# Carry trade in developing and developed countries : a Granger causality analysis with the Toda-Yamamoto approach

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## Carry trade in developing and developed countries: A Granger causality analysis with the Toda-Yamamoto approach

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## Abstract

This paper explores the relationship between the carry trade and four related financial variables (interest rate differentials, market sentiment, local stock market indices, and the US stock market index) in ten currencies (Australian Dollar, Brazilian Real, Canadian Dollar, Euro, Great British Pound, Japanese Yen, Mexican Peso, New Zealand Dollar, Russian Ruble, and Swiss Franc). By considering both periods of monetary easing and tightening in the US after the 2008 crisis, I estimate Granger causality tests using the Toda and Yamamoto (1995) approach. Additionally, according to the interest rate differentials between these countries and the US, the currencies are classified as target or funding. Results show relevant differences and similarities in the long-term relationship of these variables for each analysed currency and monetary period in the US. Most importantly, regardless the strength of the US dollar (weak or strong), exchange rate is a good predictor of carry trade activity. Results for the period of monetary tightening (stronger US dollar) show that the carry trade Granger causes the market sentiment and local stock market indices. Therefore, a hawkish monetary policy in the US may be a source of systemic risk considering its effects on the carry trade.

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# 1 Introduction

Due to the increased interconnectedness of global financial markets at the end of the 20th century and beginning of the 21st century, interest rate differentials among countries have fostered speculative capital flows seeking higher yields. Central bankers worldwide set their base interest rate accordingly with their mission. Every country has its singularity and characteristics, which demands a unique set of monetary policies. In this sense, some countries are obliged to set high interest rates (usually, developing and underdeveloped countries), while others present low interest rates (notably, developed countries). Speculators profit from this type of structure to seek financial gains, contradicting what is expected by the uncovered interest rate parity (UIP), one of the fundamental theories of international finance.

Currency speculation is not a new phenomenon, showing its first institutional developments in the Middle Ages (Accominotti 2016). Foreign exchange markets (Forex) have augmented their size significantly in recent decades. Financialization of the world economy has led the daily turnover in Forex markets to surpass by 40 times the daily amount of world trade in US Dollars in 2019, as shown in Figure 1. In 1989, the ratio FX to trade was 21, highlighting the strengthening of financialization in Forex markets during the last two decades.

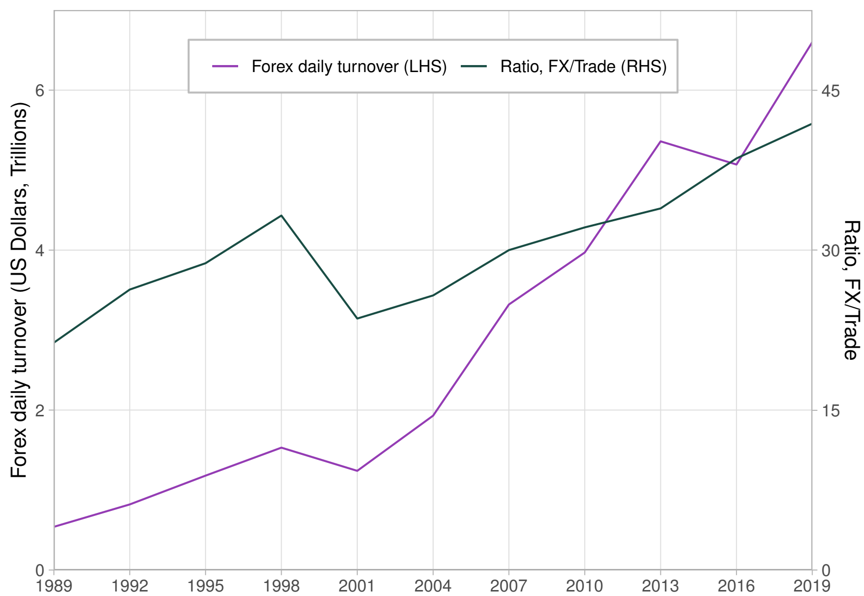


Figure 1: Forex daily turnover and ratio between Forex daily turnover and daily trade (ratio FX/Trade), 1989-2019
Source: Bank for International Settlements (BIS) for the Forex daily turnover. International Monetary Fund (IMF) for trade, using the sum of exports and imports of goods and services in current US Dollars, divided by 20 (business days). Both series are daily means for April.

