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Macroeconomic Fundamentals' Predictability of Currency Returns

Master Thesis

by

Trond Daae Tønjum & Jan Helge Slyngstad

MSc in Business with Major Finance

Supervisor: Patrick Konermann

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Abstract[1]

We study the relationship between macroeconomic fundamentals and currency returns from the perspective of a British investor. To investigate the relationship more closely, we replicate the methodologies presented by Dahlquist and Hasseltoft (2020) and implement it using the British pound as domestic currency. Based on our analysis we find an "economic momentum strategy" that exhibits a Sharpe ratio of 0.24 and that is outperformed by the carry trade strategy. Furthermore, we conclude that macro fundamentals linked to economic activity and inflation do not significantly predict currency returns from this perspective.

[1] We would like to thank our supervisor, Patrick Konermann, for all guidance received during the process.

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1 Introduction

Ever since the seminal work of Meese & Rogoff (1983), researchers have struggled to find support for macroeconomic fundamentals' ability to predict exchange rates out of sample. However, in a research paper Dahlquist & Hasseltoft (2020) find a significant relationship between currency returns and past trends in macro fundamentals linked to economic activity and inflation. They find this relationship through the construction of a trading strategy based on going long/short in currencies with strong/weak economic momentum. This strategy is called "the economic momentum strategy" and exhibits a Sharpe ratio of 0.70 over a period from 1976 to 2017. Moreover, they show that the economic momentum strategy outperforms well-established trading strategies in the form of carry, momentum, and value (Dahlquist & Hasseltoft, 2020).

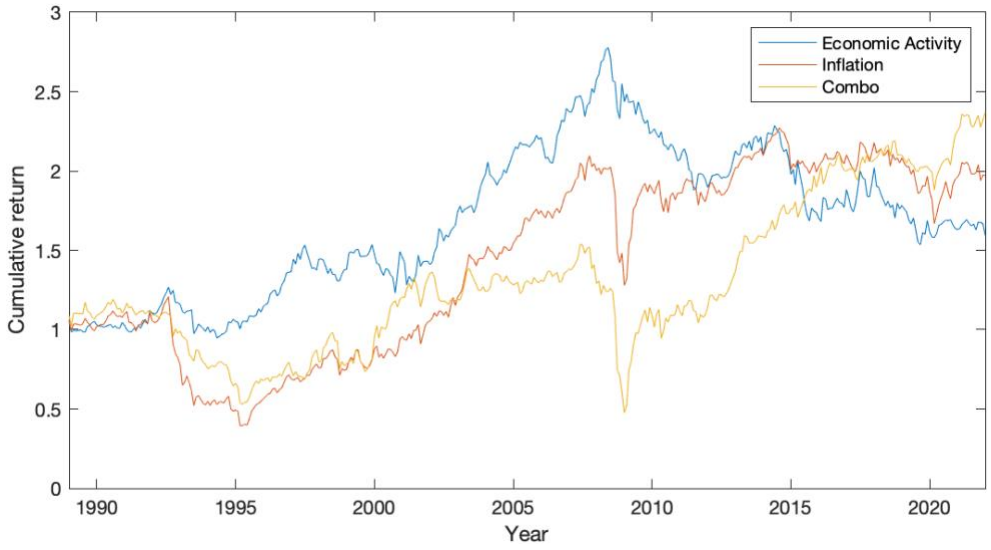

Figure 1: Cumulative portfolio returns of trend strategies. All portfolio returns are scaled ex post as to achieve an annualized ex post volatility of 5 %.

As may be observed in Figure 1, investors following strategies based on momentum in macro fundamentals linked to economic activity and inflation and a combination of these, achieve positive cumulative returns over a period from 1989 to 2022. This indicates that there might be a significant relationship between currency returns and macro fundamentals.

In this thesis we construct economic momentum strategies and use it to study the relationship between macro fundamentals, linked to economic activity and inflation, and currency returns from the perspective of a British investor to see if the results in

the research paper by Dahlquist & Hasseltoft (2020) still holds. We find this an important, and highly intriguing topic as these strategies are potential ways for investors to increase their utility measured in Sharpe ratio compared to already well-established strategies. In addition, studying trading strategies based on short- and long-term trends in a broader set of macro fundamentals is not that well researched, and gives us an opportunity to gain insight in recent research regarding currency trading strategies. The main contribution this paper presents is to investigate the strategies validity as the research question states: Can macroeconomic fundamentals linked to economic activity and inflation predict currency returns and increase utility from the perspective of a British investor?

The analysis is based on spot and forward exchange rate data from the following 21 countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and the United States, in addition to the Eurozone. For the same countries we construct strategies based on momentum in two different indexes: the economic activity index and the inflation index. The economic activity index is constructed based on the growth rate of three different fundamental variables: industrial production, retail trade, and unemployment. The inflation index is constructed based on the growth rate of two fundamental variables: consumer prices and producer prices. We report performance measures of the strategies and compare the results to the more commonly known carry trade strategy. In order to analyze if the economic momentum strategy based on macroeconomic fundamentals are able to predict currency returns, we run predictive panel regressions using the weights from the strategies constructed. Based on the data available we find that all strategies constructed provide positive Sharpe ratios, but they are outperformed by the carry trade strategy. Furthermore, based on the data used in this master thesis we find that there is no significant relationship between macroeconomic fundamentals and currency returns from the perspective of at British investor.

Our paper is structured as follows: Section 2 provides a review of relevant literature. In Section 3 we explain the empirical methodology and models used to conduct the research. Section 4 explains the data used in the analysis. In Section 5 we report the results. Finally, Section 6 concludes the thesis.

2 Literature review

In this section we review relevant literature for this thesis. This includes literature about the link between macroeconomic fundamentals and exchange rates, macro fundamentals' predictability power on currency returns, the economic momentum strategy, and cross-sectional and time-series strategies.

The idea of macro fundamentals' predictability of currency returns has since the seminal work of Meese & Rogoff (1983) had problems finding evidence. Our thesis is related to this vast literature. Starting with the Purchasing Power Parity (PPP) that states that the nominal exchange rate between two currencies should be equal to the ratio of aggregate price levels between two countries. This means that the long run PPP anchor would tend to depreciate the currency on the impact of bad inflation news. Clarida & Waldman (2008) find that inflation surprise tends to appreciate the exchange rate for countries with inflation target regimes implemented with a Taylor rule (Taylor, 1993). In countries without inflation target regimes, however, inflation surprises tend to depreciate the exchange rate. Molodtsova & Papell (2009) find similar evidence of predictability but was questioned by Engel et al. (2019) which report results that in general do not outperform the random walk. Even though Taylor (1993) rule have been questioned for its predictability, recent literature has found evidence for that fundamentals and exchange rates are linked.

Recent empirical literature has established that currency excess returns can be understood as compensation for time-varying risk. However, Della Corte et al. (2016) directs the spotlight to the economic determinants underlying currency risk premia. Della Corte et al. (2016) present evidence for a link between currency returns and countries' external imbalances. Della Corte et al.'s (2016) methodology generates a significant spread in returns which they present a simple economic intuition for: "net debtor countries offer a currency risk premium to compensate investors willing to finance negative external imbalances because their currencies depreciate in bad times".[2]

[2] Robust for a sample of 55 currencies and for a subsample of 15 developed currencies ranging from 1983-2014.

Evidence for that exchange rates Granger-causes fundamentals is found by Engel & West (2005).[3] Moreover, the use of panel techniques and long-horizon forecast have been found to be helpful to increase the forecast power of changes in exchange rates by monetary models (Engel et al., 2007). In addition, Sarno & Schmeling (2014) use a large sample of 35 currency paring ranging from 1900 to 2009 and find strong and significant predictive power for fundamentals by change in exchange rates.

