BI Norwegian Business School - campus Oslo

GRA 19502

Master Thesis

Component of continuous assessment: Thesis Master of Science
Final master thesis – Counts 80% of total grade

Does analyst dispersion on macro economic factors affect the foreign exchange risk premium?

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Start: 02.03.2018 09.00

Finish: 03.09.2018 12.00

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Programme:

Master of Science in Business, Major in Finance

Date of submission:

02.09.2018/ Oslo

"This thesis is a part of the MSc programme at BI Norwegian Business School. The school takes no responsibility for the methods used, results found and conclusions drawn."

Abstract

Borrowing in low-interest countries and investing in high-interest countries is recognized as a “carry trade” strategy, where the return is identified as the currency risk premium. In this paper, we examine if a more extensive disagreement among the analysts prior to the release of macroeconomic variables will reward investors with a higher currency risk premium. We used data on 14 different currencies with respect to the US-dollar, and constructed a global macro uncertainty index denoted by inflation rate and the unemployment rate in the selected countries.

Our results indicate that there is ample evidence that investors demand compensation for bearing more risk and for investing in currencies with higher analyst dispersion in the macro environment.

Acknowledgments

We would like to thank our thesis supervisor Dagfinn Rime P.h.d from the finance department of BI Norwegian Business School. The door to Prof. Rime's office was always open whenever we had a question about the research or the writing. He consistently allowed this paper to be our own work, but steered us in the right direction whenever he thought we needed it.

Thank You,

Vilde Marhaug and Joachim Stykket

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1.0 Introduction

A carry trade is a strategy that generate profits by investing in countries with higher interest rate and borrow in low-interest rate countries, and the profit gained is called the currency risk premium. This paper examines how macro uncertainty is reflected in global foreign exchange risk premium. The question will record various macroeconomic aspects and study the effect they have on the foreign exchange market. Macroeconomic uncertainty covers multiple variables, so this paper will focus solely on the inflation rate and the unemployment rate.

This study aims to examine if investors are rewarded with a currency risk premium by investing countries with more macroeconomic uncertainty. It is an important subject in the literature, because it supplements the theory of how the pricing of currencies works. The foreign exchange (FX) risk management industry will benefit from understanding the relationship between foreign exchange rates and macroeconomic uncertainty. This research paper will contribute to this knowledge and possibly minimize future risks.

We applied the method from previous literature by Fama and Macbeth (1973), which is a two-stage model that estimates the factor exposures and premiums. To run the Fama MacBeth regression, we used data from Verdelhan, Lustig, and Russanov (2011) as the market risk premium and carry trade risk factor. Further we constructed a global macro uncertainty index using data from Datastream, a finance and economic database. Uncertainty is measured of the analyst dispersion prior to the announcement date. The index consists of the macro uncertainty variables inflation rate and unemployment rate, which are collected on a monthly basis from the Bloomberg portal.

The base currency in our regression is the US dollar, and we use it against 14 different currencies to get a worthy amount of data with a variety of high and low macroeconomic uncertainty currencies. Our measurement of macroeconomic

uncertainty is reflected from the analyst dispersion in both the inflation rate and unemployment rate for each country.

There has been some relevant work on this subject in recent literature. In Lustig and Verdelhan (2007) paper, they studied how the aggregate consumption growth risk affects foreign exchange rates. More importantly for this thesis is Lustig, Roussanov and Verdelhan paper from 2011, where they identified common risk factors in the currency markets, which this paper relies on. Menkhoff, Sarno, Schmeling and Schrimpf's (2012) investigated the relationship between global foreign exchange risk and the cross-section excess returns from a "carry trade" strategy. Another paper that is closely related to our subject, is the work done by Della Corte and Krecetovs (2016). They studied the macro uncertainty and currency premium, and they used inflation rate, short-term interest rate, real economic growth and current account as variables for macroeconomic uncertainty. Their paper contributes to the literature by obtaining evidence that carry trade investors are compensated for bearing a global risk.

2.0 Motivation

There are several papers in the literature trying to describe how macroeconomic uncertainty affects the foreign exchange. Earlier research has shown that future predictions and shocks affect the currency rates, so an understanding of what drives macroeconomic uncertainty will benefit investors. It is an exciting topic for institutional and private investors, as this paper gives an indication on how the different currencies behave when exposed to macroeconomic-uncertainty. Understanding this behaviour can help make better decisions and improve investment strategies. If investors possess the knowledge of countries sensitivity to the different macroeconomic factors, and also understand how they react differently to events, they may reduce future uncertainty. Investors can utilize high uncertainty based of analyst dispersion to make a profit or produce a hedging strategy.

Uncertainty can be defined as a situation with unknown or lack of information. A motivation source for this thesis is worldwide events, such as “Brexit”, where Great Britain has voted against being a member in the European Union, and Trump's new rules and increased tariffs for countries. These events contribute to increased uncertainty and have affected the Economic Policy Index, an uncertainty measure we find highly related to our thesis. What we find interesting is how macroeconomic uncertainty works in practice, such as the ongoing process of Brexit and how the Economic Policy Index behave accordingly. Recent literature has shown evidence that uncertainty grows after major economic or political shocks and that there is a high chance that we will see increased uncertainty in the future (Bloom, 2009).

Another source of motivation for this thesis is how investment strategies affect unstable economies and developing countries. Corruption and dictatorship make analysis difficult, and analyst can sit on little to no information when they predict macroeconomic factors as well as some countries can submit fixed numbers. On the other hand, this topic addresses an ethical issue that will not be considered in this thesis.

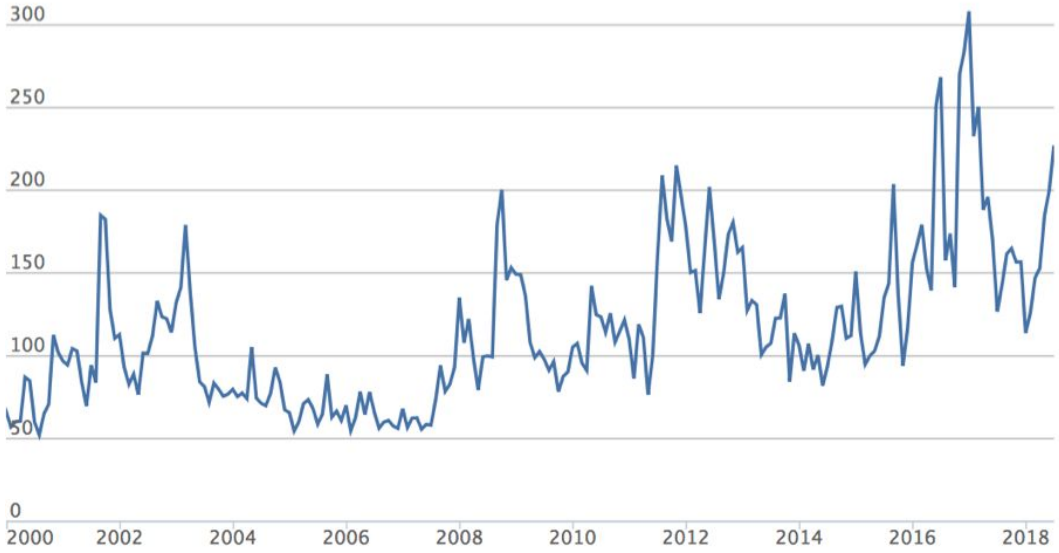

Figure 1: Economic Policy Index from 2000 to mid 2018. Collected from www.policyuncertainty.com (Baker, Bloom & Davis, 2016)

Figure 1 shows the Economic Policy Index and its spikes throughout the years. There have been several spikes in the last 18 years and some examples are: 2001: 9/11 Terrorist attack, 2003: Gulf War, 2008: Default of Lehman Brothers, 2012: Debt Ceiling dispute. Investors may wonder if it is possible to use a strategy to make a profit when there is high uncertainty based on the volatile graph, which is what we look at in this paper. From the chart, one can see that there has been more uncertainty from 2012-2018 than 2000-2006, which is interesting and raises a lot of questions. Are the economies more unstable now than earlier? Has Brexit begun a trend of leaving international unions? Is it more difficult to predict the future today than 18 years ago? These are some fascinating questions that are a source of motivation for this thesis.

3.0 Literature Review

Lustig, Roussanov and Verdelhan contributed to the literature with their paper from 2011, where they identified a "slope" factor in exchange rates. High-interest rates tend to load more on the slope compared to the low-rate currencies. The slope identifies common shocks, and they provide empirical evidence that it is related to changes in global equity market volatility. U.S. investors load up on global risk when they use a carry trade strategy. One of the most important takeaways from this paper is the two risk factors namely RX, which is average currency excess return, and HML_{FX}, which is the carry trade risk factor.

Menkhoff, Sarno, Schmeling and Schrimpf published "Carry Trades and Global Foreign Exchange Volatility" in 2012. With empirical evidence, they showed that high returns are given as compensation for risk. One of the outcomes worth noting from this study, is how they found significant evidence that the global FX volatility is a key driver of risk premium in cross section of carry trade returns. To achieve this result, they estimated portfolio betas and risk factors prices by using the two-stage ordinary least squares methodology from Fama and MacBeth (1973).

