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Carry trades and monetary conditions

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Abstract

This paper investigates the relation between monetary conditions and the excess returns arising from currency carry trades. The results indicate that carry trade average return, Sharpe ratio and downside risk differ substantially across monetary conditions before the onset of the financial crisis in 2008. Specifically, expansive policy shifts in the US result in a decrease in international risk aversion, which in turn leads to a compression in currency risk premia and higher carry trade returns. By contrast, Fed monetary policy is not able to affect international risk aversion and carry trade returns during the crisis and Zero Lower Bound (ZLB) period, when the economic recession reduced the propensity of investors to take on risk exposures.

Keywords: carry trade, international risk aversion, monetary conditions

JEL classification: F31, G15, E52

Non-technical summary

One of the cornerstones of international finance is the uncovered interest rate parity condition, which predicts that exchange rate changes will eliminate any profit arising from the differential in interest rates across countries. Nevertheless, many studies show that the opposite holds true empirically: high interest rate currencies tend to appreciate rather than depreciate against low interest rate currencies. This leads investors to engage in the so-called "carry trade", which is an investment strategy consisting of borrowing low-interest rate currencies and investing in currencies with high interest rates.

The most persuasive explanation for carry trade profitability is based on a risk argument. There are strong theoretical and empirical arguments to think that global foreign exchange (FX) volatility risk and risk aversion are keys to understanding rewards from carry trades. At the same time, there is increasing empirical evidence showing that US monetary policy induces strong comovements in the international financial variables that characterize the global financial cycle.

Against this background, my paper analyses empirically whether carry trade returns are systematically linked to changes in US monetary policy and investigates whether currency risk premia predictability provides information that is economically valuable. Currencies are sorted into six portfolios according to their forward discounts: the zero cost strategy that goes long in portfolio 6 and short in portfolio 1 results in a carry trade portfolio. Carry trade portfolio returns in each period t are measured based on changes in US monetary conditions between $t-1$ and t.

My main result is that before the onset of the financial crisis in 2008 expansive periods are characterised by significantly higher average returns and Sharpe ratios and lower downside risk. One possible narrative consistent with these findings and those of the literature on global financial cycle is that during normal times monetary expansions in the US are followed by a growth in the leverage of international banks and a reduction in aggregate risk aversion. This, in turn, leads to a compression in currency risk premia and higher carry trade returns.

Second, I show that returns from currency speculation do not significantly differ across monetary conditions during the crisis and the Zero Lower Bound (ZLB) period, when the economic recession reduced the propensity of investors to take on risk exposures. In this context, monetary expansions in the US were not able to affect international risk aversion.

1 Introduction

One of the cornerstones of international finance is uncovered interest parity (UIP), which predicts that exchange rate changes will eliminate any profit arising from the differential in interest rates across countries. Nevertheless, many studies provide empirical evidence against UIP[1]: in particular, they show that high interest rate currencies tend to appreciate rather than depreciate against low interest rate currencies (forward premium puzzle). As a consequence, one of the most popular currency speculation strategy is carry trade, which consists of borrowing low-interest rate currencies and investing in currencies with high interest rates.

The most persuasive explanation for the forward premium puzzle is the inter-temporal variation in currency risk premia. There are strong theoretical and empirical arguments to think that currency risk premia are driven by risk aversion (Brunnermeier *et al.* (2009)) and global FX volatility risk (Menkhoff *et al.* (2012)). Specifically, carry trades tend to perform poorly during periods of increasing risk aversion and unexpectedely high FX volatility. At the same time, there is increasing empirical evidence showing that US monetary policy induces strong co-movements in the international financial variables that characterize the global financial cycle (Rey (2013) and Miranda-Agrippino and Rey (2020b)). This paper analyses empirically whether carry trade returns are systematically linked to changes in monetary conditions and investigates whether currency risk premia predictability provides information that is economically valuable.

Consistent with influential studies examining the risk-return profile of carry

[1] See Engel (2014) for a review of the relevant empirical literature.

trades, currencies are allocated to six portfolios according to their forward discount at the end of each period[2]: the zero cost strategy that goes long in portfolio 6 and short in portfolio 1 results in a carry trade portfolio. Then, carry trade portfolio returns in each period t are measured based on changes in US monetary conditions between $t-1$ and t.