One of the leading financial operations in the Forex market is the currency carry trade. By targeting "international interest differentials", carry traders (investors applying the carry trade investment strategy) "shift their asset holdings from low interest-rate currencies to higher-return currencies" (Greenville 2010, p. 3).

With the speculators' positioning data supplied by the US Commodity Futures Trading Commission (CFTC) Large Trader Reporting Data, I explore the relationship of the carry trade and its related financial variables. The carry trade literature can be divided into two big strands. On the one hand, there is a vast literature exploring carry trade returns with the use of portfolio optimization (e.g. Clarida et al. 2009; Cenedese et al. 2014; Doskov and Swinkels 2015; Kang et al. 2020). On the other hand, there is another strand criticizing carry trade and its consequences (e.g. Agrippino and Rey 2013; Goda and Priewe 2019). Nonetheless, as shown by Disyatat (2013), this strand of literature lacks robust empirical analyses.

In this sense, this paper fills a gap in the carry trade literature by trying to approach both strands. Chuffart and Dell'Eva (2020) also make use of CFTC data to investigate the effects of carry trade. This is a paper that is close to the main idea explored here: carry trade (proxied by real positioning) impact other financial variables. Meanwhile, their focus is to assess the impacts of carry trade on the real economy during the Quantitative Easing period in Japan.

My results show evidence of the relationship between carry trade and four related financial variables (interest rate differentials, market sentiment, local stock indexes, and the US stock index) in ten currencies (Australian Dollar, Brazilian Real, Canadian Dollar, Euro, British Pound, Japanese Yen, Mexican Peso, New Zealand Dollar, Russian Ruble, and Swiss Franc). With two different periods based on the US monetary policy (monetary easing and tightening), the Granger causality tests with the Toda and Yamamoto (1995) technique show relevant differences and similarities in the long-term relationship of these variables for each analysed country.

# 2 Methodology and Data

By following the model estimated by Nishigaki (2007), this article focuses on the relationship among carry trade ($CT$), nominal exchange rates ($ER$), interest rates differentials ($IRD$), market sentiment ($VIX$), local stock market indices ($SM$), and the US stock market index ($SMUS$).

## 2.1 Methodology

The applied model follows the VAR system as it is similarly proposed by Amiri and Ventelou (2012).[1]

The null hypothesis of the Granger causality test is that the dependent variable does not Granger cause the independent variable (excluded variable). To find evidence that the other variables Granger cause $CT$, conditions in Table 1 must hold, as it is shown in Equation (2)[1]. Table 2 shows the conditions for the Granger causality in the direction of other variables to $CT$, following Equations (1), (3), (4), (5), and (6)[1].

[1]See the VAR model equations in the Appendix A of the supplemental material.

Table 1. Conditions for the Granger causality from the other variables to $CT$

| **Direction** | $ER \rightarrow CT$ | $IRD \rightarrow CT$ | $VIX \rightarrow CT$ | $SM \rightarrow CT$ | $SMUS \rightarrow CT$ |
|---|---|---|---|---|---|
| **Condition** | $\alpha_{21i} \neq 0 \forall_i$ | $\gamma_{21i} \neq 0 \forall_i$ | $\delta_{21i} \neq 0 \forall_i$ | $\psi_{21i} \neq 0 \forall_i$ | $\phi_{21i} \neq 0 \forall_i$ |

Table 2. Conditions for the Granger causality from $CT$ to the other variables

| **Direction** | $CT \rightarrow ER$ | $CT \rightarrow IRD$ | $CT \rightarrow VIX$ | $CT \rightarrow SM$ | $CT \rightarrow SMUS$ |
|---|---|---|---|---|---|
| **Condition** | $\beta_{11i} \neq 0 \forall_i$ | $\beta_{31i} \neq 0 \forall_i$ | $\beta_{41i} \neq 0 \forall_i$ | $\beta_{51i} \neq 0 \forall_i$ | $\beta_{61i} \neq 0 \forall_i$ |

It is worth highlighting that the ordering of the variables does not change the results from the Granger causality tests.

