ERASMUS UNIVERSITY ROTTERDAM
ERASMUS SCHOOL OF ECONOMICS
MSc Economics & Business
Master Specialisation Financial Economics

Exchange rates and economic surprise indexes[1]

[1] This paper is accompanied by a CD

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Finish date:	August 2012

PREFACE AND ACKNOWLEDGEMENTS

I would like to thank my supervisor Justinas Brazys for his support and the participants of the Seminars in Risk Management and International Investments without whom I doubt that I would have ever learned enough about exchange rates to make this thesis possible.

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ABSTRACT

I use three major currencies for the period from 2003-2012 to study the effect of economic surprise indexes on exchange rates. My tentative conclusions are that economic surprises only influence the direction of change of exchange rates. Also it appears that even simple real activity indexes can do almost as well as complex reaction based indexes such as the Citigroup Economic surprise index. Future research into the use of Economic surprise indexes in hedging is recommended.

Keywords:

Exchange rates, economic surprise indexes, macroeconomic forecasting

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1 Introduction

In this paper I will explore the influence of economic surprise indices on exchange rates. I will in particularly focus on the extent to which macroeconomic surprises can be used to devise various investment and hedging strategies. This topic has received relatively little attention in the empirical literature despite the fact that it has theoretical foundations as well as some use by investors via the Citigroup Economic Surprise index (CESI). Finally I will also attempt to compare different type of indices in order to determine the extent to which their composition matters.

The study of exchange rates has been heavily influenced by the fact that most theoretical models fail to produce accurate predictions when tested empirically. This was established in a seminal paper by Meese and Rogoff in 1983. Since then many researchers and traders have tried unsuccessfully to find a solution. Economic surprises might be a solution because of the fact that exchange rates are theorized to depend largely on expectations (Engel & West, 2005) and if those expectations are wrong that the movements wouldn't necessarily follow the theoretical trends.

In this paper I will use data from 2003 till 2012 for three major currencies in order to determine whether Economic surprises influence exchange rates. Two types of indices will be used a reaction based one CESI which incorporates some data about exchange rate reaction to surprising announcements and real activity indices made from macroeconomic forecasts and variables. I will subject those methods to a variety of empirical models from the exchange rate determination and forward premium puzzle literatures. Most of those will be applied similarly to the classical Meese and Rogoff 1983 and Fama 1984 papers. I will also attempt to determine whether some simple strategies for investing and hedging could be devised via the use of the surprise indices. Speculative trading will not be covered in the paper because the methodology to test it is quite different from that of investing and requires a paper dedicated entirely on the topic.

Overall my results suggest that substantial differences exist between my indices and the CESI. Initial results suggested that Economic surprises might account for some of the unpredictability of exchange rates but that this predictability is not easy to capitalize on in an investment strategy and is highly dependent on the forecasting performance measure used. In particular the I have performed numerous out of sample forecast models and conclude that in some cases the specific direction that the exchange rate will take(appreciate or depreciate) can be predicted somewhat better when Economic surprise indexes are used. The CESI appeared to perform no better than the custom made indices despite their relative simplicity. I have also used other more traditional measures such as the Mean Squared Error (MSE) and Mean Absolute Error (MAE) concluding that with those measures Economic surprise indexes do not appear to have predictive power.

The results indicate that economic surprise indexes do not influence substantially the forward premium though in this respect CESI was on occasion outperforming the real activity indices. In addition to those regressions I have also simulated a number of simple carry and hedging strategies. My conclusion is that no extra returns were made with respect to the carry investment strategies but the hedging based on CESI produced superior returns. In the discussion I have made some simple suggestion for continuing the topic in future research mostly revolving around a continuation of the analysis of hedging strategies and addressing a number of weaknesses of the current one like the use of market based forecasts(e.g inflation indexed swaps) rather than the survey based one used in this paper.

The rest of the paper is divided as follows: section 2 will look at the theoretical consideration behind economic surprises and the determinants of exchange rates. Section 3 will be a literature review that will describe previous empirical studies on the subject. Section 4 will look at the data that will be used in the analysis and section 5 will look at the analytical methodology. Section 6 will describe the limitations of this paper and section 7 its results. Finally section 8 will conclude with some discussion and recommendations.

2 Theory

Firstly I will describe the theoretical background behind the study of exchange rates. The various models can be grouped into several categories autocorrelative, fundamental, nonlinear and the more recent Taylor rule models. The first two groups are best described by the classical analysis of Meese and Rogoff 1983. Autocorrelative models essentially consist of attempts to extrapolate future exchange rates by using their movements in the past. The main problem with such models is that they are purely econometrically driven and don't try to explain why those price movements occur. Fundamental models on the other hand use macroeconomic variables such as inflation which would be expected to influence the demand and supply of currencies according to economic theories. Nonlinear models are best described in Altavilla and De Grauwe 2010. Those models are a version of fundamental models where the relationships between exchange rates and macroeconomic variables can be asymmetric and changing as the values of macroeconomic variables change. Finally the Taylor rule models where described by Taylor 1993. Those models attempt to model the policy responses of the Central banks. For example in the case that the economy is underperforming they expect a looser monetary policy and thus estimate what will be the influence of those policy responses on exchange rates.

In addition to those models some studies were conducted on forward exchange rates which are often used for hedging purposes. This literature mostly focuses on the forward premium puzzle. Essentially this puzzle means that forward exchange rates tend to be biased predictors of the future spot ones. A number of different explanations have been offered for this puzzle such as the existence of a risk premium (Fama 1984), market inefficiencies (Cavaglia et al 1994) and even the occurrence of rare events (Fahri and Gabaix 2008).

This last model brings us to the topic of this paper namely economic surprise. This topic has received relatively little attention. A good overview is provided in (Scotti 2012). Essentially economic surprises are defined as releases of unexpected macroeconomic news. The indexes can be divided into two groups: reaction indexes and real activity indexes.

Reaction indexes are constructed by taking into account the change in exchange rates caused by information releases such unemployment numbers over a rolling window of time. Such a reaction can be measured by the coefficients of a regression with dummy variables or by isolating returns in a short window of time around the announcement. The most famous such index is the Citigroup Economic surprise Index (CESI). The main advantage of such indexes is the fact that they can be created for any date. The main disadvantage is that they are already including exchange rate movement which makes any model that includes this index an autoregressive one. Furthermore no theoretical criterion exists as to what the size of the rolling window might be.

Real activity indexes on the other hand are made only with the use of macroeconomic information. This is done by comparing information releases with macroeconomic forecasts. The index values increase and decrease according to the size and sign of the differences between forecasted value and realized one. This means that such indexes can be created around macroeconomic announcements dates (e.g a monthly frequency is the practical minimum) or in a rolling window similarly to the reaction indexes. Furthermore that have an important advantage over reaction ones because they are constructed without the use of exchange rate information thus allowing them to be actually independent variables. They and the way in which they can be compared with reaction indexes such as CESI will be the primary focus of this paper.

The main question when discussing real activity indexes is what forecasts should be used. This is particularly important due to the fact that forecasts have been shown to be biased to factors such as recessions (Sinclair et al 2012) or even elections (Aldenhoff 2007). Furthermore forecasts often differ across experts. There are two possible solutions to that: the use of consensus forecasts or relying on some form of prediction market. Consensus forecasts are made by aggregating the input of many experts which has the problem of selecting experts and of using some methodology to aggregate it (e.g. do you remove outliers). Prediction markets on the other hand are derivatives or bets which have a payoff dependent on macroeconomic releases. The prices resulting from trading such instruments would be the market forecast.

The prediction market is theoretically superior for several reasons. (Snowberg et al 2012) Firstly, it aggregates the opinion of all forecasters without the use of some statistical procedure that may or may not be capturing all opinions. Secondly only forecasters who have an opinion will trade as opposed to forecasters that are being paid to produce forecasts regularly. Thirdly it removes the need to select experts for survey because investors can decide whether or not to trade and also different opinions will receive weight according to how big investment would any individual forecaster be willing to make. Last but not least the data for such forecasts can be real time without the use of some specific rolling window because market prices will reflect the marginal probability in any market close to efficiency.

To sum up, the various models of exchange rates can be divided into several groups: fundamental, time series, Taylor rule and nonlinear. Economic surprise indexes can be created as reactive or real activity measures and in the second case we can use either consensus forecasts or market based ones.

3 Literature review

In this section I will introduce the results on studies conducted in the field of exchange rates. Most of it will be devoted to explaining the research on exchange rates movements due to the technical complexity of the theories involved. Nevertheless I will also consider briefly research on the forward premium puzzle and macroeconomic forecasts.

Meese and Rogoff's seminal paper laid the foundations for a large amount of research in the field of exchange rate forecasting especially in the case of econometric and fundamental models. They analyzed the structural models pioneered by Hooper and Morton, Dornbusch and Frankel, and Bilson and Frenkel. These authors advocated that these models would do well in predicting exchange rate movements when in sample. The semi-reduced form of the representative equation for all the models is under this specification:

$$s = a_0 + a_1(m - m^*) + a_2(y - y^*) + a_3(r - r^*) + a_4(\pi - \pi^{e*}) + a_5\bar{TB} + a_6\bar{TB}^* + u_t$$

Where s is the log of the dollar price of the foreign currency, (m-m*) is the log of the ratio of the US to the foreign money supply, (y-y*) is the log of the ratio of US to foreign income, (r-r*) is the short term interest rate differential, (π-π*) is the expected long term inflation differential, represented by a proxy of long-term interest rate differentials, TB –TB* represents the net current trade balance and u is a disturbance term which may be serially correlated. All of the models restrain relative money supplies to 1. The Frenkel-Bilson model assumes PPP, while the Dornbusch Frankel model allows for slow domestic price adjustment, and subsequent deviations from PPP. The Hooper Morton model has no restraints.

They subsequently test the out of sample performance, due to the reasoning that in-sample tests may hide problems such as parameter instability and model misspecification. The authors use several estimations such as OLS rolling regressions and GLS rolling regressions. Even though the models are estimated using realized values of the variables, the models fail to outperform the random walk model at virtually all short horizons and across the grid of imposed parameters. The out of sample performance is measured using mean error, root mean squared error and mean absolute forecast error. They considered variations in the models, for example using price levels to substitute out for money supplies and more importantly allowed for lagged adjustment and serial correlation in the error terms with the use of statistical procedures available at the time.

In addition to the structural models, Meese and Rogoff also consider time series models ranging from the long AR model, vector autoregressions and a random walk with a drift parameter estimated as the mean monthly log exchange rate change. Yet the authors still find that no model consistently outperforms the random walk. This is not to say that the random walk is better, just that it is not worse. And not only do the authors find that the random walk outperforms the models, but also that it performs better than the forward rate, which subsequently became known as the forward premium puzzle. This development was quite low point for the theoretical works because the random walk is essentially a pure guess on what the exchange rate will be. The only positive point to note is that the models did tend to perform better at long horizons but even then their performance was not particularly good. This could be a serious problem considering that those models relied on knowing the realized values and forecasting those variables is usually appears to be impossible for periods longer than 18 months.(Isiklar and Lahiri 2007)

Cheung et al. (2005) put newer models through the test of predicting exchange rate movements. Cheung et al. class the models that they test in three ways: Interest parity models, productivity-based models and composite specification models. These models are then compared to traditional models such as the purchasing power parity and the Sticky-Price monetary model. Their analysis uses quarterly data for the United States, Canada, UK, Japan, Germany, and Switzerland over the 1973 to 2000 period. They estimated the models in first difference and error correction specifications and model performance evaluated at forecast horizons of 1, 4 and 20 quarters. They use the ratio between the MSE of the structural model and a driftless Random Walk as a means of comparison, where inferences are based on a formal test for the null hypothesis of no difference in the accuracy. Here, they use the Diebold Mariano (1995) statistic, which is defined as the ratio between the sample mean loss differential and an estimate of its standard error. They also use the direction of change statistic as a means performance evaluation. This is defined as the number of correct predictions of the direction of change over the total number of predictions. The Cheung and Chinn (1998) consistency criterion is also brought into calculation. This is a less demanding test, as it only requires that the forecast and the actual realized values co-move one to one in the long run.

They find that along the MSE performance criterion, even at long horizons, none of the structural models perform too well. Their findings also show that error correction specifications tend to perform better at long horizons. At the 20-quarter horizons PPP and IRP specifications tend to perform better than the random walk. This is in line with other findings, as previously mentioned. The direction of change statistics provides even more proof that models can outperform the random walk; however, there is no model in their analysis that is consistently better.

