000Q1")	0.147495	0.18238	0.808722	0.4215

R-squared	0.203533	Mean dependent var	0.665962
Adjusted R-squared	0.180108	S.D. dependent var	33.64793
S.E. of regression	30.4675	Akaike info criterion	9.712533
Sum squared resid	63122.24	Schwarz criterion	9.808139
Log likelihood	-341.795	Hannan-Quinn criter.	9.750552
F-statistic	8.688535	Durbin-Watson stat	1.961448
Prob(F-statistic)	0.000436		

Table A-3: Stationarity Test of Eurozone Economic Policy Uncertainty Index

Null Hypothesis: EU_EPU has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.42543	0.0561
Test critical values:	1% level	-4.09255	
	5% level	-3.47436	
	10% level	-3.1645	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(EU_EPU)

Method: Least Squares

Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EU_EPU(-1)	-0.2945	0.085975	-3.42543	0.001
C	23.21577	9.569552	2.426004	0.0179
@TREND("2000Q1")	0.593861	0.253216	2.345269	0.0219

R-squared	0.147255	Mean dependent var	2.018716
Adjusted R-squared	0.122175	S.D. dependent var	33.13441
S.E. of regression	31.0444	Akaike info criterion	9.750049
Sum squared resid	65535.34	Schwarz criterion	9.845655
Log likelihood	-343.127	Hannan-Quinn criter.	9.788069
F-statistic	5.871253	Durbin-Watson stat	1.886776
Prob(F-statistic)	0.004445		

Table A-4: Stationarity Test of Japan Economic Policy Uncertainty Index

Null Hypothesis: JP_EPU has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.02384	0.0121
Test critical values:	1% level	-4.09255	
	5% level	-3.47436	
	10% level	-3.1645	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(JP_EPU)

Method: Least Squares

Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
JP_EPU(-1)	-0.39182	0.097375	-4.02384	0.0001
C	38.99671	10.66686	3.655876	0.0005
@TREND("2000Q1")	0.070943	0.135941	0.521865	0.6035

R-squared	0.194158	Mean dependent var	0.067516
Adjusted R-squared	0.170457	S.D. dependent var	25.04817
S.E. of regression	22.81368	Akaike info criterion	9.133933
Sum squared resid	35391.56	Schwarz criterion	9.229539
Log likelihood	-321.255	Hannan-Quinn criter.	9.171952
F-statistic	8.191916	Durbin-Watson stat	2.186665
Prob(F-statistic)	0.000649		

Table A-5: Stationarity Test of VIX Index

Null Hypothesis: VIX has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.14963	0.0085
Test critical values:	1% level	-4.09255	
	5% level	-3.47436	
	10% level	-3.1645	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(VIX)

Method: Least Squares

Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
VIX(-1)	-0.40689	0.098054	-4.14963	0.0001
C	9.734457	2.794496	3.483439	0.0009
@TREND("2000Q1")	-0.04998	0.038301	-1.30503	0.1963

R-squared	0.202266	Mean dependent var	-0.18409
Adjusted R-squared	0.178803	S.D. dependent var	7.006229
S.E. of regression	6.34904	Akaike info criterion	6.575819
Sum squared resid	2741.101	Schwarz criterion	6.671425
Log likelihood	-230.442	Hannan-Quinn criter.	6.613839
F-statistic	8.620701	Durbin-Watson stat	2.128092
Prob(F-statistic)	0.00046		

Table A-6: Stationarity Test of Return to Positive Carry – EW – WS

Null Hypothesis: POSICAR_EWWS has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.38032	0.0000
Test critical values:	1% level	-4.09255	
	5% level	-3.47436	
	10% level	-3.1645	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(POSICAR_EWWS)

Method: Least Squares

Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POSICAR_EWWS(-1)	-0.89235	0.120909	-7.38032	0.0000
C	3.216339	1.404667	2.289752	0.0251
@TREND("2000Q1")	-0.04792	0.032797	-1.4612	0.1486