Fama and MacBeth studied the relationship between average return and risk factors based on the theoretical “three-factor” portfolio model. The cross-sectional regression captures the relationship between the risk factors and the premium. The return data in the paper was collected quarterly and annual, which have additional measures of risk compared to monthly returns. By using monthly percentage returns from all common stocks on New York Stock Exchange starting from January 1926 until June 1968, Fama and MacBeth obtained significant results were there was a positive trade-off between taking on risk and return for an investor, given that the market portfolio is efficient. The framework from this publication has been a contribution to the literature and to this thesis.

Della Corte and Krecetovs (2016) used the Fama and MacBeth methodology. It is a paper closely related to the subject of this paper, and their objective was to examine the relationship between macro uncertainty and currency premium. The macroeconomic factors to measure uncertainty was inflation rate, short-term interest rate, real economic growth and current account. The goal was to check whether carry trade investors are compensated for bearing a global risk. Della Corte and Krecetovs found evidence “that investment currencies deliver low returns whereas funding currencies offer a hedge when current account uncertainty is unexpectedly high”. On the other hand, they found no significant evidence for the other macro indicators and cross-section of currency excess returns.

3.1 Carry Trade Strategy and Risk Factors

In literature, papers try to investigate which risk factors describe carry trade returns. An important question is whether these currency and non-currency risks are complements or substitutes. Byrne, Ibrahim and Sakemoto (2016) investigated where carry trade risk originates from and whether all of it came from the stock market or not. Their findings were that there are risks of carry trade portfolios that are not captured by the downside stock market risk, which is contradictory to earlier studies made by such as Atansov and Nitschka (2014), Dobrynskaya (2014) and Lettau et.al (2014).

Literature within finance and macroeconomics build up significant connections between currency excess returns and macroeconomic factors. Riddiough and Sarno (2016) investigated the relationship between business cycles and the cross-section of currency returns. Their strategy was to buy strong economy currencies and sell weak economy currencies to have a profitable trading strategy. The result showed that currencies in strong economies have higher expected returns. Another important takeaway is that their carry trade investment strategy is mostly uncorrelated with a strategy based on exploiting cross-country differences in business cycles, which creates a diversification for FX investors.

Recent literature has studied how currency excess returns can be seen as a compensation for time-varying risk. Della Corte, Riddiough and Sarno (2016) paper investigated the macroeconomic forces driving currency premia and elaborates that global imbalance risk factors describe the cross-sectional variation in currency excess returns. Net debtor countries offer a currency risk premium as a compensation to investors willing to spend money in negative external imbalances. Furthermore, they state that currency premia are affected by two different factors, with the first one being the traditional interest rate differential and the second related to "evolution of net foreign asset positions and their currency of denomination".

Currencies and interest rates are determined by a variety of different factors, with inflation, political stability and economic performance being some examples. Lustig and Verdelhan (2007) looked at the relationship between consumption growth and exchange rates by building eight portfolios of foreign currency excess returns. Earlier studies from the literature by Backus and Smith (1993) and Chari, Kehoe and McGrattan (2002) suggested that there was an unrelated correlation between real exchange rates aggregate consumption. Lustig and Verdelhan found with empirical evidence that "aggregate consumption growth risk explains a large fraction of the average changes in the exchange rates".

Irving Fisher (1897) came up with a theory called the Fisher-effect. The Fisher-effect states that the real interest rate equals the nominal interest rate minus the expected inflation rate. The currency excess return and carry trade strategy highly rely on the interest rates, and Fisher's theory states that the inflation will have an impact on the real interest rate.

3.2 Macroeconomic Uncertainty

It is near impossible to predict with certainty what will happen in the future. Risk and uncertainty are two often misunderstood words in the economy. The famous economist Frank Knight (1921) used the coin toss example to demonstrate what risk is about; a 50% chance of winning with certainty, and defined risk as “a known probability distribution over a set of events”. Knight described uncertainty as “people's’ inability to forecast the likelihood of events happening”. In this paper, this is exactly how we measure the macro uncertainty. The professional forecaster´s disagreement before the announcement day reflects the likelihood of the event of happening, or the uncertainty around the event.

One measurement for uncertainty is to subtract the lowest number predicted from the highest number predicted of analyst dispersion. The analyst dispersion has frequently been used in literature as a proxy for differences of opinions in the market. According to Orlik and Veldekamp (2014), analyst dispersion could be used as a proxy for macroeconomic uncertainty. However, analysts’ earnings forecasts reflect the opinions of financial analysts and not necessarily the expectations of the average investor (Balkanska, 2018). Balkanska investigated whether higher analyst dispersion, hence more uncertainty in the market rewarded the investors with higher returns. “The results provided supportive evidence that “investors’ have a higher propensity to realize gains when facing higher information uncertainty.”

Analyst dispersion was used by Dick, Schmeling and Schrimpf (2013) to measure uncertainty in the market. Their results indicate “that forecasters’ term premium expectations were driven by expected macroeconomic conditions as well as the

uncertainty of market participants about future output and inflation." In other words, a higher disagreement among the analysts prior to the release date, the more uncertain the future. They investigated the relationship between macro uncertainty and the long-term premium on US treasury bonds. The macro uncertainty is defined by the analyst dispersion on several macro variables, such as inflation and GDP growth. Their findings show that forecasters expectations have predictive power on the actual returns of the bond.

Bloom (2009) reports that macro uncertainty rises in recessions and is backed up by several explanations. Another evidence from the paper is that uncertainty is higher in developing countries. This result was obtained by investigating and analyzing 60 different countries around the world, and Bloom concluded that "developing countries experience about one-third higher macro uncertainty".

All these findings build up to the hypothesis that higher risk factors in the currency exchange market will reward the investors with a higher currency risk premium. It is, however, fairly little research on how macro uncertainty and analyst dispersion affect the currency excess return. In this paper, we try to analyze if analyst dispersion on different macroeconomic factors affects the foreign exchange risk premium.

4.0 Theory and Methodology

4.1 Factor Risk Premium - Fama-MacBeth Two-Step Regression

Risk factors are commonly used to explain asset returns. The Fama-Macbeth two-step regression is a well known regression used to explain and test how these factors explain the currency premium.

4.1.1 Currency Excess Returns

The dependent variable in the Fama-Macbeth regression is the excess return from the carry-trade strategy in the foreign countries. We use *s* to denote the log of the spot exchange rate in units of foreign currency per U.S. dollar, and *f* for the log of the forward exchange rate, also in units of foreign currency per U.S. dollar (Lustig, Roussanov & Verdelhan, 2011).

The log excess return rx is calculated by investing in the one month forward *f(t)* and sell it after on month at spot price *s(t+1)*, simply:

$$rx(t+1) = log(f(t)) - log(s(t+1))$$

An increase in s, means there is a depreciation of the US Dollar, since one would need more dollars to buy one unit of foreign currency. The excess returns on individual currencies do not take into account bid-ask spreads, because we do not know whether the investors take a short or a long position on each particular currency.

4.1.2 Inflation and Unemployment Rate Uncertainty

The uncertainty in the market can be measured in the uncertainty in the predicted number for the next period from the professional forecasters in

Bloomberg. Higher spread results in more uncertainty. In order to factor in the uncertainty in the Fama-Macbeth regression, we denoted an index to measure the global uncertainty for inflation and unemployment rate.

The analyst dispersion can be written as:

$$HML_{Inf_n} = InfH_n - InfL_n$$

Where InfH is the highest prediction from a professional forecaster and InfL is the lowest in the specific country. The same is done for the analyst dispersion for the unemployment rate survey.

Further, we use the countries GDP to find the appropriate weight for each country and the final index can be written as:

$$Index_{Inf} = \sum \frac{GDPi}{\sum GDP_n} \times HML_{Infi}$$

For the euro, we used the average GDP between Germany and France to find the appropriate weight. This exact method was used for calculating the unemployment rate as well.

In the first step of running the regression, each currency's return is regressed against one or more factors in a time series to determine how exposed the return is to each of the factor exposures (Betas). In the second step, the cross-section of the portfolio returns is regressed against the factor exposures (betas) at each step in order to give a time series of coefficients for each factor. The average of these coefficients for each factor is the expected unit exposure over time (Fama & MacBeth, 1973).

This paper regress the returns up against the average market return(RX) and the carry trade risk factor (HML) obtained from Lustig,

Roussanov and Verdelhan's paper in 2011, the global inflation uncertainty index and the global unemployment rate uncertainty index mentioned in the previous paragraph.

