Carry Trade in Commodity Futures Markets

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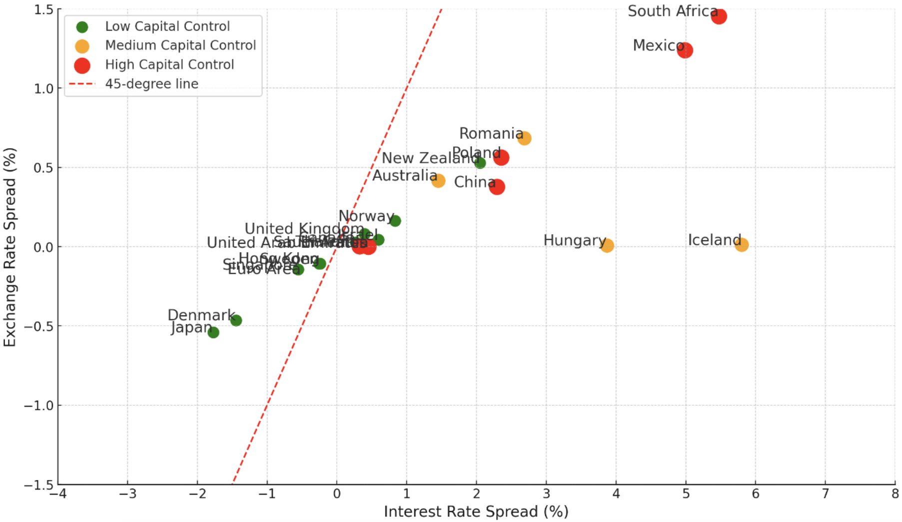
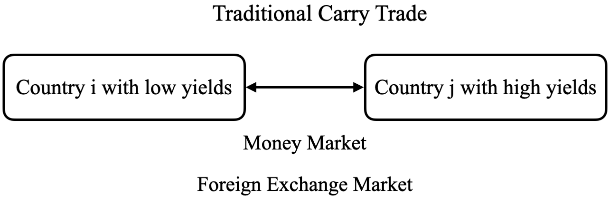
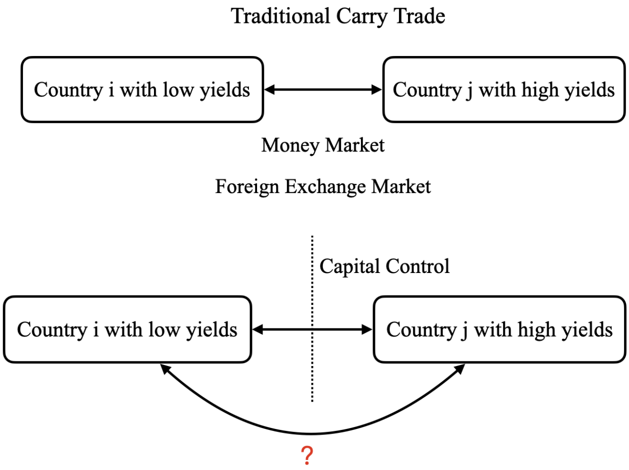
Carry Trade and UIP Deviation




Traditional Carry Trade
Country i with low yields
Country j with high yields
Money Market
Foreign Exchange Market


Traditional Carry Trade
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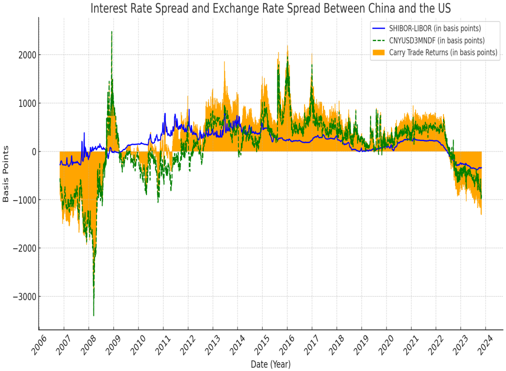
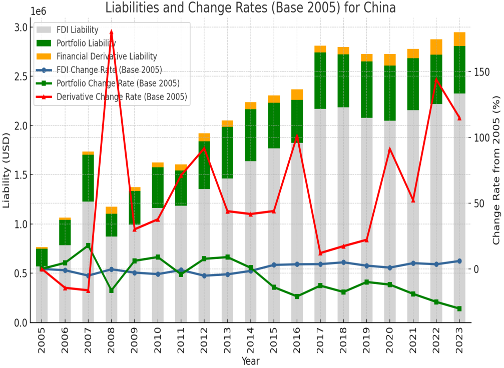
Capital Control
Country i with low yields
Country j with high yields
?

