Crowds, Crashes, and the Carry Trade

Working Paper

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Introduction

- Motivation
  - Currency carry trade (CT) is known to experience sudden and extreme losses or crashes
    - ★ Limited understanding of drivers (no consensus)
    - ★ Not driven primarily by fundamentals (Chernov et al, 2018)
    - ★ Non-linear relationship (negatively skewed) between CT activity and their returns (Brunnermeier et al, 2009)

- Objective
  - Link whether and how crowdedness increases the likelihood and intensity of a carry trade crash

Basic Mechanism

- Carry trade returns are a consequence of the carry trade activity
  - Large negative exchange rate shock trigger a mass liquidation of CT positions due to constraints
  - Simultaneous unwinding results in a large order flow that further depreciates the investment currency
- Assumptions
  - Leverage
  - Institutional constrains (only bind in event of loss)
- Impact intuitive but not obvious
  - Macro models: shifts would be due to fundamentals
  - Heterogeneous participants

Hypothesis

Hypothesis 1

The likelihood of an extreme negative carry trade return realization (crash) is higher during times of elevated carry trade crowdedness

Hypothesis 2

Elevated carry trade crowdedness amplifies any positive effects of the other factors on the likelihood of a carry trade crash

Definition - Payoff

- Payoff to currency trading strategies (perspective of US investor):

$$z_{t+1}^{j} \equiv (1 + i_t^j) \frac{S_t^j}{S_{t+1}^j} - (1 + i_t^{\$}) \quad (1)$$

S_t^j is spot exchange rate of currency j at time t
$i_t^{\$}$ is one-period dollar interest rate
i_t^j is one-period foreign currency j's interest rate

- If covered interest rate parity (CIP) holds

$$z_{t+1}^{j} = \left[\frac{F_t^j}{S_{t+1}^j} - 1 \right] (1 + i_t^{\$}) \quad (2)$$

F_t^j is the forward exchange rate

Definition - CT Payoff

- Payoff of a single foreign currency carry trade:

$$Z_{t+1}^{j} = w_t^j z_{t+1}^{j} \tag{3}$$

where:

$$w_t^j = \begin{cases} +1, & \text{if } i_t^j \geqslant \mathrm{i}_t^{\$} \\ -1, & \text{otherwise} \end{cases}$$

Data

- Data: Spot + 1-month forward exchange rates (close, ask, bid, high low), TED spread, CBOE VIX index, AUD turnover, AUM, eurocurrency interest rate, Fama-French factors
- Period: Jan 1976 - Apr 2016
- G10 currencies: AUD, GBP, CAD, EUR, DEM, JPY, NZD, NOK, SEK, CHF, USD
- Source: Datastream, Bloomberg, FRED, Kenneth's Frech, Reserve Bank of Australia, Barclay Hedge

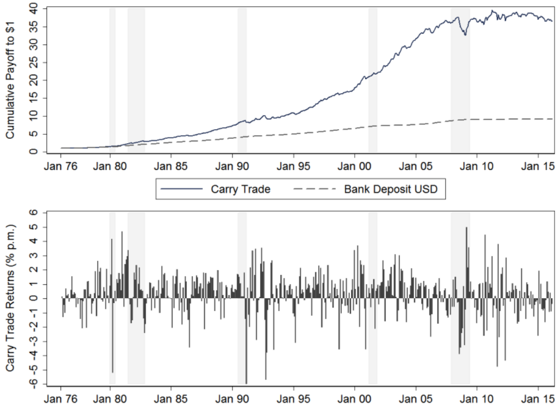
Definitions

- CT Portfolio:

$$R_{Carry,t+1} = \frac{1}{N_t} \sum_{j=1}^{N_t} Z_{t+1}^{j} \tag{4}$$

Equal-weighted (rebalanced monthly) carry trade portfolio of N_t currencies

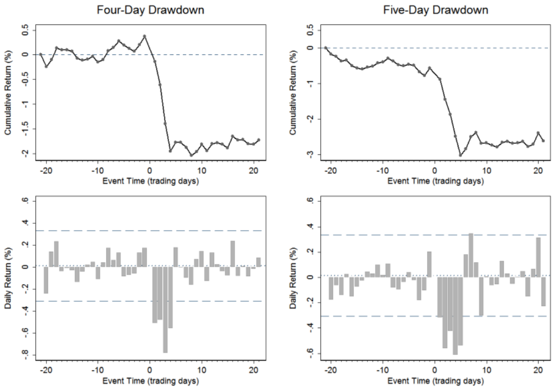
Carry Trade Performance



Definitions

- Carry trade crashes: drawdown belonging to the top (most negative) 100 drawdowns in the sample