This can be expressed in the equation form below,

$$R_{1,t} = \alpha_1 + \beta_{1,F1}RX_{1,t} + \beta_{1,F2}HML_{fx1,t} + \beta_{1,F3}Index_{Inf_{1,t}} + \beta_{1,F4}Index_{UE1,t} + \epsilon_{1,t}$$
$$R_{2,t} = \alpha_2 + \beta_{2,F1}RX_{1,t} + \beta_{2,F2}HML_{fx1,t} + \beta_{2,F3}Index_{Inf_{1,t}} + \beta_{2,F4}Index_{UE1,t} + \epsilon_{2,t}$$
$$\dots$$
$$R_{n,t} = \alpha_n + \beta_{n,F1}RX_{1,t} + \beta_{n,F2}HML_{fx1,t} + \beta_{n,F3}Index_{Inf_{1,t}} + \beta_{n,F4}Index_{UE1,t} + \epsilon_{n,t}$$

Where Rt is the currency excess return with the USD as a base currency at time *t*, F is the factors and β is the factor exposures that describe how the return is exposed to the factors. Each regression uses the same factors *F*, since the aim is to determine the exposure of the currency excess return to a given set of factors.

The second step is to compute cross-sectional regressions of the returns of the estimates of the β calculated from the first step. Each regression uses the same β's from the first step, since the goal is the exposure of the n returns over m factor exposures over time.
This can be expressed in the regression below:

$$R_{i,1} = \gamma_{1,0} + \gamma_{1,1}\beta_{1,F1} + \gamma_{1,2}\beta_{1,F2} + \gamma_{1,3}\beta_{1,F3} + \gamma_{1,4}\beta_{1,F4} + \epsilon_{i,1}$$
$$R_{i,2} = \gamma_{2,0} + \gamma_{2,1}\beta_{1,F1} + \gamma_{2,2}\beta_{1,F2} + \gamma_{2,3}\beta_{1,F3} + \gamma_{2,4}\beta_{1,F4} + \epsilon_{i,2}$$
$$\dots$$
$$R_{i,T} = \gamma_{T,0} + \gamma_{n,1}\beta_{1,F1} + \gamma_{n,2}\beta_{1,F2} + \gamma_{n,3}\beta_{1,F3} + \gamma_{n,4}\beta_{1,F4} + \epsilon_{i,T}$$

Where R is the same return as in the equation for step one, γ is the regression coefficients that later are used to calculate the risk premium.

5.0 Data

Our thesis supervisor, Dagfinn Rime ph.d. provided us with a variety of both macroeconomic and foreign exchange data. The macroeconomic dataset contained various factors such as gross domestic product, consumer price index and the unemployment rate from 25 different countries. The same source also provided us with a foreign exchange rate dataset which included daily spot rates for bid, ask and the average, as well as forward rates. Both the macroeconomic- and foreign exchange data were obtained from Bloomberg and collected from WM/Reuters.

As mentioned in previous chapters, Lustig, Roussanov & Verdelhan paper from 2011 studied risk factors in currency markets. Their paper identified two factors, RX and HML_{fx}. RX is the average currency return and could be interpreted similarly as the market return in the Capital Asset Price Model (CAPM) formula, but for the foreign exchange market. $HML_{fx}$is the carry trade risk factor and it uses the strategy of borrowing in low-interest countries and investing in countries with high interest. We extract this data from Adrien Verdelhan's homepage and obtain the two factors RX and HML_{fx}, which we use in our regression. Figure 2 shows the carry trade risk factor over time and it has been relatively stable, with a downturn during the financial crisis in 2008.

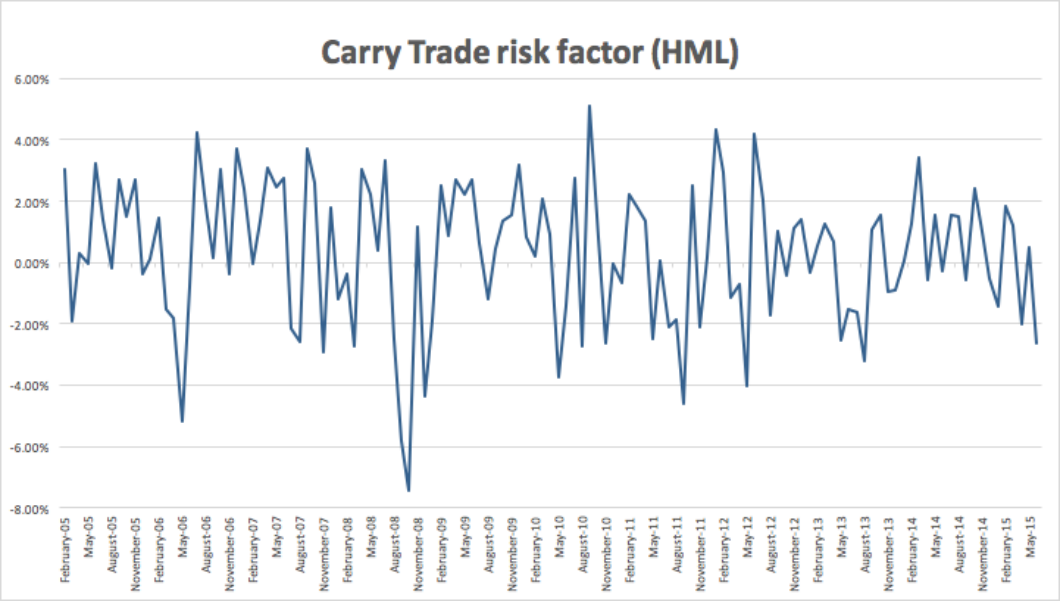

Figure 2: Carry trade risk factor from 2005 to 2015.

There are multiple public known measurements for uncertainty. In our paper, we compare our index to the Economic Policy Index constructed by Bloom, Baker & Davies (2016) to investigate similarities and differences. The data we use for these examinations are obtained and downloaded from Economic Policy Index own webpage.

Our data was based on 15 currencies that give a broad perspective from the global foreign exchange market. The currencies are Australian dollar, Brazilian real, Canadian dollar, Euro, Great British pound, Japanese yen, South Korean won, Mexican peso, Norwegian kroner, New Zealand dollar, Poland złoty, Russian ruble, Singapore dollar, Turkish lira and United States dollar. The economies in our dataset range from stable economies to relatively uncertain environments and this gives a vast amount of variety when building our uncertainty indices. If we only were to add stable economies in the creation of our uncertainty index, our data would possibly not have captured the entire global environment.

The inclusion of the US, Japan, Canada and Brazil, helps us build our indices on some of the most powerful nations and key players in the global economy. Including the less influential countries in the dataset was crucial as they can operate and react differently from actions and events in the global macroeconomic environment. The countries we chose also had a sufficient amount of data on forecasts for Consumer Price Index (CPI) and Unemployment rate (UE). In China the unemployment rate has been more or less constant at four percent in the last decades. Even if they are one of the most influential players in the world economy they are omitted from our dataset since they do not reflect the uncertainty measured in this paper.

With all the data available, some adjustments to had to be included. Using a monthly strategy, all of our macroeconomic data had to fit on a monthly basis. In some countries, the unemployment rate and consumer price index were announced quarterly. In order to convert the data to monthly basis, we sat the two following months equal to the month they were released. In addition, there were some

missing observations in some countries. These were replaced with the period after, such that we got a sufficient dataset to work with. The release of the unemployment rate and CPI are on different dates, so in order to compare them, we have set the spot and forward rates to the last business day of the month.

Our paper heavily relies on surveys from the professional analysts in order to test our regression. The most important variables in our dataset are the analyst dispersion defined as the highest predicted number minus the lowest predicted number from the survey (hml) on both cpi and the unemployment rate. The number of survey observations is also critical in order to check the robustness in the dataset.

6.0 Findings and Discussion

6.1 Beta Analysis

From the first step in the Fama and Macbeth regression (Appendix 1) we get individual betas and outputs from each currency to each individual factor. This is the same as many individual OLS's and is interesting when analyzing the factors in each country since the coefficient gives information about the sensitivity to the macroeconomic factors in the regression.

When analyzing the currency excess return up against the average market return (RX) we mostly have negative coefficients for the different currencies. However, it is exceptions with the Russian rubel and the Japanese yen where the coefficient is positive. The Japanese Yen is usually a currency investors turn to as a safe haven, and the demand tends to increase in times of a high uncertainty globally. Russia is on the other hand, a country with high political uncertainty. A theory for the finding in this analysis could be that the rubels return are driven by other variables not included in this regression. According to Rudyakov. (2016), the economy in Russia tend to decline, as the uncertainty in the country are increasing.

The carry-trade risk factor is for the majority of the currencies positive, which means the higher risk, the higher return. It is, however, an exception to the Brazilian real, where the coefficient is negative. This could be caused by the fact that Brazil is a country in a deep economic crisis. However, the coefficient is not statistically significant and will be counted as zero. For the Australian dollar(AUD), Norwegian kroner(NOK), New Zealand dollar (NZD) and South Korean won(KRW) the coefficient is the highest. This means the return for the currencies are dependent on the carry trade strategy and that it is currencies where investors can expect high returns when the carry trade rate increases.

According to the regression, currencies have different sensitivity to the inflation uncertainty index. The GBP, the Norwegian krone and the Polish złoty have the highest sensitivity to the inflation analyst dispersion.
On the other hand, the Mexican peso, Russian rubel and the Turkish lira do all have a negative coefficient for the inflation uncertainty which are interesting findings. A possible explanation for this is that all of these countries are countries with a high uncertainty associated with their political regime, and this can cause the currency market to react differently to the inflation uncertainty. (TheGlobalEconomy, 2018)

When it comes to the unemployment rate analyst dispersion, there was no pattern among the currencies. Worth noting is the extremities, like the high positive coefficients for KRW and NZD, while the CAD and RUB had a high negative number.