Molodtsova et al. investigate out-of-sample exchange rate predictability with Taylor rule fundamentals. They investigate a number of Taylor rule based models and class them in several ways. The first type of model is either symmetric or asymmetric, the difference between the two being that the asymmetric includes the real exchange rate on the right hand side of the equation. The second variant of the model includes smoothing so that the lagged interest rate differential appears on the right-hand-side, or with no smoothing at all. The third type is a homogenous model, if the response coefficients of the two countries are the same, or a heterogeneous if they are not. The fourth and final type is one that includes no constant if the two countries have identical target inflation rates and equilibrium interest rates, and includes a constant if they differ. “Quasi-real time trends” are used, so that ex-post data does not have to be used when constructing the data. They find strong evidence of short-run exchange rate predictability using Taylor rule-based models. At the one-month horizon statistically significant evidence of exchange rate predictability at the 5% level for 11 of the 12 currencies is found with the specification that produced the most evidence of exchange rate predictability being a symmetric model with heterogeneous coefficients, smoothing, and a constant.

In a paper by Altavilla and De Grauwe (2010) an investigation is made into a newer set of models’ predictive power. The models are classed as linear and non-linear models that characterize the relationship between exchange rate and the underlying fundamentals. They use 3 performance measures, namely point forecast evaluation, forecast encompassing and the direction of change statistic of Cheung and Chinn (1998). Under the point forecast criterion they find that forecast performance varies significantly across forecast horizons, across currencies and across sub-samples. They find that combining forecast from a number of models yields better results, but in general linear models perform better at short horizons when the deviation from equilibrium is not large, while more complex non-linear models tend to perform better at longer horizons. The forecast encompassing test shows that indeed mean-reversion models out-perform the random walk. The results under the direction-of-change statistic reinforce their findings, showing that a combination of the different frameworks generate more accurate forecast in terms of forecasting the sign of the exchange rate change.

The forward premium puzzle is a highly researched topic where different papers have argued for different explanations. Nevertheless the most widely cited of those papers is Fama's work in 1984. He studied the lack of predictive power of forward rates by dividing the forward rate into two parts the spot rate that exists in the future and a risk premium. He analyzed 30 day futures and concluded that the risk premiums are time varying, that they cause most of the variation in forward rates and that they are negatively correlated with the future spot rates. Nevertheless this conclusion is based on the assumption that the market is efficient and can guess correctly what will be the spot exchange rates at the delivery date of the future contract. Economic surprise indexes can help in this regard because they measure the extent to which the market's expectation failed and could therefore be a good control for establishing whether risk premiums are truly time varying.

Finally, there has been some research in the field of macroeconomic forecasts. Various researchers have established that macroeconomic forecasts are often distorted by events such as recessions (Sinclair et al 2012) or even elections (Aldenhoff 2007). One of the more interesting studies involves the forecast created by the IMF by Frank-Oliver Aldenhoff. His results are indicated that the IMF staff often makes too optimistic forecasts in order to justify its lending decisions and also this bias appeared to be correlated with election dates. Such behavior is not limited to the public sector alone.

Jonas Dovern and Johannes Weisser analyzed data from the well-known forecast company Consensus Economics for the G7 countries and concluded that the forecasts tend to be biased in situations where the forecasters have to learn about large structural shocks or gradual changes in the trend of a variable. In addition, they concluded that many forecasters smooth their forecast for GDP in particular. Those developments could be a problem for my analysis because in the event that those biases are known to the market exchange rates might not react. Reaction based economic surprise indexes could account for this implicitly because of they are already based on market reactions.

Another possible solution to this problem is the use of prediction markets. The most extensive such market was Economic derivatives where various derivatives could be bought and sold on auctions in order to predict various macroeconomic releases.(Gürkaynak and Wolfers 2006)(Snowberg et al 2012) Research on the data provided by those markets have established that their predictions were not suffering from the biases known to forecast surveys and were better predictions. Despite that this market has been closed due to insufficient number of participants and therefore trying to use its data will be of no use to future traders and investors. Another possibility is the use of data such as inflation indexed bonds, options or swaps.(Kitsul and Wright 2012) Unfortunately the author has determined that essentially all of those instruments are either limited to US data or have been around for only a handful of years. Therefore the only viable possibility for an extensive analysis is still via forecast surveys. Therefore an analysis will be made using them with reaction based indices in order to determine their efficiency.

To sum up this section, various researchers have concluded that exchange rates are hard to predict. This is partially associated with the forward premium puzzle where forward rates fail to predict future spot rates. Furthermore, conventional forecast surveys tend to have various biases but they are still the only viable way to conduct a serious econometric analysis. This last statement might change in the future.

4 Data

The data used is primarily from the Datastream database. I will be using data from January 2003 till March 2012 on a monthly frequency. This starting period is used because of the availability of CESI. The period until Dec 2006 is used as an estimation period before the start of the rolling windows analysis described in the Methodology section 5.2. The rest is used for out of sample testing. A comprehensive list of all variables can be found in Appendix A. Exchange rates for the Euro, Japanese yen and British pound compared with the dollar are produced by Thompson Reuters. All exchange rates have been converted to be expressed in European terms which means units of foreign currency necessary to buy (or sell since those are middle rates) one dollar. All exchange rates are downloaded as of the 30th of the month or the last trading day. Thompson Reuters also provides cash deposit interest rates with 1, 3 and 12 month maturities. I am using those interest rates instead of more commonly used rates such as LIBOR in part due to the current scandal elaborated on in section 6 Limitations. I will also use forward exchange rates taken from WM/Reuters with the same maturities. Next I will discuss the various macroeconomic variables that will be used in the analysis. All except the stated forecasts are final realized values and will be discussed in two groups firstly the ones used in the study of exchange rates and then the ones used for index construction.

In this paragraph I will describe briefly the variables used for the models in section 5.2. For money supply I use M1 provided via banking survey[2] by the OECD. I use M1 because as elaborated in other papers (Cheung et al 2005) it is the monetary aggregate that is most directly influenced by Central bank actions. Broader aggregates such as M2 usually include items such as saving deposits (ECB) which would be dependent on the influence of the real economy and all of my models include other variables to track real economy developments. My inflation is derived from the CPI measures of the OECD. The CPI is chosen because again it is by far the most commonly cited measure of inflation in the literature of exchange rates. This is the case because currency investors are normally interested in being able to consume their profits and without clear preferences utility function of the representative investor the use of as broad measure as possible is the only plausible option. The same source as that of CPI is also used to provide the trade balance of the respective countries and currency zones with the exception of the UK where the measure is from their national statistics agency the ONS. Finally industrial production is also produced by the OECD. Those three measures are seasonally adjusted by the data vendors.

[2] The money supply for the Eurozone and UK have been downloaded respectively from the European Central Bank and from the Bank of England(UK central bank) both gathered via banking survey.

Furthermore, forecasts were downloaded for the measurement of economic surprises. An important thing to keep in mind is that since some forecasts are made for not seasonally adjusted macroeconomic variables they will be compared to the realized values downloaded separately to match whether they are adjusted or not rather than the variables described in the previous paragraph that would be plugged into exchange rate models. Furthermore an assumption is made that those forecasts can work as proxies for the prediction of a survey of all market participants. The inflation forecasts are from the Centre for European Economic research (ZEW) and the inflation rates from the ECB and national institutions for the other countries. The Industrial production forecasts are from Directorate General for Economic and Financial Affairs (DG ECFIN) in the case of the UK and the Eurozone. The forecast for USA is from Thompson Reuters and for Japan from their Ministry of Economy, Trade and Industry. Realized values for the Eurozone and UK are from the OECD and the others from national institutions of the respective country. Eurozone and UK forecasts for unemployment are from Directorate General for Economic and Financial Affairs for the US it is from Thompson Reuters and for Japan from their Economic Planning Association.

I will create two economic surprise indexes of my own for each of the three currencies. Each index will be created for a separate currency and additional calculations will be performed to transform them for the analysis. Their creation will be done via the use of principal component analysis in a manner similar to Alexander (2009). We will use the spreads between the returns of the three forecasted variables described in the previous paragraph which will be calculates as

$$\text{spread} = \left(\frac{\text{forecast} - \text{forecast}(-1)}{\text{forecast}(-1)}\right) - \left(\frac{\text{realized} - \text{realized}(-1)}{\text{realized}(-1)}\right)$$

The first principal component of the spreads will be used in each case as economic surprise index. The index will always use the spreads of the respective country whose currency is studied. In addition one index will be created from the spreads of the United States. The first index FULL will contain the spreads of all three variables whereas the second index RESTR will use only the spreads for inflation and unemployment leaving out industrial production. Therefore in total we will have a total of 8 indexes 4 FULL indexes and 4 RESTR indexes.

Those three macroeconomic variables are chosen because no specific theory exists on what should be the composition of surprise indices and those three variables are the most commonly cited when an economy is described,The division between FULL and RESTR is done because inflation and unemployment tend to be the variables at the center of political discussions usually in connection with the Philips curve

(Blanchard et al 2007). Overall one would expect that the RESTR index will reflect mostly outcomes caused by unexpected policy changes. Furthermore higher than expected unemployment should cause higher expected inflation in the long run as central bank loosen their monetary policy. . This means that we should observe high values of the index leading to depreciation in the corresponding currency as markets react to either unexpected inflation or change their expectations for future inflation. The full index should have those effects but in addition it will include a subtle point. In macroeconomics higher inflation could be caused by an economy that is overheating. Such a development will also cause higher interest rates and thus an appreciation of the national currency. Therefore by introducing a proxy for GDP growth such as industrial production one should be able to differentiate between the two effects. Thus the FULL index should represent only the stronger of those two effects and might turn out to be better at predictor the direction of exchange rates. One important point that I would like to make is that in several of the models variables are introduced with values that won't be known to an investor. This is done in order to create a biased to success situation for the models and thus if they still fail to produce good forecasts their predictive power will be rejected.

The indexes are matched with the returns in such a way as to assure that those models are being used properly. In all of the investment and hedging strategies that are used lagged values are used in a way that will ensure that no forward information is used. This is done by downloading all market variables[3] (e.g. exchange rates, MSCI indexes) on the 30th of the month and using all macroeconomic variables for that month. That way the indexes contain the forecast for a specific month plus the actual observations for that month. An additional delay is introduced in the strategies in order to make strategies that don't use forward information.

Finally, I will also use the Citigroup Economic Surprise Index but with some modifications. Firstly the index will be rescaled to correspond to a range between 1 and 2. In order to do that without introducing changes I will use a simple formula:

$$OldRange = (OldMax - OldMin)$$
$$NewRange = (NewMax - NewMin)$$
$$NewValue = (((OldValue - OldMin) * NewRange) / OldRange) + NewMin$$

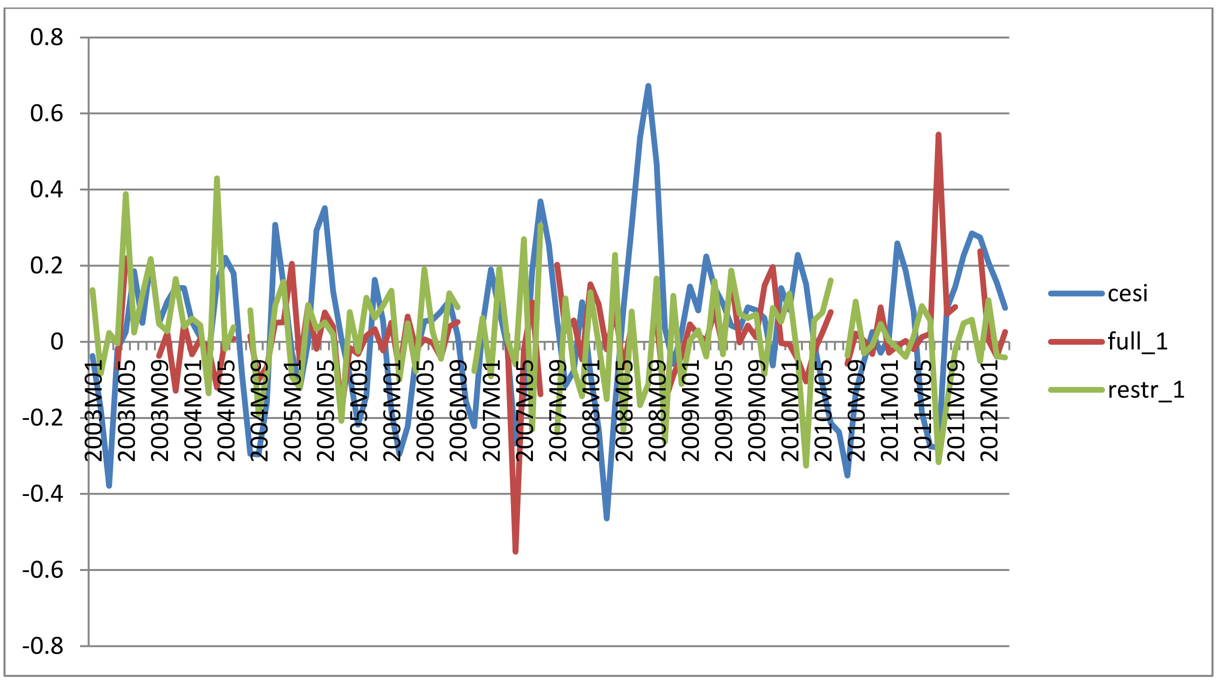
Where Old Max and Min are the observed minimum and maximum values of the index, New Max and Min will be 2 and 1 respectively and new value is the values that the index will take in each point of time. This will be done also to all FULL and RESTR indexes in order to ensure that all indices are in the same units. Next a new index will be calculated as the

[3] Interest rates were downloaded for the 3rd next month in order to account for some time to set up a deposit.