Berg & Mark (2018) link currency excess returns to macroeconomic uncertainty. They propose a risk factor to study the cross-sectional variation of carry-trade generated portfolios of currency excess returns as a function of their exposure to systematic global macroeconomic risk. This risk factor is supposed to reflect variations in global economic uncertainty. The methodology behind the risk factor is the high-minus-low differences between the top and bottom quartiles of conditional moment of country-level skewness of the unemployment rate gap. Berg & Mark (2018) find that the risk factor is robustly priced into the carry-trade generated currency excess returns and that the connection of the unemployment gap to currency returns, is that it is a variable of interest to central banks in conduction monetary policy and setting the policy rate.

Della Corte et al. (2021) find evidence for a link between currency excess returns and sovereign risk. They measure the sovereign risk of a country by the spread on the country's sovereign CDS. The spread reflects the market's default expectations (local global economy) as well as distress risk premia demanded by investors for facing unpredictable variation in market spreads (risk aversion). The empirical results of Della Corte et al. (2021) suggest that the driving force behind relationship between sovereign risk and currency excess returns is mostly changes in default expectations rather than distress risk premia.[4]

Engel et al. (2015) find empirical results for a variety of forecasting models to have lower root mean squared prediction error (root MSPE) compared to the random walk model. The forecasting models tested are those of a Taylor rule (Taylor, 1993) model, those of a monetary model; and PPP. However, the models have lower root MSPE in

[3] With the use of quarterly bilateral dollar exchange rates ranging from 1975-2011, for the dollar versus the G7 countries.
[4] FX rates against the USD for 40 FX rates of developed and emerging countries ranging from January 2003 to July 2017.

the second part of their forecasting sample whereas the first part has a higher root MSPE compared to the random walk. They conclude with that their results may be ephemeral.

Nucera (2017) aims to fill the gap in the literature of the relationship between currency excess returns and unemployment by assessing empirically whether and to what extent cross-sectional differences in countries' unemployment fluctuations are informative about currency excess returns. They find that currencies associated with good, or less negative unemployment fluctuation (i.e., lower growth of the unemployment rate) generate higher currency excess returns than currencies with negative, or less good unemployment fluctuations. They emphasize that this can be explained by currencies associated with good, or less negative unemployment fluctuation on average appreciate against the US dollar in a response to higher interest rates.

As we can see, the literature over the subject is vast and shows links between a variety of individual fundamentals and the currency return rate. However, the literature on construction short- and long-term strategies based on broader sets of fundamentals is fairly new. Dahlquist & Hasseltoft (2020) find predictability of macro fundamentals of currency excess returns with the economic momentum strategy generating an annualized Sharpe ratio of 0.70 in the perspective of USD. This contrasts with the recent literature struggling to find support for macro fundamentals' predictability as discussed earlier. They also conclude that their strategy can outperform the well-established cross-sectional and time-series strategies as carry, momentum, and value. These types of strategies are what have recently been in the focus of researchers because of the problem of finding evidence for macro fundamentals' predictability on currency returns.

The more commonly momentum strategy and the economic momentum strategy is both based on momentum, but in different variables. The momentum strategy is distinct from the economic momentum strategy as this is a strategy that goes long currencies with high past returns and short currencies with low past returns whereas the economic momentum strategy is based on momentum in macro fundamentals (Menkhoff et al., 2012b). The predictive power of the momentum strategy based on exchange rates diminishes beyond 1 month (Dahlquist & Hasseltoft, 2020). Furthermore, the strategy

is also reported to not being able to explain the returns in firm fundamentals in stock markets by the returns based on momentum in prices (HUANG et al., 2017; Novy-Marx, 2015).

Our research is also related to the carry trade strategy, as we use this strategy as a benchmark when assessing the performance of the economic momentum strategies. The carry strategy can be explained as a strategy that goes long in currencies where the corresponding country has high interest rates and goes short in the currencies where the corresponding country has low interest rates. This strategy exploits the deviations from the uncovered interest rate parity (UIP) and therefore is profitable when the corresponding currency for a high interest rate depreciates relative to the low interest rate country by less than the interest rate differential. Alternatively, the carry strategy can be implemented by going long in currencies that trade at a forward discount and short currencies that trade at a forward premium. The carry strategy is then profitable when the currency trading at a forward discount depreciates less than the forward discount. Existing research that has studied the carry strategy has reported significant excess returns (Burnside, Eichenbaum, & Rebelo, 2011; Daniel et al., 2014). However, the carry strategy is shown to perform badly in highly volatile environments (Bhansali, 2007; R. Clarida et al., 2009; Menkhoff et al., 2012a). The carry strategy is well known and a popular research topic as researchers struggle to explain the excess returns of this strategy and what risks this carry strategy compensates the investor for. The carry strategy has been studied on by a variety of researches that link the excess returns to various economic risks such as: crash and downside risks (Chernov et al., 2018), peso problems (Burnside, Eichenbaum, Kleshchelski, et al., 2011), volatility risk (Menkhoff et al., 2012a), illiquidity risk (Abankwa & Blenman, 2015), global risk (Lustig et al., 2011) and aggregate consumption and macroeconomic risks (Colacito et al., 2018; Hoffmann & Studer-Suter, 2017; Lustig & Verdelhan, 2007; Zviadadze, 2017).

Finally, our research is related to Hsu & Chen (2021) that points out that most of the literature on currency momentum strategies has its focus on strategies relative to the US dollar (USD). They shift the focus of currency momentum strategies to the perspective of Chinese Yuan (RMP). In this thesis, we shift the focus to the perspective of the British Pound (GBP).

3 Empirical methodology

Our research question states: Can macroeconomic fundamentals linked to economic activity and inflation predict currency returns and increase utility from the perspective of a British investor? Because of this, the entire thesis tests the hypothesis that the economic momentum strategy does not increase the utility for a British investor, and that there is no significant relationship between fundamental variables and strategy returns:

$$H_0: No\ significant\ relationship$$

$$H_1: Significant\ relationship$$

To test this hypothesis, we replicated the methodology from Dahlquist & Hasseltoft (2020) when we constructed the economic momentum strategy, as well as the carry trade strategy used as a benchmark. In this part of the thesis a detailed description of the empirical methodology used to construct the strategies is provided, as well as how we evaluate the performance of the strategies.

3.1 Momentum in economic variables

The key findings in our analysis are based on measuring trends in indexes based on fundamental variables. The goal is to evaluate different trend frequencies and avoid a random lookback period. Because of this we apply the following lookback periods: 6, 12, 18, 24, 30, 36, 42, 48, 54, and 60 months.[5] The trend measure z is based on log growth rates, with back-end smoothing, in the fundamental indexes:

$$z_{c,i,l,t} = \ln\left(X_{c,i,t}\right) - average\left(ln\left(X_{c,i,t-l} : near\ lagged\ time\ l\right)\right)$$

[5] Dahlquist & Hasseltoft (2020) consider lookback periods ranging from 1-60 months. However, they explain that restricting the lookback periods to 6, 12, 18, 24, 30, 36, 42, 48, 54, 60 months makes little differences to the results.

Where $X_{c,i,t-l}$ denotes for currency *c* in index *i* at time *t* for the lookback period *l*. The scale of the growth rate corresponds to the investment signal and measures the strength of the time trend. The trend measure is computed at the end of each month due to portfolio rebalancing. We use back-end smoothing as this will reduce the random noise in the data. Front-end smoothing is not applied as this may potentially delay the investment signal (Dahlquist & Hasseltoft, 2020; Levine & Pedersen, 2015).