China as an Example: Financial Derivative Account?





Evidence of Commodity Financing

8 Mar, 2022

LME halts nickel trading; Tsingshan faces $8B trading loss amid nickel surge

TOP NEWS IN METALS & MINING

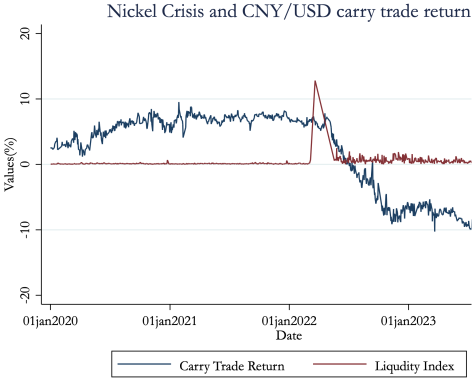
* The London Metals Exchange suspended nickel trading after three-month spot nickel prices more than doubled overnight to a record high of $101,365 per tonne in early trading March 8, S&P Global Commodity Insights reported.

* China's Tsingshan Holding Group Co. Ltd. is facing mounting trading losses, which stood at $8 billion as of March 7, sources familiar with the company told *The Wall Street Journal*, amid a surge in nickel prices triggered by the Russia-Ukraine conflict.

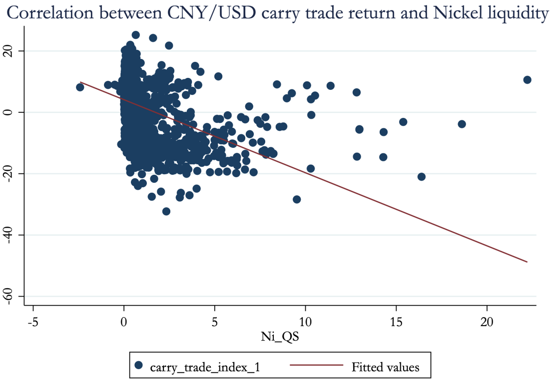
Figure: S&P Global News

- In 2014, industry estimates indicated that approximately $109 billionin foreign exchange (FX) loans in China were backed by commodities as collateral (Yuan, Layton, Currie, and Courvalin 2014).
- In August 2022, Chinese merchants, mostly state-owned firms, discovered that a domestic copper trader didn't hold nearly $500 million worth of ore that was supposed to be their collateral.
- In December 2022, Swiss-based commodities trader Trafigura alleged they were tricked into providing credit for $577 million of nonexistent quantities of nickel and aluminum.