## 2.2 Data

As a proxy for carry trade ($CT$), the weekly data provided by the US Commodity Futures Trading Commission's (CFTC) Commitments of Traders Report (COTR) is used. This report only provides information for 12 currencies. Excluding the Euro FX/British Pound and the South African Rand, my dataset is composed of 10 of them (Australian Dollar - AUD, Brazilian Real - BRL, Canadian Dollar - CAD, Euro - EUR, British Pound - GBP, Japanese Yen - JPY, Mexican Peso - MXN, New Zealand Dollar - NZD, Russian Ruble - RBL, and Swiss Franc - CHF). The reasons for exclusion is that the former is not a pair with the US dollar, and the latter lacks data.

There are some caveats in the use of this proxy. Usually, exchanges in currency markets are over-the-counter (OTC) operations, complicating the modelling of carry trade activity (Galati et al. 2007; Gubler 2014). Not only CFTC data represents a small fraction of carry trade, but some traders may also be using these contracts for other purposes (Curcuru et al. 2011). Each contract has information that is not publicly available, leaving space to misinterpretation. Nonetheless, as pointed out by BIS (2015), CFTC data is a reliable indicator of trends in carry trade activity. Also, it is the best publicly available data on speculative traders.

Using the number of contracts of non-commercial traders, I calculate the carry trade as the ratio of positions, as proposed by Nishigaki (2007). For target currencies, the ratio is calculated by dividing long positions by short positions ($CT$). Conversely, short positions over long positions are the ratio for funding currencies ($CTF$). As pointed out by Curcuru et al. (2011, p. 438), "engagement in carry trades could be indicated by a net short futures position in the funding currency, paired with a net long futures position in the target currency." Therefore, the use of a specific ratio for each type of currency (target or funding) is more adequate to model its behaviour.

The interest rate differential gives the classification of target and funding currencies. If the difference between the country's policy interest rate and the US policy interest rate ($IRD$) is positive, the country's currency is classified as a target currency. Contrariwise, a negative value for $IRD$ indicates a funding currency. In this case, following Gubler (2014), the interest rate differential ($IRDF$) is given by the difference between the US policy interest rate and policy country's interest rate. Figure 2 illustrates the results for the $IRD$.

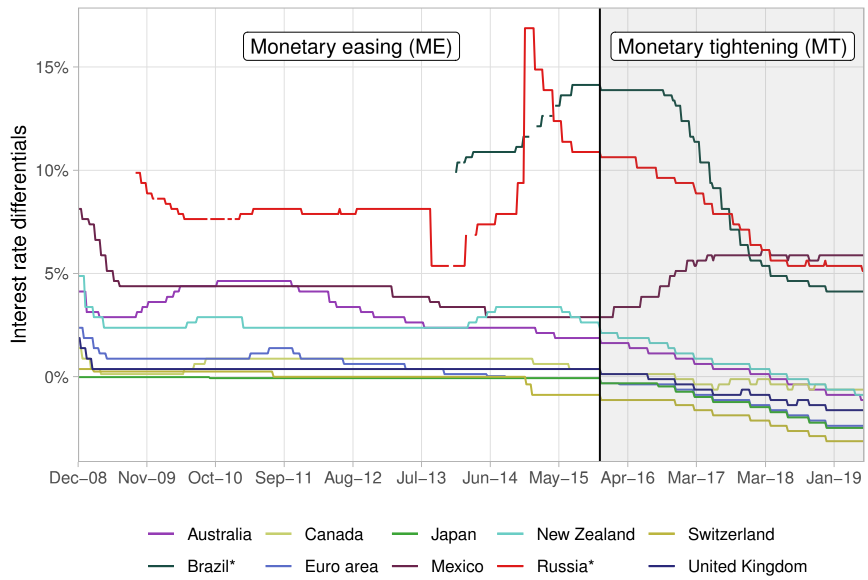


Figure 2: Difference between the country's policy interest rate and the US policy interest rate, in per cent
*: Gaps are present due to lack of data in other variables.