3.2 Economic momentum portfolios

Dahlquist & Hasseltoft (2020) explain that when constructing the portfolios there are two dimensions that must be considered: the fundamental index and the lookback periods. A strategy for both fundamental indexes and all lookback periods is constructed, creating 2 × 10 = 20 sub-strategies. In accordance with the strength of the trend measure, computed in Section 3.1, currencies are cross-sectionally ranked at the end of each month. When constructing the economic momentum portfolios the currencies are weighted based on their cross-sectionally ranked signal[6]:

$$w_{c,i,l,t} = k_t \left[rank\left(z_{c,i,l,t}\right) - \frac{1}{C_t} \sum_{c=1}^{C_t} rank(z_{c,i,l,t}) \right]$$

Where $w_{c,i,l,t}$ is the rank-based weight for currency *c* using the fundamental index *i* for lookback period *l* at time *t*. C_t is the number of currencies available at time *t*, and k_t is a scaling factor that ensures that each sub-strategy invests one pound on the short side and one pound on the long side.[7] An advantage with rank-based weighting is that it will reduce the effect of measurement errors, revisions, and outliers in the data. Furthermore, the rank-based weighting scheme can possibly provide diversification because the investment then incorporates all assets available in contrast to investing in e.g., top and bottom quintiles of assets. The portfolio return at time *t+1* for fundamental index *i* and lookback period *l* is calculated as follows:

[6] Corresponding to the method used by Asness et al. (2013) and (Koijen et al., 2018).
[7] Rank-based weighting makes the strategy pound neutral.

$$R_{i,l,t+1} = \sum_{c=1}^{Ct} w_{c,i,l,t} R_{c,t+1}$$

Where $R_{c,t+1}$ denotes the excess return for currency *c* in time *t+1* (Dahlquist & Hasseltoft, 2020).

Based on the sub-strategies, we create aggregated portfolios across indexes and lookback periods. Because the volatility of each sub-strategy varies, we weigh each sub-strategy by the inverse of its past volatility and scale the weights to sum to one. The past volatility is calculated as the exponentially weighted moving average volatility of the strategy returns, applying a RiskMetrics lambda of 0.94. Doing this leaves us with two different sub-combos: the economic activity portfolio and the inflation portfolio. Furthermore, we diversify across all sub-strategies to create a combined portfolio (Dahlquist & Hasseltoft, 2020). In Section 5 of this paper, we report results for all strategies constructed.

3.3 Carry portfolio

When assessing the performance of the economic momentum strategies we use the well-established carry trade strategy as comparison. In order to be consistent with the pound neutrality of the economic momentum strategies, the carry trade portfolio is created by cross-sectionally ranking currencies according to their forward premia at the end of each month. The carry trade portfolios are constructed using rank-based weighting:

$$w_{c,t} = k_t \left[rank\left(S_{c,t} - F_{c,t}\right) - \frac{1}{C_t} \sum_{c=1}^{C_t} rank(S_{c,t} - F_{c,t}) \right]$$

Where $S_{c,t} - F_{c,t}$ denotes for the forward premia of currency, *c*, at time *t*. k_t is a scaling factor making sure that the long and short side have one pound invested, implying a zero cost and pound-neutral portfolio (Dahlquist & Hasseltoft, 2020).

3.4 Evaluation

We evaluate the performance of the portfolios using simple economical and statistical measures, referring to mean, standard deviation, skewness, excess kurtosis, AR(1) and Sharpe ratio.

In addition, we run predictive regressions for the portfolios to investigate the relationship between macroeconomic fundamentals and excess returns. We run the regression using the next period's currency return as the dependent variable and the standardized portfolio weights as independent variables:

$$R_{c,t+1} = \alpha_t + \beta \widetilde{w}_{c,t} + \epsilon_{c,t+1},$$

Where $R_{c,t+1}$ is the monthly excess return for currency at time $t + 1$, α_t is the time fixed effects, and $\widetilde{w}_{c,t}$ is the cross-sectionally standardized portfolio weight for currency c at time t. The predictive panel regression may indicate whether the strategies capture cross-sectional predictability of currency returns (Dahlquist & Hasseltoft, 2020).

4 Data

4.1 Exchange rates

Data on daily spot rates and one-month forward points is retrieved from the Bloomberg Terminal from December 1988 to January 2022.[8] The results in this thesis are based on data from developed markets, referring to the following 21 countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and the United States, in addition to the Eurozone (Dahlquist & Hasseltoft, 2020).

All currencies are expressed in GBP per unit of foreign currency, meaning that a decrease in the foreign exchange rate of currency *c* at time *t*, $S_{c,t}$, suggests depreciation of the foreign currency and appreciation of the GBP.[9] We assume that the GBP is the home currency, and the excess return of investing in foreign currency *c* using a forward contract, $F_{c,t}$, is calculated as follows:

$$R_{c,t+1} = \frac{(S_{c,t+1} - F_{c,t})}{F_{c,t}}$$

Currencies now part of the Eurozone use historical currencies up until the date of adopting the Euro, commonly on December 31st, 1998. This applies to currencies pegged to the Euro as well (Dahlquist & Hasseltoft, 2020). Summary statistics in Table 1 provide a more detailed description of the data.

4.2 Fundamental indexes

Data is retrieved from the statistical database of the OECD on five different fundamental variables: Industrial production, retail sales, unemployment, consumer prices, and producer prices. Based on the five fundamental variables, we build country-level indexes that estimate economic activity and inflation. To make our analysis as

[8] We decided to retrieve data from the Bloomberg Terminal in contrast to Refinitiv Eikon/Datastream as used by Dahlquist and Hasseltoft (2020). The reason for this is that a lot of historical data on forward rates was no longer available in Refinitiv Eikon/Datastream. The Bloomberg terminal therefore provided us with more data.

[9] We use spot and forward contracts against the USD, as they provide us with the most amount of historical data. We convert the data to be expressed against the GBP.

intuitive as possible, we applied the most straightforward construction of the indexes, using the equal-weighted average of the growth rates of the fundamental variables. More precisely, the economic activity index is created using the equal-weighted average of the growth rates in retail sales, industrial production, and the inverse of unemployment.[10] Similarly, the inflation index is created using the equal-weighted average of the growth rates in producer prices and consumer prices. The indexes can be interpreted as a proxy for the economic conditions in the represented country, meaning that an increase/decrease in the indexes means better/worse economic conditions (Dahlquist & Hasseltoft, 2020).

We applied monthly data dating from January 1980 to January 2022.[11] However, for a few selected countries, primarily Australia and New Zealand, monthly data is not available. In these cases, we use quarterly data with repeating values instead. When creating the indexes, we use all fundamental variables available at that specific point in time (Dahlquist & Hasseltoft, 2020). Summary statistics for the indexes are found in Table 2.

[10] Data on all fundamental variables are collected as the growth rate since last period, except for the monthly unemployment variable. The growth rate in the unemployment variable is calculated using the inverse of unemployment.

[11] Data for the fundamental variables start earlier than the exchange rate data because we use lags in the fundamental indexes when measuring the time trends.