Evidence of Negative Correlation

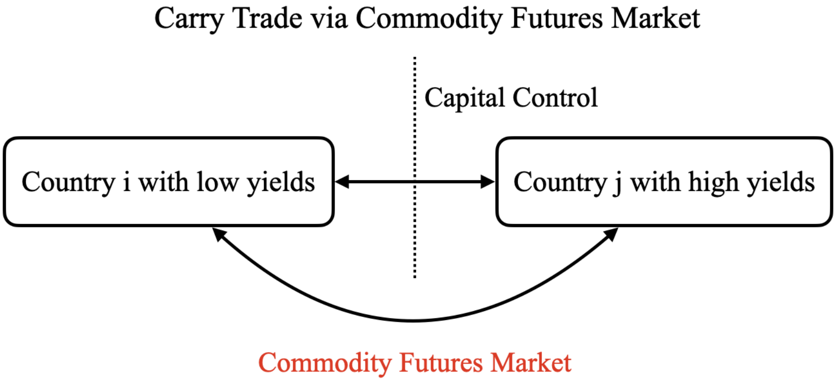


(a) Dynamic time series

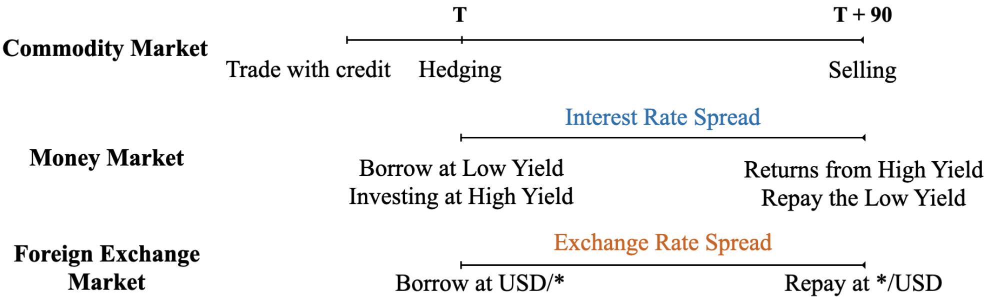


(b) Simple correlation

What do we analyze in this paper?



The Returns of Commodity Carry Trader



The Determination of Carry Trade Returns

- With *complete markets*, carry trade returns are primarily driven by the Foreign Exchange Risk Premium (FXRP) (Campbell and Clarida, 1987; Froot and Ramadorai, 2005):

$$\mathbb{E}_t rx_{t+1}^{\frac{*}{\$},FX} = \mathbb{E}_t \Delta s_{t+1} + \left(y_t^{\$} - y_t^{*}\right)$$

- This paper argues that, with *Incomplete markets*, such as capital control policies, the carry trade returns not only FXRP, but also include risk premium from commodity markets.

$$\mathbb{E}_t rx_{t+1}^{\frac{*}{\$},FX} = \mathbb{E}_t \Delta s_{t+1} + \left(y_t^{\$} - y_t^{*}\right) + \mathbb{E}_t \Delta P_{commodity,t+1}$$

Hypothesis

Hypothesis 1: Commodity Liquidity Risk has a significant effect on Carry Trade Returns (*Premium* ↑ or *Loss* ↓)

Hypothesis 2: The impact from commodity liquidity risk is further strengthened by capital controls.

Who and where is the carry trade happening?

- **Traditional Carry Trade**: Hedge funds, banks
  - Risk-free Currency (Brunnermeier et al., 2008; Clarida, Davis, and Pedersen, 2009)
  - Treasury Bond (Lustig, Stathopoulos, and Verdelhan, 2019)
- **Unconventional Carry Trade**: Non-financial firms
  - Trade credit Channel (Bruno and Shin, 2017; Hardy and Saffie, 2023)
  - Round-trip reimports Channel (Liu et al., 2022)
  - Commodity-financing Channel(Hsu and Wu, 2023; Tang and Zhu, 2016)

- **Less attention given to unconventional carry trade strategies.**
- **Only developed countries (such as G10) or single country.**

Risks of Carry Trade

- ◇ Currency risks (Lustig, Roussanov, and Verdelhan (2014)), Term risks (Lustig, Stathopoulos, and Verdelhan (2019))
- ◇ FX liquidity risks (Söderlind and Somogyi (2022))
- ◇ Jump risks (Lee and Wang (2019))
- ▶ **Risks in the commodity futures market?**

Contributions

1. **Unconventional Carry Trade** This paper expands the scope of research on unconventional carry trade by exploring the details of carry trade strategies within the commodity futures market.
2. **Capital Immobility** Unlike the traditional carry trade literature, this paper examines not only developed countries without capital control policies but also investigates developing countries with capital immobility.
3. **Risk Premium from Futures Market** In this paper, we also explore the impact of risks in the commodity futures market on carry trade returns.

Summary of Results

- Overall, the Commodity Liquidity Risk has significant negative effect on carry trade returns, which is about -0.226.
- The risk premia vary across different commodity types. Precious Metals and Raw Metals are two commodities often used.
- Liquidity risk contributes more significantly to carry trade returns with medium-level capital controls, especially in the bonk market and money market capital interventions.