R-squared	0.444907	Mean dependent var	-0.02296
Adjusted R-squared	0.42858	S.D. dependent var	7.305356
S.E. of regression	5.522287	Akaike info criterion	6.296796
Sum squared resid	2073.704	Schwarz criterion	6.392402
Log likelihood	-220.536	Hannan-Quinn criter.	6.334816
F-statistic	27.25095	Durbin-Watson stat	1.920547
Prob(F-statistic)	0.0000		

Table A-7: Stationarity Test of Return to Positive Carry – RP – WS

Null Hypothesis: POSICAR_RPWS has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.98815	0.0000
Test critical values:	1% level	-4.09255	
	5% level	-3.47436	
	10% level	-3.1645	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(POSICAR_RPWS)

Method: Least Squares

Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POSICAR_RPWS(-1)	-0.83548	0.119556	-6.98815	0.0000
C	3.295434	1.237457	2.663069	0.0097
@TREND("2000Q1")	-0.03973	0.027977	-1.41995	0.1602

R-squared	0.418266	Mean dependent var	-0.05592
Adjusted R-squared	0.401157	S.D. dependent var	6.0657
S.E. of regression	4.693941	Akaike info criterion	5.971757
Sum squared resid	1498.249	Schwarz criterion	6.067363
Log likelihood	-208.997	Hannan-Quinn criter.	6.009776
F-statistic	24.446	Durbin-Watson stat	1.876732
Prob(F-statistic)	0.0000		

Table A-8: Stationarity Test of Return to Positive Carry – OP – WS

Null Hypothesis: POSICAR_OPWS has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.20995	0.0000
Test critical values:	1% level	-4.09255	
	5% level	-3.47436	
	10% level	-3.1645	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(POSICAR_OPWS)

Method: Least Squares

Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POSICAR_OPWS(-1)	-0.86205	0.119564	-7.20995	0.0000
C	3.56892	1.439663	2.478996	0.0157
@TREND("2000Q1")	-0.0449	0.03297	-1.36168	0.1778

R-squared	0.43348	Mean dependent var	-0.10239
Adjusted R-squared	0.416818	S.D. dependent var	7.275448
S.E. of regression	5.555994	Akaike info criterion	6.308967
Sum squared resid	2099.097	Schwarz criterion	6.404573
Log likelihood	-220.968	Hannan-Quinn criter.	6.346986
F-statistic	26.01557	Durbin-Watson stat	1.924129
Prob(F-statistic)	0.0000		

Table A-9: Stationarity Test of Return to Positive Carry – EW – AE

Null Hypothesis: POSICAR_EWAE has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.52289	0.0000
Test critical values:	1% level	-4.09255	
	5% level	-3.47436	
	10% level	-3.1645	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(POSICAR_EWAE)

Method: Least Squares

Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POSICAR_EWAE(-1)	-0.90729	0.120604	-7.52289	0.0000
C	1.535835	1.086877	1.413071	0.1622
@TREND("2000Q1")	-0.01318	0.025776	-0.51144	0.6107
R-squared	0.454236	Mean dependent var		-0.05958
Adjusted R-squared	0.438184	S.D. dependent var		5.922183
S.E. of regression	4.438935	Akaike info criterion		5.860041
Sum squared resid	1339.882	Schwarz criterion		5.955647
Log likelihood	-205.032	Hannan-Quinn criter.		5.898061
F-statistic	28.29799	Durbin-Watson stat		1.976943
Prob(F-statistic)	0.0000			

Table A-10: Stationarity Test of Return to Positive Carry – EW – EM

Null Hypothesis: POSICAR_EWEM has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.76543	0.0000
Test critical values:	1% level	-4.09255	
	5% level	-3.47436	
	10% level	-3.1645	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(POSICAR_EWEM)

Method: Least Squares

Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POSICAR_EWEM(-1)	-0.94148	0.12124	-7.76543	0
C	3.297867	1.030702	3.199631	0.0021
@TREND("2000Q1")	-0.05119	0.02353	-2.17557	0.0331