Summary statistics: monthly excess return

Currency	Start date	End date	Mean	Max	Min	N
AUD	31.01.1989	31.01.2022	0,23	13,21	-9,11	397
ATS	31.01.1989	31.12.1998	0,15	11,35	-4,95	120
BEF	31.01.1989	31.12.1998	0,07	10,97	-4,64	120
CAD	31.01.1989	31.01.2022	0,11	14,92	-7,64	397
DKK	31.01.1989	31.12.1998	0,21	11,26	-5,03	120
FIM	31.01.1989	31.12.1998	0,02	7,04	-8,25	120
FRF	31.01.1989	31.12.1998	0,20	12,11	-5,52	120
DEM/EUR	31.01.1989	31.01.2022	0,22	23,05	-14,64	397
IEP	31.01.1989	31.12.1998	-0,08	21,33	-12,25	120
ILS	31.08.1998	31.01.2022	0,26	9,89	-8,13	282
ITL	31.01.1989	31.12.1998	-0,21	7,37	-6,72	120
JPY	31.01.1989	31.01.2022	0,13	19,37	-10,35	397
NLG	31.01.1989	31.12.1998	0,05	10,99	-5,44	120
NZD	31.01.1989	31.01.2022	0,31	14,95	-11,39	397
NOK	31.01.1989	31.01.2022	0,11	9,01	-7,92	397
PTE	31.01.1989	31.12.1998	-0,13	8,98	-9,41	120
ESP	31.01.1989	31.12.1998	-0,18	6,74	-9,96	120
SEK	31.01.1989	31.01.2022	0,03	9,35	-12,98	397
CHF	31.01.1989	31.01.2022	0,09	19,46	-7,70	397
USD	31.01.1989	31.01.2022	0,08	13,75	-8,64	397

Table 1: Start date, end date, mean, max, min, and the number of observations for all currencies monthly excess return. Mean, max and min is given in percentage points. N is the number of observations. Currencies are used until replaced by or pegged to the EUR. GBP is not included as it is considered to be the domestic currency.

Summary statistics: indexes

	Economic Activity				Inflation			
Country	Mean	Max	Min	N	Mean	Max	Min	N
Australia	135	223	77	505	284	486	100	505
Austria	118	141	97	228	144	178	100	228
Belgium	100	116	91	228	154	190	100	228
Canada	146	233	97	505	208	323	100	505
Denmark	108	125	91	228	165	199	100	228
Finland	147	208	98	228	184	231	100	228
France	113	131	98	228	182	220	100	228
Germany/Eurozone	129	164	89	505	165	228	100	505
Ireland	127	161	94	228	188	233	100	228
Israel	211	322	99	385	203493	333690	100	505
Italia	115	135	91	228	256	378	100	228
Japan	146	177	100	505	132	141	100	505
Netherlands	87	100	81	228	130	149	100	228
New Zealand	117	262	42	505	324	528	100	505
Norway	142	193	91	505	260	466	100	505
Portugal	124	154	94	228	406	649	100	228
Spain	106	120	92	228	241	358	100	228
Sweden	180	300	83	505	253	378	100	505
Switzerland	83	129	50	505	163	193	100	505
United Kingdom	114	134	93	505	257	398	100	505
United States	133	245	98	505	201	324	100	505

Table 2: Mean, max, min and the number of observations for all countries in the Economic Activity index and the Inflation index. The start value for each index is 100. N is the number of observations. The indexes ends when country's currency is replaced by or pegged to the EUR.

4.3 Subsample analysis

In the main part of our analysis, we report the performance of our strategies over a period of more than 30 years. As an investment horizon that long can be unrealistic for many investors, we also want to analyze the strategies over shorter periods that might be more reasonable for the majority of investors. Furthermore, when analyzing the performance using subsamples, it is easier to understand how the strategies function in different periods with different characteristics.

To take a closer look at this, we run the same tests as before, but we divide the sample into three 10-year subsamples. As the data for excess return starts in January 1989 and ends in January 2022, we split the data into the following periods: 1989 – 1999, 2000 – 2010, 2011 – 2022. This means that the sample size for the first and second subsample is 132 observations. The third subsample consist of 133 observations. We considered analyzing even shorter subsamples but decided on these as we feel the statistical power would become too weak using ever shorter periods.

Dahlquist & Hasseltoft (2020) split their sample into two 20-year subsamples; from 1976 to 1996, and 1997 to 2017. The results from the two subsamples showed fairly similar results: a Sharpe ratio of 0.73 in the first period and 0.69 in the second. They also find that the trend combo significantly predicts excess returns. However, these are still long investment horizons, and we therefore wanted to check the performance of the strategy in shorter horizons. We present the results for the subsample analysis in Section 5.2.

5 Empirical results

5.1 Main analysis

Existing literature has been struggling to find evidence for macroeconomic fundamentals' predictability on currency returns. However, it has been proven in various studies that there might be a link between fundamentals and exchange rates, as shown in Section 2. Dahlquist & Hasseltoft (2020) report predictability for currency returns based on macro fundamentals with an economic momentum strategy. We want our thesis to contribute to the lack of studies where other currencies than USD is the domestic currency in currency momentum strategies (Hsu & Chen, 2021). Therefore, in this thesis, we shifts the perspective from an American investor to a British investor when studying macro fundamentals' predictability power of currency returns with the economic momentum strategy (Dahlquist & Hasseltoft, 2020).

To make sure that our approach for the analysis is correct, we try to replicate the analysis of Dahlquist & Hasseltoft (2020). Therefore, we firstly construct the trend strategies for USD as domestic currency. The empirical results from this replication can be found in Appendix A and C. We observe a difference in the results of our replication in relation to Dahlquist & Hasseltoft (2020) which we have two possible explanations for: 1. Dahlquist & Hasseltoft (2020) retrieves their dataset for daily spot rates and 1-month forward rates from Datastream, whereas we retrieve the data from the Bloomberg Terminal. We had some issues retrieving the currency data and the data we gathered might therefore be inconsistent with the data used by Dahlquist & Hasseltoft (2020). 2. Dahlquist & Hasseltoft (2020) retrieve data from 1979 and onward, whereas our dataset starts in 1989. We observe from their cumulative return figure that earlier years seems to be less volatile which might impact the Sharpe ratio. Nevertheless, we observe similar trends in Sharpe ratios for inflation sub-strategies. Even though the results from our replication were inconsistent with the findings of Dahlquist & Hasseltoft (2020), we decided to carry on with the analysis and discuss the results we achieved with GBP as domestic currency.

Results commented in this analysis are in the perspective of the GBP if not else is specified. Figure 2 shows annualized Sharpe ratios for all sub-strategies of the two indexes economic activity and inflation. As we can see, the economic activity sub-

strategies generate positive Sharpe ratios. However, for the inflation sub-strategies, the strategy for lookback period 6 has a negative Sharpe ratio.[12]