Carry Trade Returns ($CTR_{i,t}$)

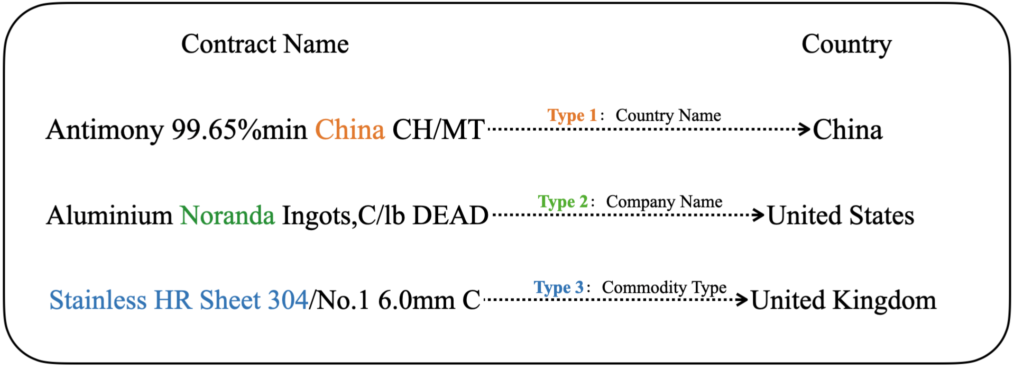
$$CTR_{i,t} = (r^f_{i,t} - r^f_{US,t}) - \frac{NDF_{i,t}}{e^{Spot}_{i,t}}$$

Where:

- $r^f_{i,t}$ is the 3-month interbank offered rate for country i.
- $r^f_{US,t}$ is the 3-month LIBOR in USD.
- $NDF_{i,t}$ is the 3-month non-deliverable forward (NDF) rate for currency i against the USD.
- $e^{Spot}_{i,t}$ is the spot exchange rate for currency i against the USD.
- The time range for the data is from January 3, 2000, to September 13, 2024. Appendix.

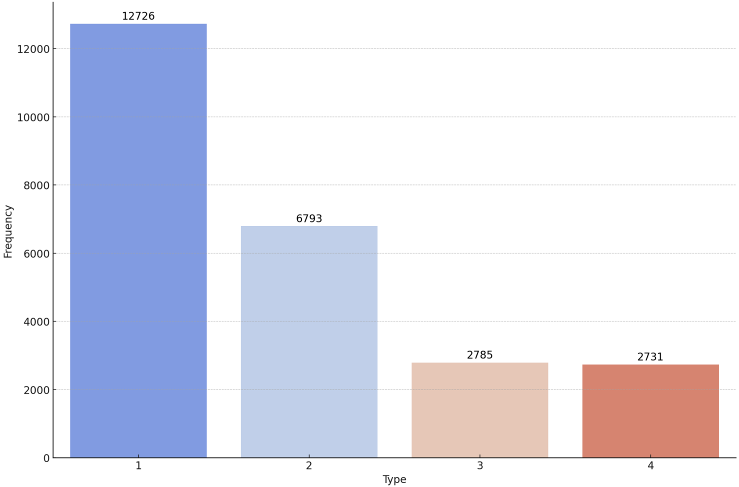
Liquidity Risk Index ($LRI_{i,t}$)

We collected 25,035 global commodity contracts details from 2001 till 2024. By applying a **Large Language Model (LLM)**, we used the name of each contract to determine the trader's locations, the principles applied for the LLM are:



Liquidity Risk Index ($LRI_{i,t}$)

The distributions of commodity contracts:



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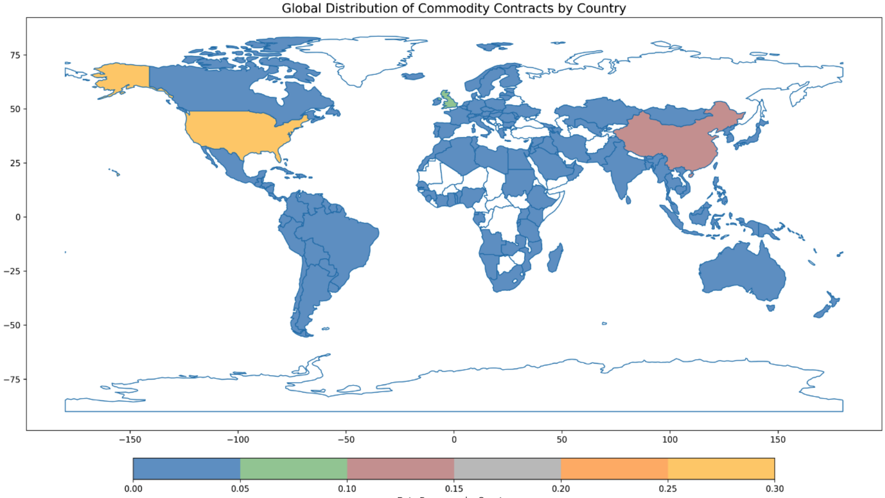