My main result is that before the onset of the financial crisis in 2008 expansive periods are characterised by significantly higher average returns and Sharpe ratios and lower downside risk. These results are in line with those of Mueller *et al.* (2017) showing that the adoption of an expansionary monetary policy by the Fed increases the difference between announcement- and nonannouncement-day carry trade returns. One possible narrative consistent with these findings and those of the literature on global financial cycle is that during normal times monetary expansions in the US are followed by a growth in the leverage of international banks and a reduction in aggregate risk aversion. This, in turn, leads to a compression in currency risk premia and higher carry trade returns.

Second, I show that returns from currency speculation do not significantly differ across monetary conditions during the crisis and the Zero Lower Bound (ZLB) period, when the economic recession reduced the propensity of investors to take on risk exposures. In this context, monetary expansions in the US were not able to affect international risk aversion. These results are consistent with those of Miranda-Agrippino and Rey (2020a), who document that global risk aversion responds very differently to expansionary monetary shocks after the Lehman Brothers bankruptcy of 2008.

[2]The innovation of sorting currencies into portfolios is due to Lustig and Verdelhan (2007) and it has been followed by other papers afterwards: see Lustig *et al.* (2011) and Menkhoff *et al.* (2012) among others.

The link between monetary policy and risk-taking in domestic financial markets has been pointed out by several studies suggesting the existence of a risk-taking channel in the transmission of monetary policy, defined as the impact of changes in policy rates on the willingness of market participants to bear risks (Borio and Zhu (2012)). For example, Bekaert *et al.* (2013) document empirically that in the pre-crisis period an expansive monetary policy in the US decreases both risk aversion and uncertainty, with the former effect being stronger. However, the considered effects are weaker when the sample period includes the crisis started in 2008. This also confirms that the impact of changes in US monetary policy on the willingness of investors to take risks is not significant during crisis times.

The remaining of this work proceeds as follows. Next section presents the data and describes the monetary policy indicator used in the analysis. Section 3 provides a discussion of the findings. Section 4 concludes the paper.

2 Data and variables

2.1 Currency data

The dataset consists of daily spot and one month forward exchange rates per US dollar covering the period from January 1990 to December 2015. These data are available on Datastream. Following the relevant literature since Fama (1984), logarithms of spot and forward rates are considered. They will be denoted as s and f respectively.

The sample contains the following countries: Australia, Austria, Belgium, Canada, Hong Kong, Czech Republic, Denmark, euro area, Finland, France, Germany, Greece, Hungary, India, Indonesia, Ireland, Italy, Japan, Kuwait, Malaysia, Mexico, Netherlands, New Zealand, Norway, Philippines, Poland, Portugal, Saudi Arabia, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Thailand and the United Kingdom. The euro series starts in January 1999. Euro area countries are excluded after this date and only the euro series remains.

2.2 Portfolios

Currencies are allocated to six portfolios[3] according to their forward discounts $f_t - s_t$ observed at the end of each month t. If the covered interest parity (CIP) holds empirically at the frequency analyzed, then the forward discount is equal to the interest rate differential versus US interest rate and sorting on forward discount is equivalent to sorting on interest rate differentials. The CIP assumption was uncontroversial at daily and lower frequency before the global financial crisis in 2008 (Akram *et al.* (2008)), but it is currently the topic of active debate. Du *et al.* (2018) find that there have been systematic violations of the CIP during the extreme episodes of the financial crisis and even post-crisis. On the other hand, Rime *et al.* (2017) argue that the documented CIP deviations reflect money market segmentation rather than arbitrage opportunities and conclude that the CIP in fact holds remarkably well.

Currencies are ranked from low to high interest rates (or forward discounts): therefore, currencies with the lowest interest rates or smallest forward discounts are contained in portfolio 1, while currencies with the highest interest

[3]The relevant data are available at Adrien Verdelhan website: http://web.mit.edu/adrienv/www/Data.html.

rates or largest forward discounts are contained in portfolio 6. The zero cost strategy that goes long in portfolio 6 and short in portfolio 1 (the high-minus-low strategy, H/L) is labelled carry trade portfolio.

Monthly excess returns for buying a foreign currency k in the forward exchange market and selling it in the spot market after one month are:

$$rx_{t+1}^{k} \approx f_{t}^{k} - s_{t+1}^{k} \tag{1}$$

where s_{t+1}^{k} and f_{t}^{k} are respectively the logarithm of daily spot and one month forward exchange rates at the end of month $t+1$ and t. Gross returns for portfolio j are computed as the equally weighted average of excess returns for the constituent currencies. Net excess returns are derived using the bid-ask quotes for spot and forward contracts. In addition, it is assumed that investors go short in portfolio 1 and long in all the other foreign currencies.