Carry Trade Crashes



Definitions - Carry Trade Crowdedness

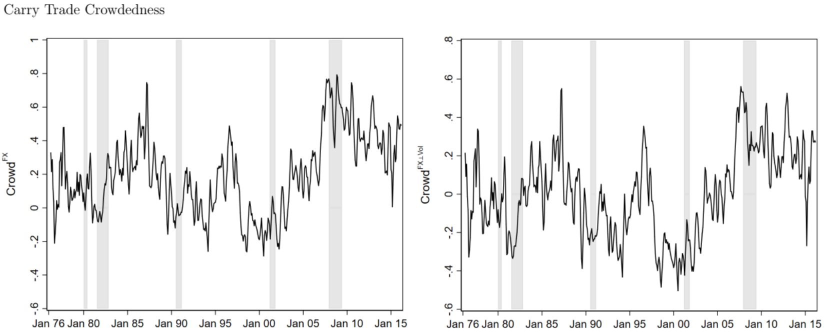
- Currency co-momentum (4 most likely target currencies)
  - Purge effects of the global FX and U.S. shocks (dollar factor - average currency excess return of all other currencies against the USD) - country specific effect

$$\left(\frac{S^j_{\tau+1} - S^j_{\tau}}{S^j_{\tau}}\right) = \alpha + \beta_{DOL} DOL_{\tau+1} + e^j_{\tau+1} \tag{5}$$

  - Use the regression residuals to calculate correlation coefficients btw the currencies:

$$Crowd^{FX}_t = \frac{corr^{I_1 I_2}_t + corr^{F_1 F_2}_t - corr^{I_1 F_1}_t - corr^{F_2 I_1}_t - corr^{I_2 F_1}_t - corr^{F_2 I_2}_t}{6} \tag{6}$$

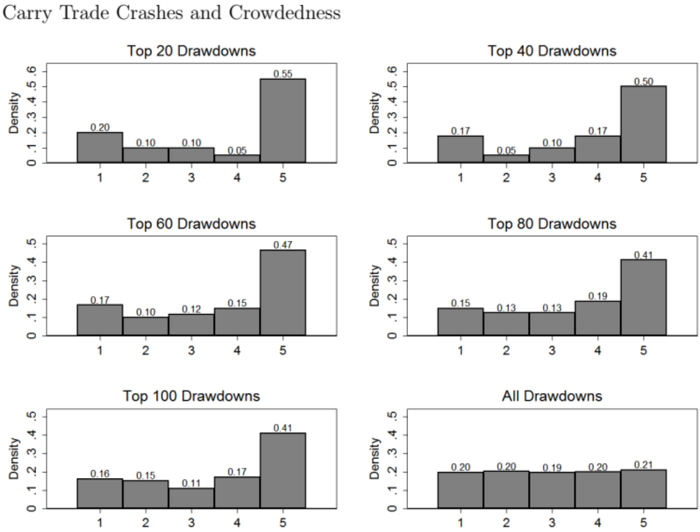
Carry Trade Crowdedness



Other Definitions

- FX volatility (Bakshi and Panayotov, 2013): square root of the sum of squares of daily log changes in the spot exchange rate against the USD over a month
- FX illiquidity (Karnaukh et al., 2015): average between a relative bid-ask spread and a bid-ask estimator (Corwin and Schultz, 2012)
- TED spread (funding illiquidity) - difference btw the 3-month U.S. LIBOR and U.S. T-Bill interest rates
- CBOE VIX Index (stock market volatility)

Result - Carry trade crashes and Crowdedness



Carry trade crashes, crowdedness and alternative factors

- Elevated level of crowdedness increases the probability of a crash?

$$\mathbb{P}(Crash_t = 1) = b_0 + b_1 I_{t-1,Crowd,Q(5)} + b_2 I_{t-1,X^k,Q(5)} \tag{7}$$