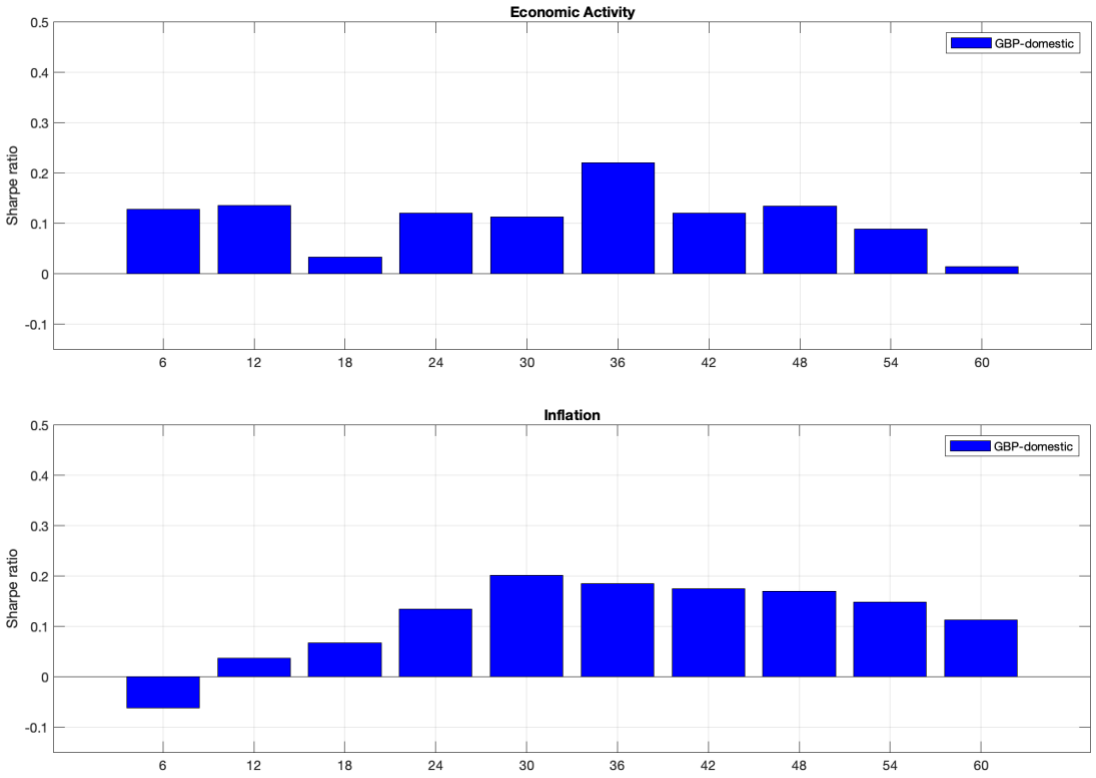

Figure 2: Annualized Sharpe ratios of sub-combos, economic activity, and inflation, over a range of lookback periods (sub-strategies). The GBP is the domestic currency.

Table 11 and Table 12 in Appendix B shows the correlation between the returns of each sub-strategy based on the economic activity index and inflation index. The correlation tables show less than perfect correlation, and this might indicate that there are diversification benefits of creating aggregated portfolios based on the different sub-strategies within each index (Della Corte et al., 2009; Rapach & Zhou, 2013; Wright, 2008). Therefore, by using the method described in Section 3, we create two sub-combos: economic activity and inflation. Furthermore, we observe that the correlation between these sub-combos is 0.44, and this might indicate that there are diversification benefits of diversifying across the two sub-combos creating a combo strategy. The

[12] The annualized Sharpe ratios for USD as domestic currency is shown in Figure 5 in Appendix A.

performance of the three strategies, as well as the carry strategy introduced in Section 3.3, are reported in Table 3.

	GBP - domestic			
	Economic Activity	Inflation	Combo	Carry
Mean	0.585	1.221	1.237	9.476
Standard deviation	5.629	7.220	5.196	17.642
Skewness	0.078	-1.303	-1.044	-0.008
Excess kurtosis	1.490	8.679	6.469	2.977
AR(1)	-0.055	0.064	0.074	0.021
Sharpe Ratio	0.104	0.169	0.238	0.537

Table 3: Performance measures of sub-combo strategies, combo strategy, and the carry strategy. Measures are based on monthly returns, but means, standard deviations, and Sharpe ratio are annualized. AR(1) refers to the first-order autocorrelation of returns.

From Table 3 we observe a Sharpe ratio of 0.10 for the economic activity sub-combo with a positive skewness and positive excess kurtosis. The inflation sub-combo reports a Sharpe ratio of 0.17 with a negative skewness and positive excess kurtosis. Furthermore, the combo strategy generates a Sharpe ratio of 0.24 with a negative skewness and positive excess kurtosis. As mentioned earlier we compare the results of the strategies using the carry strategy as a benchmark. The carry strategy reports a Sharpe ratio of 0.54 with a negative skewness and positive kurtosis. Thus, the carry strategy outperforms all the trend strategies. Measures for USD as domestic currency are reported in Table 13 in Appendix C. We observe that the Sharpe ratios for the trend strategies with USD as domestic currency are higher, though the Sharpe ratios for the trend strategy in the perspective of GBP is positive.

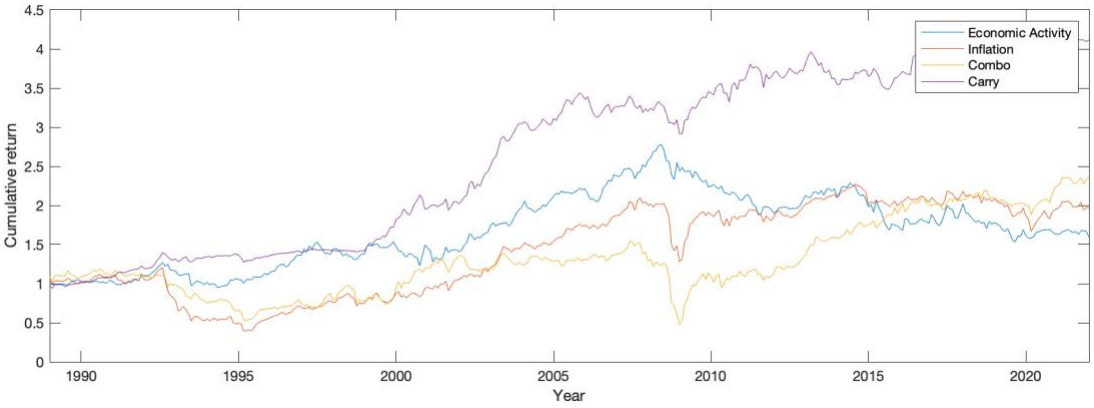

Figure 3: Cumulative portfolio returns of the three trend strategies and the Carry strategy. All portfolio returns are scaled ex post as to achieve an annualized ex post volatility of 5%. GBP is the domestic currency.

Figure 3 shows the cumulative returns of the trend strategies in addition to the carry strategy. In the beginning of the period the economic activity sub-combo seems to outperform the inflation sub-combo, with the combo strategy in the middle. After 2002-2003, where the dot-com bubble took place, the cumulative return of the combo flattens out until the global financial crisis of 2008 – 2009. However, the economic activity and inflation sub-combos increase until the global financial crisis. After the global financial crisis, the economic activity sub-combo mostly decreases, whereas the inflation sub-combo and the combo increases. The reason for this is that the weights for the combo strategy are adjusted to achieve optimal Sharpe ratio and therefore goes long in the inflation sub-combo and shorts the economic activity sub-combo. Hence, we can see that strength of the combo increases when the economic activity sub-combo decreases, and thus outperforms the inflation sub-combo. Also, when both the economic activity and inflation sub-combos increases, the trend combo flattens out. The carry strategy, however, outperforms all the trend strategies.

Figure 4 reports the volatility of the four strategies. We can see that the volatility of the three trend strategies spikes in financial crises such as the 1992 crisis and the dot-com bubble (2000). Furthermore, in the global financial crisis in 2008 – 2009 the volatility spikes even higher. Comparing the carry strategy to this, we can see that the carry is a lot more volatile throughout the years, which might explain the high cumulative returns in Figure 3.

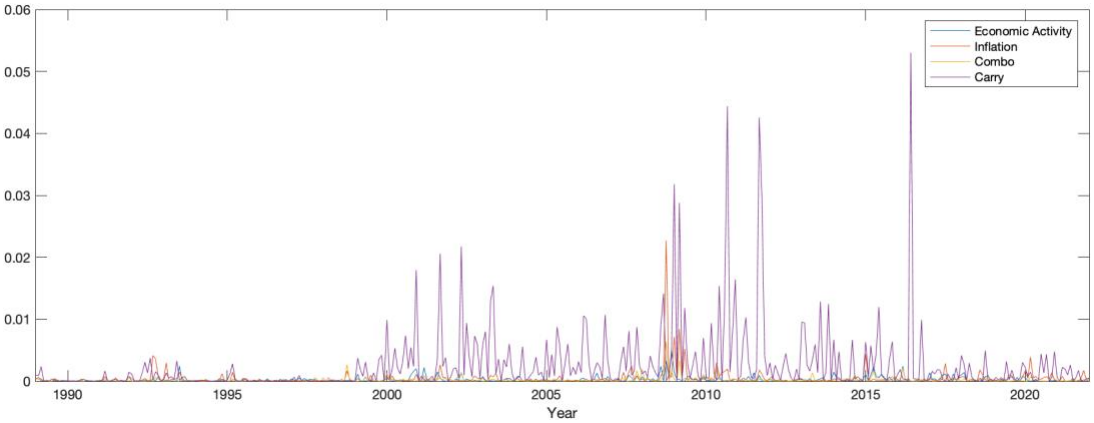

Figure 4: Time series of volatility of the portfolio returns of the three trend strategies and the carry strategy.