As shown in Figure 2, currencies changed their classification accordingly to the movements of the US monetary policy. During the monetary easing (ME) period, only the currencies of Japan and Switzerland are classified as funding currencies, being the US Dollar the target currency. During the monetary tightening (MT) period, there are significant changes. First, currencies of Canada, the Euro area, and the United Kingdom reclassify as funding currencies. Second, currencies of Australia and New Zealand present target and funding classifications, creating respectively two subsamples MTT and MTF. Table 3 shows the number of observations for each country and sample.

Additionally, an exogenous dummy variable for the tapering period (TAPER) in the monetary easing (ME) period is included. TAPER starts in May 2013, with Ben Bernanke mentioning for the first time the possibility of tapering (Chari et al. 2017). It ends with the first hike in the US policy interest rate on December 15 2015. This dummy is critical to account for the period wherein the quantitative easing monetary policies started to unwind.

Table 4 shows the detailed description of each variable. Based on Donnelly (2019), nominal exchange rates ($ER$) are in the same form as used by market practitioners. Market sentiment is given by ($VIX$). To account for the stock market activity of each country and in the US, main market indexes are used ($SM$ and $SMUS$, respectively). Overall, I follow the same group of variables proposed by Nishigaki (2007).

Table 3. Sample description

| Country | Period | Sample | | | |
|---|---|---|---|---|---|
| | | **ME** | **MT** | **MTT** | **MTF** |
| Australia | 12/30/2008 - 06/25/2019 | 364 | | 118 | 66 |
| Brazil* | 01/14/2014 - 06/25/2019 | 94 | 184 | | |
| Canada | 12/30/2008 - 06/25/2019 | 364 | 184 | | |
| Euro area | 12/30/2008 - 06/25/2019 | 364 | 184 | | |
| Japan | 12/30/2008 - 06/25/2019 | 364 | 184 | | |
| Mexico | 12/30/2008 - 06/25/2019 | 364 | 184 | | |
| New Zealand | 12/30/2008 - 06/25/2019 | 364 | | 130 | 54 |
| Russia* | 10/06/2009 - 06/25/2019 | 315 | 184 | | |
| Switzerland | 12/30/2008 - 06/25/2019 | 364 | 184 | | |
| United Kingdom | 12/30/2008 - 06/25/2019 | 364 | 184 | | |

**:* Period differs from other countries due to lack of data.

# 3 Estimation results[2]

## 3.1 Preliminary procedures

In order to capture long-term impacts, I opt to use all variables in levels. The Toda and Yamamoto (1995) technique is applied to deal with non-stationary variables.

As pointed out by Amiri and Ventelou (2012), the Toda and Yamamoto (1995) approach is useful to circumvent models' misspecification with non-stationary variables. In order to guarantee the usual asymptotic chi-square null distribution of the Wald tests, lagged exogenous variables are added to each non-stationary variable. The number of lags depends on the integration order ($d$) and the maximum lag length of the VAR model ($p$). Hence, the number of lags of these variables in the final models is specified by $d$ plus $p$, generating a modified Wald test (MWald test). Therefore, "it is clearly desirable to have a testing procedure which is robust to the integration and cointegration properties of the process so as to avoid the possible pretest biases." (Toda and Yamamoto 1995, p. 226)

First, to find the integration order ($d$), I apply the unit-roots test with one structural break with unknown breakpoints developed by Clemente et al. (1998). In the AO (Additive Outlier) model, equation (7) is estimated to remove the deterministic part of the variable:

$$y_t = \mu + d_1 DU_{1t} + \widetilde{y}_t \qquad (1)$$

In the next step, the test searches for the minimal $t$-ratio for the unit-root hypothesis ($\rho = 1$) in the following model

[2] Command (Stata 13 Do-file) and data to replicate the results are available as supplemental material, as well as an Appendix providing detailed results.