2.3 Descriptive statistics for portfolios

For comparison with prior research, descriptive statistics for the currency portfolios are presented in tables 1 and 2 without regard to monetary conditions. Table 1 reports results for gross excess returns in US dollars, while table 2 provides statistics for excess returns net of transaction costs. Panel A considers the full sample, while panel B and C focus respectively on the period January 1990 to December 2007 (i.e. before the outbreak of the global financial crisis) and January 2008 to December 2015 (crisis and ZLB period).

Panel A and B of both tables reveal that unadjusted and adjusted annualized average returns and Sharpe ratios increase when moving from portfolio 1 to portfolio 6 and the H/L portfolio. But the payoffs to the carry trade portfolio shrink when considering transaction cost adjustments: for example, the average return on the carry trade portfolio over the full sample decreases from 739 basis points to 420 basis points. The skeweness (SK) is generally consistent with Brunnermeier *et al.* (2009), who show that currencies with high interest rate differential are related to negative conditional skewness of exchange rate movements. It is also interesting to note that the annualised Sharpe Ratios increase monotonically as we move from portfolio 1 to portfolio 6 and the H/L portfolio and, even after controlling for transaction costs, the Sharpe ratios for portfolios 6 and the carry trade portfolio are notable. No clear pattern emerges for standard deviation, kurtosis (KR) and 5% quantile[4].

Panel C of tables 1 and 2 shows that after the outbreak of the financial crisis the H/L portfolio is characterised by low gross excess returns, negative net returns and a more left skewed distribution. The 5% quantile shows a decreasing trend when moving from portfolio 2 to portfolio 6.

2.4 Monetary policy indicator

To proxy for changes in monetary conditions, Federal Reserve (Fed) monetary policy is considered. Given the role of the US dollar as the main currency of global banking, monetary actions in the US induce significant variations in risk aversion and asset prices worldwide through their impact on funding costs, leverage decisions and cross-border capital flows of international banks (Miranda-Agrippino and Rey (2020b)).

Following Nakamura and Steinsson (2018) and Jarocinski and Karadi (2020), who build on Gurkaynak *et al.* (2005), monetary policy shocks are measured by

[4]For portfolio 1, no 5% quantile is reported because the investor is short in these currencies.

a composite indicator of changes in Fed funds and Eurodollar futures with horizons up to one year over a 30-minute window around FOMC announcements. This indicator is the first principal component of the surprises in the following five interest rates: the Fed funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting and the expected three-month eurodollar interest rates at horizons of two, three and four quarters. The shock for a given month t is constructed by adding up the intraday surprises occurring in month t on the days with FOMC announcements[5].

Since the focus of the analysis is identifying expansive shifts in Fed policy, a binary variable (MPI_t) is considered. When the monetary policy indicator decreases from month $t-1$ to month t, MPI_t is labelled "expansive" for the considered month[6]. Otherwise, MPI_t is labelled "non-expansive": this includes also the 95 months for which there are no monetary policy shocks.

3 The impact of US monetary policy on carry trade returns

I begin my empirical investigation by documenting the net excess returns of the carry trade portfolio in different monetary conditions. Panel A of table 3 presents summary statistics for months characterised by non-expansive monetary policy, while panel B considers expansive months and compares H/L average net returns (*Mean diff*) and 5% quantile (*Quantile diff*) across monetary periods. The p-values of *Mean diff* refer to the β from the following

[5] The monthly dataset is available at https://www.aeaweb.org/articles?id=10.1257/mac.20180090

[6] Of the 311 months considered in the sample, MPI_t is "expansive" in 74 months.

regression:

$$rx_t^{H/L} = \omega + \beta \times MPI_t + \epsilon_t \tag{2}$$

where the intercept ω measures the carry trade portfolio average return during non-expansive monetary conditions, MPI_t is a dummy variable that takes the value of one for expansive monetary policy shifts between $t-1$ and t and zero otherwise, the coefficient β measures the spread between retuns earned on expansive and non-expansive periods and ϵ_t is the error term.