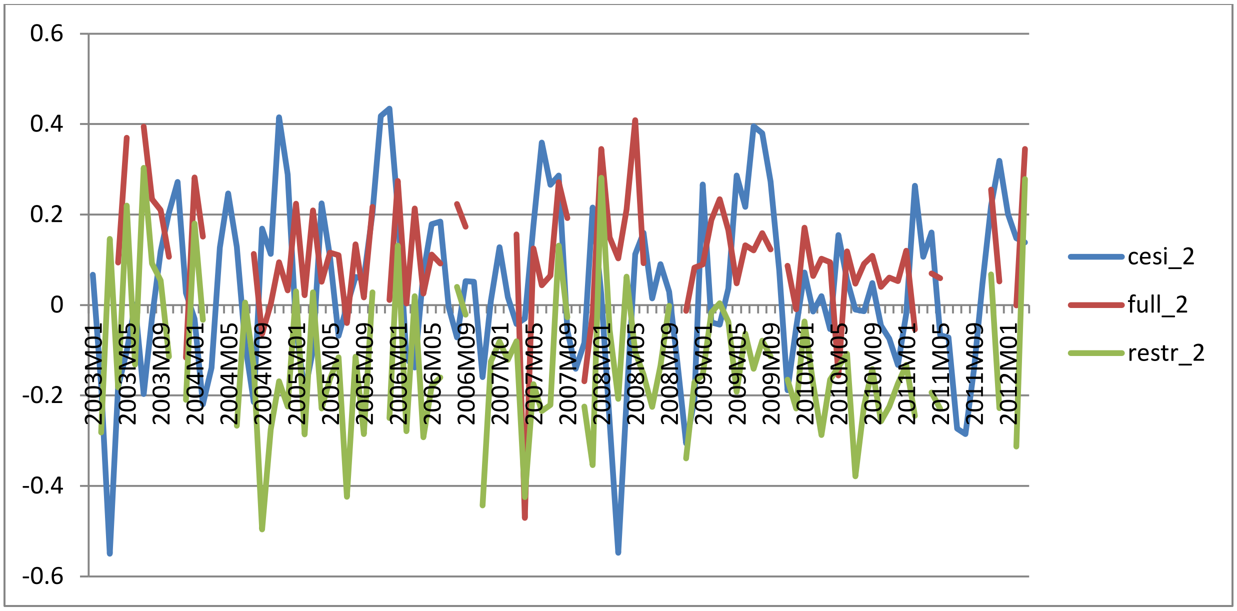
$$Index = \ln(CESI) - \ln(\overline{\overline{CESI}})$$

Where CESI without a bar is the index of the USA and the one with a bar is the index of the foreign country and ln is the natural log. The procedure will be done for all currency pairs and will also be repeated with the FULL and RESTR indexes though no two different types of indexes will be mixed. This effectively produces a log ratio similar to the one used in Meese and Rogoff that will be used in all calculations of the analysis. All references for indexes from this point onwards will be about those ratios.

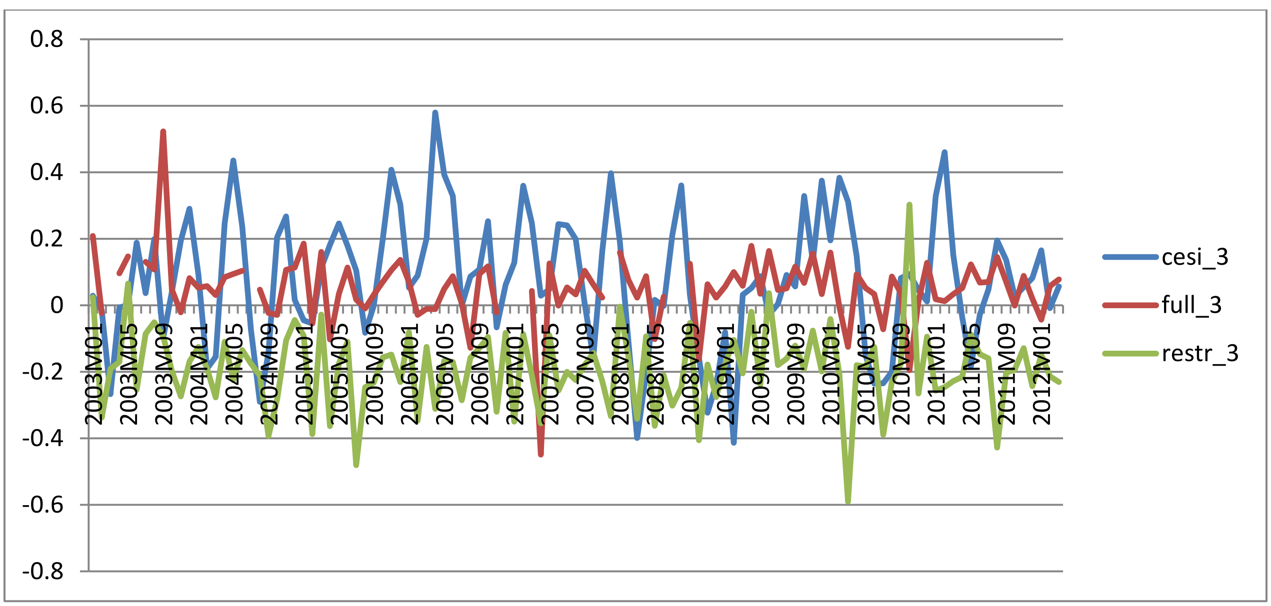
Before explaining the Methodology of the paper I would like to point out some of the differences between the indexes created in the previous paragraph.If we look at Graphs 1, 2 and 3 where all of the indexes are plotted by currency two things come to mind. Firstly, that CESI relates to the other indices differently in each currency pair. For example in the case of the Euro CESI appears to have limited if any correlation with the other indices but in the case of the yen and the pound it does converge with FULL on occasions. Secondly we observe that CESI appear to be the most unstable variable.



Graph 1 Euro indexes: the values of the index ratios on the vertical axis and time on the horizontal one. Since those are already the log ratios after all transformations they are in the same units.



Graph 2 Yen indexes: the values of the index ratios on the vertical axis and time on the horizontal one. Since those are already the log ratios after all transformations they are in the same units.



Graph 3 Pound indexes: the values of the index ratios on the vertical axis and time on the horizontal one. Since those are already the log ratios after all transformations they are in the same units.

The second statement receives some support from table 1, 2 and 3 where the standard deviation of CESI is bigger than those of the other indexes suggesting that a trading strategy that is sensitive to the size of changes in the index will be trading far more with CESI than with one of the other indexes. A second thing to notice is that FULL appears to be somewhat nonlinear with high kurtosis indicating that changes in this index can be rapid.

	Euro		
	CESI_1	FULL_1	RESTR_1
Mean	0.02	0.02	0.02
Maximum	0.47	0.55	0.43
Minimum	-0.46	-0.55	-0.33
Std. Dev.	**0.17**	0.11	0.13
Skewness	-0.26	-0.07	-0.01
Kurtosis	2.99	**12.67**	3.91
Jarque-Bera	1.12	378.11	3.34
Probability	0.57	**0.00**	0.19
Observations	97.00	97.00	97.00

Table 1 Euro indices Descriptive statistics. All bolded values are indicating significant differences between the different indexes

	Yen		
	CESI_2	FULL_2	RESTR_2
Mean	0.04	0.11	-0.13
Maximum	0.43	0.41	0.30
Minimum	-0.55	-0.47	-0.50
Std. Dev.	**0.18**	0.13	0.16
Skewness	-0.17	-0.75	0.49
Kurtosis	**3.05**	**6.82**	3.31
Jarque-Bera	0.41	61.76	3.86
Probability	0.81	**0.00**	0.15
Observations	88.00	88.00	88.00

Table 2 Yen indices Descriptive statistics. All bolded values are indicating significant differences between the different indexes

	Pound		
	CESI_3	FULL_3	RESTR_3
Mean	0.07	0.05	-0.19
Maximum	0.58	0.52	0.30
Minimum	-0.41	-0.45	-0.59
Std. Dev.	**0.19**	0.10	0.12
Skewness	-0.09	-0.46	0.12
Kurtosis	3.12	**12.22**	**5.52**
Jarque-Bera	0.22	368.60	27.41
Probability	0.90	**0.00**	**0.00**
Observations	103.00	103.00	103.00

Table 3 Pound indices Descriptive statistics. All bolded values are indicating significant differences between the different indexes

5 Methodology

The analysis will be conducted in three sections. The first one will look at the relationships between the indexes, the second one will consider the impact on predicting exchange rates and designing investment strategies based on the indexes and the third one will analyze their influence on hedging opportunities.

5.1 Index relationships

Firstly we will start by examining the extent to which our customized indexes are connected with the CESI index which uses the actual reaction of exchange rates. In order to do that we will use spanning tests inspired by the paper of (De Roon et al 2012) and (Gürkaynak and Wolfers 2006)

These spanning tests are calculated as simple regressions where

$$I^x = a + b_1 * I^y \qquad\qquad I^y = c + b_2 * I^x$$

I^x and I^y are the different economic surprise indexes for each currency thus giving us a total of four equations per currency because regressing FULL and RESTR is unnecessary. In order to correct for heteroskedasticity and serial correlation we will estimate the regressions using the Newey-West standard errors specification (West and Newey 1987). Those four regressions will be estimated for each of the three currencies. If the constant of an equation e.g. c is not statistically different from 0 If on the other hand c is statistically different from 0 then this means can mean that the index measures changes with a fixed bias compared with the independent variable Furthermore another important condition is whether b_2 is equal to 1. If that is the case then the index used as independent variable measures economic surprises with an impact similar to the dependent variable and this will imply that it will be sufficient to use only the index that is used as an independent variable due to the fact that the index used as dependent variable is spanned and therefore doesn't contain any additional information. If on the other hand the coefficient is smaller than 1 then the independent variable index is measuring economic surprises in as having larger impact which would mean that this index is smoothing the effect of individual forecast errors and this would imply that the index used as a dependent variable contains information that is not included in the other index. Finally we will also look at the adjusted R^2 measures for each regression in order to see the predictive power of the regression. If the R^2 is higher then we should expect that the spanning will be stronger meaning that the dependent variable index contains less additional information. Afterwards regressions will also be estimated of the type

$$Ix = c + b_1 * Iy + b_2 * Iz$$

Again by letting the different indexes alternate their positions in the equation. This will allow us to see whether any additional information contained in one index could be gleaned by using one of the other two. The explanation of the expected coefficients is similar to the one in the univariate regressions except that any changes in the significance of b would be of particular importance.

5.2 Exchange rate determination and investment

Secondly, we will consider the extent to which economic surprise indexes can be used to explain exchange rates. We will use several different types of techniques in order to determine which one performs best against the random walk after an economic index has been added. We will use a univariate technique, an old fundamentals model from the 70s, a Taylor rule and a nonlinear specification. All of the models will attempt to forecast s which is the natural log of the dollar exchange rate with the respective currency in terms of the dollar price of the foreign currency. I will estimate the forecasts for three exchange rates the Euro, the Japanese yen and the British pound with forecast horizons of 1,3 and 12 months[4]. Furthermore each of the models will be estimated separately for each of the economic surprise indexes. I will use the period from January 2003 till December 2006 for estimation and then we will use the period from January 2007 till March 2012[5] for out of sample testing with monthly frequency. All regressions will be estimated monthly using a rolling window of 4 years moving one observation for each forecast with a first differences specification of the described multivariate models. Moving averages will be taken from the surprise indices in order to account for longer maturities. (e.g. a 12 month moving average for the 12 month duration)

Firstly we will follow Meese and Rogoff 1983 and will estimate a univariate model. The model that we will use is the long AR. This is an unconstrained regression which will regress the exchange rate on its own lagged value plus a constant. The number of lags M to be used will be based on a rule M=N/ln(N) where N is the size of the sample. An important difference from Meese and Rogoff's version is that I will also add an economic surprise index as a second variable.