Table 4. Description of variables

| Variable | Definition | Source |
|---|---|---|
| $ER$ | Nominal exchange rates (AUDUSD, USDBRL, USDCAD, EURUSD, USDJPY, USDMXN, NZDUSD, USDRBL, USDCHF, and GBPUSD) | BIS |
| $CT$ | Ratio of long positions over short positions (Long/Short) | CFTC |
| $CTF$ | Ratio of short positions over long positions (Short/Long) | CFTC |
| $IRD$ | Difference between the country's policy interest rate and the US policy interest rate | BIS |
| $IRDF$ | Difference between the US policy interest rate and the country's policy interest rate | BIS |
| $VIX$ | - CBOE DJIA Volatility Index (Australia, Canada, Japan, Mexico, New Zealand, Russia, Switzerland, and the United Kingdom)<br>- CBOE Brazil ETF Volatility Index (Brazil)<br>- CBOE EuroCurrency ETF Volatility Index (Euro area) | FRED |
| $SM$ | - S&P/ASX 200, ^AXJO (Australia)<br>- IBOVESPA, ^BVSP (Brazil)<br>- S&P/TSX, ^GSPTSE (Canada)<br>- EURONEXT 100, ^N100 (Euro area)<br>- NIKKEI 225, ^N225 (Japan)<br>- S&P/BMV IPC, ^MXX (Mexico)<br>- S&P/NZX 50, ^NZ50 (New Zealand)<br>- MOEX Russia, IMOEX.ME (Russia)<br>- Swiss Market Index, ^SSMI (Switzerland)<br>- FTSE 100, ^FTSE (United Kingdom) | Yahoo Finance* |
| $SMUS$ | S&P 500, ^GSPC (United States) | Yahoo Finance* |

**:* Data is gathered using the R package quantmod (function GetSymbols), developed by Ryan and Ulrich (2020). The R package BatchGetSymbols, written by Perlin (2020), was used to confirm that the data collected was clean. Due to problems with data for Russia, data from the Moscow Exchange (MOEX) was used for cleaning.

$$\widetilde{y}_t = \sum_{i=0}^{k} \omega_{1t} DTB_{1t-1} + \rho \widetilde{y}_{t-1} \sum_{i=0}^{k} c_i \Delta \widetilde{y}_{t-1} + e_t \tag{2}$$

Table 5 summarizes the results of the unit-roots tests, with details in the supplementary material (Appendix).

Second, tests for the optimal lag length are applied to choose the maximum lag length of the VAR model ($p$). These tests generate two tests statistics (likelihood-ratio - LR and Akaike's final prediction error - FPE) and three information criteria (Akaike - AIC, Hannan and Quinn - HQIC, and Schwarz's Bayesian - SBIC). I do not rely solely on these tests to choose p because residual autocorrelation may be present. Thus, Lagrange-multiplier (LM) tests for residual autocorrelation are also computed. With $d$ and $p$, the final robustness check is the stability test, i.e. eigenvalue stability condition (see the Appendix for further details).

Table 5. Stationary variables, I(0)

| **Country** | **ME** | **MT** | **MTT** | **MTF** |
|---|---|---|---|---|
| Australia | $CT$, $VIX$ | | $VIX$, $SM$ | $ER$, $VIX$ |
| Brazil | $VIX$, $SMUS$ | * | | |
| Canada | $CT$, $VIX$ | * | | |
| Euro area | $IRD$, $VIX$ | $CTF$, $VIX$, SM | | |
| Japan | $VIX$ | $ER$, $SM$ | | |
| Mexico | $ER$, $IRD$, $VIX$ | $ER$, $IRD$ | | |
| New Zealand | $VIX$ | | $ER$, $VIX$ | * |
| Russia | $VIX$, $SM$ | * | | |
| Switzerland | $CTF$, $ER$, $VIX$ | $ER$, $SM$ | | |
| United Kingdom | $CT$, $IRD$, $VIX$ | $SM$ | | |

**:* All variables are I(1).

## 3.2 Empirical results

Table 6 shows the results for the target currencies during the ME period. On the one hand, all variables are jointly Granger causing carry trade ($CT$) in Australia, Brazil, the Euro area, Mexico, and the United Kingdom. Individually, the exchange rate ($ER$) is a good predictor for the carry trade in almost all countries (except for Canada, Mexico, and Russia). Additionally, other variables preceding carry trade are interest rate differentials ($IRD$) for the Euro area, market sentiment ($VIX$) for Australia, and the local stock market index ($SM$) for Brazil.