6.2 Gamma Analysis

The gamma's in the regression gives information about how much the investors are rewarded for taking risk. As shown in Figure 3 and 4, this varies over short periods of time, but will in theory even out in the long-run perspective. As shown in the graphs, the gammas for the market return and carry trade factor have been relatively stable (Figure 3), with a downturn around the financial crisis in 2008.

This is not surprising, since the financial crisis caused a huge downturn in the market and the economy in general. During this period of time, few investors got high rewards in risky investments. As for our uncertainty indices, the gamma's are relatively stable over time, but it is however a spike around 2008 (Figure 4). This is sufficient with Bloom's (2009) theory, where he concluded that macro uncertainty rises during recessions.

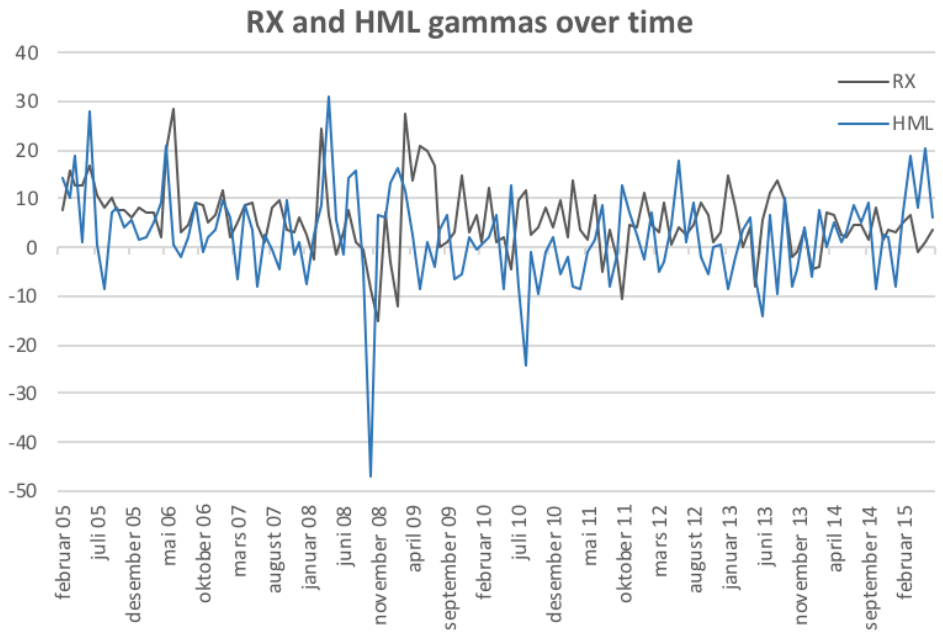

Figure 3: Average currency excess return (RX) and carry trade risk factor (HML) gammas over time.

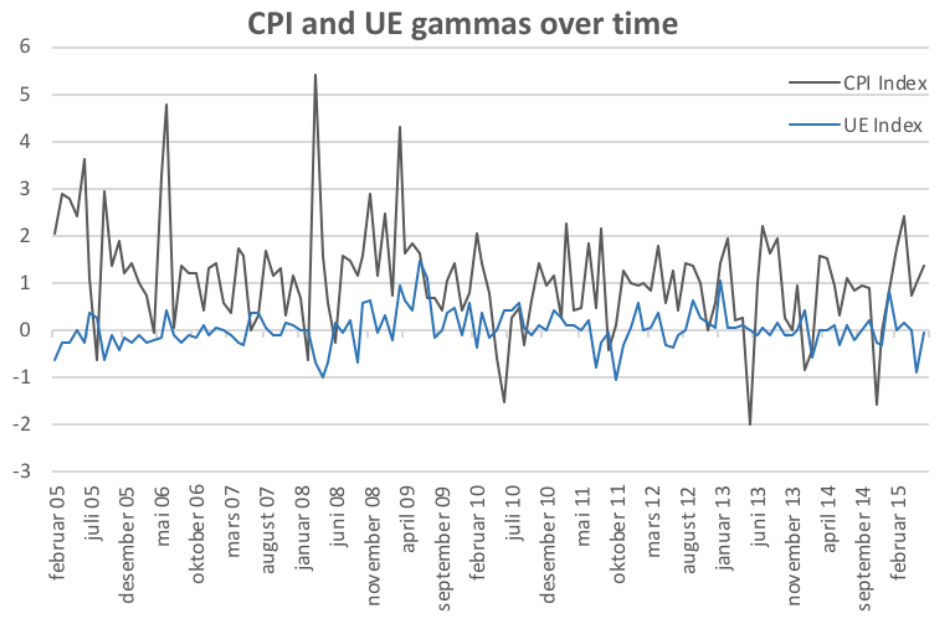

Figure 4: Inflation (CPI) and Unemployment rate (UE) uncertainty index gammas over time.

6.3 Regression Output

Regression output Fama Macbeth 2-step.					
	γ C	γ RXmean	γ Carrytrade	γ CPI	γ UE
Coefficient	-0.1303	5.6133	2.2493	1.0759	0.011
Std. Error	0.1156	1.6144	2.8873	0.3421	0.1171
T-stats	-1.1272	3.4770	0.7790	3.1455	0.0939
P-value	0.2888	0.0070	0.4559	0.0118	0.9272

R2	0.6182
Adjusted R-squared	0.4485

Figure 5: Regression output from the second step of Fama and Macbeth. Including the gamma coefficients, std. error. t-stat, p-value, R2 and adjusted R2.

The regression output (Figure 5) from the second and final step of the Fama and Macbeth shows significant results that the inflation analyst dispersion (coeff.1.0759) index and the average market currency returns (coeff 5.6133) will positively affect the currency excess return in the specific countries. Our model has an explanatory effect on R-square 0.62, which is relatively high. However, the adjusted R-squared is significantly lower with a 0.44, which can indicate that is might be some omitted variable bias in our model.

The regression output from the first step containing the β coefficients (Appendix 1) from the first step of the Fama-MacBeth regression. Each row includes the coefficients from a regression over time of asset returns on factors.
The regression output from the second step containing the factor risk premia γ from the second step of the Fama-MacBeth regression. Each row contains the coefficients from a cross-sectional regression asset returns on γs calculated from the first step of the regression (Fama & MacBeth, 1973).

Frankel and Rose (1998) found empirical evidence that countries with closer trade links tend to have more tightly correlated business cycles due to endogeneity and omitted variable biases. This can explain the adjusted R-squared and provide a

theory that it is most likely other factors that included in the regression that affects the currency excess return.

After running the regression listed in the research methodology chapter, we find significant results that our inflation uncertainty index and the average market return may have a positive effect on the currency excess return. For our unemployment uncertainty index, we can not find any significant evidence that it will impact the returns.

That investors require compensation in return for taking on more risk have been proven in several research papers. In Fama and MacBeth (1973) study they looked at the relationship between average return and several risk factors in their "three-factor" portfolio model. Fama and Macbeth found significant results that there was a positive trade-off between taking on risk and return for an investor. If we define high uncertainty around macroeconomic factors a risk factor, their findings comply with our significant results. Investors require a higher return with a higher uncertainty in the macroeconomic environment.

Menkhoff, Sarno, Schmeling and Schrimpf (2012) found that the global FX volatility is a key driver of risk premium in cross section of carry trade returns. Our analyst dispersion indices are based upon global macroeconomic factors, so results that find evidence that our indices will affect the carry trade returns is sufficient and in line with Menkhoff, Sarno, Schmeling and Schrimpf 's findings. Irving Fisher came in 1897 up the theory called the Fisher-effect. The theory describes the relationship between interest rates and inflation and states that the real interest rate equals the nominal interest rate minus the expected inflation rate. The currency excess return are as earlier mentioned highly dependent on the interest rates.

Fisher's theory states that countries with a high inflation rate will have a higher interest rate, hence a higher excess return. Our results from the regression analysis are significant with this theory. It is sufficient evidence that inflation analyst

dispersion will impact the currency excess return since it is highly dependent on interest rates.

Our findings also comply with the findings from Balkanska´s (2018) article "Disposition effect and analyst forecast dispersion" where they investigated whether higher analyst dispersion, more uncertainty in the market rewarded the investors with higher returns. The results of this paper provide supportive evidence that investors have a higher likelihood of realizing gains when facing higher information uncertainty which is the same conclusion we can draw from the results in Figure 5.

The regression output indicated only significant results for our inflation uncertainty index and not the unemployment uncertainty. According to Feldmann (2011) it is significant evidence that the currency exchange rate can cause the unemployment rate to change, and not the other way around. A possible reason that we do not get significant results for this factor is that the news of a change in unemployment rate will be a more long-term effect, rather than an immediate reaction from the news.