Liquidity Risk Index ($LRI_{i,t}$)

- I refer to the paper by (Marshall, Nguyen, and Visaltanachoti 2012) to introduce the *Quoted Spread* as liquidity index to measure the liquidity risk.

$$LRI^{j}_{i,t} = \frac{PA^{j}_{i,t} - PB^{j}_{i,t}}{PM^{j}_{i,t}}$$

1. $PA^{j}_{i,t}$ represents the Average Ask price for commodity futures contracts of type j, in country i, at time t.
2. $PB^{j}_{i,t}$ is the Bid price for commodity futures contracts of type j, in country i, at time t.
3. $PM^{j}_{i,t}$ is the Mid point price for a commodity futures contract of type j, in country i, at time t.

Empirical Model

Measuring the relationship between the liquidity risk index and carry trade returns:

$$CTR_{i,t} = \beta_0 + \beta_1 LRI^j_{i,t} + \beta_2 Region + \beta_3(LRI^j_{i,t} \times Region) + \alpha_i + \lambda_t + \epsilon_{i,t}$$

- The panel data consist of daily data for 24 countries from 2001 to 2024.
- $LRI^j_{i,t}$ represents different liquidity risk indices across various commodity types.
- We also substitute Region with Development Status.

Carry Trade Returns and Liquidity Risk by Weighted Average

Table: Descriptive Statistics

Variable	Explanations	Obs	Mean	Std. Dev.	Min	Max
Date	Observation date (numerical)	43812	3399.752	1591.036	1	5999
Country	Country identifier	43812	10.749	4.376	1	16
Development Status	1 for developing, 2 for developed	43812	1.586	0.493	1	2
Region	Regional classification	43812	3.672	1.327	1	5
Carry trade returns (CTR)	Returns from carry trade	43812	1.019	2.505	-20.879	41.633
Liquidity risk (LRI)	Liquidity risk indicator	43812	-0.072	0.098	-8.565	3.262
Natgas LRI	LRI for natural gas	1050	-0.071	0.009	-0.197	-0.052
Metals LRI	LRI for base metals	11876	-0.040	0.066	-0.948	0.923
Grains LRI	LRI for grains	330	-0.077	0.003	-0.077	-0.046
Crude LRI	LRI for crude oil	29906	-0.084	0.146	-8.565	3.262
Prec LRI	LRI for precious metals	14652	-0.066	0.016	-0.177	-0.003

Appendix: Placebo Test

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LRI	-0.226**	6.653	-0.262*						
	(-3.07)	(1.70)	(-2.21)						
America × LRI		-7.258							
		(-1.64)							
Asia × LRI		-6.003							
		(-1.52)							
Australia × LRI		-50.63**							
		(-3.15)							
Europe × LRI		-6.939							
		(-1.77)							
Developed × LRI			0.0499						
			(0.38)						
Prec LRI				-3.661**					
				(-3.15)					
Oilpro LRI					1.288				
					(1.04)				
Natgas LRI						0.508			
						(0.63)			
Metals LRI							10.88***		
							(32.50)		
Grains LRI								134.9	
								(0.96)	
Crude LRI									-0.0557
									(-0.71)
_cons	0.746***	0.746***	0.744***	0.808***	0.0139	0.616***	1.089***	11.07	0.924***
	(119.70)	(94.91)	(97.88)	(10.51)	(0.15)	(9.82)	(64.68)	(1.03)	(81.41)
Time F.E.	Y	Y	Y	Y	Y	Y	Y	Y	Y
Country F.E.	Y	Y	Y	Y	Y	Y	Y	Y	Y
Weighted Average	Y	Y	Y	Y	Y	Y	Y	Y	Y
R-square	0.828	0.828	0.828	0.914	0.830	0.956	0.786	0.910	0.728
Observations	43401	43401	43401	14490	21999	126	10733	164	29883
F	9.417	5.978	4.781	9.952	1.085	0.397	1056.457	0.929	0.508

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

Impact of the Bypass Mechanism

In the second empirical model, we incorporated the capital control index to measure the bypass effect resulting from capital controls:

$$CTR_{i,t} = \beta_0 + \beta_1 LRI_{i,t} + \beta_2 ka_{i,t} + \beta_3 (LRI_{i,t} \times ka_{i,t}) + \alpha_i + \lambda_t + \epsilon_{i,t}$$

- The panel data still consist of daily data for 24 countries from 2001 to 2024.
- Two types of capital control index.