Table 6. Granger causality tests for target currencies, ME period

| | Variable Granger causes $CT$ | | | | | | $CT$ Granger causes variable | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $ER\rightarrow CT$ | $IRD\rightarrow CT$ | $VIX\rightarrow CT$ | $SM\rightarrow CT$ | $SMUS\rightarrow CT$ | All$\rightarrow CT$ | $CT\rightarrow ER$ | $CT\rightarrow IRD$ | $CT\rightarrow VIX$ | $CT\rightarrow SM$ | $CT\rightarrow SMUS$ |
| Australia | 0.0690* | 0.3713 | 0.0440** | 0.9281 | 0.7600 | 0.0237** | 0.0107** | 0.0177** | 0.0579* | 0.0032*** | 0.3430 |
| Brazil | 0.0138** | 0.8548 | 0.3617 | 0.0072*** | 0.8281 | 0.0136** | 0.7520 | 0.3516 | 0.0003*** | 0.8471 | 0.3479 |
| Canada | 0.3964 | 0.9922 | 0.7171 | 0.7768 | 0.7653 | 0.6446 | 0.6495 | 0.1778 | 0.0668* | 0.4429 | 0.9260 |
| Euro area | 0.0018*** | 0.0648* | 0.9997 | 0.7238 | 0.5735 | 0.0193** | 0.4133 | 0.4627 | 0.9528 | 0.8781 | 0.9076 |
| Mexico | 0.4464 | 0.1380 | 0.0284 | 0.9543 | 0.7690 | 0.0841* | 0.8426 | 0.8025 | 0.6783 | 0.7541 | 0.0986* |
| New Zealand | 0.0075*** | 0.8657 | 0.4763 | 0.6224 | 0.6691 | 0.1286 | 0.2216 | 0.9520 | 0.0002*** | 0.8175 | 0.5921 |
| Russia | 0.8960 | 0.9999 | 0.2621 | 0.8321 | 0.8158 | 0.9648 | 0.6354 | 0.9972 | 0.0131*** | 0.5677 | 0.8950 |
| United Kingdom | 0.0001*** | 0.4233 | 0.7454 | 0.1410 | 0.5969 | 0.0008*** | 0.3816 | 0.3306 | 0.0000*** | 0.3244 | 0.8850 |

*Notes:* '***', '**', and '*' denote significance at 1%, 5%, and 10% respectively.

On the other hand, there are statistically significant results showing that carry trade also Granger causes the other variables. Mainly, $CT$ is anticipating movements in market sentiment for almost all countries (excluding the Euro area and Mexico), highlighting the important link with market instability. As other variables are concerned, $CT$ precedes $ER$, $IRD$, and $SM$ for Australia. The results for the Australian Dollar show that carry trade impacts go further from the financial market, impacting the real economy. For Mexico, $CT$ predicts movements in the US stock market, showing evidence of their financial market linkages.

As for funding currencies during the ME period, Table 7 illustrates the results. All variables jointly Granger cause carry trade ($CTF$) for Japan, showing significant individual results for

$ER$ and $VIX$. For Switzerland, $ER$ is Granger causing $CTF$. Moreover, there is evidence for bi-directional Granger causality between ERF and $CTF$ for Japan. As for the Swiss case, $CTF$ is preceding movements in the interest rate differential ($IRDF$). Last but not least, $CTF$ is a good predictor of local stock prices for both Japan and Switzerland. As highlighted by Nishigaki (2007), speculative investors use funding currencies as leverage to buy other assets. With the upsurge (reduction) in short positions in the futures market, an appreciation (depreciation) in the funding currencies expected. Therefore, a higher (lower) value of the local currency in comparison to the US dollar may increase (decrease) investors' interest in local stock markets.