Concerning *Quantile diff*, the p-values refer to β_θ from the following quantile regression[7]:

$$rx_t^{H/L} = \omega_\theta + \beta_\theta \times MPI_t + \epsilon_{t,\theta} \tag{3}$$

where θ is the chosen confidence level, the intercept ω_θ measures the θ-quantile of the carry trade portfolio during non-expansive monetary conditions, β_θ represents the spread between the portfolio θ-quantile on expansive and non-expansive periods and $\epsilon_{t,\theta}$ is an error term such that its θ-conditional quantile is equal to 0.

Several noteworthy observations emerge from table 3. First, the difference between H/L average net returns on expansive and non-expansive months is positive when considering the full sample or the pre-crisis period, while it is negative from 2008 onwards. Carry trade portfolio average net returns for the full sample are equal to 7.83% (3.03%) during expansive (non-expansive) monetary periods. However, this 4.80pp difference is not statistically significant, given a p-value of 0.24. When focussing on the pre-crisis period, the

[7]The quantile regression differs from an ordinary least squares in two respects. First, the quantile regression minimizes the sum of absolute errors, rather than the sum of squared errors. Second, it puts differential weights on the errors depending on whether an error term is above or below the quantile.

H/L average net returns are equal to 12.94% (4.15%) during expansive (non-expansive) monetary periods and the resulting 8.79pp difference is significantly different from zero (with a p-value of 0.05). During the crisis and ZLB period carry trade net returns are negative (-9.32%) on expansive months, while they are slightly positive (+0.78%) during the remaining months. The resulting difference is not statistically significant (with a p-value of 0.29).

Second, the H/L portfolio is characterized by a lower downside risk during expansive months when considering the full or the pre-crisis sample, while the opposite is true during the crisis and ZLB period. The portfolio 5% quantile is equal to -7.01% (-14.48%) during expansive (non-expansive) monetary periods before the financial crisis of 2008 and the resulting 7.47pp difference is significantly different from zero (with a p-value of 0.08). The spread between the portfolio 5% quantile on expansive and non-expansive months between January 1990 and December 2015 is equal to 3.66%, but it is not significantly different from zero (with a p-value of 0.64). This spread is equal to -6.14pp during the crisis and ZLB period and it is statistically significant (with a p-value of 0.06).

Third, the large variations in H/L average net returns across monetary conditions are not accompanied by an equally large variation in net returns standard deviations. As a result, the corresponding Sharpe ratios follow a pattern similar to the one described for average net returns. Specifically, the Sharpe ratio is equal to 1.71 during expansive months and 0.48 during non-expansive months before the crisis, while it is equal to -0.90 (0.10) during the expansive (non-expansive) months of the crisis and ZLB period.

Fourth, the large H/L net returns and Sharpe ratios during the expansive months of the pre-crisis period are accompanied by a mildly negative skewness

(-0.07), while the negative performance of the same portfolio during the expansive months of the crisis and ZLB period is accompanied by a much more negative skewness (-0.62).

3.1 The role of FX volatility risk

High returns from currency speculation can be understood as compensation for bearing global FX volatility risk (Menkhoff *et al.* (2012)). Therefore, to shed more light on the role of monetary conditions for currency risk premia, in this section I control equations (2) and (3) for FX volatility risk.

In line with Menkhoff *et al.* (2012), global FX volatility in month t is measured as:

$$\sigma_t^{FX} = \frac{1}{T_t} \sum_{\tau \in T_t} \left[\sum_{k \in K_\tau} \frac{|r_\tau^k|}{K_\tau} \right] \tag{4}$$

where $|r_\tau^k| = |\Delta s_\tau|$ is the absolute log return for currency k on day τ, K_τ is the number of available currencies on day τ and T_t is the number of trading days in month t. Innovations in global FX volatility ($\Delta\sigma_t^{FX}$) are computed using the residuals from an estimated AR(1) model for σ_t^{FX}.

Panel A of table 4 shows that MPI_t is a statistically significant variable for H/L average monthly net returns when considering the pre-crisis or the full sample: the impact of expansive monetary policy is equal respectively to 0.7% and 0.5%. When focussing on the crisis and ZLB period, MPI_t has a negative but not statistically significant effect (-0.1%) on carry trade returns. Panel A also reveals that the monthly effect of a positive one standard deviation shock to FX volatility innovations[8] on net H/L returns is always negative and

[8]The monthly standard deviation of $\Delta\sigma_t^{FX}$ is equal to 0.09% for the full sample, 0.07% before the financial crisis and 0.11% during the crisis and ZLB period.

significant. It is equal to -0.97% for the full sample, -0.82% before the financial crisis and -1.13% during the crisis and ZLB period.