6.4 Robustness

6.4.1 Statistical Tests

Before running the regression, and to increase the credibility in our results, several statistical tests was computed on our dataset. In order to check for stationarity and unit roots we ran the Augmented Dickey-Fuller test (Appendix 5) on each of our four variables (Average Market Return, Carry Trade Risk Factor, Inflation Uncertainty Index and Unemployment uncertainty Index.) and concluded they all were stationary at a 1% confidence level.

Together with the Fama and MacBeth regression on Eviews we also ran a Newey West with a bandwidth of 3 to correct for any extent of multicollinearity and heteroscedasticity.

6.4.2 Shanken's Correction

The Fama-Macbeth method is sufficient in correcting cross-sectional correlation in the error terms, but it does, however, not correct for possible time-series correlation in the residuals. A possible way to fix this is to use the method suggested by Shanken and Kothari (1992) for correcting for standard errors. To strengthen the credibility of the regression results in this paper, the correction for the t-stats could have been performed on our dataset.

6.4.3 Number of Observations

The model in this paper heavily relies on professional forecasts of future consumer price index and unemployment rates. A higher number of professional forecaster participants per period contributes to increasing the robustness of our model. Our dataset contained a various number of participants, so in order to capture the uncertainty for each factor, the highest and lowest value was used in the calculation. If the data is rich and contains a high number of contributors, one could use percentiles such as the upper 95% and lower 5%, in order to remove the extreme outliers.

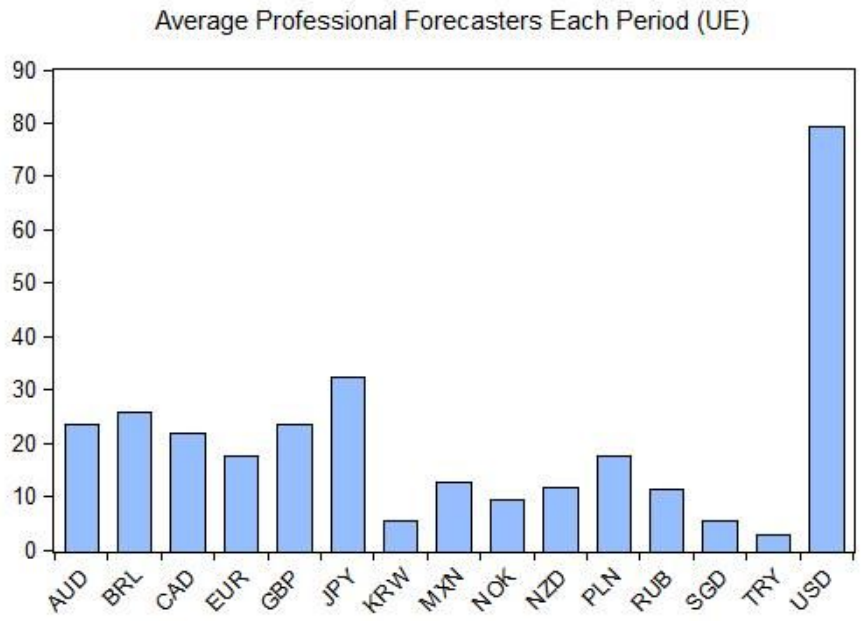

Figure 6: Average professional forecasting observations for Unemployment Rate the next month in each country.

In our unemployment rate dataset, the average professional forecasts range from 3 at lowest in Turkey to 79 as the highest average in the United States. From GDP Rankings, the US is placed as the largest economy in the world, which is probably the reason why they have the highest average participants for each period. Turkey, on the other hand, is seen more as of an unstable regime. (TheGlobalEconomy, 2018). Turkeys low number of average participants indicates that only one prediction is excluded on average. For our model, a potential problem occurs; few participants make the model less robust as the high minus low equation could potentially include some extreme values and therefore make the index less viable.

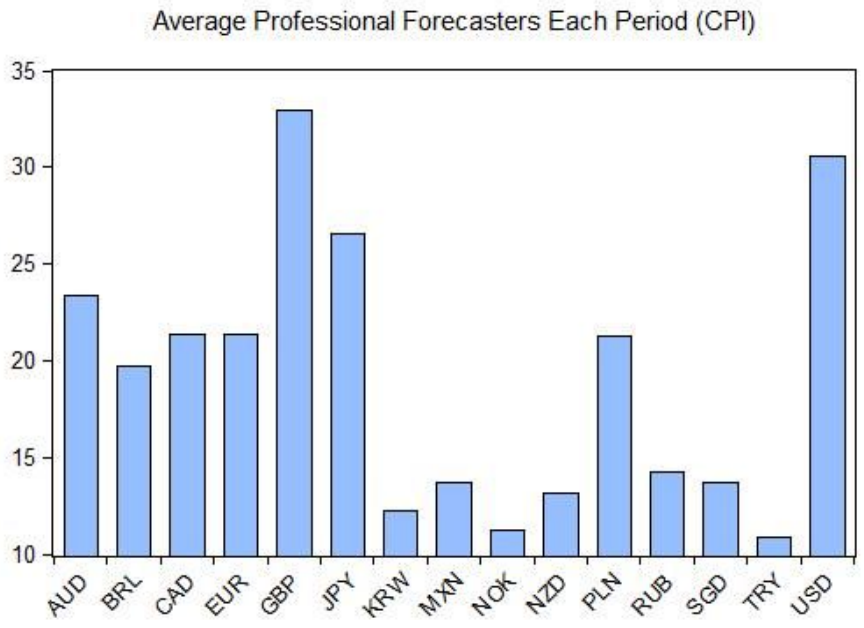

Figure 7 : Average professional forecasting observations for Consumer Price Index the next month in each country.

Examining the dataset that contains consumer price index forecasts, Turkey has yet again the lowest number of participants, but an average of 11 is not as low as compared to the three from the UE forecasting participants. There are 33 professional forecasters on average that tries to predict the CPI of the GBP next month and are the therefore the highest average number in our dataset. Comparing the average participants for the two factors, the forecasts for unemployment rate has four countries that have less than ten forecasters on average, which reduce the robustness of the UE Index. When looking at averages, there are some hidden statistics. An example is the number of professional forecasters for the Brazilian Consumer Price Index.

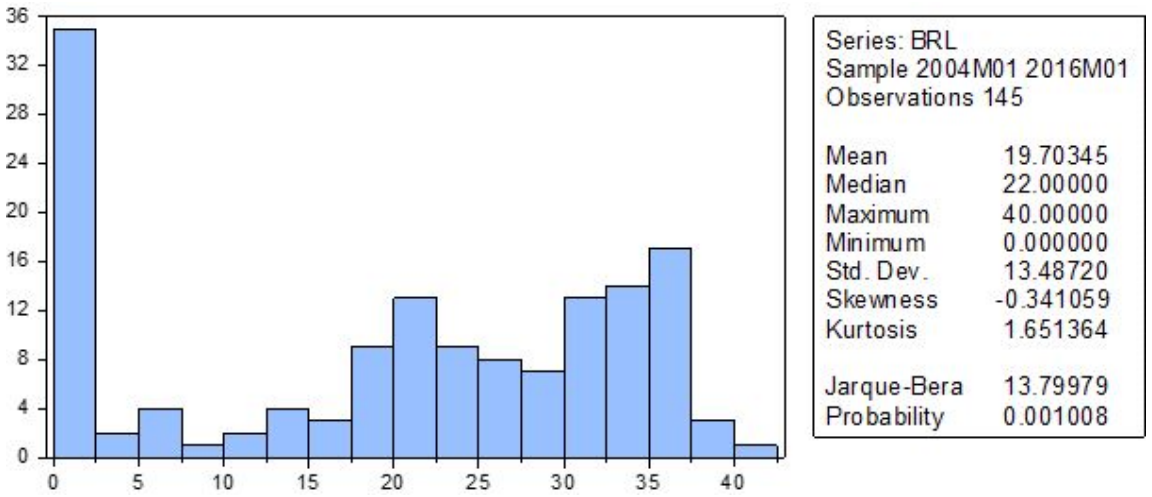

Figure 8: Histogram and statistics of the professional monthly forecasts of the Brazilian Consumer Price Index.

Figure 8 presents some interesting numbers, the professional forecasters for the Brazilian CPI is close to 20 on average each period and the standard deviation is approximately 13.5, which means that the number of forecasters tend to vary. The number of forecasters ranges from the minimum at zero to the maximum being just over 40 participants. Another interesting takeaway is the 35 missing observations, which is most out of the 15 countries. In figure 6 and 7, the missing observations were set to zero to give a useful illustration of the dataset. In our model, missing observations (NA) from the current month got replaced by previous month to obtain sufficient data for the construction of the two indices.

6.4.4 Measuring Uncertainty

Uncertainty is a widely used term when the future is unknown. In our paper, we made an uncertainty index related to consumer price index and the unemployment rate. There are some publicly known indices such as the CBOE Volatility Index (VIX) and the Economic Policy Uncertainty Index. VIX is a measurement of the expected volatility on the S&P 500 index options, while Economic Policy Index measures the policy-related uncertainty.