Next we will estimate the Hooper-Morton model as used by Meese and Rogoff again with an addition.

$$s = a_0 + a_1 * (m - \overline{m}) + a_2 * (y - \overline{y}) + a_3 * (r - \overline{r}) + a_4 * (\pi - \overline{\pi}) + a_5 * TB + a_6 * \overline{TB} + a_7 * I$$

where m is the money supply, y is industrial production which is used as a proxy for gdp due to non-availability of monthly gdp data, r is the interest rate for the forecast period e.g. 3 month rate or 12 month

[4] Only tables for 3 months will be shown in the text the others are available on the CD.
[5] The observation of December 2010 was removed for Japan due to an obvious outlier.

rate, π is inflation , TB is net trade balance[6] and I is economic surprise index. All variables without a bar represent the United States whereas all variables with bars stand for the respective foreign country with the exception of I which is a ratio. I have chosen to use this model from Meese and Rogoff largely because it is the most theoretically sound and comprehensive model that they use.

The third model that I will use is inspired by the Taylor rule and is taken from Molodtsova and Papell 2009. I estimate a model that is symmetric and has a constant with heterogeneous coefficients since this is the kind of model that their paper supports. I do not implement interest rate smoothing. The model that I use takes the following form

$$\Delta s_{t+1} = b_0 - b_1 * \pi_t + b_2 * \overline{\pi_t} - b_3 * z_t + b_4 * \bar{z}_t - b5 * r_t + b_6 * \bar{r}_t - 1 + b_7 * I$$

where z is the output gap which is measured as the deviation of the industrial production from a linear trend calculated as the residual of

$$y = c_0 + c_1 * trend + z$$

Where trend is a trend variable that takes the value of 1 at the first point of the estimation period n1 and has a value of trend = t for each nt thus having a value equal to the number of the respective point in time. This trend is attempting to simulate the actual targets of central banks with respect to economic growth.

Finally I will use a model from Altavilla and De Grauwe 2010 where we have selected the nonlinear VECM (vector error correction model) specification. This model was chosen due to its high performance at short term forecasting demonstrated in their paper. Furthermore this model uses only ex ante values in its prediction variables which mean that it can actually be used for forecasting by investors. I estimate it with a vector of the variables

$$\chi = \{(r - \bar{r}), (y - \bar{y}), (\pi - \bar{\pi}), I, s\}$$

$$\Delta\chi t = c + \sum_{i=1}^{k-1} \Gamma_i \, \Delta\chi_{t-i} + \Pi\chi_{t-k} + \varepsilon_t$$

Following Altavilla and DeGrauwe we estimate our model with a nonlinear quadratic trend an endogenous shift of the constant and 2 lags of each variable. Unlike them I have modeled 2 cointegration relationships due to indications from Johansen cointegration test.

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[6] In order to assure that the ratios would reflect real changes and won't take disproportionate values I have converted foreign money supplies, current accounts and industrial production into dollars.

After I have calculated all of those forecasts we will compare them with the random walk forecasts derived in the next paragraph via four different criteria: the MSE (mean squared error), the MAE (mean absolute error), the Diebold Mariano statistic and the direction of change statistic.

The random walk states that market prices evolve in a random manner, therefore making it impossible to correctly predict future prices. A random walk process basically describes that each period's value is equal to last period's value plus a constant drift term. If the drift term if set to be 0, then it is called a driftless random walk. The random-walk specification in this paper is generated by drawing a random number from a normal distribution with the mean and standard deviations from the estimation period of the respective exchange rate similarly to the one used by Cheung et al 1995.

The MSE is the calculated as the ratio of the squared errors of the models and the squared errors of the random walk forecast. (Cheung et al 2005)The squared errors are calculated as follows

$$se = (a - f)^2$$

Where f is the respective forecast value predicted by the model and a is the actual observed value of the exchange rate. Then I calculate the means of the squared errors for the tested model and for the random walk and I divide them.

$$MSE_{model}/MSE_{random\ walk}$$

This measure is traditionally used because errors does not cancel each other out and thus allow researchers to access the accuracy of the models to a greater degree. If it is the case that the MSE ratio is smaller than 1 then it will mean that my forecasting model is better than the random walk model.

In addition, we can calculate the MAE which is almost identical to the MSE except that absolute errors are used instead of squared ones.

$$ae = a - f$$

This measure is useful when fat tails or non-normality is present in the exchange rates. (Meese and Rogoff 1983)

Nevertheless in order to determine whether the ratios results are statistically significant I will have to use the Diebold and Mariano statistic. This statistic allows us to compare how two different models compare against the random walk (Cheung et al 2005) The statistic is calculated as

$$d = se_{(random\,walk)} - se$$

$$d = d_0$$

where the second equation is an OLS regression with Newey-West standard errors and d_0 is a constant so essentially I am regressing the difference of the squared errors on nothing but a constant

The p-value of the constant indicates whether the two models differ in a statistically significant manner.

Finally once we have determined that we will proceed to estimate the final measure the direction of change statistic. This measure is calculated as the number of predictions in the right direction of change divided by the total number of predictions. (Cheung et al 2005) According to this statistic the model will be considered good if it predicts correctly more than 50% of the time which is the equivalent of saying that the model predicts whether the exchange rate will depreciate more often than a coin. Furthermore in reasonably sized samples its statistical significance can be measured via the Sign test.(Diebold and Mariano 1995) I use the studentized version of the sign test with respective test statistic computed as follows:

$$Z = \frac{S_a - 0.5T}{\sqrt{0.25T}} \quad \sim \quad N(0,1).$$

Where S_a is the absolute number of adequate forecasts and T is the common sample period.

Hence, the appropriate p-value can be drawn from the standard cumulative normal distribution. This probability is one sided with a null that the forecast is correct more than 50% of the time.

This statistic will allow us to judge the extent to which various models can predict without over relying on the MSE. One additional point is that persistent trends can make meeting the benchmark 50% rather easy. This should not be a problem since I have included a univariate long AR model. This model is trying to capture such trends and would outperform significantly the other models if any strong trend exists in the data.

Nevertheless all of those models rely on realized values that won’t be available to an actual investor. Therefore in order to assess the business uses of surprise indexes I will estimate the dollar returns of a number of investment strategies connected with exchange rates. Those strategies are all based on converting a hypothetical investment and putting it in a deposit and are done for all currencies simultaneously. This is quite different from the Meese and Rogoff regression where only the coefficient are out of sample and already known values are used. Furthermore none of the previously used control variables are included because this is an attempt to make a simple one rule strategy. Firstly we will look at a simple equally weighted strategy where an investment is made in all three currencies as a cash deposit. This strategy will serve as a benchmark instead of a more classical carry strategy.[7]

Secondly we will have three strategies that will make an investment in a currency only in the case that one particular economic surprise index of that currency in the previous month has had a value in the top 25 percent compared with its values over the previous 2 years otherwise the money will be kept in a dollar depositIf more than one currency meets the requirement the investment will be split evenly between all currencies that meet it. Thirdly we will have a strategy that makes an investment in a currency only if all three indexes are in their top 25 %. Last but not least I will also estimate 4 strategies based on the same criterion except that bottom 25% will be used instead of the top. All 9 strategies will be compared via a Sharpe ratio (Sharpe 1966) calculated as follows:

$$S = \frac{R_t - R_f}{\sigma}$$

Where S is the Sharpe ratio, Rt is the annualized monthly realized return of our respective strategy, Rf is the risk free rate, which in our case is the interest rate of US dollar cash deposits and σ is the standard deviation of the excess returns (Rt-Rf). This ratio is a measure of the return of a portfolio per unit of risk.

5.3 Hedging

In order to determine the influence of economic surprises I will firstly analyze the influence of economic surprises on the determination of future exchange rates. Afterwards I will calculate several hedging strategies dependent on economic surprise indices.

For the study of future exchange rates I will follow the analysis of Fama (Fama 1984) on the forward premium puzzle. I will run 2 main OLS regressions which will be as follows:

$$F_t - S_{t+1} = a + \beta_1 (F_t - S_t) + \beta_2 * I + e$$

$$S_{t+1} - S_t = \alpha_2 + \beta_3 * (Ft - St) + \beta_4 * I + u$$

Where F is the natural logarithm of the future exchange rate, S is the logarithm of the spot exchange rate at a certain point of time, t is the time buying the future contract t+1 is the delivery time. I is a moving

[7] Normally a carry strategy involves investing in high interest rate currencies but since all three currencies are from major developed economies that is impractical in this analysis. Furthermore since the dollar is the world's reserve currency the use of other currencies might have carry like properties.

average of the respective economic surprise index where the window is considered to be the period from the purchase of the future contract till the delivery date t+1 .E and u are error terms. In the regressions I will use the standard errors calculated by the Newey-West algorithm in order to account for serial correlation. The models will be estimated for three different future maturities 1 months, 3 months and 1 year[8].

According to the theory of future prices as unbiased estimates of the future spot prices we would expect that both alphas will be insignificant. If β_1 is significant then the premium has a time variation of its own which would be against the hypothesis that future prices are unbiased predictors. Also in the case that β_3 is significant and close to 1 the hypothesis of unbiased estimators will be confirmed.

In addition, to those models in the section for exchange rates a third regression will be run in the form

$$F_t - S_t = \alpha_3 + \beta_5 * (Rex - Rus) + \beta_6 * I + v$$

Where Rex is the nominal interest rate of the country studied and Rus is the nominal interest rate in the United States of America and v is an error term. These regressions will be run in the same fashion as the above mentioned models and will allow us a check on index predictive power independent from those in section 5.2. It is an in simple version of the Interest parity models assumed by Fama as part of the efficient market hypothesis and is done as an indication on whether economic surprise indexes might be having an influence on the spot market only. If in this regression *I* is significant but not in the previous two models then it will mean that traders expect surprises to influence only the immediate spot and forward rates and that such influences are not limited to interest rate changes. The exchange rates used in our dataset are expressed in European terms which mean that the theoretical models expect β_5 to be positive and close to 1.

Finally I will also consider the dollar returns of several hedging strategies. They will be shown separately for each currency and will consist of investment in the MSCI index of the respective country which will be hedged according to the strategy. This is done because one of the most important aspects of practical investing is whether to hedge currency risk and if so by how much. (Eun and Resnick 1988) By having a passive investment in an ETF and only varying whether it is hedged or not we can see whether the cost of hedging is dependent on the occurrence of economic surprises in the recent past. The first strategy hedges the currency exposure always and serves as a benchmark. Then we have three strategies hedges it entirely only after a month when the respective economic surprise index is in the top 25% of its values compared with the previous 2 years. During all other months the strategy is unhedged. Alternatively another three

[8] Only tables for 3 months will be shown in the text the others are available on the CD

strategies will do exactly the same except that the criterion will be the bottom 25% of index values. The performance of all strategies will be compared in a manner similar to the one in section 5.2 except that this time the risk free rate will be the return of MSCI USA. This will be done for each of the three observed currency pairs.

6 Limitations

In this section I will discuss the various limitations that the analysis of this paper has in order to ensure that no unsupported conclusion can be drawn from the analysis.

Firstly, the period used in this paper is relatively short and includes a major economic crisis. This could have implications since a number of the models used rely on historical data which could provide skewed results. This is partly reduced by the fact that the models used often use rolling windows. In addition any investor who wants to use strategies based on economic surprises will be similarly limited.

Secondly, in this analysis I have used forecasts from only one survey for each variable. This is largely due to data availability. Nevertheless other sources of surveys e.g The Economist Intelligence unit could also be used as well as some market based forecasts. Such as inflation swaps or economic derivatives if such a market develops in the future. Nevertheless this provide me with the opportunity to determine whether the more extensively made CESI is really a better indicator or whether it is needlessly complex.

Thirdly, I use M1 as money supply and industrial production is used as a proxy for GDP when studying exchange rate models. The first is a commonly used measure throughout the literature because M1 is the measure that captures the central bank policies. Nevertheless there might be important economic event that will influence higher aggregates like M2 in a different way than M1 in which case my models might not be optimal. The second is done because I wanted to study exchange rates at a monthly frequency and GDP numbers are not available at frequencies higher than quarterly.