To study the fundamental variables predictability of currency returns we run predictive panel regressions in which next month's currency returns are predicted using the current month's portfolio weights as described in Section 3.4. Table 4 reports the results of the panel regressions. All regressions are done for both time fixed and entity fixed effects, and for a combination of the two. However, we only report results for time fixed effects as this replicates the panel regression model used by Dahlquist & Hasseltoft (2020).[13] Time fixed and entity fixed effects or a combination of the two makes little difference to the main results.

	Currency returns				
	1	2	3	4	5
Economic Activity	0.074				0.032
	(0.179)				(0.183)
Inflation		0.214			0.207
		(0.181)			(0.185)
Trend Combo			0.191		
			(0.179)		
Carry				0.343	
				(0.086)	
Adjusted R^2 (%)	39.26	39.28	39.27	39.47	39.26
Number of observations	5036	5036	5036	5036	5036

Table 4: Coefficients, standard errors, adjusted R^2 and number of observations for regression results of time fixed panel regressions explained in Section 3.4. Next month's currency returns are predicted using the current month's portfolio weights: $R_{c,t+1} = \alpha_t + \beta \widetilde{w}_{c,t} + \epsilon_{c,t+1}$, where $R_{c,t+1}$ denotes the monthly excess return for currency c at time t + 1 and $\widetilde{w}_{c,t}$ denotes the cross-sectional standardized portfolio weight for currency c at time t.

The results reported in Table 4 shows a coefficient for the combo strategy of 0.191. This would for example imply that a portfolio weight one standard deviation above the mean predicts a positive currency returns in 0.19% the next month. However, the results reported in Table 4 shows no significant coefficients at the 5 % level for the

[13] Results for the other regressions can be found in Table 9 and Table 10 in Appendix B.

trend strategies. The carry strategy, however, is significant at a 1 % level. This indicate that none of the trend strategies predicts future currency returns at a 5 % level when GBP is the domestic currency. However, the carry strategy positively predicts future currency returns with highly significant coefficient at a 1 % level.

Table 14 in Appendix C reports time fixed effects panel regressions for the strategies with USD as the domestic currency replicated from Dahlquist & Hasseltoft (2020). The results reported in this table shows that the combo strategy is significant at a 5 % level and the inflation sub-combo is significant at a 10 % level. Moreover, the carry strategy is significant at a 1 % level. This indicates that from a USD domestic perspective, the inflation sub-combo, the combo strategy and the carry strategy predicts future currency returns at a 10 %, 5 % and 1 % level, respectively. Looking at Table 15 in Appendix C, results for a panel regression with a combination of time fixed and entity fixed effects, the combo strategy is highly significant at a 1 % level in the USD domestic perspective indicating strong predictability of future currency returns. From this we observe that the economic momentum strategies are not able to significantly predict currency returns from the perspective British investors.

Shifting the focus back to the GBP perspective, we study whether the carry strategy can explain the returns of the combo strategy. Therefore, we run a time-series regression using returns of the combo strategy as dependent variables, and the returns of the carry trend as independent variables. The results are reported in Table 5.

	Returns on trend combo
	1
Constant	0.037
	(0.073)
Carry	0.084
	(0.014)
Adjusted R^2 (%)	7.72
Number of observations	397

Table 5: Coefficients, standard errors, adjusted R^2 and number of observations. The table presents a time-series regression of the monthly returns of the combo strategy on the carry strategy. The combo strategy is the dependent variable, and the returns of the carry trend is the independent variable.

The table reports a highly significant coefficient for the carry strategy and suggests that a portion of the combo returns reflects cross-sectional differences in interest rate differentials in a GBP perspective, in line with the findings of Dahlquist & Hasseltoft (2020) for the USD.

We have until now compared the trend strategies with the well-established carry strategy. We have seen that the carry strategy is highly volatile, and we therefore study if a diversification of the combo strategy and the carry strategy would return a higher Sharpe ratio while reducing the risk. The correlation between the combo strategy and the carry strategy is 0.28, which might indicate that there are diversification benefits of diversifying across the two strategies by creating a diversified portfolio. In Table 6 we report the results of the diversified portfolio strategy compared to the previous constructed strategies.

	GBP - domestic				
	Economic Activity	Inflation	Combo	Carry	Div
Mean	0.585	1.221	1.237	9.476	6.592
Standard deviation	5.629	7.220	5.196	17.642	11.968
Skewness	0.078	-1.303	-1.044	-0.008	0.053
Excess kurtosis	1.490	8.679	6.469	2.977	3.003
AR(1)	-0.055	0.064	0.074	0.021	0.231
Sharpe Ratio	0.104	0.169	0.238	0.537	0.551

Table 6: Performance measures of sub-combo strategies, the combo strategy, the carry strategy, and the diversified portfolio strategy. The measures are based on monthly returns, but means, standard deviations, and Sharpe ratio are annualized. AR(1) refers to the first-order autocorrelation of returns.

The diversified portfolio strategy does indeed return a higher Sharpe ratio of 0.55 indicating that the risk-adjusted performance is improved by diversifying between the combo strategy and the carry strategy.

5.2 Subsample analysis

In this part of the thesis, we perform the same analysis as executed in Section 5.1, however we split the data set into subsamples consisting of approximately 10 years. The first subsample is from January 1989 to December 1999. The second from January 2000 to December 2010, and finally the third subsample lasts from January 2011 until January 2022.

	1989 - 1999			2000-2010			2011 - 2022		
	Economic Activity	Inflation	Combo	Economic Activity	Inflation	Combo	Economic Activity	Inflation	Combo
Mean	1,583	-0,720	-0,506	1,561	3,971	0,937	-1,375	0,419	3,265
Standard deviation	3,855	5,491	3,938	6,543	9,012	6,591	6,064	6,612	4,595
Skewness	-0,485	-1,486	-0,834	0,065	-1,607	-1,254	0,292	-0,595	-0,344
Excess kurtosis	2,937	3,389	3,436	1,430	10,023	6,418	0,189	1,153	0,173
AR(1)	-0,138	0,188	-0,062	-0,029	0,070	0,209	-0,059	-0,055	-0,110
Sharpe Ratio	0,411	-0,131	-0,128	0,239	0,441	0,142	-0,227	0,063	0,711

Table 7: Performance measures of sub-combo strategies, Combo strategy, and the Carry strategy. The measures are based on monthly returns, but means, standard deviations, and Sharpe ratio are annualized. AR(1) refers to the first-order autocorrelation of returns.

As may be observe in Table 7, the strategies do not perform well for shorter periods. This is emphasized by the varying performance the three strategies achieve in the three different time periods. The three strategies all have one period where they perform bad, one period they perform fairly well, and one period they perform well. In some of the periods the strategies even give a negative Sharpe ratio, showing that the economic momentum strategies decrease the utility for the investors.