6.4.5 Economic Policy Index

The Economic Policy Index (EPU) was first constructed in 2013 by Baker, Bloom and Davis. It is built upon three different elements; the first component of the index is constructed based on the frequency coverage of the 10 largest newspaper in the US and it is achieved by examining the volume of uncertainty discussions. The second component consists of the Congressional Budget Office Federal tax code provisions with the expiration of 10 years. The last part consists of the disagreement between the Federal Reserve Bank of Philadelphia´s Survey of Professional Forecasters.

Comparison of EPU-, CPI- and UE Uncertainty Index

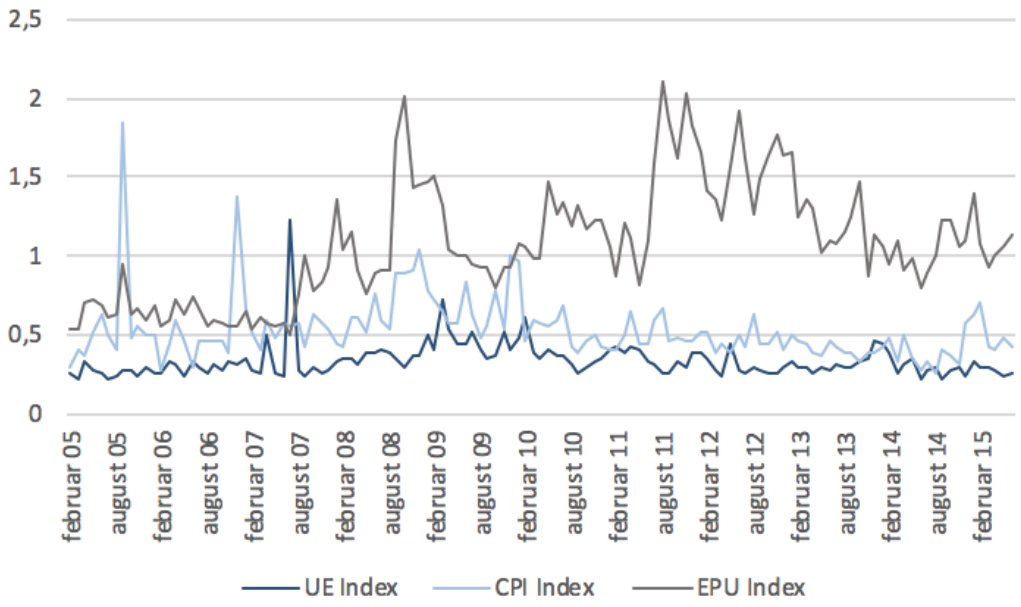

Figure 9: Comparison of the CPI, UE and EPU uncertainty indices over a ten year period.

EPUs goal is to cover the global general policy uncertainty. From figure 9, it is simple to interpret global events based on the EPU index, such as the financial crisis in 2008 and debt ceiling dispute: Euro debt from 2011. This is a result of the index is built upon different components. Compared to our construction of the index, we believe that the news coverage plays a crucial part in hitting the spikes when important global events occur. The goal of our index related to CPI and UE, is to cover the uncertainty connect only to these two factors. Therefore, these the two indices we constructed do not tend to spike as often as EPU as a result of events from the world economy.

Correlation Matrix			
	CPI	UE	EPU
CPI	1		
UE Index	0.157	1	
EPU	0.065	-0.023	1

Figure 10: Correlation matrix of CPI, UE and EPU uncertainty indices.

The low correlation from figure 10 between our analyst disagreement indices with EPU does not come as a surprise, as the analyst dispersion is just one of the three components from the EPU index. Therefore, our built indices do not share many common features with the EPU index.

6.4.6. Single Currencies vs Portfolios

Our paper distinguishes itself from others papers in the literature since we used single currencies to predict returns rather than portfolios. There are both positive and negative aspects to the way we calculate returns. When creating a portfolio of more assets or currencies, it is easier to mitigate outliers in the data. On the other side, in this paper we want to obtain outliers in order to catch the macroeconomic uncertainty. Single currencies are also more sensitive compared to portfolios. There is a variety of single currencies, and some of them are steadier than others. Euro is an example of a currency that needs more than just a national event in order to make major movements compared to a country with its own currency, such as the Norwegian krone.

7.0 Conclusion

The research in this paper found sufficient evidence that analyst dispersion on inflation rate affect the foreign exchange risk premium. Our results indicate that there is ample evidence that investors demand compensation for bearing more risk and for investing in currencies with higher analyst dispersion in the macro environment. Uncertainty is measured based of analyst dispersion and investors are rewarded by taking more risk based on these disagreements.

Our analysis was based on four different factors and 15 unique currencies. We constructed two of the factors by using the high minus low approach to measure uncertainty for both the unemployment rate and consumer price index. In addition, we used the EPU index as another uncertainty proxy. Our results discovered that only CPI and RX were significant at the 5% level.

Furthermore, investors that wants to take on additional risk would want compensation in form of higher returns and our results find sufficient evidence that with higher level of uncertainty results with improved expected return, which is in line with capital asset pricing model theory.

8.0 Contribution and Further Research

In this paper we have provided significant evidence that uncertainty from analyst dispersion affect the foreign exchange risk premium on certain macroeconomic factors. The measurement for uncertainty in our research has close to zero correlation with the EPU index. This raises a lot of interesting and important future research questions: Will adding more factors increase correlation with EPU and catch omitted factors? Are there any undiscovered factors that can explain macroeconomic uncertainty? Can unemployment rate uncertainty be significant by examining the relationship on a longer time horizon? Is it possible to make an index of multiple factors and different weights, so that one measure it against the foreign exchange risk premium? These are just some of the questions that arise based on our findings.

For further research it could also be interesting to look into the different currencies sensitivity to the macro uncertainty factors. Our findings indicates that countries with high political uncertainty could have a higher sensitivity to inflation. Another interesting subject could be the Norwegian krone high sensitivity to both the inflation index and the carry trade risk factor.

9.0 Appendix

	Constant	RX	HML	CPI INDEX	UE INDEX
	Coeff (t-stat)	Coeff (t-stat)	Coeff (t-stat)	Coeff (t-stat)	Coeff (t-stat)
AUD	-0.3119	-0.0364	0.0729	0.0479	0.2159
	(-1.3048)	*(-0.9776)*	*(2.2919)*	*(0.1500)*	*(0.3810)*
BRL	-0.8882	-0.0988	-0.0221	0.3502	0.0955
	(-3.7148)	*(-2.6527)*	*(-0.6962)*	*(1.0965)*	*(0.1686)*
CAD	0.1891	-0.0021	0.0437	0.0076	-0.7313
	(0.7912)	*(-0.0566)*	*(1.3747)*	*(0.0238)*	*(-1.2905)*
EUR	0.0359	-0.0356	0.0207	0.2842	-0.2835
	(0.1505)	*(-0.9565)*	*(0.6538)*	*(0.8898)*	*(-0.5003)*
GBP	-0.3395	-0.1367	0.0135	0.5932	0.2645
	(-1.4200)	*(-3.6673)*	*(0.4251)*	*(1.8572)*	*(0.4667)*
JPY	0.3178	0.0298	0.0011	0.0932	-0.4263
	(1.3295)	*(0.8014)*	*(0.0366)*	*(0.2918)*	*(-0.7522)*
KRW	-0.4901	-0.0732	0.0568	0.0604	0.9626
	(-2.0499)	*(-1.9642)*	*(1.7882)*	*(0.1892)*	*(1.6986)*
MXN	-0.3196	-0.0495	0.0270	-0.1595	0.1717
	(-1.3367)	*(-1.3290)*	*(0.8516)*	*(-0.4996)*	*(0.3030)*
NOK	-0.2021	-0.0776	0.0468	0.3955	-0.2710
	(-0.8453)	*(-2.0837)*	*(1.4732)*	*(1.2385)*	*(-0.4783)*
NZD	-0.6769	-0.0413	0.0649	0.2582	0.8844
	(-2.8311)	*(-1.1087)*	*(2.0418)*	*(0.8086)*	*(1.5606)*
PLN	-0.2422	-0.1056	0.0223	0.4781	-0.7275
	(-1.0132)	*(-2.8348)*	*(0.7014)*	*(1.4970)*	*(-1.2837)*
RUB	0.2363	0.0451	0.0129	-0.4150	-1.0146
	(0.9885)	*(1.2123)*	*(0.4069)*	*(-1.2995)*	*(-1.7904)*
SGD	-0.1101	-0.0372	0.0177	0.2658	0.1961
	(-0.4608)	*(-1.0004)*	*(0.5577)*	*(0.8322)*	*(0.3460)*
TRY	-0.7640	-0.0739	0.0245	-0.1391	0.1315
	(-3.1952)	*(-1.9845)*	*(0.7711)*	*(-0.4357)*	*(0.2321)*

Appendix 1: Betas and t-stats from 1-step in Fama-Macbeth regression.