Table 7. Granger causality tests for funding currencies, ME period

| | Variable Granger causes $CTF$ | | | | | | $CTF$ Granger causes variable | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $ER\to CTF$ | $IRDF\to CTF$ | $VIX\to CTF$ | $SM\to CTF$ | $SMUS\to CTF$ | All$\to CTF$ | $CTF\to ER$ | $CTF\to IRDF$ | $CTF\to VIX$ | $CTF\to SM$ | $CTF\to SMUS$ |
| Japan | 0.0001*** | 0.9882 | 0.0538* | 0.7254 | 0.8043 | 0.0031*** | 0.0219** | 0.7318 | 0.8856 | 0.0009*** | 0.5406 |
| Switzerland | 0.0315** | 0.2420 | 0.7194 | 0.1945 | 0.3151 | 0.1662 | 0.2932 | 0.0559* | 0.0022*** | 0.0002*** | 0.4742 |

*Notes:* '***', '**', and '*' denote significance at 1%, 5%, and 10% respectively.

Results for target currencies during the monetary tightening period are in Table 8. Jointly, all variables Granger cause $CT$ for Australia and Russia. For Australia, Brazil, and Mexico, $ER$ and $IRD$ are preceding changes in $CT$. Also, $VIX$ and $SM$ Granger cause $CT$ for Russia and Australia, respectively. Linkages to the impact of the carry trade in the real economy are supported by the Granger causality of $CT$ to $VIX$ and $SM$, as shown by the results of Australia, Mexico, and New Zealand. Additionally, $CT$ precedes changes in $IRD$ for Australia and Brazil.

Table 8. Granger causality tests for target currencies, MT period

| | Variable Granger causes $CT$ | | | | | | $CT$ Granger causes variable | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $ER\to CT$ | $IRD\to CT$ | $VIX\to CT$ | $SM\to CT$ | $SMUS\to CT$ | All$\to CT$ | $CT\to ER$ | $CT\to IRD$ | $CT\to VIX$ | $CT\to SM$ | $CT\to SMUS$ |
| Australia* | 0.0036*** | 0.0783* | 0.5150 | 0.5115 | 0.0144** | 0.0133** | 0.1550 | 0.0080*** | 0.0016*** | 0.0850* | 0.2292 |
| Brazil | 0.0938* | 0.0429** | 0.7410 | 0.4735 | 0.6990 | 0.2299 | 0.4449 | 0.0340** | 0.7168 | 0.1873 | 0.6518 |
| Mexico | 0.0075*** | 0.0142** | 0.4638 | 0.8785 | 0.6085 | 0.1219 | 0.5304 | 0.3040 | 0.0023*** | 0.0545* | 0.3163 |
| New Zealand* | 0.4363 | 0.7138 | 0.1302 | 0.6977 | 0.1170 | 0.1943 | 0.2292 | 0.4252 | 0.0001*** | 0.0351** | 0.5152 |
| Russia | 0.5043 | 0.2712 | 0.0001*** | 0.4899 | 0.2214 | 0.0002*** | 0.4339 | 0.6712 | 0.6069 | 0.2167 | 0.8777 |

*Notes:* For Australia and New Zealand, MTT period. '***', '**', and '*' denote significance at 1%, 5%, and 10% respectively.

For funding currencies, Table 9 shows the results for the MT period. Except for Canada and the Euro area, all variables jointly predict $CTF$. $ER$ precedes $CT$ for all countries (except for Canada). As Gubler (2014) pointed out for the Swiss Franc as a funding currency, nominal exchange rate fluctuations are a good predictor of carry trade with the US Dollar as a target currency. For Switzerland, both $IRDF$ and $SMUS$ Granger cause $CTF$. With the $IRDF$ peaking at this period for the Swiss economy, carry trade provides excellent opportunities to borrow in Swiss francs and invest with leverage in the US stock market. As pointed out by Vallet (2016), Switzerland has an advantage of "interest rates bonus". For the Euro area, $IRDF$ is Granger causing $CTF$. As for the local stock markets, their movement precedes the carry trade activity. As shown by Nishigaki (2007), with the possibility to use leverage with carry trade, international speculative investors can borrow (in the funding currency) and invest locally (domestic stock market).