R-squared	0.47005	Mean dependent var	-0.03521
Adjusted R-squared	0.454464	S.D. dependent var	5.258528
S.E. of regression	3.883972	Akaike info criterion	5.592929
Sum squared resid	1025.796	Schwarz criterion	5.688535
Log likelihood	-195.549	Hannan-Quinn criter.	5.630948
F-statistic	30.15704	Durbin-Watson stat	1.911891
Prob(F-statistic)	0.0000		

Table A-11: Stationarity Test of Return to Carry to Risk – EW – WS

Null Hypothesis: CARRYRISK_EWWS has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.51365	0.0000
Test critical values:	1% level	-4.09255	
	5% level	-3.47436	
	10% level	-3.1645	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(CARRYRISK_EWWS)

Method: Least Squares

Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CARRYRISK_EWWS(-1)	-0.90262	0.120131	-7.51365	0
C	1.890604	1.049958	1.800646	0.0762
@TREND("2000Q1")	-0.0219	0.024666	-0.8877	0.3778
R-squared	0.453685	Mean dependent var		-0.08873
Adjusted R-squared	0.437617	S.D. dependent var		5.628223
S.E. of regression	4.220728	Akaike info criterion		5.759227
Sum squared resid	1211.389	Schwarz criterion		5.854833
Log likelihood	-201.453	Hannan-Quinn criter.		5.797247
F-statistic	28.23518	Durbin-Watson stat		1.942651
Prob(F-statistic)	0.0000			

Table A-12: Stationarity Test of Return to Yield Slope – EW – WS

Null Hypothesis: YSLOPE_EWWS has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.48085	0.0000
Test critical values:	1% level	-4.09255	
	5% level	-3.47436	
	10% level	-3.1645	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(YSLOPE_EWWS)

Method: Least Squares

Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
YSLOPE_EWWS(-1)	-0.90509	0.120987	-7.48085	0
C	2.459636	1.054696	2.33208	0.0227
@TREND("2000Q1")	-0.03396	0.024569	-1.38232	0.1714
R-squared	0.45149	Mean dependent var		-0.07409
Adjusted R-squared	0.435357	S.D. dependent var		5.561732
S.E. of regression	4.179236	Akaike info criterion		5.739469
Sum squared resid	1187.689	Schwarz criterion		5.835075
Log likelihood	-200.751	Hannan-Quinn criter.		5.777488
F-statistic	27.98612	Durbin-Watson stat		1.995441
Prob(F-statistic)	0.0000			

Table A-13: Stationarity Test of Return to Policy Change – EW – WS

Null Hypothesis: CHANGE_EWWS has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.09622	0.0000
Test critical values:	1% level	-4.09455	
	5% level	-3.47531	
	10% level	-3.16505	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(CHANGE_EWWS)

Method: Least Squares

Included observations: 70 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CHANGE_EWWS(-1)	-1.14486	0.161334	-7.09622	0
D(CHANGE_EWWS(-1))	0.248898	0.119198	2.088105	0.0407
C	2.330394	1.157698	2.012954	0.0482
@TREND("2000Q1")	-0.04547	0.027269	-1.66765	0.1001

R-squared	0.492194	Mean dependent var	-0.09371
Adjusted R-squared	0.469112	S.D. dependent var	6.144106
S.E. of regression	4.476721	Akaike info criterion	5.891104
Sum squared resid	1322.708	Schwarz criterion	6.019589
Log likelihood	-202.189	Hannan-Quinn criter.	5.94214
F-statistic	21.32367	Durbin-Watson stat	1.955757
Prob(F-statistic)	0.0000		

Table A-14: Stationarity Test of Return to Valuation – EW – WS

Null Hypothesis: VALUA_EWWS has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.14709	0.0000
Test critical values:	1% level	-4.09455	
	5% level	-3.47531	
	10% level	-3.16505	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(VALUA_EWWS)