- $Crash_t$: binary variable. Equals 1 on the day of the start of the carry trade crash

- $I_{t-1,Crowd,Q(5)}$: binary variable. Equals 1 on the days when the carry trade crowdedness is above the 80th percentile of its sample distribution

Carry trade crashes, crowdedness and alternative factors

Crash Probability: Crowdedness, FX Volatility, and FX Illiquidity

	(1) $\mathbb{P}$ (Crash=1)	(2) $\mathbb{P}$ (Crash=1)	(3) $\mathbb{P}$ (Crash=1)	(4) $\mathbb{P}$ (Crash=1)	(5) $\mathbb{P}$ (Crash=1)
Panel A: FX Volatility					
Constant	0.95***	0.70***	0.58***	0.44***	0.57***
	(0.09)	(0.09)	(0.08)	(0.09)	(0.09)
$\mathbf{I}_{\text{Crowd},Q(5)}$		1.26***		0.90***	0.12
		(0.32)		(0.29)	(0.25)
$\mathbf{I}_{\text{FX-Vol},Q(5)}$			1.85***	1.66***	0.88***
			(0.35)	(0.33)	(0.34)
$\mathbf{I}_{\text{Crowd},Q(5)} \cdot \mathbf{I}_{\text{FX-Vol},Q(5)}$					2.52***
					(0.82)
Observations	10,479	10,479	10,479	10,479	10,479
R-squared	0.000	0.002	0.007	0.008	0.010
Panel B: FX Illiquidity					
Constant	1.22***	0.83***	0.74***	0.56***	0.70***
	(0.14)	(0.13)	(0.12)	(0.13)	(0.13)
$\mathbf{I}_{\text{Crowd},Q(5)}$		1.57***		1.00***	0.23
		(0.40)		(0.37)	(0.33)
$\mathbf{I}_{\text{FX-Illiq},Q(5)}$			2.38***	2.06***	0.99*
			(0.49)	(0.47)	(0.52)
$\mathbf{I}_{\text{Crowd},Q(5)} \cdot \mathbf{I}_{\text{FX-Illiq},Q(5)}$					2.62***
					(1.01)
Observations	6,568	6,568	6,568	6,568	6,568
R-squared	0.000	0.003	0.008	0.009	0.011

*** p<0.01, ** p<0.05, * p<0.1

Carry trade crashes, crowdedness and alternative factors

Crash Probability: Crowdedness, VIX, and TED Spread

	(1) $\mathbb{P}$(Crash=1)	(2) $\mathbb{P}$(Crash=1)	(3) $\mathbb{P}$(Crash=1)	(4) $\mathbb{P}$(Crash=1)	(5) $\mathbb{P}$(Crash=1)
Panel A: VIX					
Constant	1.21***	0.85***	0.91***	0.62***	0.81***
	(0.13)	(0.13)	(0.13)	(0.14)	(0.14)
$\mathbf{I}_{\text{Crowd},Q(5)}$		1.50***		1.37***	0.47
		(0.40)		(0.39)	(0.37)
$\mathbf{I}_{\text{VIX},Q(5)}$			1.59***	1.37***	0.26
			(0.45)	(0.43)	(0.38)
$\mathbf{I}_{\text{Crowd},Q(5)} \cdot \mathbf{I}_{\text{VIX},Q(5)}$					3.46***
					(1.12)
Observations	6,612	6,612	6,612	6,612	6,612
R-squared	0.000	0.002	0.003	0.005	0.009
Panel B: TED spread					
Constant	1.09***	0.78***	0.91***	0.62***	0.73***
	(0.12)	(0.12)	(0.12)	(0.13)	(0.12)
$\mathbf{I}_{\text{Crowd},Q(5)}$		1.31***		1.30***	0.81**
		(0.36)		(0.35)	(0.36)
$\mathbf{I}_{\text{TED},Q(5)}$			0.73**	0.59*	− 0.03
			(0.35)	(0.34)	(0.29)
$\mathbf{I}_{\text{Crowd},Q(5)} \cdot \mathbf{I}_{\text{TED},Q(5)}$					2.06**
					(0.96)
Observations	7,427	7,427	7,427	7,427	7,427
R-squared	0.000	0.002	0.000	0.003	0.004