Results in panel B indicate that MPI_t has a positive effect on the downside risk of the H/L portfolio when considering the full sample or the period before the outbreak of the financial crisis. The spread between the carry trade portfolio 5%-quantile on expansive and non-expansive periods is equal respectively to 0.9% and 1.6%, although the difference is statistically significant only for the pre-crisis sample. When focussing on the crisis and ZLB period, the considered spread is equal to -0.8% but not significantly different from zero. It is also interesting to note the impact of a positive one standard deviation shock to FX volatility innovations on the downside risk of the H/L portfolio is always negative and statistically significant.

These findings suggest that controlling for the quantity of FX volatility risk does not affect the relation between monetary policy shocks and carry trade returns. Therefore, I conjecture that US monetary policy could influence H/L portfolio returns via its impact on the price of risk, which depends on the degree of investors' risk aversion.

The link between monetary policy and risk-taking in domestic financial markets has been pointed out by several studies suggesting the existence of a risk-taking channel in the transmission of monetary policy (see, for example, Bekaert *et al.* (2013)). At the same time, there is increasing empirical evidence showing that altering the degree of risk aversion of international banks is a powerful channel for the global transmission of US monetary policy (see, for instance, Miranda-Agrippino and Rey (2020b) and Ha (2021)). However, this channel seems to be less effective after the Lehman Brothers bankruptcy (Miranda-Agrippino and Rey (2020a)).

3.2 The interaction with global risk aversion

Given the close link between US monetary policy and risk-taking in international financial markets, I continue my empirical investigation by controlling equations (2) and (3) for changes in global risk aversion, as measured by variations in the VIX equity-option implied volatility index (ΔVIX_t). This approach is in line with Brunnermeier *et al.* (2009), who show that carry trade performance tends to be negatively related to ΔVIX_t.

Panel A of table 5 shows that MPI_t is never statistically significant for H/L average net returns, while ΔVIX_t is always significant and has a negative effect on the considered returns. Results for the 5% quantile regression are similar, although the effect of ΔVIX_t is not statistically different from zero in the pre-crisis period (panel B).

As documented by Bekaert *et al.* (2013), the VIX index can be decomposed into a component that reflects stock market uncertainty and a residual that reflects only risk aversion[9]. Therefore, I control equations (2) and (3) also for the variation in the VIX residual component. The results, displayed in table 6, mirror those of table 5. This seems to confirm that US monetary policy influences H/L portfolio returns via its impact on the price of risk. In other words, an important channel through which expansive US monetary policy has an impact on carry trade returns is global risk aversion.

To further investigate this channel, I estimate the following regression:

$$\Delta RA_t = \omega + \beta_1 \times MPI_t + \beta_2 \times \Delta RA_{t-1} + \epsilon_t \tag{5}$$

[9]The relevant time series are available at Marie Hoerova website: http://mariehoerova.net/

where ΔRA_t represents the variation in either the VIX index or its residual component. Panel A of table 7 shows that an expansive monetary policy shock has a negative impact on ΔVIX_t when considering the pre-crisis period or the full sample, although the effect is statistically significant only before the crisis. When focussing on the crisis and ZLB period, the impact of MPI_t on ΔVIX_t is positive but not statistically different from zero. Results from panel B reveal that the link between expansive monetary shocks and variations in the VIX residual component are even stronger. The impact of MPI_t on $\Delta VIXR_t$ is always negative and it is statistically significant when analysing both the pre-crisis and the full sample[10].

One possible narrative consistent with my results is that during normal times monetary expansions in the US were followed by a higher leverage and a greater propensity to take risks of international banks. This, in turn, led to a compression in currency risk premia and higher carry trade returns. On the other hand, Fed monetary policy was not able to affect global risk aversion during the crisis started in 2008, when the economic recession reduced the propensity of investors to take on risk exposures.

4 Conclusion

This paper empirically investigates the relation between US monetary policy and the excess returns arising from currency carry trades. The analysis shows that before the onset of the financial crisis in 2008 expansive periods are char-

[10]It is conceivable that, for example, bad news on expected economic growth may simultaneously make a monetary expansion more likely and cause people to be more risk averse because they fear a more uncertain future. The reults displayed in table 7 do not change when controlling equation (5) for a business cycle indicator such as the log-difference of industrial production.

acterized by higher average returns and Sharpe ratios and lower downside risk. In particular, expansive policy shifts result in a decrease in international risk aversion, which in turn leads to a compression in the currency risk premia demanded by the investors and higher carry trade returns.