Capital Control Index ($ka_{i,t}$ et al.)

This paper referred to the capital control index based on the Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER):

- Annual indicators of controls on inflows and controls on outflows for 10 categories of assets for 100 countries, 1995 - 2021 by Fernández et al. (2016). For more details, click here to see Appendix Table.

The Role of Capital Control

- Due to the limited frequency of the capital control index, two approaches can be taken to incorporate the index into the regression when investigating the bypassing incentives of carry trade:

1. Aggregating the data at year level, and relaxing the Country F.E..

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LRI	-1.281	-1.652	**71.70*** **	**82.27*** **	**90.66** **	**85.77*** **	**35.36*** **
	(-0.24)	(-0.30)	(4.29)	(4.40)	(3.84)	(4.34)	(8.51)
ka	-2.293		-3.117				
	(-1.41)		(-1.92)				
kai		-2.960					
		(-0.97)					
kao		0.219					
		(0.09)					
ka $\times$ LRI			**-86.09** **				
			(-2.98)				
bo $\times$ LRI				**-83.03* **			
				(-2.94)			
mm $\times$ LRI					**-93.97* **		
					(-2.74)		
ci $\times$ LRI						**-95.17** **	
						(-3.31)	
cc $\times$ LRI							**-90.28** **
							(-3.68)
Time F.E.	Y	Y	Y	Y	Y	Y	Y
Country F.E.	N	N	N	N	N	N	N
Weighted Average	Y	Y	Y	Y	Y	Y	Y
R-square	0.864	0.864	0.864	0.914	0.830	0.956	0.728
Observations	153	153	154	154	154	154	154

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

Limitations of Yearly Data Analysis

- Loss of granularity.
- Unobserved Country-specific Characteristics. If countries with higher LRI also tend to have unobserved factors that increase CRT (e.g., more open financial markets, better governance)

The Role of Capital Control

- Due to the limited frequency of the capital control index, two approaches can be taken to incorporate the index into the regression when investigating the bypassing incentives of carry trade:

1. Aggregating the data at year level, and relaxing the Country F.E..
2. Daily Expansion of the capital control index

Daily Capital Control

	(1) carry_trade_returns	(2) carry_trade_returns	(3) carry_trade_returns
LRI	-4.413***	-1.820***	0.00752
	(-12.79)	(-4.60)	(0.02)
ka	-3.060***		
	(-23.78)		
ka × LRI	**-1.035**		
	(-1.65)		
kai		-5.094***	
		(-18.29)	
kai × LRI		**-43.75*****	
		(-13.21)	
kao		1.807***	
		(7.01)	
kao × LRI		**39.91*****	
		(12.73)	
bo			-6.562***
			(-30.40)
bo × LRI			**40.72*****
			(18.13)
mm			-2.402***
			(-12.83)
mm × LRI			**-41.81*****
			(-18.11)
Time F.E.	Y	Y	Y
Country F.E.	Y	Y	Y
Weighted Average	Y	Y	Y
R-square	0.856	0.857	0.884
Observations	29773	29773	29773

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

The Role of Capital Control

- Due to the limited frequency of the capital control index, two approaches can be taken to incorporate the index into the regression when investigating the bypassing incentives of carry trade:

1. Aggregating the data at year level, and relaxing the Country F.E..
2. Daily Expansion of the capital control index
3. Classify the capital control level.

Classify the capital control level

- The Capital Control index ranges from 0 to 1, as noted by (Fernández et al., 2016).
- I tried to explore different methods to classify capital control levels based on existing literature and frameworks.