*** p<0.01, ** p<0.05, * p<0.1

Crash Intensity

$$Q_{R_{\text{Carry},t}}(q) = \alpha_q + \beta_q \, \mathrm{I}_{t-1,\text{Crowd},Q(5)} + b_2 \, \mathrm{I}_{t-1,\text{FX-Vol},Q(5)} + b_3 \, \mathrm{I}_{t-1,\text{Crowd},Q(5)} \cdot \mathrm{I}_{t-1,\text{FX-Vol},Q(5)}$$

Daily Carry Trade Returns Quantile Regression: FX Volatility and FX Illiquidity

	Q(0.05)	Q(0.10)	Q(0.2)	Q(0.3)	Q(0.4)	Q(0.5)	OLS
Panel A: FX Volatility							
$\mathbf{I}_{\text{Crowd},Q(5)}$	− 0.069***	− 0.036**	− 0.012	− 0.007	− 0.005	− 0.004	− 0.001
	(0.024)	(0.015)	(0.010)	(0.007)	(0.007)	(0.005)	(0.009)
$\mathbf{I}_{\text{FX-Vol},Q(5)}$	− 0.366***	− 0.267***	− 0.111***	− 0.057***	− 0.022***	0.003	− 0.016
	(0.024)	(0.015)	(0.010)	(0.007)	(0.007)	(0.005)	(0.010)
Constant	− 0.408***	− 0.275***	− 0.153***	− 0.077***	− 0.022***	0.021***	0.017***
	(0.012)	(0.007)	(0.005)	(0.003)	(0.003)	(0.002)	(0.003)
$\mathbf{I}_{\text{Crowd},Q(5)}$	0.021	− 0.007	− 0.008	− 0.007	− 0.008	− 0.009	− 0.006
	(0.032)	(0.019)	(0.012)	(0.009)	(0.008)	(0.006)	(0.008)
$\mathbf{I}_{\text{FX-Vol},Q(5)}$	− 0.234***	− 0.209***	− 0.099***	− 0.057***	− 0.026***	− 0.003	− 0.021*
	(0.031)	(0.019)	(0.012)	(0.009)	(0.008)	(0.006)	(0.011)
$\mathbf{I}_{\text{Crowd},Q(5)} \cdot \mathbf{I}_{\text{FX-Vol},Q(5)}$	− 0.335***	− 0.214***	− 0.024	− 0.000	0.011	0.015	0.016
	(0.057)	(0.035)	(0.021)	(0.016)	(0.015)	(0.011)	(0.024)
Constant	− 0.423***	− 0.280***	− 0.154***	− 0.077***	− 0.021***	0.022***	0.018***
	(0.012)	(0.008)	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)
Panel B: FX Illiquidity							
$\mathbf{I}_{\text{Crowd},Q(5)}$	0.006	0.013	0.016	0.003	− 0.005	− 0.010	0.002
	(0.038)	(0.028)	(0.015)	(0.012)	(0.012)	(0.011)	(0.012)
$\mathbf{I}_{\text{FX-Illiq},Q(5)}$	− 0.091**	− 0.083**	− 0.059***	− 0.043***	− 0.024*	0.002	− 0.020
	(0.045)	(0.033)	(0.018)	(0.014)	(0.014)	(0.013)	(0.015)
$\mathbf{I}_{\text{Crowd},Q(5)} \cdot \mathbf{I}_{\text{FX-Illiq},Q(5)}$	− 0.447***	− 0.330***	− 0.083***	− 0.032	− 0.007	0.002	− 0.000
	(0.071)	(0.052)	(0.028)	(0.022)	(0.021)	(0.020)	(0.029)
Constant	− 0.507***	− 0.345***	− 0.195***	− 0.102***	− 0.036***	0.022***	0.014***
	(0.017)	(0.012)	(0.007)	(0.005)	(0.005)	(0.005)	(0.005)