The considered returns are not affected by US monetary policy during the crisis and ZLB period, when the economic recession reduced the propensity of investors to take on risk exposures. In this context, Fed monetary expansions were not able to affect international risk aversion.

Table 1: Descriptive statistics for currency portfolios: gross returns

The table reports annualized mean, standard deviation, Sharpe ratio and 5% quantile for gross excess returns of currency portfolios sorted monthly according to their forward discounts. For portfolio 1, the table reports *minus* the actual average excess return and no 5% quantile because the investor is short in these currencies. Means, standard deviations and quantiles are reported in percentage points. Portfolio 1 contains currencies with the lowest forward discount, while portfolio 6 contains currencies with the highest forward discount. H/L denotes the zero cost strategy that goes long in portfolio 6 and short in portfolio 1. Annualized means are computed multiplying monthly means by 12, while annualized standard deviations and quantiles are computed multiplying monthly standard deviations and quantiles by $\sqrt{12}$. The Sharpe ratio is the ratio of annualized mean to the annualized standard deviation. The table also reports skewness (SK) and kurtosis (KR) of currency portfolios.

	pf1	pf2	pf3	pf4	pf5	pf6	H/L
Panel A: full sample							
Mean	-2.49	-0.36	0.46	1.71	3.66	4.91	7.39
St. Dev.	6.79	6.37	6.36	7.18	7.94	9.49	8.51
Sharpe Ratio	-0.37	-0.06	0.07	0.24	0.46	0.52	0.87
5% Quantile	-	-9.56	-10.05	-11.01	-11.36	-14.40	-13.40
SK	0.07	0.14	-0.09	-0.55	-0.36	-0.48	-0.26
KR	4.70	5.10	4.17	5.57	5.38	5.16	3.60
Panel B: pre-crisis sample							
Mean	-2.79	0.29	0.82	3.50	4.30	7.40	10.19
St. Dev.	6.62	6.49	6.09	6.44	6.98	8.75	8.52
Sharpe Ratio	-0.42	0.05	0.13	0.54	0.62	0.85	1.20
5% Quantile	-	-10.45	-9.23	-8.80	-9.84	-12.99	-12.81
SK	-0.14	0.37	-0.04	-0.57	-0.34	-0.05	-0.18
KR	4.29	4.73	3.97	7.56	6.41	4.61	3.66
Panel C: crisis and ZLB sample							
Mean	-1.80	-1.82	-0.34	-2.31	2.21	-0.71	1.09
St. Dev.	7.20	6.11	6.94	8.52	9.80	10.85	8.25
Sharpe Ratio	-0.25	-0.30	-0.05	-0.27	0.23	-0.07	0.13
5% Quantile	-	-8.71	-13.73	-16.56	-18.39	-18.88	-14.24
SK	0.42	-0.52	-0.16	-0.34	-0.29	-0.85	-0.52
KR	5.23	5.87	4.27	3.42	3.86	4.86	3.24

Table 2: Descriptive statistics for currency portfolios: net returns

The table reports annualized mean, standard deviation, Sharpe ratio and 5% quantile for net excess returns of currency portfolios sorted monthly according to their forward discounts. For portfolio 1, the table reports *minus* the actual average excess return and no 5% quantile because the investor is short in these currencies. Means, standard deviations and quantiles are reported in percentage points. Portfolio 1 contains currencies with the lowest forward discount, while portfolio 6 contains currencies with the highest forward discount. H/L denotes the zero cost strategy that goes long in portfolio 6 and short in portfolio 1. Annualized means are computed multiplying monthly means by 12, while annualized standard deviations and quantiles are computed multiplying monthly standard deviations and quantiles by $\sqrt{12}$. The Sharpe ratio is the ratio of annualized mean to the annualized standard deviation. The table also reports skewness (SK) and kurtosis (KR) of currency portfolios.