Method: Least Squares

Included observations: 70 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
VALUA_EWWS(-1)	-0.88234	0.123455	-7.14709	0
C	-0.68728	1.070841	-0.64181	0.5232
@TREND("2000Q1")	0.024309	0.025708	0.945584	0.3478
R-squared	0.433275	Mean dependent var		0.099429
Adjusted R-squared	0.416358	S.D. dependent var		5.670584
S.E. of regression	4.332126	Akaike info criterion		5.811906
Sum squared resid	1257.41	Schwarz criterion		5.90827
Log likelihood	-200.417	Hannan-Quinn criter.		5.850183
F-statistic	25.61157	Durbin-Watson stat		1.914403
Prob(F-statistic)	0.0000			

Table A-15[24]: Granger Causality for Variable in Subsection; Weight Strategy, Carry Trade and Policy Uncertainty

Pairwise Granger Causality Tests

Lags: 11

Null Hypothesis:	Obs	F-Statistic	Prob.
GEPU does not Granger Cause BENCHMARK	25	1.84819	0.4031
BENCHMARK does not Granger Cause GEPU		0.31745	0.9171
US does not Granger Cause BENCHMARK	25	8.02611	0.1159
BENCHMARK does not Granger Cause US		0.97905	0.6081
EU does not Granger Cause BENCHMARK	25	2.84795	0.2885
BENCHMARK does not Granger Cause EU		0.30937	0.9213
JP does not Granger Cause BENCHMARK	25	2.4672	0.3237
BENCHMARK does not Granger Cause JP		0.57959	0.777
GEPU does not Granger Cause RP	25	0.33259	0.9092
RP does not Granger Cause GEPU		0.19694	0.9726
US does not Granger Cause RP	25	0.64377	0.7454
RP does not Granger Cause US		0.29943	0.9265
EU does not Granger Cause RP	25	0.80569	0.6735
RP does not Granger Cause EU		0.25832	0.9466
JP does not Granger Cause RP	25	0.3822	0.8824
RP does not Granger Cause JP		1.00906	0.598
GEPU does not Granger Cause OP	25	2.30668	0.3412
OP does not Granger Cause GEPU		11.8194	0.0805*
US does not Granger Cause OP	25	0.83425	0.6619
OP does not Granger Cause US		4.39021	0.2
EU does not Granger Cause OP	25	1.7419	0.4208
OP does not Granger Cause EU		0.29036	0.931

[24] For table A-15 – A-17, *, ** and *** indicate significance at the 10%, 5% and 1% significance levels respectively.

Null Hypothesis:	Obs	F-Statistic	Prob.
JP does not Granger Cause OP	25	0.40536	0.8697
OP does not Granger Cause JP		0.53878	0.798

Table A-16: Granger Causality for Variable in Subsection; Sample Selection, Carry Trade and Policy Uncertainty

Pairwise Granger Causality Tests

Lags: 11

Null Hypothesis:	Obs	F-Statistic	Prob.
GEPU does not Granger Cause BENCHMARK	25	1.84819	0.4031
BENCHMARK does not Granger Cause GEPU		0.31745	0.9171
JP does not Granger Cause BENCHMARK	25	2.4672	0.3237
BENCHMARK does not Granger Cause JP		0.57959	0.777
US does not Granger Cause BENCHMARK	25	8.02611	0.1159
BENCHMARK does not Granger Cause US		0.97905	0.6081
EU does not Granger Cause BENCHMARK	25	2.84795	0.2885
BENCHMARK does not Granger Cause EU		0.30937	0.9213
GEPU does not Granger Cause EM	25	0.1573	0.9854
EM does not Granger Cause GEPU		2.0775	0.3696
JP does not Granger Cause EM	25	0.18236	0.9777
EM does not Granger Cause JP		0.35711	0.896
US does not Granger Cause EM	25	0.17095	0.9814
EM does not Granger Cause US		0.81176	0.671
EU does not Granger Cause EM	25	0.23195	0.9585
EM does not Granger Cause EU		6.44696	0.1418
GEPU does not Granger Cause AE	25	0.83223	0.6627
AE does not Granger Cause GEPU		0.65604	0.7396
JP does not Granger Cause AE	25	12.4621	0.0766*
AE does not Granger Cause JP		1.1383	0.5574
US does not Granger Cause AE	25	1.26521	0.5222
AE does not Granger Cause US		3.17228	0.264
EU does not Granger Cause AE	25	0.63921	0.7476
AE does not Granger Cause EU		0.66193	0.7368