Fourthly, I do not use interest rate smoothing for the Taylor rule based model. The idea behind such this change is that a change in the interest rate might be absorbed gradually by the market and it has been supported empirically in Molodtsova.

Fifthly, I use only three currencies all of which are from developed countries. Therefore the conclusions of this analysis might not be applicable to small or developing because of the influence of factors such as illiquidity or political risk. Nevertheless from an investor's perspective the currencies discussed are the most liquid ones and would be important for trading.

Sixthly, I am using cash deposits interest rates for my exchange rate models. Some investors might have been using Libor interest rates at the time but considering the currently ongoing scandal related to this measure and the fact that some of the market participants might have been aware of it. (Enrich 2012) I have chosen not to use it at least to the extent where it can be avoided.

Finally, in this paper I use the automated Newey and West lag selection to account for heteroskedasticity and serial correlation. Research has indicated that custom made lags derived from economic theory could be superior (West and Newey 1994).

7 Results

7.1 Index relationships

currency	dependant	independant	alpha	p-val	beta	p-val(=0)	p-val(=1)	R2-adj
Euro	cesi	cur_full	0.02	0.33	0.05	0.79	0.00	-0.01
Euro	cesi	cur_restr	0.03	0.21	0.11	0.37	0.00	0.00
Euro	cur_full	cesi	0.01	0.28	0.02	0.79	0.00	-0.01
Euro	cur_restr	cesi	0.02	**0.08**	0.05	0.40	0.00	0.00
Japan	cesi	cur_full	0.05	**0.06**	-0.05	0.67	0.00	-0.01
Japan	cesi	cur_restr	0.02	0.52	-0.11	0.30	0.00	0.00
Japan	cur_full	cesi	0.11	**0.00**	-0.02	0.67	0.00	-0.01
Japan	cur_restr	cesi	-0.13	**0.00**	-0.08	0.32	0.00	0.00
UK	cesi	cur_full	0.07	**0.01**	-0.04	0.78	0.00	-0.01
UK	cesi	cur_restr	0.07	**0.01**	-0.05	0.69	0.00	-0.01
UK	cur_full	cesi	0.05	**0.00**	-0.01	0.79	0.00	-0.01
UK	cur_restr	cesi	-0.19	**0.00**	-0.02	0.70	0.00	-0.01

Table 4 Univariate Index relationships. The first three columns describe the components of the equations. All bolded values are statistically significant p-values.

As we can see in Table 4 the constant is significant in all but four equations. This would normally imply that overall most of the economic indices have a fixed bias to each other which could be removed by an additional normalization. Nevertheless this result should not have an influence on the other coefficients... Next we should look at the betas. None of them are statistically significant which indicates that the indexes do not span each other meaning that the information that they contain is completely different. This could explain the significance observed in the alphas. No relationship appears to exist at all in the case when we look at R^2.

Next we will look at the changes that will ensue in the case when we consider several indexes together in Table 5.All of the significant alphas are in regressions where my indexes are dependents. This clearly supports the original conclusion from the previous section that my indexes for Japan and UK have different means that CESI doesn't. Nevertheless this should not influence the other cofficients.

All of the significant betas are in the Japanese and UK equations are significant but they are all coefficients between FULL and RESTR a connection that is due to their similar construction. Furthermore those are again the only equations with any predictive power. This result once again confirms that CESI and my indexes do not appear to be related despite the fact that one would expect my indexes to be a subset of CESI.

To sum up, the CESI index is not explained by my customized indexes. In European even the FULL and RESTR do not appear to be connected suggesting that industrial production differs from inflation and unemployment perhaps due to policy or the multi country nature of the Eurozone.

currency	dependant	independant1	independant2	alpha	p-val	beta1	p-val(=0)	p-val(=1)	beta2	p-val(=0)	p-val(=1)	R2-adj
euro	cur_full	cesi	cur_rest	0.01	0.36	0.02	0.82	0.00	0.05	0.76	0.00	-0.02
euro	cur_rest	cesi	cur_full	0.02	0.12	0.10	0.10	0.00	0.06	0.77	0.00	0.00
euro	cesi	cur_full	cur_rest	0.02	0.41	0.04	0.82	0.00	0.18	0.11	0.00	0.00
japan	cur_full	cesi	cur_rest	0.19	**0.00**	0.00	0.91	0.00	0.66	**0.00**	0.00	0.69
japan	cur_rest	cesi	cur_full	-0.24	**0.00**	-0.01	0.70	0.00	1.05	**0.00**	0.76	0.69
japan	cesi	cur_full	cur_rest	0.03	0.39	0.02	0.91	0.00	-0.06	0.69	0.00	-0.02
uk	cur_full	cesi	cur_rest	0.13	**0.00**	-0.01	0.75	0.00	0.39	**0.02**	0.00	0.21
uk	cur_rest	cesi	cur_full	-0.22	**0.00**	0.00	0.95	0.00	0.58	**0.00**	0.04	0.21
uk	cesi	cur_full	cur_rest	0.08	**0.01**	-0.04	0.74	0.00	0.01	0.95	0.00	-0.02

Table 5 Multivariate relationships of the indexes. The first four columns describe the components of the equations. All bolded values are statistically significant p-values

7.2 Exchange rates

In this part I examine each criterion one by one in order to determine the observed prediction successes. This will be done with different forecast horizons starting with 3 months then 1 month and finally 12 months. I will only report the 3 month tables in order to maintain some brevity

Firstly, we will look at the MSE criterion in Table 6.

		Messe Univar	Messe Fund	Mol	VECM
Euro	cesi	0.84	**0.09**	1.22	1.35
Euro	FULL	0.71	**0.08**	1.08	0.73
Euro	RESTR	0.74	**0.08**	1.25	1.79
Euro	Bench	0.89	**0.10**	1.44	1.62
		Messe Univar	Messe Fund	Mol	VECM
Japan	cesi	0.78	**0.17**	0.76	0.89
Japan	FULL	0.89	**0.15**	1.71	1.93
Japan	RESTR	0.71	**0.13**	0.74	2.00
Japan	Bench	0.70	**0.16**	0.66	0.70
		Messe Univar	Messe Fund	Mol	VECM
UK	cesi	0.96	**0.09**	0.69	0.82
UK	FULL	0.68	**0.06**	0.55	0.66
UK	RESTR	0.75	**0.08**	0.58	0.77
UK	Bench	0.92	**0.10**	0.75	0.89

Table 6 MSE criterion for 3 month forecast horizon. The numbers are the MSE ratio. If the ratio is lower than 1 than the model is outperforming the random walk. The bolded figures indicate the model with least amount of errors for the specific currency and index. Messe Univar is the long AR model. Messe fund is the fundamental model from Meese and Rogoff. Mol is the Taylor rule model from Molodtsova et al and VECM is the nonlinear model

The results from the MSE criterion appear to be quite unexpected. There is no index where at least one of the models is not outperforming the random walk. By far the best model appears to be the Hooper-Morton fundamental model which does best in every case. In this particular horizon the indexes appear to improve the predictive power of the fundamental model especially in the case of the real activity indexes.

euro		Messe Univar	Messe Fund	Mol	VECM
	cesi	0.00	0.00	0.00	0.00
	p-val	0.26	**0.00**	0.30	0.44
	FULL	0.00	0.00	0.00	0.00
	p-val	0.16	**0.00**	0.45	0.41
	RESTR	0.00	0.00	0.00	0.00
	p-val	0.10	**0.00**	0.46	0.31
	Bench	0.00	0.00	0.00	0.00
	p-val	0.52	**0.00**	0.25	0.41
japan		Messe Univar	Messe Fund	Mol	VECM
	cesi	0.00	0.00	0.00	0.00
	p-val	0.15	**0.00**	0.32	0.64
	FULL	0.00	0.00	0.00	0.00
	p-val	0.20	**0.00**	0.45	0.43
	RESTR	0.00	0.00	0.00	0.00
	p-val	0.19	**0.00**	1.00	0.21
	Bench	0.00	0.00	0.00	0.00
	p-val	**0.05**	**0.00**	**0.03**	**0.10**
uk		Messe Univar	Messe Fund	Mol	VECM
	cesi	0.00	0.00	0.00	0.00
	p-val	0.89	**0.00**	0.16	0.38
	FULL	0.00	0.00	0.00	0.00
	p-val	0.19	**0.00**	0.12	0.35
	RESTR	0.00	0.00	0.00	0.00
	p-val	0.19	**0.00**	**0.03**	0.19
	Bench	0.00	0.00	0.00	0.00
	p-val	0.68	**0.00**	**0.07**	0.63

Table 7 DM statistic with square differences 3 month. The upper number for each specification is the Diebold Mariano statistic and the p value is the probability that the model is not outperforming the random walk. Bolded figures indicate the probabilities significant under conventional levels. Messe Univar is the long AR model. Messe fund is the fundamental model from Meese and Rogoff. Mol is the Taylor rule model from Molodtsova et al and VECM is the nonlinear model

This development is in line with the results in section 7.1 which suggested that CESI and the real activity indexes measure different things. In the cases of 1 month and 12 month horizons the introduction of the indexes appears to make either minor improvement or even to worsen the performance of the models. Outside fundamental the other specifications have differing performance with different indexes doing differently in different currencies without obvious patterns. One interesting point is that at the 12 month horizon the long AR model has the second best performance instead of the VECM which is theorized to perform better at long horizons.

A look at the Diabold and Mariano statistic in Table 7 shows us that those results are significant. The fundamental model does better than the random walk in all cases. The Taylor model is the only other one that does better and it does so only in with the pound and yen without an index and once with RESTR. Interestingly enough looking at the probabilities the CESI does not appear to be enhancing performance any better than the simple real activity indexes. At horizons of 1 and 12 months the results appear to be similar with the model without an index performing best overall. To conclude the MSE criterion does not appear to indicate that economic surprise indexes are important for exchange rate determination.

		Messe Univar	Messe Fund	Mol	VECM
Euro	cesi	0.94	**0.31**	1.06	1.03
Euro	FULL	0.83	**0.28**	0.94	0.84
Euro	RESTR	0.86	**0.31**	1.12	1.10
Euro	Bench	0.85	**0.29**	1.02	0.92
		Messe Univar	Messe Fund	Mol	VECM
Japan	cesi	0.89	**0.36**	0.83	0.87
Japan	FULL	0.97	**0.33**	1.19	1.22
Japan	RESTR	0.87	**0.32**	0.91	1.26
Japan	Bench	0.83	**0.35**	0.78	0.80
		Messe Univar	Messe Fund	Mol	VECM
UK	cesi	0.99	**0.31**	0.81	0.94
UK	FULL	0.81	**0.25**	0.77	0.82
UK	RESTR	0.86	**0.28**	0.76	0.83
UK	Bench	0.95	**0.31**	0.84	0.89

Table 8 MAE Criterion 3 month The numbers are the MAE ratio. If the ratio is lower than 1 than the model is outperforming the random walk. The bolded figures indicate the model with least amount of errors for the specific currency and index. Messe Univar is the long AR model. Messe fund is the fundamental model from Meese and Rogoff. Mol is the Taylor rule model from Molodtsova et al and VECM is the nonlinear model

In order to make sure that the observed results are not driven by fat tails I will next examine the MAE in Table 8. The fundamental model is still clearly the best predictor though the difference with the underperforming models has decreased though none of them is particularly better than the others.

Interestingly the real activity indexes sometimes lead to improvement over the original model in some cases but the same is not true about CESI. In the case of 1 and 12 months horizons the results appear to be similar. The only difference is that in the long horizon the real activity indexes worsen the performance of the Taylor rule. This is especially true for the Eurozone and FULL confirming again the result from section 7.1 that European industrial production appears to behave differently from those in Japan and the UK.

We can find the Diebold-Mariano statistic in Table 9. Overall the results are the same except that CESI does manage to achieve a better probability than the models without index but still does so fewer times than the real activity indexes. Furthermore the DM statistic for horizons of 1 and 12 months largely supports those findings with some differences. In the short horizon the model without an index is clearly the best performer and the real activity indexes deter it less than CESI does. In the long horizon on the other hand we have CESI improving the performance of the long AR model and FULL strongly improving the performance of the other models. This suggests that the result with the Taylor model might be due to an outlier.

To sum up those indicators, economic surprise indexes do not appear to influence exchange rates in the short horizon though their influence increases over longer horizons. Furthermore despite their simplicity of construction the real activity indexes appeared to perform better than CESI which suggests that CESI might be trying to include too many variables at once or that the effect of surprises is not concentrated around announcement days.