*** p<0.01, ** p<0.05, * p<0.1

Crash Intensity

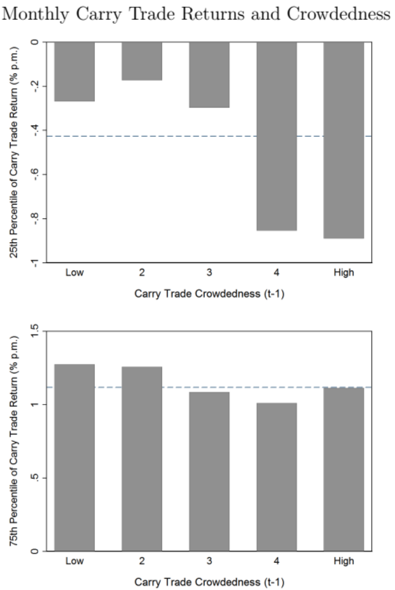
$$Q_{R_{\text{Carry},t}}(q) = \alpha_q + \beta_q \, \mathrm{I}_{t-1,\text{Crowd},Q(5)} + b_2 \, \mathrm{I}_{t-1,\text{TED},Q(5)} + b_3 \, \mathrm{I}_{t-1,\text{Crowd},Q(5)} \cdot \mathrm{I}_{t-1,\text{TED},Q(5)}$$

Daily Carry Trade Returns Quantile Regression: TED Spread

	Q(0.05)	Q(0.10)	Q(0.2)	Q(0.3)	Q(0.4)	Q(0.5)	OLS
$\mathbf{I}_{\text{Crowd},Q(5)}$	− 0.191***	− 0.080***	− 0.037***	− 0.018*	− 0.011	− 0.005	− 0.002
	(0.030)	(0.021)	(0.011)	(0.009)	(0.007)	(0.007)	(0.011)
$\mathbf{I}_{\text{TED},Q(5)}$	− 0.028	− 0.009	0.019	0.024**	0.020**	0.005	− 0.005
	(0.032)	(0.022)	(0.012)	(0.010)	(0.008)	(0.008)	(0.011)
Constant	− 0.489***	− 0.324***	− 0.183***	− 0.096***	− 0.035***	0.022***	0.015***
	(0.017)	(0.011)	(0.006)	(0.005)	(0.004)	(0.004)	(0.005)
$\mathbf{I}_{\text{Crowd},Q(5)}$	− 0.054	− 0.007	− 0.007	− 0.006	− 0.008	− 0.010	− 0.005
	(0.035)	(0.023)	(0.014)	(0.010)	(0.009)	(0.008)	(0.011)
$\mathbf{I}_{\text{TED},Q(5)}$	0.096**	0.071***	0.049***	0.035***	0.022**	− 0.000	− 0.008
	(0.039)	(0.026)	(0.016)	(0.012)	(0.010)	(0.009)	(0.009)
$\mathbf{I}_{\text{Crowd},Q(5)} \cdot \mathbf{I}_{\text{TED},Q(5)}$	− 0.487***	− 0.364***	− 0.125***	− 0.078***	− 0.013	0.016	0.012
	(0.070)	(0.047)	(0.029)	(0.021)	(0.018)	(0.016)	(0.030)
Constant	− 0.504***	− 0.340***	− 0.188***	− 0.098***	− 0.036***	0.023***	0.015***
	(0.016)	(0.011)	(0.007)	(0.005)	(0.004)	(0.004)	(0.004)
Observations	7426	7426	7426	7426	7426	7426	7426

*** p<0.01, ** p<0.05, * p<0.1

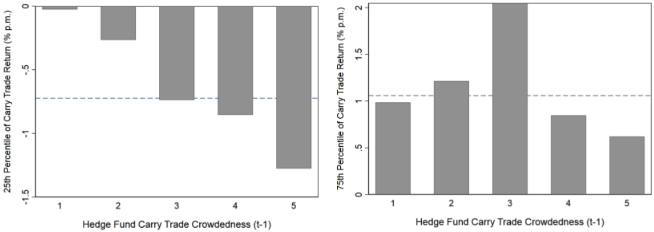
Monthly carry trade returns and crowdedness



Robustness

- Is the carry trade measurement right?
  - Alternative measurement for CT crowdedness: historic hedge fund exposure to the currency CT

Monthly Carry Trade Returns and Hedge Fund Based Crowdedness



Conclusion

- 40% to 50% of the most extreme carry trade drawdowns occur following periods that are identified (in-sample) as having the highest levels of carry trade crowdedness
- High levels of crowdedness double the probability of realizing an extreme carry trade loss after controlling for other factors
- The level of crowdedness amplifies negative carry trade returns and has no effect on the positive ones

Thank you!

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