Table A-17: Granger Causality for Variable in Subsection; Five Criteria, Carry Trade and Policy Uncertainty

Pairwise Granger Causality Tests

Date: 07/10/18 Time: 12:31

Sample: 2000S1 2017S2

Lags: 11

Null Hypothesis:	Obs	F-Statistic	Prob.
GEPU does not Granger Cause BENCHMARK	25	1.84819	0.4031
BENCHMARK does not Granger Cause GEPU		0.31745	0.9171
JP does not Granger Cause BENCHMARK	25	2.4672	0.3237
BENCHMARK does not Granger Cause JP		0.57959	0.777
US does not Granger Cause BENCHMARK	25	8.02611	0.1159
BENCHMARK does not Granger Cause US		0.97905	0.6081
EU does not Granger Cause BENCHMARK	25	2.84795	0.2885
BENCHMARK does not Granger Cause EU		0.30937	0.9213
CARRYRISK does not Granger Cause GEPU	25	0.5729	0.7804
GEPU does not Granger Cause CARRYRISK		0.4918	0.8228
CHANGE does not Granger Cause GEPU	25	1.21376	0.5359
GEPU does not Granger Cause CHANGE		0.49263	0.8223
VALUATION does not Granger Cause GEPU	25	1.12137	0.5624
GEPU does not Granger Cause VALUATION		0.09128	0.9976
YIELD does not Granger Cause GEPU	25	2.93019	0.2819
GEPU does not Granger Cause YIELD		0.73115	0.7052
CARRYRISK does not Granger Cause JP	25	0.36255	0.8931
JP does not Granger Cause CARRYRISK		1.50269	0.4664
CHANGE does not Granger Cause JP	25	2.00176	0.3801
JP does not Granger Cause CHANGE		0.838	0.6604
VALUATION does not Granger Cause JP	25	4.23352	0.2065
JP does not Granger Cause VALUATION		1.41255	0.4862

Null Hypothesis:	Obs	F-Statistic	Prob.
YIELD does not Granger Cause JP	25	1.40791	0.4873
JP does not Granger Cause YIELD		0.50618	0.8151
CARRYRISK does not Granger Cause US	25	1.23514	0.5301
US does not Granger Cause CARRYRISK		1.56303	0.4541
CHANGE does not Granger Cause US	25	2.24857	0.348
US does not Granger Cause CHANGE		0.68099	0.7279
VALUATION does not Granger Cause US	25	1.06783	0.5789
US does not Granger Cause VALUATION		0.25627	0.9476
YIELD does not Granger Cause US	25	0.98772	0.6052
US does not Granger Cause YIELD		0.98044	0.6077
CARRYRISK does not Granger Cause EU	25	0.74752	0.698
EU does not Granger Cause CARRYRISK		1.04884	0.5849
CHANGE does not Granger Cause EU	25	58.4589	0.0169 ***
EU does not Granger Cause CHANGE		1.15482	0.5525
VALUATION does not Granger Cause EU	25	353.201	0.0028 ***
EU does not Granger Cause VALUATION		0.26754	0.9423
YIELD does not Granger Cause EU	25	415.898	0.0024 ***
EU does not Granger Cause YIELD		0.96162	0.6142

Table A-18: Summary Statistic 45 Carry-Trade Portfolio since January 2000 – December 2017