Next in order not to rely on only one measure I have calculated the Direction of change statistic. We can see it in Tables 10-12 for each currency tables for 1 and 12 month horizon will not be shown in the text.

euro		Messe Univar	Messe Fund	Mol	VECM
	cesi	0.00	0.02	0.00	0.00
	p-val	0.57	**0.00**	0.45	0.84
	FULL	0.00	0.03	0.00	0.01
	p-val	0.22	**0.00**	0.77	0.32
	RESTR	0.01	0.02	0.00	0.00
	p-val	0.15	**0.00**	0.47	0.78
	Bench	0.01	0.02	0.00	0.00
	p-val	0.16	**0.00**	0.72	0.50
japan		Messe Univar	Messe Fund	Mol	VECM
	cesi	0.00	0.02	0.01	0.00
	p-val	0.28	**0.00**	0.21	0.32
	FULL	0.00	0.02	0.00	-0.01
	p-val	0.41	**0.00**	0.59	0.44
	RESTR	0.00	0.02	0.00	-0.01
	p-val	0.32	**0.00**	0.70	0.14
	Bench	0.01	0.02	0.01	0.01
	p-val	0.13	**0.00**	**0.01**	0.13
uk		Messe Univar	Messe Fund	Mol	VECM
	cesi	0.00	0.02	0.00	0.00
	p-val	0.93	**0.00**	0.12	0.57
	FULL	0.01	0.02	0.01	0.01
	p-val	0.14	**0.00**	**0.10**	0.16
	RESTR	0.00	0.02	0.01	0.01
	p-val	0.18	**0.00**	**0.01**	0.14
	Bench	0.00	0.02	0.00	0.00
	p-val	0.73	**0.00**	0.17	0.46

Table 9 DM statistic for absolute differences 3 month The upper number for each specification is the Diebold Mariano statistic and the p value is the probability that the model is not outperforming the random walk. Bolded figures indicate the probabilities significant under conventional levels. Messe Univar is the long AR model. Messe fund is the fundamental model from Meese and Rogoff. Mol is the Taylor rule model from Molodtsova et al and VECM is the nonlinear model

EU	Random Walk	Messe Univar	Messe Fund	Mol	VEC
CESI	0.57	0.57	0.90	0.54	0.49
sample	61.00	61.00	60.00	61.00	61.00
p-val	0.88	0.88	**1.00**	0.74	0.45
FULL	0.48	0.56	0.85	0.58	0.56
sample	61.00	52.00	54.00	43.00	43.00
p-val	0.35	0.80	**1.00**	0.86	0.78
RESTR	0.57	0.54	0.86	0.51	0.52
sample	61.00	57.00	58.00	55.00	54.00
p-val	0.88	0.75	**1.00**	0.55	0.61
BENCH	0.49	0.57	0.90	0.49	0.57
sample	61.00	61.00	60.00	61.00	61.00
p-val	0.45	0.88	**1.00**	0.45	0.88

Table 10. Direction of Change criterion. Euro exchange rate at a 3 month horizon Ratio of adequate forecasts shown in the index rows. Sample size is listed below them. P-values regarding the conducted sign test on whether the direction is bigger than 0.50 in the third row per maturity. Messe Univar is the long AR model. Messe fund is the fundamental model from Meese and Rogoff. Mol is the Taylor rule model from Molodtsova et al and VECM is the nonlinear model

In this criterion the fundamental model is again clearly the optimal one for the Euro for the 3 month horizon. Interestingly enough when looking at the indexes it turns out that whereas the differences between them are negligible and in all but the Taylor model the model without index is the best and FULL improves performance only in one case. When looking at 1 month horizon the benchmark model always performs best and in addition the VECM proves to have significant predictive power though only when it is not Using FULL or CESI Over the long horizon the fundamental model is again the best performer and again the indexes do not improve the original models. One interesting point is that the Taylor rule model gains predictive power in all cases except when FULL is included which confirms again that the European FULL has negative influence over Taylor models in long horizons.

Next we will look at the Japanese Yen on table 11.

Japan	Random Walk	Messe Univar	Messe Fund	Mol	VECM
CESI	0.39	0.51	0.86	0.54	0.56
sample	61.00	61.00	59.00	61.00	61.00
p-val	0.05	0.55	**1.00**	0.74	0.81
FULL	0.57	0.38	0.88	0.53	0.65
sample	61.00	42.00	49.00	34.00	34.00
p-val	0.88	0.06	**1.00**	0.63	**0.96**
RESTR	0.48	0.40	0.88	0.34	0.37
sample	61.00	45.00	51.00	41.00	41.00
p-val	0.35	0.09	**1.00**	0.02	0.04
BENCH	0.54	0.46	0.86	0.56	0.62
sample	61.00	61.00	59.00	61.00	61.00
p-val	0.74	0.26	**1.00**	0.81	**0.97**

Table 11 Direction of Change criterion. Yen exchange rate with a 3 month horizon Ratio of adequate forecasts shown in the index rows. Sample size is listed below them. P-values regarding the conducted sign test on whether the direction is bigger than 0.50 in the third row per maturity. Messe Univar is the long AR model. Messe fund is the fundamental model from Meese and Rogoff. Mol is the Taylor rule model from Molodtsova et al and VECM is the nonlinear model

In the case of the Japanese yen the fundamental model is clearly the best. With respect to the indexes and benchmark every one of them gets to be best at least once except for RESTR. For the horizon of 1 month both real activity indexes manage to perform better than the benchmark. For the horizon of 12 months the results are similar to those for 3 months though a Taylor model with FULL is significant.

Finally Table 12 will show us the criterion for the British pound. The fundamental model is again the best performer. Two points stand out. Firstly, this time CESI is the best type fundamental and secondly that VECM again has predictive power. In the case of the 1 month horizon the fundamental RESTR is marginally better than the benchmark and VECM is again strong performer. When looking at the 12 month horizon we see the fundamental CESI as the best predictor. Nevertheless other indexes do bettr in some of the other models although their results are not statistically significant.

UK	Random Walk	Messe Univar	Messe Fund	Mol	VECM
CESI	0.51	0.54	0.82	0.49	0.57
sample	61.00	61.00	60.00	61.00	61.00
p-val	0.55	0.74	**1.00**	0.45	0.88
FULL	0.49	0.61	0.79	0.46	0.61
sample	61.00	56.00	57.00	50.00	49.00
p-val	0.45	**0.95**	**1.00**	0.29	**0.94**
RESTR	0.48	0.51	0.80	0.46	0.59
sample	61.00	61.00	60.00	61.00	61.00
p-val	0.35	0.55	**1.00**	0.26	**0.92**
BENCH	0.51	0.49	0.80	0.54	0.64
sample	61.00	61.00	60.00	61.00	61.00
p-val	0.55	0.45	**1.00**	0.74	**0.99**

Table 12 Direction of Change criterion. Pound exchange rate with 3 month horizon Ratio of adequate forecasts shown in the index rows. Sample size is listed below them. P-values regarding the conducted sign test on whether the direction is bigger than 0.50 in the third row per maturity. Messe Univar is the long AR model. Messe fund is the fundamental model from Meese and Rogoff. Mol is the Taylor rule model from Molodtsova et al and VECM is the nonlinear model

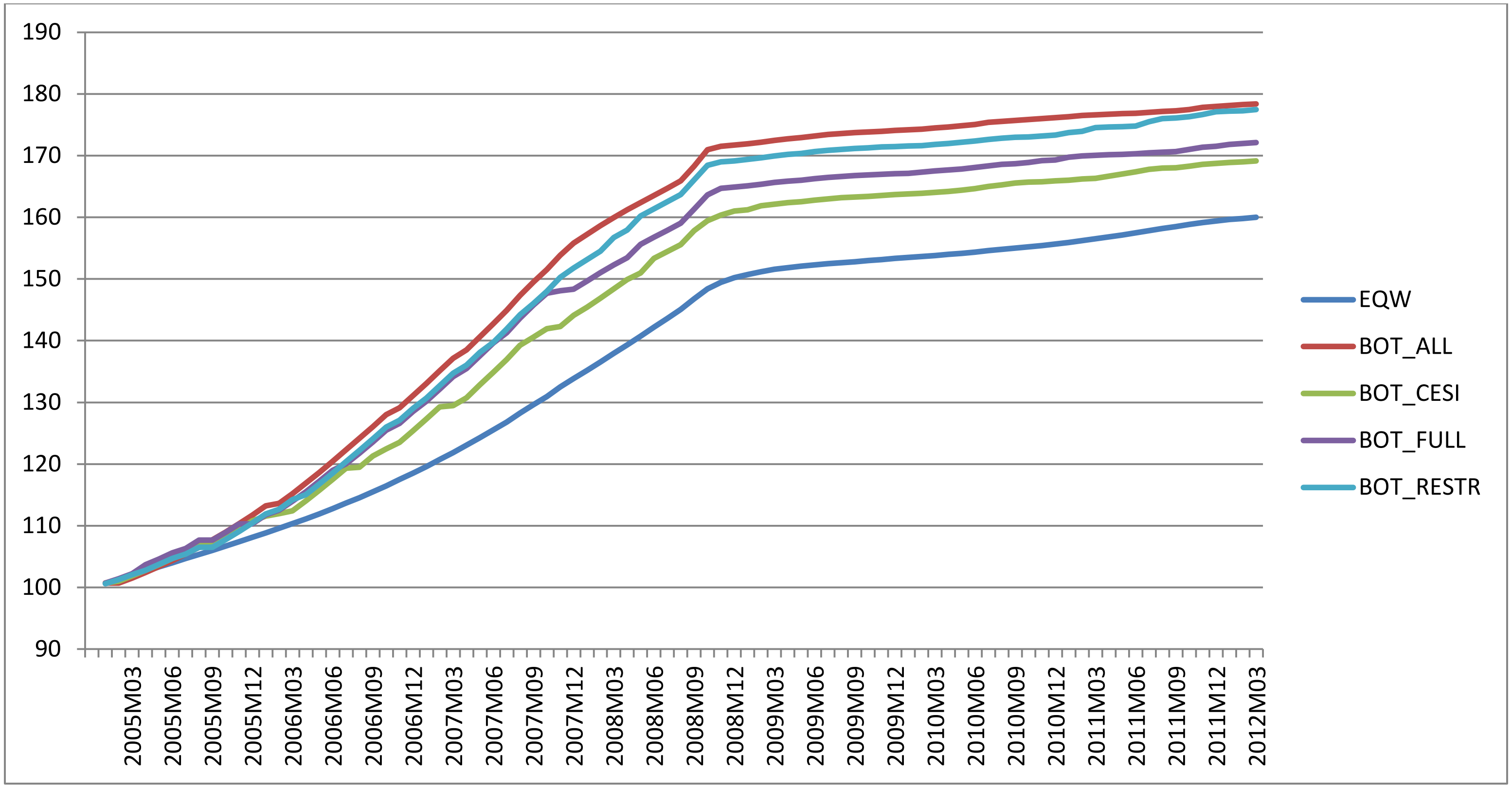
All those results are not conclusive on whether economic surprise indices have an influence on exchange rates. The MAE and MSE criterions suggest that they do not and that the real activity indexes were better than CESI. Whereas the Direction of Change criterion often had index models outperforming those without index. An important point is that different indexes were better with different models, currencies and forecast horizons without an obvious pattern.

This analysis is based on ex post realized values for the rest of this section I will demonstrate the extent to which those indexes can be applied to an actual investment strategy. The strategies are described in detail in the methodology section. I have plotted the cumulative returns of all the investment strategies in Graphs 4 and 5.