Table 9. Granger causality tests for funding currencies, MT period

| | Variable Granger causes $CTF$ | | | | | | $CTF$ Granger causes variable | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $ER \to CTF$ | $IRDF \to CTF$ | $VIX \to CTF$ | $SM \to CTF$ | $SMUS \to CTF$ | All$\to CTF$ | $CTF \to ER$ | $CTF \to IRDF$ | $CTF \to VIX$ | $CTF \to SM$ | $CTF \to SMUS$ |
| Australia* | 0.0323** | 0.1012 | 0.8550 | 0.0715* | 0.1909 | 0.0656* | 0.1040 | 0.3168 | 0.7488 | 0.9954 | 0.4580 |
| Canada | 0.6226 | 0.6228 | 0.4557 | 0.7414 | 0.1372 | 0.3900 | 0.0185** | 0.4607 | 0.0000*** | 0.0747** | 0.0289** |
| Euro area | 0.0759* | 0.0279** | 0.7845 | 0.3672 | 0.6791 | 0.1033 | 0.0994* | 0.4433 | 0.0342** | 0.7538 | 0.9454 |
| Japan | 0.0412** | 0.5194 | 0.3446 | 0.0001*** | 0.1677 | 0.0000*** | 0.8205 | 0.3287 | 0.6732 | 0.0451** | 0.1237 |
| New Zealand* | 0.0134** | 0.1053 | 0.8448 | 0.2399 | 0.7215 | 0.0718* | 0.2880 | 0.2086 | 0.0242** | 0.7772 | 0.7968 |
| Switzerland | 0.0295** | 0.0913* | 0.1613 | 0.3978 | 0.0066*** | 0.0052*** | 0.6266 | 0.1635 | 0.3141 | 0.0136** | 0.1481 |
| United Kingdom | 0.0008*** | 0.9577 | 0.3457 | 0.5971 | 0.8893 | 0.0411** | 0.0972* | 0.5902 | 0.9149 | 0.2962 | 0.0423** |

*Notes:* For Australia and New Zealand, MTF period. '***', '**', and '*' denote significance at 1%, 5%, and 10% respectively.

Additionally, as Table 9 shows, $CTF$ predicts $ER$ for Canada, the Euro area, and the United Kingdom. As far the market sentiment is concerned, $CTF$ Granger causes it for Canada, the Euro area and New Zealand. In terms of stock markets, there is significant evidence of Granger causality from carry trade to (1) $SM$ for Canada, Japan, and Switzerland; (2) $SMUS$ for Canada and the United Kingdom.

Although using different datasets and methodologies, my results are similar to Klitgaard and Weir (2004), Mogford and Pain (2006), Nishigaki (2007), Gubler (2014), and Mulligan and Steenkamp (2018).

# 4 Conclusion

This paper fills a gap in the carry trade literature with the use of CFTC data to empirically explore target and funding currencies during the periods of monetary easing and tightening in the US. The empirical approach with the Granger causality tests with the Toda and Yamamoto (1995) technique is also a novelty in this literature. Instead of focusing on the short-term, these new empirical results take into consideration long-term effects to better understand the dynamics of the carry trade in the selected countries.

By focusing on the US futures market, which is one of the largest in the world, my results show evidence of different behaviour of carry traders along with different currencies and US monetary policies. During the monetary easing period, the group of target currencies is much bigger than in the monetary tightening period.

Overall, for both target and funding currencies and both periods, the exchange rate is a good predictor of carry trade. Similarly, when the related financial variables (interest rate differentials, market sentiment, and local and US stock indexes) are jointly considered, there is evidence that they precede movements in the carry trade activity. The Granger causality from carry trade to market sentiment points out to another similarity, which highlights the linkage between speculative investments and market instability.

For target currencies, the bi-directional Granger causality of interest rates differentials and carry trade make clear the importance of the latter for monetary policy. Central banks from Brazil and Mexico deliberately use the interest rate policy to administrate the exchange rate, impacting speculative foreign capital movements (including, carry trade).

Finally, during the monetary tightening period, both $CT$ and $CTF$ Granger cause stock market indexes. For target currencies, there is reasonable evidence that carry trade is preceding the movements of the stock markets of Australia, Mexico, and New Zealand. As far funding currencies are concerned, carry trade predicts fluctuations in the stock market indexes of Canada, Japan, and Switzerland. One of the main difference from target to funding currencies in this period is that the carry trade Granger causes the US stock market, as shown by the results of Canada and the United Kingdom. Additionally, carry trade is Granger causing market sentiment in this period, which indicates a possible linkage of these speculative operations to systemic risk.

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