Portfolio	Annualized Return	Standard Deviation	Sharpe's Ratio	Skewness	Kurtosis
Positive Carry - EW - WS	6.4	11.12	0.58	-0.82	2.77
Carry-to-Risk - EW - WS	4.91	8.43	0.58	-0.48	2.27
Yield Slope - EW - WS	5.36	8.37	0.64	0.17	-0.44
Policy Change - EW - WS	2.13	9.12	0.23	-0.9	2.4
Valuation - EW - WS	0.51	8.6	0.06	-0.31	-0.42
Positive Carry - EW - AE	4.53	8.77	0.52	-1.53	4.26
Carry-to-Risk - EW - AE	2.45	8.69	0.28	-1.32	4.34
Yield Slope - EW - AE	3.06	7.6	0.4	-0.35	-0.02
Policy Change - EW - AE	0.92	6.39	0.14	-0.51	0.73
Valuation - EW - AE	0.38	6.66	0.06	0.68	2.92
Positive Carry - EW - EM	6.15	7.95	0.77	0.49	2.77
Carry-to-Risk - EW - EM	3.72	8.86	0.42	-0.44	1.15
Yield Slope - EW - EM	6.02	7.18	0.84	0.21	-0.05
Policy Change - EW - EM	3.14	8.29	0.38	0.22	-0.19

Portfolio	Annualized Return	Standard Deviation	Sharpe's Ratio	Skewness	Kurtosis
Valuation - EW - EM	-0.7	9.78	-0.07	0.26	0.69
Positive Carry - RP - WS	9.08	9.59	0.95	-0.94	3.41
Carry-to-Risk - RP - WS	3.62	8.91	0.41	-0.67	3.36
Yield Slope - RP - WS	4.93	8.12	0.61	0.12	-0.32
Policy Change - RP - WS	0.76	12.54	0.06	-1.32	4.05
Valuation - RP - WS	-0.97	9.14	-0.11	-0.24	-0.21
Positive Carry - RP - AE	4.04	9.13	0.44	-1.18	2.83
Carry-to-Risk - RP - AE	0.56	9.09	0.06	-0.44	1.42
Yield Slope - RP - AE	3.48	8.35	0.42	-0.57	1.53
Policy Change - RP - AE	-0.14	7.69	-0.02	-0.66	1.28
Valuation - RP - AE	-2.35	9.08	-0.26	-0.03	-0.16
Positive Carry - RP - EM	6.07	7.44	0.82	0.1	1.42
Carry-to-Risk - RP - EM	3.33	7.63	0.44	-0.8	0.81
Yield Slope - RP - EM	5.52	6.45	0.86	0.07	-0.28
Policy Change - RP - EM	1.14	7.99	0.14	-0.15	0.57
Valuation - RP - EM	-0.98	7.95	-0.12	-0.23	0.32

Portfolio	Annualized Return	Standard Deviation	Sharpe's Ratio	Skewness	Kurtosis
Positive Carry - OP - WS	9.17	11.3	0.81	-0.07	0.17
Carry-to-Risk - OP - WS	3.16	8.8	0.36	-1.13	3.6
Yield Slope - OP - WS	4.87	8.99	0.54	-0.24	0.04
Policy Change - OP - WS	1.63	9.1	0.18	-0.7	2.13
Valuation - OP - WS	1.25	9.41	0.13	-0.35	-0.47
Positive Carry - OP - AE	4.7	10.26	0.46	-0.1	3.92
Carry-to-Risk - OP - AE	0.91	9.41	0.1	-0.5	0.55
Yield Slope - OP - AE	3.1	8.28	0.37	-0.71	2.09
Policy Change - OP - AE	-0.56	7.98	-0.07	1.42	-0.48
Valuation - OP - AE	-2.39	9.32	-0.26	0.01	-0.32
Positive Carry - OP - EM	8.77	9.92	0.88	0.42	1.65
Carry-to-Risk - OP - EM	2.49	8.41	0.3	-0.9	2.46
Yield Slope - OP - EM	5.43	6.9	0.79	-0.12	0.2
Policy Change - OP - EM	1.02	10.3	0.1	0.75	7.16
Valuation - OP - EM	0.82	9.93	0.08	-0.48	3.14

Table A-19[25]: Sharpe's Ratio Significant Test for Equally-Weighted & Risk Parity Portfolios

	Equally-Weighted	Risk Parity
Mean	1.31211486	1.42668581
Variance	3.31943991	5.27813893
Observations	18	18
Hypothesized Mean Difference	0	
df	32	
t Stat	-0.1657764	
P(T<=t) one-tail	0.43468794	
t Critical one-tail	1.69388875	
P(T<=t) two-tail	0.86937587	
t Critical two-tail	2.03693334	