Time Fixed effects

	Currency returns								
	1989 - 1999			2000 - 2010			2011 - 2022		
	1	2	3	1	2	3	1	2	3
Economic Activity	0.299			0.246			-0.217		
	(0.367)			(0.336)			(0.261)		
Inflation		-0.336			0.627**			0.066	
		(0.390)			(0.335)			(0.261)	
Trend Combo			-0.342			0.148			0.515***
			(0.369)			(0.336)			(0.261)
Adjusted R^2 (%)	44.23	44.23	44.23	30.25	30.42	30.23	40.57	40.54	40.73
Number of observations	2386	2386	2386	1320	1320	1320	1330	1330	1330

Table 8: Coefficients, standard errors, adjusted R^2 and number of observations for results of panel regressions explained in Section 3.4 for subsamples. Next month's currency returns are predicted using the current month's portfolio weights: $R_{c,t+1} = \alpha_t + \beta \tilde{w}_{c,t} + \epsilon_{c,t+1}$, where $R_{c,t+1}$ denotes the monthly excess return for currency c at time t + 1 and $\tilde{w}_{c,t}$ denotes the cross-sectional standardized portfolio weight for currency c at time t. Regression reported is time fixed effects. *: significant *at 20 % level, **: significant at 10 % level, ***: significant at 5 % level.*

However, the inconsistent performance in our analysis may be explained by the predictive panel regressions we also run for the subsamples. In Table 8 the results from the regressions are reported. In only one of the periods the weight of the strategies can explain excess return for the next period with a significance level at 5%. This is for the combo strategy in the period 2011-2022 where Table 7 reports a Sharpe ratio of 0.71. In general, we observe the results to not be consistent and in line with the findings from

the main analysis and amplify our argument that the economic indexes we created are not able to predict currency returns.

Dahlquist & Hasseltoft (2020) split their data into two 20-year subsamples and perform the same tests. They find that the performance of the strategies is fairly consistent in both periods, giving a Sharpe ratio of 0.73 and 0.69. As shown in the results discussed above this is not the case in our analysis of shorter subsamples. We discussed why our findings might not be in line with the results of Dahlquist & Hasseltoft (2020) in Section 5.1, and we will not further discuss this in this section.

6 Conclusion

In this master thesis, we investigate the relationship between currency returns and macroeconomic fundamentals linked to inflation, economic activity, and a combination of these. We do this by replicating the methodology of Dahlquist & Hasseltoft (2020), and implement it using the British pound (GBP) as home currency. We study the relationship through constructing trading strategies called "economic momentum strategies", strategies that goes long in currencies with strong economic momentum and goes short in currencies with weak economic momentum. The performance of the strategies are reported and we compare the results to the carry trade strategy. Furthermore, by using the weights of the strategies we run predictive panel regressions and investigate if the weights can significantly predict currency returns.

Based on the data used in this thesis we find that all strategies constructed exhibits positive Sharpe ratios, where the combination strategy exhibits the highest with a ratio of 0.24. However, in contrast to the findings of Dahlquist & Hasseltoft (2020), all strategies are outperformed by the carry trade strategy. Nevertheless, we find an increase in utility when diversifying across the combination strategy and carry strategy. Furthermore, we find that the weights of the economic momentum strategies are not able to significantly predict currency returns from the perspective of a British investor. In spite of that, when we replicated the results from the perspective of an American investor, we find that the strategies are able to significantly predict currency returns. As a result of this we conclude that the methodology by Dahlquist & Hasseltoft (2020), do not hold from the perspective of a British investor.

Because we had some trouble collecting data on currency spot and forward rates, we would recommend investigating the topic using data from different databases to see if the results remain the same. Furthermore, we would recommend studying the methodology by Dahlquist & Hasseltoft (2020) from the perspective other currencies, to see if the results hold then. It would also be interesting to analyze other asset classes and the momentum in their corresponding return drivers.

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8 Appendices

A Figures for USD as domestic currency

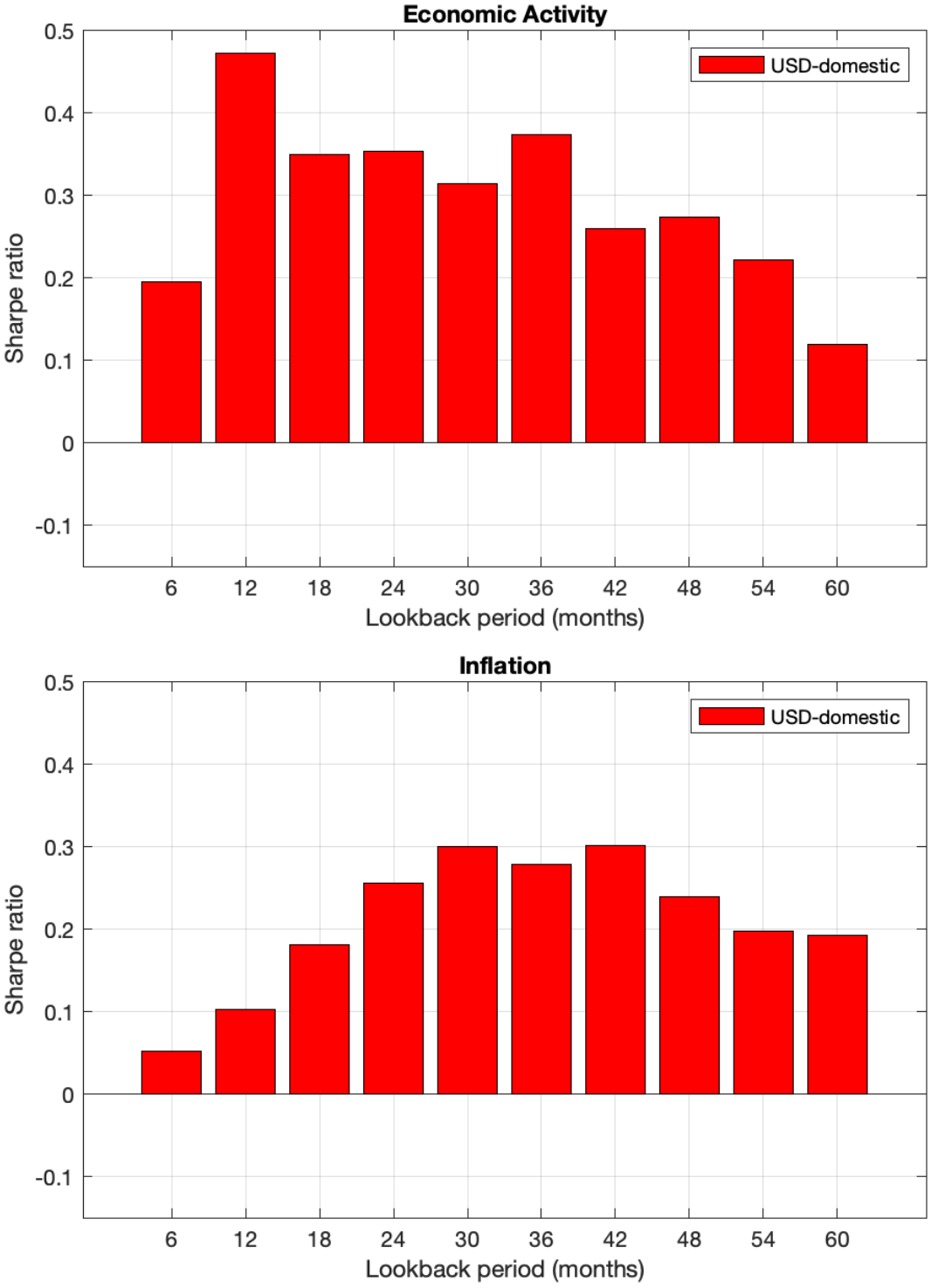

Figure 5: Annualized Sharpe ratios of sub-combos, economic activity, and inflation, over a range of lookback periods (sub-strategies).