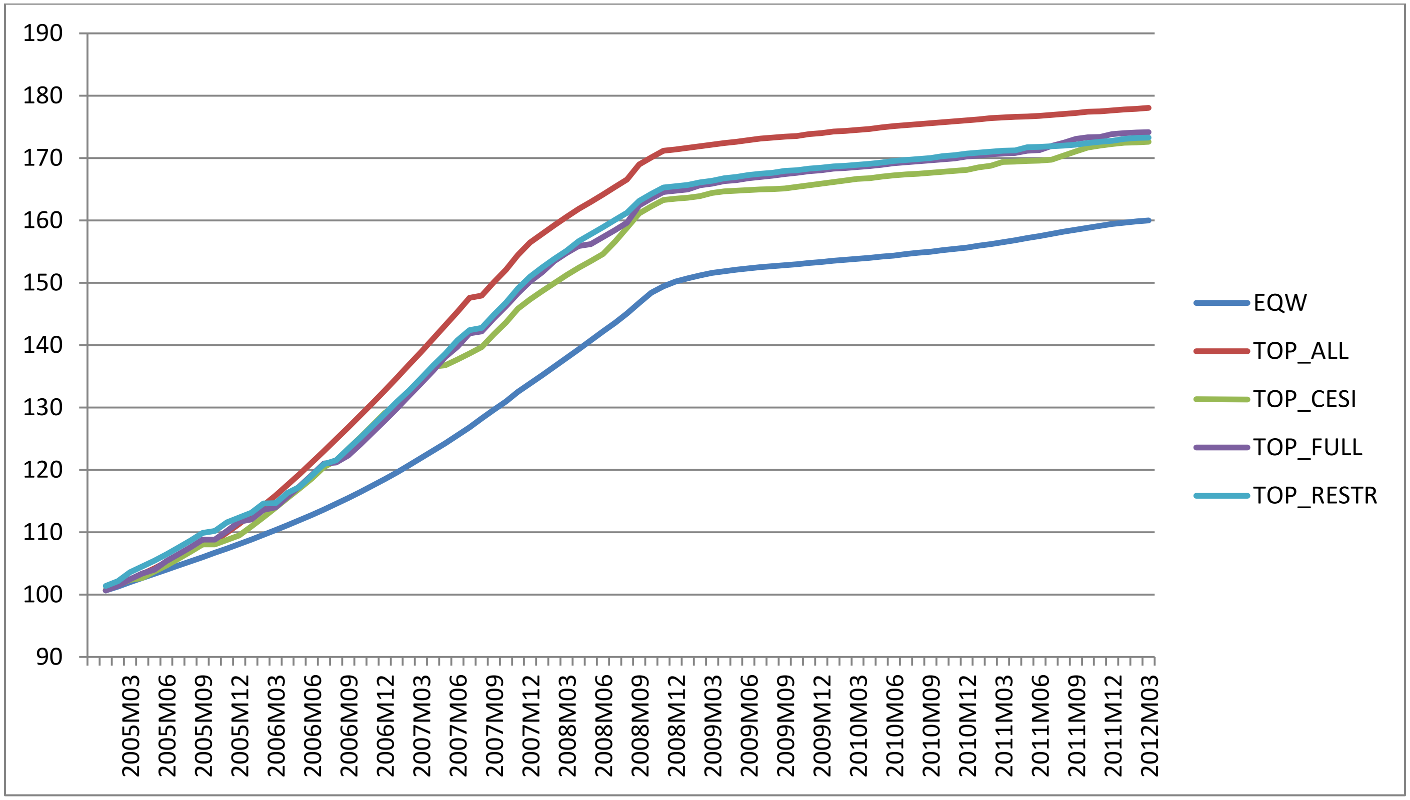
It can be seen clearly that the Equally Weighed strategy is the worst one whereas the All strategy is the best strategy in both groups. Also in both groups the strategy based on CESI appears to behave differently than the ones based on my indexes and all index strategies exhibit similar overall pattern likely driven by the interest rate changes. In order to explore the differences between the strategies I have shown the correlations between their excess returns in Table 13. The specific equation is simply the strategy return minus the US interest rate therefore a value of 0 will just mean that the strategy was not invested in a foreign currency.

It can be seen clearly that most of the correlations are quite small. The correlations within groups(top and bottom) tend to be between 0.37 and 0.55.The smallest correlation is always that between Top index and Bottom strategy of the same index and all negative correlations are between top and bottom strategies. The equally weighted strategy has small correlations only with the ALL strategies because of their heavy use of the US interest rate. Sharpe ratios can be seen in Table 14. The equally weighted strategy has been underperforming substantially as its Sharpe ratio indicates. All of the index strategies has managed to do better which stands to confirm the results from the Direction of Change criterion that all indexes can anticipate the direction of exchange rates to some extent. It does not appear to be possible to find a substantial difference between Top and Bottom strategies though the CESI performs slightly worse than the real activity indexes. At the same time it should be pointed out that those strategies were underperforming too and are traded regularly and thus would incur transaction costs in the real world. Furthermore the fact that the ALL strategies which are the least likely to invest in foreign currency had the best performance indicates that investing in foreign exchange during the period might have just been a bad investment.

To sum up this section, my analysis provided some evidence that economic surprises can influence exchange rates. This influence can differ for different measures. In addition to this I have established that those indexes do not appear to be usable as leading indicators for trading strategies but attention will have to be paid to their specific circumstances. In the future the possibility remains that such indexes could be built with market based forecasts or those economic surprises might be useful for hedging strategies a topic that I will address next.



Graph 4 Bottom strategies: Those are the cumulative returns of the strategies whose criterion is based on an index being in the bottom 25% of its values. The vertical scale shows the portfolio value if it was worth 100 in December 2004 and the horizontal one the period. EQW is the benchmark equally weighed strategy. All is the case when an investment in foreign exchange is made only when all indexes meet the criterion and the others represent the portfolios in which only one index is required to meet it.



Graph 5 Top strategies: Those are the cumulative returns of the strategies whose criterion is based on an index being in the top 25% of its values. The vertical scale shows the portfolio value if it was worth 100 in December 2004 and the horizontal one the period. EQW is the benchmark equally weighed strategy. All is the case when an investment in foreign exchange is made only when all indexes meet the criterion and the others represent the portfolios in which only one index is required to meet it.

	EQW	TOP_ALL	TOP_CESI	TOP_FULL	TOP_RESTR	BOT_ALL	BOT_CESI	BOT_FULL	BOT_RESTR
EQW	1.00	0.17	0.49	0.38	0.44	0.26	0.55	0.42	0.46
TOP_ALL	0.17	1.00	0.48	0.61	0.57	-0.02	0.07	-0.03	-0.02
TOP_CESI	0.49	0.48	1.00	0.41	0.45	-0.03	0.10	0.11	0.11
TOP_FULL	0.38	0.61	0.41	1.00	0.76	-0.03	0.44	-0.04	-0.03
TOP_RESTR	0.44	0.57	0.45	0.76	1.00	-0.03	0.37	0.09	-0.04
BOT_ALL	0.26	-0.02	-0.03	-0.03	-0.03	1.00	0.38	0.38	0.54
BOT_CESI	0.55	0.07	0.10	0.44	0.37	0.38	1.00	0.37	0.31
BOT_FULL	0.42	-0.03	0.11	-0.04	0.09	0.38	0.37	1.00	0.56
BOT_RESTR	0.46	-0.02	0.11	-0.03	-0.04	0.54	0.31	0.56	1.00

Table 13 Correlations between excess returns of strategies. They are the strategy return minus the US interest rate therefore a value of 0 will just mean that the strategy was not invested in a foreign currency. Top are the strategies whose criterion is based on an index being in the top 25% of its values in order to invest in foreign currency whereas Bot is when the index is in the bottom 25%. EQW is the benchmark equally weighed strategy. All is the case when an investment in foreign exchange is made only when all indexes meet the criterion and the others represent the portfolios in which only one index is required to meet it.

	EQW	BOT_ALL	BOT_CESI	BOT_FULL	BOT_RESTR	TOP_ALL	TOP_CESI	TOP_FULL	TOP_RESTR
mean	-0.53	-0.09	-0.31	-0.24	-0.11	-0.10	-0.23	-0.19	-0.21
st. deviation	1.17	0.67	1.22	1.10	0.86	0.69	1.07	1.11	1.04
max	1.44	3.13	2.93	2.60	2.60	0.37	2.40	1.39	2.19
min	-2.74	-3.34	-4.96	-4.42	-3.84	-4.95	-4.67	-4.96	-4.95
Sharpe	-0.46	-0.14	-0.25	-0.22	-0.13	-0.15	-0.21	-0.17	-0.20

Table 14 Descriptive statistics of the excess returns. They are the strategy return minus the US interest rate therefore a value of 0 will just mean that the strategy was not invested in a foreign currency. Top are the strategies whose criterion is based on an index being in the top 25% of its values in order to invest in foreign currency whereas Bot is when the index is in the bottom 25%. EQW is the benchmark equally weighed strategy. All is the case when an investment in foreign exchange is made only when all indexes meet the criterion and the others represent the portfolios in which only one index is required to meet it.

7.3 Hedging

In this section I will explore whether the forward premium puzzle is affected by economic surprise indexes and the possibilities for devising hedging strategies. I will report again only the tables with a horizon of 3 months. The tables will be grouped per currencyand will include all three equations in the order in which they were shown in section 5.3.

Firstly, we will look at the Euro in table 15. The alphas and first coefficients of both theoretical equations are insignificant. This means that the forward risk premium doesn't appear to have a time variation of its own. Nevertheless the fact that the coefficient of the spot equation is insignificant means that future prices are not unbiased predictors of exchange rates. The only index that appears to be significant is CESI which manages to explain a portion of the observed failure of forward rates. None of the indexes is significant in the Interest rate parity equation despite the fact that its significant alpha suggests missing factors. In the case of the 1 month horizon the results appear to be the same whereas over the long horizon CESI is insignificant but FULL actually manages to explain some of the bias of forward rates.

index	Dependant	C	p-val	b1	p-val	b2	p-val	adj. R^2
cesi	forward	0.007	0.327	-1.926	0.433	-0.090	**0.026**	0.106
cesi	spot	-0.007	0.327	2.926	0.234	0.090	**0.026**	0.120
cesi	Interest	0.000	**0.000**	0.002	**0.000**	-0.001	0.105	0.929
full	forward	0.005	0.501	-1.198	0.533	-0.011	0.763	-0.015
full	spot	-0.005	0.501	2.198	0.254	0.011	0.763	-0.003
full	interest	0.000	**0.000**	0.002	**0.000**	0.000	0.677	0.929
restr	forward	0.002	0.828	-2.126	0.428	0.055	0.170	0.015
restr	spot	-0.002	0.828	3.126	0.245	-0.055	0.170	0.031
restr	interest	0.000	**0.000**	0.002	**0.000**	0.000	0.454	0.924

Table 15 Euro forwards 3 month horizon The equations are as follows forward is the equation with the divergence between forward and spot rates as dependent variable. Spot regressing the difference between spot rates and interest is the equation mimicking the interest parity condition. Statistically significant coefficients are bolded.

Next we will look at the Japanese yen in table 16. Overall the results are similar for the models with the forward premium appearing time invariant but the forward rate being a biased predictor. Not a single of the indices is significant. In the case of 1 month horizon results are the same qualitatively. Over the long horizon all variables except for the indexes appear to be significant suggesting missing factors and time variation of the risk premium but none of the economic surprise indices appear to have explanatory power. The large R^2 of the Interest rate parity specification is due to the fact that both the interest differential and its coefficient are in sample in contrast to the Meese and Rogoff regressions where the coefficient is out of sample.

index	Dependant	C	p-val	b1	p-val	b2	p-val	adj. R^2
cesi	forward	0.013	0.146	1.528	0.297	0.026	0.275	0.009
cesi	spot	-0.013	0.146	-0.528	0.718	-0.026	0.275	-0.006
cesi	interest	-0.001	**0.000**	0.002	**0.000**	0.000	0.301	0.985
full	forward	0.010	0.426	1.206	0.456	0.000	0.993	-0.011
full	spot	-0.010	0.426	-0.206	0.899	0.000	0.993	-0.024
full	interest	-0.001	**0.000**	0.002	**0.000**	0.000	0.819	0.984
restr	forward	0.016	0.165	1.398	0.355	0.020	0.564	-0.001
restr	spot	-0.016	0.165	-0.398	0.792	-0.020	0.564	-0.016
restr	interest	-0.001	**0.000**	0.002	**0.000**	0.000	0.977	0.985

Table 16 Yen forwards 3 month horizon. The equations are as follows forward is the equation with the divergence between forward and spot rates as dependent variable. Spot regressing the difference between spot rates and interest is the equation mimicking the interest parity condition. Statistically significant coefficients are bolded.

index	Dependant	C	p-val	b1	p-val	b2	p-val	adj. R^2
cesi	forward	0.008	0.459	-1.213	0.656	-0.033	0.252	-0.002
cesi	spot	-0.008	0.459	2.213	0.417	0.033	0.252	0.007
cesi	interest	-0.001	**0.001**	0.003	**0.000**	0.001	0.114	0.943
full	forward	0.002	0.829	0.199	0.935	0.048	0.296	-0.010
full	spot	-0.002	0.829	0.801	0.742	-0.048	0.296	-0.009
full	interest	0.000	**0.000**	0.003	**0.000**	0.000	0.998	0.933
restr	forward	0.009	0.451	-0.871	0.731	0.024	0.500	-0.013
restr	spot	-0.009	0.451	1.871	0.461	-0.024	0.500	-0.004
restr	interest	0.000	**0.001**	0.003	**0.000**	0.000	0.294	0.940

Table 17 Pound forwards 3 month horizon. The equations are as follows forward is the equation with the divergence between forward and spot rates as dependent variable. Spot regressing the difference between spot rates and interest is the equation mimicking the interest parity condition. Statistically significant coefficients are bolded.