Table A-20: Sharpe's Ratio Significant Test for Equally-Weighted & MVO Portfolios

	Equally-Weighted	MVO
Mean	1.31211486	1.40910644
Variance	3.31943991	6.19157517
Observations	18	18
Hypothesized Mean Difference	0	
df	31	
t Stat	-0.133431	
P(T<=t) one-tail	0.44735747	
t Critical one-tail	1.69551878	
P(T<=t) two-tail	0.89471494	
t Critical two-tail	2.03951345	

[25] Table A-19 – A-26, these tables report the significant test of Sharpe's ratio between benchmark portfolio and others portfolio. The dataset uses in the test is the annualized Sharpe's ratio on each year from 2000 – 2017. The null hypothesis is that two any portfolios equal in performance. *, ** and *** indicate significance at the 10%, 5% and 1% significance levels respectively.

Table A-21: Sharpe's Ratio Significant Test for Whole Sample & Advanced Economy Portfolios

	Whole Sample	Advanced Economy
Mean	1.31211486	1.489543119
Variance	3.31943991	3.402772161
Observations	18	18
Hypothesized Mean Difference	0	
df	34	
t Stat	-0.2903374	
P(T<=t) one-tail	0.38666085	
t Critical one-tail	1.69092426	
P(T<=t) two-tail	0.7733217	
t Critical two-tail	2.03224451	

Table A-22: Sharpe's Ratio Significant Test for Whole Sample & Emerging Country Portfolios

	Whole Sample	Emerging Country
Mean	1.31211486	1.785976085
Variance	3.31943991	12.35950942
Observations	18	18
Hypothesized Mean Difference	0	
df	26	
t Stat	-0.5077255	
P(T<=t) one-tail	0.3079631	
t Critical one-tail	1.70561792	
P(T<=t) two-tail	0.61592619	
t Critical two-tail	2.05552944	

Table A-23: Sharpe's Ratio Significant Test for Positive Carry & Carry to Risk Portfolios

	Positive Carry	Carry to Risk
Mean	1.31211486	0.960351415
Variance	3.31943991	1.904990493
Observations	18	18
Hypothesized Mean Difference	0	
df	32	
t Stat	0.65293129	
P(T<=t) one-tail	0.2592322	
t Critical one-tail	1.69388875	
P(T<=t) two-tail	0.5184644	
t Critical two-tail	2.03693334	

Table A-24: Sharpe's Ratio Significant Test for Positive Carry & Yield Slope Portfolios

	Positive Carry	Yield Slope
Mean	1.31211486	0.98977002
Variance	3.31943991	3.96151592
Observations	18	18
Hypothesized Mean Difference	0	
df	34	
t Stat	0.50683054	
P(T<=t) one-tail	0.30777258	
t Critical one-tail	1.69092426	
P(T<=t) two-tail	0.61554515	
t Critical two-tail	2.03224451	

Table A-25: Sharpe's Ratio Significant Test for Positive Carry & Policy Change Portfolios

	Positive Carry	Policy Change
Mean	1.31211486	0.509948375
Variance	3.31943991	1.351225856
Observations	18	18
Hypothesized Mean Difference	0	
df	29	
t Stat	1.5747491	
P(T<=t) one-tail	0.06308108*	
t Critical one-tail	1.69912703	
P(T<=t) two-tail	0.12616216	
t Critical two-tail	2.04522964	

Table A-26: Sharpe's Ratio Significant Test for Positive Carry & Valuation Portfolios

	Positive Carry	Valuation
Mean	1.31211486	0.85963555
Variance	3.31943991	6.42955499
Observations	18	18
Hypothesized Mean Difference	0	
df	31	
t Stat	0.61483001	
P(T<=t) one-tail	0.27157701	
t Critical one-tail	1.69551878	
P(T<=t) two-tail	0.54315402	
t Critical two-tail	2.03951345	

VITA

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