B Tables for GBP as domestic currency

Entity Fixed effects

	Currency returns				
	1	2	3	4	5
Economic Activity	0.068				0.039
	(0.247)				(0.247)
Inflation		0.477			0.473
		(0.314)			(0.316)
Trend Combo			0.386		
			(0.264)		
Carry				0.416	
				(0.128)	
Adjusted R^2 (%)	-0.23	-0.18	-0.19	-0.03	-0.20
Number of observations	5036	5036	5036	5036	5036

Table 9: Coefficients, standard errors, adjusted R^2 and number of observations for regression results of panel regressions explained in Section 3.4. Next month's currency returns are predicted using the current month's portfolio weights: $R_{c,t+1} = \alpha_c + \beta \widetilde{w}_{c,t} + \epsilon_{c,t+1}$, where $R_{c,t+1}$ denotes the monthly excess return for currency c at time t + 1 and $\widetilde{w}_{c,t}$ denotes the cross-sectional standardized portfolio weight for currency c at t. Regression reported is entity fixed effects.

Time Fixed and entity fixed effects

	Currency returns				
	1	2	3	4	5
Economic Activity	0.052				0.024
	(0.193)				(0.193)
Inflation		0.449			0.446
		(0.245)			(0.246)
Trend Combo			0.341		
			(0.206)		
Carry				0.346	
				(0.103)	
Adjusted R^2 (%)	39.14	39.19	39.18	39.34	39.17
Number of observations	5036	5036	5036	5036	5036

Table 10: Coefficients, standard errors, adjusted R^2 and number of observations for regression results of panel regressions explained in Section 3.4. Next month's currency returns are predicted using the current month's portfolio weights: $R_{c,t+1} = \alpha_t + \lambda_c + \beta \widetilde{w}_{c,t} + \epsilon_{c,t+1}$, where $R_{c,t+1}$ denotes the monthly excess return for currency c at time t + 1 and $\widetilde{w}_{c,t}$ denotes the cross-sectional standardized portfolio weight for currency c at t. Regression reported is combination of time fixed effects and entity fixed effects.

	EA6	EA12	EA18	EA24	EA30	EA36	EA42	EA48	EA54	EA60
EA6	1.00									
EA12	0.62	1.00								
EA18	0.52	0.88	1.00							
EA24	0.51	0.79	0.91	1.00						
EA30	0.45	0.68	0.82	0.91	1.00					
EA36	0.41	0.61	0.72	0.82	0.91	1.00				
EA42	0.37	0.58	0.70	0.79	0.89	0.95	1.00			
EA48	0.37	0.55	0.67	0.76	0.84	0.90	0.94	1.00		
EA54	0.36	0.53	0.63	0.71	0.78	0.84	0.87	0.94	1.00	
EA60	0.32	0.50	0.60	0.65	0.74	0.78	0.82	0.87	0.94	1.00

Table 11: Correlation table for the returns *of each sub-strategy based on economic activity index. GBP is the domestic currency*.

	Inf6	Inf12	Inf18	Inf24	Inf30	Inf36	Inf42	Inf48	Inf54	Inf60
Inf6	1.00									
Inf12	0.84	1.00								
Inf18	0.73	0.91	1.00							
Inf24	0.72	0.87	0.92	1.00						
Inf30	0.68	0.83	0.88	0.94	1.00					
Inf36	0.65	0.81	0.85	0.91	0.97	1.00				
Inf42	0.65	0.80	0.83	0.89	0.94	0.97	1.00			
Inf48	0.60	0.77	0.81	0.87	0.91	0.94	0.97	1.00		
Inf54	0.59	0.75	0.78	0.85	0.89	0.92	0.95	0.98	1.00	
Inf60	0.57	0.73	0.76	0.84	0.88	0.90	0.93	0.97	0.98	1.00

Table 12: Correlation table for the returns of each sub-strategy based on inflation index. GBP is the domestic currency.

C Tables for USD as domestic currency

	USD - domestic			
	Economic Activity	Inflation	Combo	Carry
Mean	1.343	1.576	2.091	2.676
Standard deviation	4.788	6.336	6.177	5.500
Skewness	-0.246	-0.970	-0.659	-0.226
Excess kurtosis	0.404	4.696	1.128	1.747
AR(1)	0.026	0.070	0.001	-0.031
Sharpe Ratio	0.280	0.249	0.339	0.487

Table 13: Performance measures of sub-combo strategies, Combo strategy, and the Carry strategy. The measures are based on monthly returns, but means, standard deviations, and Sharpe ratio are annualized. AR(1) refers to the first-order autocorrelation of returns.

Time Fixed effects

	Currency returns - USD - domestic			
	1	2	3	4
Economic Activity	0.021			
	(0.016)			
Inflation		0.029*		
		(0.016)		
Trend Combo			0.035**	
			(0.016)	
Carry				0.048***
				(0.015)
Adjusted R^2 (%)	48.95	48.68	48.98	54.09
Number of observations	5046	5047	5046	5046

Table 14: Coefficients, standard errors, adjusted R^2 and number of observations for regression results of panel regressions explained in Section 3.4. Next month's currency returns are predicted using the current month's portfolio weights: $R_{c,t+1} = \alpha_t + \beta \tilde{w}_{c,t} + \epsilon_{c,t+1}$, where $R_{c,t+1}$ denotes the monthly excess return for currency c at time t + 1 and $\tilde{w}_{c,t}$ denotes the cross-sectional standardized portfolio weight for currency c at time t. Regression reported is time fixed effects. *: significant at 10% level, **: significant at 5% level, ***: significant at 1% level.

Time Fixed and entity fixed effects

	Currency returns - USD - domestic			
	1	2	3	4
Economic Activity	0.017			
	(0.017)			
Inflation		0.052**		
		(0.022)		
Trend Combo			0.052***	
			(0.020)	
Carry				0.050***
				(0.019)
Adjusted R^2 (%)	48.88	48.65	48.94	54.01
Number of observations	5046	5047	5046	5046

Table 15: Coefficients, standard errors, adjusted R^2 and number of observations for regression results of panel regressions explained in Section 3.4. Next month's currency returns are predicted using the current month's portfolio weights: $R_{c,t+1} = \alpha_t + \lambda_c + \beta \widetilde{w}_{c,t} + \epsilon_{c,t+1}$, where $R_{c,t+1}$ denotes the monthly excess return for currency c at time t + 1 and $\widetilde{w}_{c,t}$ denotes the cross-sectional standardized portfolio weight for currency c at t. Regression reported is combination of time fixed effects and entity fixed effects. *: significant at 10% level, **: significant at 5% level, ***: significant at 1% level.

Entity Fixed effects

	Currency returns - USD - domestic			
	1	2	3	4
Economic Activity	0.019			
	(0.025)			
Inflation		0.05		
		(0.031)		
Trend Combo			0.055*	
			(0.028)	
Carry				0.045*
				(0.028)
Adjusted R^2 (%)	-0.025	-0.019	-0.018	-0.021
Number of observations	5046	5047	5046	5046

Table 16: Coefficients, standard errors, adjusted R^2 and number of observations for regression results of panel regressions explained in Section 3.4. Next month's currency returns are predicted using the current month's portfolio weights: $R_{c,t+1} = \alpha_c + \beta \widetilde{w}_{c,t} + \epsilon_{c,t+1}$, where $R_{c,t+1}$ denotes the monthly excess return for currency c at time t + 1 and $\widetilde{w}_{c,t}$ denotes the cross-sectional standardized portfolio weight for currency c at t. Regression reported is entity fixed effects. *: significant at 10% level, **: significant at 5% level, ***: significant at 1% level.