Descriptive Statistics for Monthly Currency Excess Return					
	Mean	**Median**	**Maximum**	**Minimum**	**Std. Dev.**
AUD	-0,19 %	-0,17 %	2,59 %	-3,17 %	0,75 %
BRL	-0,68 %	-0,63 %	2,66 %	-2,85 %	0,83 %
CAD	-0,04 %	-0,02 %	2,56 %	-1,98 %	0,62 %
EUR	0,10 %	0,07 %	1,94 %	-1,66 %	0,57 %
GBP	0,06 %	0,00 %	3,36 %	-2,08 %	0,74 %
JPY	0,23 %	0,19 %	2,52 %	-1,58 %	0,61 %
KRW	-0,12 %	-0,10 %	2,44 %	-1,70 %	0,62 %
MXN	-0,34 %	-0,38 %	3,41 %	-1,72 %	0,66 %
NOK	-0,07 %	-0,08 %	2,64 %	-2,27 %	0,80 %
NZD	-0,23 %	-0,20 %	2,09 %	-2,37 %	0,76 %
PLN	-0,23 %	-0,19 %	3,68 %	-3,19 %	0,95 %
RUB	-0,31 %	-0,23 %	2,03 %	-4,87 %	0,83 %
SGD	0,10 %	0,10 %	2,10 %	0,00 %	0,38 %
TRY	-0,79 %	-0,73 %	1,17 %	-4,11 %	0,80 %

Appendix 2: Descriptive statistics for monthly currency excess return. These statistics includes mean, median, minimum and maximum observation, and standard deviation.

Descriptive Statistics for HML Consumer Price Index						
	Mean	Median	Maximum	Minimum	Std. Dev.	Frequency
AUD	0,60 %	0,60 %	1,20 %	0,40 %	0,16 %	Q
BRL	0,61 %	0,25 %	9,55 %	0,00 %	1,19 %	M
CAD	0,56 %	0,50 %	1,40 %	0,20 %	0,23 %	M
EUR	0,26 %	0,25 %	0,85 %	0,00 %	0,15 %	M
GBP	0,50 %	0,40 %	2,00 %	0,20 %	0,24 %	M
JPY	0,46 %	0,40 %	3,80 %	0,10 %	0,32 %	M
KRW	0,56 %	0,50 %	2,60 %	0,00 %	0,33 %	M
MXN	0,35 %	0,21 %	4,37 %	0,05 %	0,54 %	M
NOK	0,69 %	0,60 %	4,50 %	0,20 %	0,55 %	M
NZD	0,44 %	0,40 %	1,00 %	0,00 %	0,26 %	Q
PLN	0,50 %	0,40 %	4,90 %	0,10 %	0,48 %	M
RUB	0,81 %	0,60 %	3,90 %	0,00 %	0,72 %	M
SGD	0,83 %	0,80 %	3,20 %	0,10 %	0,45 %	M
TRY	0,97 %	0,81 %	3,09 %	0,17 %	0,55 %	M
USD	0,51 %	0,40 %	3,30 %	0,10 %	0,36 %	M

Appendix 3: Descriptive statistics for HML consumer price index. These statistics includes mean, median, minimum and maximum observation, standard deviation, and the frequency of announcements.

Descriptive Statistics for HML Unemployment Rate						
	Mean	Median	Maximum	Minimum	Std. Dev.	Frequency
AUD	0,29 %	0,30 %	4,20 %	0,10 %	0,33 %	M
BRL	0,70 %	0,60 %	2,45 %	0,20 %	0,35 %	M
CAD	0,22 %	0,20 %	1,10 %	0,00 %	0,12 %	M
EUR	0,23 %	0,20 %	0,70 %	0,05 %	0,11 %	M*
GBP	0,23 %	0,20 %	6,70 %	0,00 %	0,54 %	M
JPY	0,23 %	0,20 %	0,90 %	0,10 %	0,11 %	M
KRW	0,22 %	0,20 %	2,50 %	0,00 %	0,22 %	M
MXN	0,53 %	0,48 %	1,30 %	0,12 %	0,23 %	M
NOK	0,15 %	0,10 %	0,40 %	0,00 %	0,08 %	M
NZD	0,39 %	0,40 %	0,70 %	0,20 %	0,12 %	Q
PLN	0,34 %	0,30 %	2,00 %	0,10 %	0,25 %	M
RUB	0,56 %	0,50 %	3,70 %	0,10 %	0,40 %	M
SGD	0,31 %	0,30 %	1,00 %	0,00 %	0,21 %	Q
TRY	0,57 %	0,50 %	2,00 %	0,00 %	0,36 %	M
USD	0,31 %	0,30 %	2,40 %	0,20 %	0,20 %	M

Appendix 4: Descriptive statistics for HML unemployment rate. These statistics includes mean, median, minimum and maximum observation, standard deviation, and the frequency of announcements.

*The euro consists of countries that release their numbers monthly and quarterly, such as France (Q) and Germany (M)

Augmented Dickey-Fuller test			
	T-stat	Test critical values	
RXM	-11.12	1 %	-3.48
HML	-9.80	5 %	-2.88
CPI	-8.56	10 %	-2.57
UE	-3.93		

Appendix 5: Augmented Dickey-Fuller test to check for unit roots in the data. All four variables are significant at the 1% level. The more negative the t-stat is, the stronger one can reject the hypothesis of a unit root.

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Preliminary Thesis Report

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I. Abstract

Recent literature has shown that the uncovered interest parity (UIP) does not hold in reality, which opens up for arbitrage opportunities. Borrowing in low interest countries and investing in high interest countries on the global foreign exchange (FX) is recognized as a “carry trade” strategy. In our paper, we want to examine if investors are rewarded with a higher currency risk premium by investing in currencies of countries with more macro uncertainty. In our method, we use data on 10 different currencies and our macro uncertainty index will be measured by inflation rate and unemployment rate.

II. Introduction

In theory, the (UIP) states there should not be possible obtaining risk-free profits across borders in order to exploit interest rate differences. Literature have shown that UIP does not hold in reality (Hansen & Hodrick, 1983; Fama, 1984; Hodrick & Srivastava, 1984; Korajczyk, 1985; Wolff, 1987). This introduces arbitrage opportunities and in this study, we will look on how the arbitrage opportunity is connected to macro uncertainty and currency risk premium. In particular, we will want to look on how macro uncertainty is reflected in global foreign exchange risk premium. The question will record various macroeconomic aspects and see the effect they have on the foreign exchange market. Macro uncertainty can consist of numerous factors, so we will in this paper focus solely on the inflation rate and unemployment rate.

The aim of this study, is to see if investors are rewarded with a currency risk premium by investing in countries with high uncertainty. It is an important subject in the literature, because it supplements the theory of how the pricing of currencies works. By investigating how macro uncertainty affects the currencies, this result can help the industry working with risk management of global FX getting a deeper understanding of currency pricing and volatility.

We will apply the method from earlier literature by Fama and Macbeth (1973), which is a two-stage model that helps estimate the beta and market. In order to run a Fama MacBeth regression, we need an index which can operate as the market risk premium in order to solve our task. So, we need to construct an uncertainty index using data from Datastream, a finance and economic database that contains time series from millions of different financial securities, instruments and indicators for various asset classes.

The index will consist of the macro uncertainty variables inflation rate and unemployment, that are collected monthly. Base currency in our regressions will be the US dollar. We will use data on 10 different currencies, so that we get a good amount of data with variety of high and low macro uncertainty currencies.

Our measurement of macro uncertainty will be reflected in a high spread of both the inflation rate and unemployment rate.

There has been done some relevant work on this subject in recent literature. In Lustig and Verdelhan (2007) paper, they studied how the aggregate consumption growth risk affects and foreign exchange rates. Menkhoff, Sarno, Schmeling and Schrimpf (2012) investigated the relationship between global FX risk and the cross section excess returns from a “carry trade” strategy. A paper that is closely related to our subject, is the work done by Corte and Krecetovs (2015). In their paper, they looked at macro uncertainty and currency premium and they used inflation rate, short-term interest rate, real economic growth and current account as some of the variables for macro uncertainty.

The rest of this preliminary paper is organized as follows; Section III is a literature review, providing theoretical and previous work to our empirical analysis. Section IV is our empirical method, showing the formulas and variables. Section V is a description of the data and lastly, section VI is the reference list.

III. Literature Review

Macroeconomic uncertainty

No one can predict with certainty what will happen in the future. Risk and uncertainty are two often misunderstood words in the economy. The famous economist Frank Knight (1921) used the coin toss example to demonstrate what risk is about; a 50% chance of winning with certainty, and defined risk as “a known probability distribution over a set of events”. King described uncertainty as “people's’ inability to forecast the likelihood of events happening”. It is uncertain how many coins have been produced by mankind, and to try to find out, one will have to estimate across hundreds of countries throughout the history.

Bloom (2004) reports that macro uncertainty rises in recessions and is backed up by several explanations. Stock-returns volatility increases in recessions because firms tend to take on debt. The frequency of newspaper articles about economic

uncertainty is on average 51 percentage higher than average during recessions (Baker, Bloom, and Davis, 2012). This evidence is backed up by Vavra (2013) as well, where the paper examined price changes from thousands of different products, such as Coca-Cola or Duracell AAA batteries and concluded that those "kinds of items were about 50 percent more volatile during recessions".

Another evidence from the Bloom´s (2004) paper is that uncertainty is higher in developing countries. The paper looked into and analyzed 60 different countries around the world, and Bloom concluded that "developing countries experience about one-third higher macro uncertainty".