Finally I will also consider the British pound in Table 17. None of the indexes is significant and the forward and spot equations suggest results similar to those of the dollar. The forward rates are a biased predictor but economic surprise indexes do not appear to have any influence on them. In the case of 1 month horizon the results are qualitatively the same except that in the Interest parity equation CESI becomes significant with a very small positive coefficient. The result could be spurious or it could mean that large increases in CESI have led to a somewhat higher risk premium. In the 12 month horizon all indexes are insignificant despite significant alphas of most equations suggesting that there are missing factors not related to the economic surprise indices.

In order to determine whether some practical use can be made of economic surprise indices I have also calculated a number of hedging strategies described in the Methodology section. All of the strategies will be grouped by currency. The statistics are available on Tables 18 -20.

Firstly the bottom CESI strategy has the highest Sharpe ratio in all exchange rates(marginally so for the Euro). This is in line with the overall interpretation of the index since a low value will indicate an appreciation of the dollar and thus losses for unhedged investors. The always hedged strategy appears to have the highest return in the Euro and Yen but is at a loss in the case of the Pound and is also riskiest. The top and bottom strategies appear to be delivering similar results overall for the other indexes. This development can be due to the 1 month horizon of the strategies and of course all of the Sharpe ratios remain quite low.

To sum up, in this section I tried to study the extent to which the forward premium and hedging are influenced by economic indices. The result is that economic surprises do not appear to influence the forward premium or the need to hedge in a systematic fashion. Interestingly enough when comparing between the indexes the CESI outperformed the real activity indexes contrary to the results from section 7.2.

	EQW_1	TOP_CESI_1	TOP_RESTR_1	TOP_FULL_1	BOT_CESI_1	BOT_FULL_1	BOT_RESTR_1
mean	0.70	-1.60	-0.03	-0.19	0.11	-0.68	-0.28
st. deviation	42.12	5.56	3.55	4.80	4.03	4.97	4.26
max	121.18	14.35	18.12	16.10	16.61	10.20	16.61
min	-120.24	-25.60	-11.98	-19.68	-16.04	-28.94	-19.68
Sharpe	0.02	-0.29	-0.01	-0.04	0.03	-0.14	-0.06

Table 18 Descriptive statistics of the euro excess returns . They are the strategy return minus the MSCI USA therefore a value of 0 will just mean that the strategy was not hedged foreign currency risk. Top are the strategies whose criterion is based on an index being in the top 25% of its values in order to hedge foreign currency whereas Bot is when the index is in the bottom 25%. EQW is the benchmark always hedged strategy. All is the case when an investment in foreign exchange is made only when all indexes meet the criterion and the others represent the portfolios in which only one index is required to meet it.

	EQW_2	TOP_CESI_2	TOP_FULL_2	TOP_RESTR_2	BOT_CESI_2	BOT_FULL_2	BOT_RESTR_2
mean	2.03	-0.15	-0.51	0.08	1.52	0.05	-0.35
st. deviation	27.52	5.05	5.48	6.24	10.03	7.07	7.01
max	92.87	18.35	24.99	24.99	57.17	37.10	37.10
min	-65.52	-18.22	-35.15	-35.15	-22.48	-22.48	-22.48
Sharpe	0.07	-0.03	-0.09	0.01	0.15	0.01	-0.05

Table 19 Descriptive statistics of the yen excess returns. Description provided above.

	EQW_3	TOP_CESI_3	TOP_RESTR_3	TOP_FULL_3	BOT_CESI_3	BOT_FULL_3	BOT_RESTR_3
mean	-1.11	-0.92	-0.04	-0.38	0.87	-0.51	-0.09
st. deviation	32.93	6.05	4.50	4.83	5.42	5.71	4.71
max	99.34	23.77	18.51	18.51	19.13	14.71	15.69
min	-94.69	-23.08	-18.91	-18.91	-20.62	-23.08	-21.50
Sharpe	-0.03	-0.15	-0.01	-0.08	0.16	-0.09	-0.02

Table 20 Descriptive statistics of the pound excess returns. They are the strategy return minus the MSCI USA therefore a value of 0 will just mean that the strategy was not hedged foreign currency risk. Top are the strategies whose criterion is based on an index being in the top 25% of its values in order to hedge foreign currency whereas Bot is when the index is in the bottom 25%. EQW is the benchmark always hedged strategy. All is the case when an investment in foreign exchange is made only when all indexes meet the criterion and the others represent the portfolios in which only one index is required to meet it.

8 Discussion and Conclusion

In this paper I explored the influence of economic surprises on exchange rates. The focus I was particularly on the extent to which macroeconomic surprises can be used to devise various investment and hedging strategies.

The study of exchange rates has been heavily influenced by the fact that most theoretical models fail to produce accurate predictions when tested empirically. This was established in a seminal paper by Meese and Rogoff in 1983. Since then many researchers and traders have tried unsuccessfully to find a solution. Economic surprises might be a solution because of the fact that exchange rates are theorized to depend largely on expectations and if those expectations are wrong that the movements wouldn't necessarily follow the theoretical trends.

In this paper I use data from 2003 till 2012 for three major currencies in order to determine whether Economic surprises influence exchange rates. Two types of indices were used a reaction based one CETI and real activity indices made from macroeconomic forecasts and variables. I subjected those methods to a variety of empirical models from the exchange rate determination and forward premium puzzle literatures. Most of those were applied similarly to the classical Meese and Rogoff 1983 and Fama 1984 papers. I also attempted to determine whether some simple strategies for investing and hedging could be devised via the use of the surprise indices.

Overall my results suggest that substantial differences exist between my indices and the CESI. Initial results suggested that Economic surprises might account for some of the unpredictability of exchange rates. More traditional indicators such as average errors have rejected any influence of economic surprises but it appears that they might be capable of anticipating to some extent the direction in which exchange rates will move. It might be possible to use this predictability to capitalize on in an investment strategy but is limitations should be considered carefully. Furthermore the investment strategies were calculated without taking transaction costs into account and considering the sheer amount of volatility that the indexes have it is quite likely that a lot of already unremarkable return would be lowered by them. Therefore it is unlikely that a simple investment strategy can be build that uses an economic surprise index and the reaction based indices do not appear to be better performers than even relatively simple real activity ones.

I have also considered the extent to which economic surprises might influence forward rates. The result is that economic surprises do not appear to influence the forward premium or the need to hedge in a systematic fashion. Interestingly enough when comparing between the indexes in a simple strategy the CESI outperformed the real activity indexes contrary to the results from section 7.2. Nevertheless the Sharpe ratios did indicate improvement over a simple domestic investment in the case of two currencies. This result might turn out to be spurious but when considered together with the results about the direction of change it might indicate a potential use of economic surprise indexes.

One such way in which the results of the paper could be capitalized on is by devising a strategy similar to the random walk inspired strategies studied by Eun and Resnick 1997 but dependent on economic surprises. That way the direction of change predictability might be used for hedging purposes though an additional research on this topic will be necessary.

I would make several recommendations for future research. Firstly whether there will be a difference if a surprise indexes are built with different forecasts having a unique makeup for each country. Secondly whether the results of this analysis will hold for smaller and developing countries and if not what factors could be responsible for this situation. Thirdly in the future when more data is available from instruments such as inflation indexes swaps whether their forecasts could be used to build better economic surprise indices.

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10 Appendix: List of variables

Section	Country	Variable	Provider	Other	Code Datastream
FX	Eurozone	spot exchange rate	Thompson Reuters		EUDOLLR
FX	Japan	spot exchange rate	Thompson Reuters		JAPAYE$
FX	UK	spot exchange rate	Thompson Reuters		UKDOLLR
FX	Eurozone	forward exchange	WM/Reuters	1,3,12 month	USEUR1F ,….
FX	Japan	forward exchange	WM/Reuters	1,3,12 month	USJPY1F ,….
FX	UK	forward exchange	WM/Reuters	1,3,12 month	USGBP1F ,….
Fundamental	Eurozone	deposit interest rates	Thomson Reuters	1,3,12 month	ECEUR1M, …
Fundamental	Japan	deposit interest rates	Thomson Reuters	1,3,12 month	ECJAP1M , …
Fundamental	UK	deposit interest rates	Thomson Reuters	1,3,12 month	ECUKP1M, …
Fundamental	US	deposit interest rates	Thomson Reuters	1,3,12 month	ECUSD1M , …
Fundamental	Eurozone	industrial production	OECD	seasonally adj.	EKOPRI35G
Fundamental	Japan	industrial production	OECD	seasonally adj.	JPOPRI35G
Fundamental	UK	industrial production	OECD	seasonally adj.	UKOPRI35G
Fundamental	US	industrial production	OECD	seasonally adj.	USOPRI35G
Fundamental	Eurozone	cpi	OECD	seasonally adj.	EUOCP009F
Fundamental	Japan	cpi	OECD	seasonally adj.	JPOCP009F
Fundamental	UK	cpi	OECD	seasonally adj.	UKOCP009F
Fundamental	US	cpi	OECD	seasonally	USOCP009F

				adj.	
Fundamental	Eurozone	net trade	OECD	seasonally adj.	EKOXT014B
Fundamental	Japan	net trade	OECD	seasonally adj.	JPOXT014B
Fundamental	UK	net trade	Office for National Statistics	seasonally adj.	UKIKBJ..B
Fundamental	US	net trade	OECD	seasonally adj.	USMXT030B
Fundamental	Eurozone	money supply	ECB	seasonally adj.	EMM1....B
Fundamental	Japan	money supply	OECD	seasonally adj.	JPOMA027B
Fundamental	UK	money supply	Bank of England	seasonally adj.	
Fundamental	US	money supply	OECD	seasonally adj.	USOMA027B
indexes	Eurozone	CPI forecast	ZEW	not adj.	EMZEWCP.R
indexes	Japan	CPI forecast	ZEW	not adj.	JPZEWCP.R
indexes	UK	CPI forecast	ZEW	not adj.	UKZEWCP.R
indexes	US	CPI forecast	ZEW	not adj.	USZEWCP.R
indexes	Eurozone	CPI	ECB	not adj.	EMCP7500F
indexes	Japan	CPI	Ministry of Internal Affairs	not adj.	JPCPIGLAF
indexes	UK	CPI	Office for National Statistics	not adj.	UKD7BT..F
indexes	US	CPI	Bureau of Labor Statistics	not adj.	USCP67..F
indexes	Eurozone	forecast industrial	DG ECFIN	seasonally adj.	EMEUSIPAQ
indexes	Japan	forecast industrial	Ministry of Economy	not adj.	JPIPFMANH
indexes	UK	forecast industrial	DG ECFIN	seasonally adj.	UKTTA5BSQ
indexes	US	forecast industrial	Thomson Reuters	seasonally adj.	USMIPTOTG
indexes	Eurozone	industrial production	OECD	seasonally adj.	EKOPRI35G

indexes	Japan	industrial production	Ministry of Economy	not adj.	JPIPMMALH
indexes	UK	industrial production	OECD	seasonally adj.	USOPRI35G
indexes	US	industrial production	Federal Reserve	seasonally adj.	USIPTOT.G
indexes	Eurozone	forecast unemploy.	DG ECFIN	seasonally adj.	EMEUSCUNQ
indexes	Japan	forecast unemploy.	Economic Planning Association	not adj.	JPESPCUMR
indexes	UK	forecast unemploy.	DG ECFIN	seasonally adj.	UKTOT7BSQ
indexes	US	forecast unemploy.		seasonally adj.	
indexes	Eurozone	unemployment	Eurostat	seasonally adj.	EMTOTUN%Q
indexes	Japan	unemployment	Ministry of Internal Affairs	not adj.	JPUN%TOTR
indexes	UK	unemployment	Office for National Statistics	seasonally adj.	UKUN%TOTQ
indexes	US	unemployment	Bureau of Labor Statistics	seasonally adj.	USUN%TOTQ
indexes	Eurozone	cesi	Citigroup		EKCESIR
indexes	Japan	cesi	Citigroup		JPCESIR
indexes	UK	cesi	Citigroup		UKCESIR
indexes	US	cesi	Citigroup		USCESIR
strategies	Eurozone	msci	Msci	in dollars	MSEURI$(RI)
strategies	Japan	msci	Msci Barra	in dollars	
strategies	UK	msci	Msci	in dollars	MSUTDK$(RI)
strategies	US	msci	MSCI	in dollars	MSUSAML(RI)