	pf1	pf2	pf3	pf4	pf5	pf6	H/L
Panel A: full sample							
Mean	-1.50	-1.17	-0.48	0.56	2.31	2.70	4.20
St. Dev.	6.80	6.37	6.36	7.16	7.96	9.41	8.46
Sharpe Ratio	-0.22	-0.18	-0.08	0.08	0.29	0.29	0.50
5% Quantile	-	-9.90	-10.36	-11.25	-11.85	-14.71	-14.28
SK	0.11	0.13	-0.10	-0.56	-0.38	-0.57	-0.33
KR	4.85	5.12	4.19	5.60	5.49	5.19	3.57
Panel B: pre-crisis sample							
Mean	-1.77	-0.63	-0.13	2.43	2.89	4.75	6.51
St. Dev.	6.62	6.49	6.09	6.43	7.01	8.65	8.46
Sharpe Ratio	-0.27	-0.10	-0.02	0.38	0.41	0.55	0.77
5% Quantile	-	-10.68	-9.47	-9.12	-10.28	-13.50	-14.17
SK	-0.14	0.36	-0.04	-0.59	-0.39	-0.18	-0.26
KR	4.31	4.72	3.96	7.59	6.65	4.51	3.57
Panel C: crisis and ZLB sample							
Mean	-0.90	-2.39	-1.28	-3.63	0.98	-1.91	-1.01
St. Dev.	7.23	6.12	6.94	8.50	9.80	10.87	8.29
Sharpe Ratio	-0.12	-0.39	-0.18	-0.43	0.10	-0.18	-0.12
5% Quantile	-	-8.86	-14.02	-16.86	-18.68	-19.18	-14.90
SK	0.52	-0.54	-0.18	-0.34	-0.30	-0.89	-0.57
KR	5.53	5.92	4.31	3.42	3.86	4.98	3.38

Table 3: H/L net returns across monetary conditions: summary statistics
The table shows annualized mean, standard deviation, Sharpe ratio and 5% quantile for net excess returns of the H/L portfolio as well as their skewness (SK) and kurtosis (KR) across different monetary conditions. Returns are measured in month t based on changes in monetary policy from month $t-1$ to month t. H/L denotes the zero cost strategy that goes long in portfolio 6 and short in portfolio 1: portfolio 6 contains currencies with the highest forward discount, while portfolio 1 contains currencies with the lowest forward discount. Means and quantiles are reported in percentage points. The Sharpe ratio is the ratio of annualized mean to the annualized standard deviation. Annualized means are computed multiplying monthly means by 12, while annualized standard deviations and quantiles are computed multiplying monthly standard deviations and quantiles by $\sqrt{12}$. "Mean diff" indicates the difference (in percentage points) between average net returns earned on expansive and non-expansive periods, while "Quantile diff" indicates the spread (in percentage points) between the H/L portfolio 5% quantile on expansive and non-expansive months. P-values are reported in parentheses: those referring to "Mean diff" are based on Newey and West (1987) standard errors, while those for "Quantile diff" are based on standard errors obtained via XY-pair bootstrap.

	Full sample	Pre-crisis	Crisis and ZLB
Panel A: non-expansive months			
Mean	3.03	4.15	0.78
St. Dev.	8.41	8.72	7.76
Sharpe Ratio	0.36	0.48	0.10
5% Quantile	-14.40	-14.48	-13.43
SK	-0.27	-0.25	-0.43
KR	3.51	3.64	2.94
Panel B: expansive months			
Mean	7.83	12.94	-9.32
St. Dev.	8.65	7.56	10.38
Sharpe Ratio	0.90	1.71	-0.90
5% Quantile	-10.74	-7.01	-19.57
SK	-0.54	-0.07	-0.62
KR	3.81	2.73	3.18
Mean diff	4.80	8.79	-10.10
	(0.24)	(0.05)	(0.29)
Quantile diff	3.66	7.47	-6.14
	(0.64)	(0.08)	(0.06)

Table 4: H/L net returns, monetary shocks and FX volatility risk

The table presents the results obtained when H/L portfolio net excess returns are regressed on a constant, FX volatility innovations ($\Delta\sigma_t^{FX}$) and the dummy variable MPI_t. H/L denotes the zero cost strategy that goes long in portfolio 6 and short in portfolio 1: portfolio 6 contains currencies with the highest forward discount, while portfolio 1 contains currencies with the lowest forward discount. P-values of coefficient estimates are reported in parentheses: those referring to expected returns are based on Newey and West (1987) standard errors, while those for the 5% quantile are based on standard errors obtained via XY-pair bootstrap.