There are many perceptions and unique ways to measure uncertainty, Baker, Bloom, and Davis (2016) developed an index of economic policy uncertainty (EPU) for 12 different major economies, which is based on the frequency of newspapers coverage. EPU have spiked when world known events such as the 9/11 attacks, gulf war and the financial crisis in 2007-2008. With increased uncertainty, this index shows a decline in investment, output and employment in for example the US at the macro level.

Xiaoqiang (1997) studied macro uncertainty and risk premium in the FX market by using Lucas´ two country, dynamic, general equilibrium asset-pricing model. In the paper, Xiaoqiang looked into three different currencies and discovered time-varying risk to be a significant explanation of the deviation of the forward foreign exchange rate from the future spot rate. Furthermore, the paper empirical support that "the risk premium appears to be induced by time-varying volatility in money and production – that is, the macroeconomic uncertainty in two economies".

Carry trade strategy

According to uncovered interest parity (UIP), if investors are risk neutral and form expectations rationally, exchange rate changes will eliminate any gain arising from the differential in interest rates across countries. However, numerous empirical studies in the literature have shown that this does not hold in reality

(Hansen & Hodrick, 1983; Fama, 1984; Hodrick & Srivastava, 1984; Korajczyk, 1985; Wolff, 1987a). This creates arbitrage opportunities, so that an investor can have a profitable strategy by borrowing in low interest currencies and investing in high interest currencies, this is also known as a "carry trade" strategy. This has also given rise to the "forward premium puzzle" (Fama, 1984). Fama argues that time-varying risk premia can be explained if

(a) "risk premia are more volatile than expected future exchange rate changes"

(b) "risk premia are negatively correlated with the size of the expected depreciation".

Menkhoff, Sarno, Schmeling and Schrimpf (2012) paper studied the relationship between global FX volatility risk and carry trade strategy. In order to estimate portfolio betas and risk factor prices, they used Fama Macbeth ordinary least squares methodology. With empirical evidence, they showed that high returns are given as compensation for risk. One of the most interesting outcomes from this study, is how the global FX volatility is a key driver of risk premium in cross section of carry trade returns.

Fama and MacBeth (1973) studied the relationship between average return and risk based on the theoretical "two-factor" portfolio model. Douglas (1969) was one of the first and the result violated the hypothesis that investors attempt to hold efficient portfolios. The return data in the paper was collected quarterly and annual, which have additional measures of risk compared to monthly returns. By using monthly percentage returns from all common stocks on New York Stock Exchange starting from January 1926 until June 1968, Fama and Macbeth significant results were there was a positive trade-off between taking on risk and return for an investor, given that the market portfolio is efficient.

Milton Friedman commented the fixed rate between the U.S. Dollar and Mexican peso in early 1970 (Sill, 2000). The reasoning was that Mexican bank deposit interest rates exceeded compared to the U.S. bank deposits. In 1976, a float rate was introduced and the peso relative to the USD feel 46 percent. Peso problem is

a well-known term in finance and can be described as "when the possibility that some infrequent or unprecedented event *may* occur affects asset prices".

Burnside, Eichenbaum, Kleshchelski, and Rebelo (2011) investigated if peso problems could explain the returns of a carry trade strategy. Their sample was from January 1975 to July 2009 and the data used was bid and ask spot exchange rates data from 21 different countries. The results were that equally-weighted portfolios of carry-trade strategies generated large payoffs and were not correlated with standard risk factors. They also point out how they base their results on a linear asset pricing framework and that payoffs of carry trade strategy can have a different results using a non-linear SDF model.

In the literature papers try to investigate which risk factors that can describe carry trade returns. An important question is whether these currency and non-currency risks are complements or substitutes. Byrne, Ibrahim and Sakemoto (2016) investigated where carry trade risk originates from and whether all of it came from the stock market or not. Their findings were that there are risks of carry trade portfolios that are not captured by the downside stock market risk, which is contradictory to earlier studies made by such as Atansov and Nitschka (2014), Dobrynskaya (2014) and Lettau et. al (2014).

Risk factors in in foreign exchange market

Currencies and interest rates are determined by a variety of different factors, with inflation, political stability and economic performance being some examples. Lustig and Verdelhan (2007)looked the relationship between consumption growth and exchange rates by building eight portfolios of foreign currency excess returns. Earlier studies from the literature by Backus and Smith (1993) and Chari, Kehoe and McGrattan (2002) suggested that there was an unrelated correlation between real exchange rates aggregate consumption. Lustig and Verdelhan found with empirical evidence that "aggregate consumption growth risk explains a large fraction of the average changes in the exchange rates".

Literature within finance and macroeconomics has endeavour, with restricted achievement, to build up any significant connection between currency excess returns and macroeconomic basics. Riddiough and Sarno (2016) investigated the relationship between business cycles and the cross-section of currency returns. Their strategy was to buy strong economy currencies and sell weak economy currencies to have a profitable trading strategy. The result showed that currencies in strong economies yielded higher expected returns. Another important takeaway is that their strategy carry trade investment strategy is largely uncorrelated with a strategy based on exploiting cross-country differences in business cycles, which creates a diversification for FX investors.

Lustig, Roussanov and Verdelhan (2011) identified in their paper a "slope" factor in exchange rates. High interest rates tend to load more on the slope compared to the low rate currencies. The slope identifies common shocks and they provide with empirical evidence that it is related to changes in global equity market volatility. U.S. investors load up on global risk when they use a carry trade strategy.

Recent literature has studied on how currency excess returns can be seen as a compensation for time-varying risk. Corte, Riddiough and Sarno (2016) paper investigates the macroeconomic forces driving currency premia and elaborates that global imbalance risk factors describes the cross-sectional variation in currency excess returns. Net debtor countries offer a currency risk premium as a compensation to investors willing to spend money in negative external imbalances. Furthermore, they state that currency premia are affected by two different factors, with the first one being the traditional interest rate differential and the second related to "evolution of
net foreign asset positions and their currency of denomination".

Atanasov and Nitschka (2015) looked into the relationship of foreign currency returns and systematic risk. Their results revealed the "presence of a common

source of systematic risk in stock and foreign currency returns that is reflected in the market return's cash-flow news component".

IV. Empirical Method

In our research, we will follow the asset pricing methodology for risk premium outlined in the studies by Fama and MacBeth (1973). They derived a two parameter model for expected returns for risk. Further, we will go on and follow the factor model identified by Lustig, Roussanov and Verdelhan (2011), in order to factor in the macro uncertainty.

Fama and Macbeth (1973) identified the following model for excess return in an asset

(1)

$$E(\bar{R}i) = E(\bar{R}f) + (E(\bar{R}m) - E(\bar{R}f))\beta i$$

Where the beta is given by.

(2)

$$\beta i = \frac{cov(\bar{R}_i, \bar{R}_m)}{\sigma^2(\bar{R}_m)}$$

The term t refers to period t, so that is the one-period percentage return on security i from t - 1 to t. The equation allows each term to vary stochastically each period.

Since the purpose of our research is to examine the relationship between the risk premium and macro uncertainty, a large part of the research process will be to identify a "macro uncertainty index" that we will use to estimate the betas for the cross section.
We will use the prediction spread from the different indexes in the countries in order to properly weight the data and create a general index for international macro uncertainty.

We will use this index to estimate betas. According to (Lustig, Roussanov and Verdelhan, 2011) "Linear factor models predict that average returns on a cross-section of assets can be attributed to risk premiums associated with their exposure to a small number of risk factors." In the arbitrage pricing theory (APT) of Ross (1976), these factors capture common variation in individual currency returns. They defined a "slope" and a level factor from a principal component analysis on the excess return on currencies. They identified the "slope as the only plausible risk factor that might explain the cross-section of portfolio returns". The slope identifies common shocks and they provide with empirical evidence that it is related to changes in global equity market volatility.
The cross sectional regression can given by:

(3)

$$Ri = a0+\beta\ HML+\beta\ RX+ \in$$

Where HML is the slope defined as carry trades by Lustig, Roussanov and Verdelhan (2011) and RX is the average excess return on currencies.

In order to estimate the currency prices and the portfolio betas, we will follow the two-stage model from Fama and Macbeth, (1973). In the first stage, we will run a time-series regression on currency returns and our macro index in order to estimate the betas .

Step two will be to run the cross sectional regression of the average excess returns on the betas that was earlier estimated to estimate the factor price. This approach is also used by Lustig, Roussanov and Verdelhan (2011) in their analysis on cross sections.

V. Data description

We will collect the data from Bloomberg. We will identify key macro variables from various countries and use them to identify a "macro uncertainty index". For the currencies we will use end of the month price collected from Datastream. Base

currency in our regressions will be the US dollar. We will use data on 10 different currencies, so that we get a good amount of data with variety of high and low macro uncertainty currencies. Our measurement of macro uncertainty will be reflected in a high spread of both the inflation rate and unemployment rate.
For the Risk free rate the government treasury bond rates will be collected from Bloomberg. For the slope identified by (Lustig, Roussanov and Verdelhan, 2011) the Carry ETF from Deutsche Bank will be used.

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