	Full sample	Pre-crisis	Crisis and ZLB
	Panel A: H/L average return		
Constant	0.002	0.003	0.001
	(0.128)	(0.165)	(0.635)
MPI_t	0.005	0.007	-0.001
	(0.064)	(0.056)	(0.856)
$\Delta\sigma_t^{FX}$	-11.056	-10.932	-10.178
	(0.000)	(0.000)	(0.000)
	Panel B: H/L 5% quantile		
Constant	-0.037	-0.0413	-0.033
	(0.000)	(0.000)	(0.000)
MPI_t	0.009	0.016	-0.008
	(0.157)	(0.037)	(0.370)
$\Delta\sigma_t^{FX}$	-15.338	-16.947	-12.151
	(0.000)	(0.000)	(0.000)

Table 5: H/L net returns, monetary shocks and VIX
The table presents the results obtained when H/L portfolio net excess returns are regressed on a constant, the variable ΔVIX_t and the dummy variable MPI_t. H/L denotes the zero cost strategy that goes long in portfolio 6 and short in portfolio 1: portfolio 6 contains currencies with the highest forward discount, while portfolio 1 contains currencies with the lowest forward discount. P-values of coefficient estimates are reported in parentheses: those referring to expected returns are based on Newey and West (1987) standard errors, while those for the 5% quantile are based on standard errors obtained via XY-pair bootstrap.

	Full sample	Pre-crisis	Crisis and ZLB
	Panel A: H/L average return		
Constant	0.003	0.004	-0.000
	(0.088)	(0.081)	(0.918)
MPI_t	0.003	0.005	-0.004
	(0.354)	(0.201)	(0.562)
ΔVIX_t	-0.002	-0.002	-0.002
	(0.000)	(0.011)	(0.000)
	Panel B: H/L 5% quantile		
Constant	-0.043	-0.042	-0.040
	(0.000)	(0.000)	(0.000)
MPI_t	0.011	0.017	-0.031
	(0.204)	(0.174)	(0.131)
ΔVIX_t	-0.001	-0.000	-0.002
	(0.075)	(0.876)	(0.065)

Table 6: H/L net returns, monetary shocks and VIX residual

The table presents the results obtained when H/L portfolio net excess returns are regressed on a constant, the change in the VIX residual component $\Delta VIXR_t$ and the dummy variable MPI_t. H/L denotes the zero cost strategy that goes long in portfolio 6 and short in portfolio 1: portfolio 6 contains currencies with the highest forward discount, while portfolio 1 contains currencies with the lowest forward discount. P-values of coefficient estimates are reported in parentheses: those referring to expected returns are based on Newey and West (1987) standard errors, while those for the 5% quantile are based on standard errors obtained via XY-pair bootstrap.

	Full sample	Pre-crisis	Crisis and ZLB
	Panel A: H/L average return		
Constant	0.003	0.004	0.001
	(0.058)	(0.083)	(0.655)
MPI_t	0.002	0.006	-0.010
	(0.505)	(0.093)	(0.210)
$\Delta VIXR_t$	-0.001	-0.000	-0.001
	(0.000)	(0.001)	(0.000)
	Panel B: H/L 5% quantile		
Constant	-0.037	-0.042	-0.030
	(0.000)	(0.000)	(0.000)
MPI_t	0.008	0.016	-0.052
	(0.467)	(0.148)	(0.034)
$\Delta VIXR_t$	-0.001	-0.001	-0.001
	(0.019)	(0.393)	(0.001)

Table 7: Risk aversion variations and monetary shocks
The table presents the results obtained when changes in global risk aversion are regressed on a constant, their lagged value and the dummy variable for the monetary policy indicator. P-values of coefficient estimates are reported in parentheses and are based on Newey and West (1987) standard errors.

	Full sample	Pre-crisis	Crisis and ZLB
	Panel A: ΔVIX_t		
Constant	0.109	0.352	-0.379
	(0.556)	(0.101)	(0.277)
MPI_t	-0.517	-1.352	2.023
	(0.374)	(0.011)	(0.244)
ΔVIX_{t-1}	0.115	0.046	0.170
	(0.088)	(0.473)	(0.059)
	Panel B: $\Delta VIXR_t$		
Constant	0.629	0.866	0.102
	(0.216)	(0.099)	(0.933)
MPI_t	-2.812	-3.335	-1.067
	(0.018)	(0.009)	(0.703)
$\Delta VIXR_{t-1}$	-0.244	-0.215	-0.282
	(0.003)	(0.004)	(0.058)

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