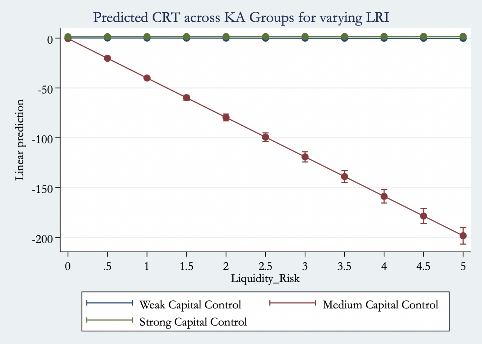
$$\text{Capital Control Category} =$$
$$\begin{cases} \text{"Weak Capital Control"} & \text{if } 0 \leq \text{ka} \leq 0.33 \\ \text{"Medium Capital Control"} & \text{if } 0.33 < \text{ka} \leq 0.66 \\ \text{"Strong Capital Control"} & \text{if } 0.66 < \text{ka} \leq 1 \end{cases}$$

Average Marginal Effects of Liquidity Risk by Capital Control Levels

	(1)
LRI	-0.0668
	(-1.16)
Medium Capital Control	-0.615***
	(-7.84)
Strong Capital Control	1.242***
	(47.79)
Medium Capital Control× LRI	**-39.52*** **
	(-46.67)
Strong Capital Control× LRI	0.140
	(1.54)
Time F.E.	Y
Country F.E.	Y
Weighted Average	Y
N	43406

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	dy/dx	Delta-method std. err.	z	P>|z|	[95% conf. interval]
Weak Capital Control	-0.0667635	0.0575346	-1.16	0.246	[-0.1795294, 0.0460023]
Medium Capital Control	**-39.58431*** **	0.8445804	-46.87	0.000	[-41.23966, -37.92896]
Strong Capital Control	0.0732273	0.0707761	1.03	0.301	[-0.0654913, 0.2119458]



Conclusions

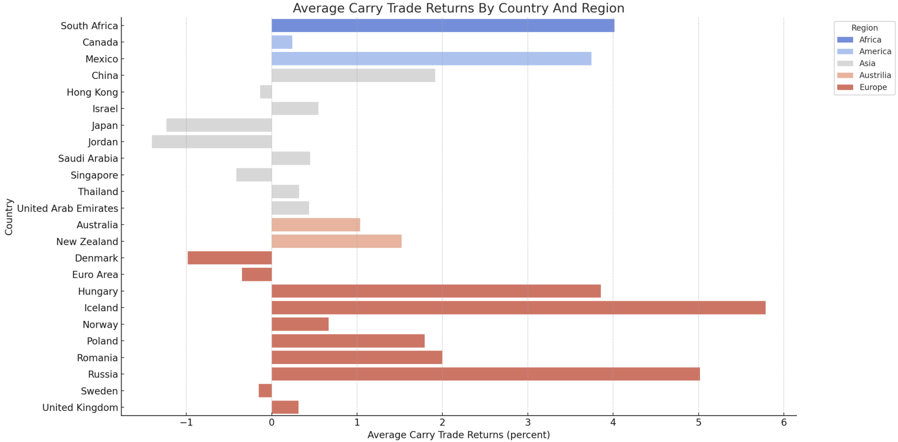
- Overall, the Commodity Liquidity Risk has significant negative effect on carry trade returns, which is about -0.226.
- The risk premia vary across different commodity types. Precious Metals and Raw Metals are two commodities often used.
- Liquidity risk contributes more significantly to carry trade returns with medium-level capital controls, especially in the bonk market and money market capital interventions.

Thank you!

Andrés Fernández, Michael W Klein, Alessandro Rebucci, Martin Schindler, and Martín Uribe. Capital Control Measures: A New Dataset. *IMF Economic Review*, 64(3): 548–574, August 2016. doi: 10.1057/imfer.2016.11. URL https://ideas.repec.org/a/pal/imfecr/v64y2016i3d10.1057_imfer.2016.11.html.

Ke Tang and Haoxiang Zhu. Commodities as Collateral. *The Review of Financial Studies*, 29(8):2110–2160, 2016. URL https://ideas.repec.org/a/oup/rfinst/v29y2016i8p2110-2160..html.

Appendix: Distribution of Carry Trade Returns ($CTR_{i,t}$)



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Carry Trade Returns and Liquidity Risk by Weighted Average

Table: Placebo Check: Regression on Non-Exchange Countries

Variable	**(1) Carry Trade Returns**	**(2) Carry Trade Returns**
LRI	-0.368*** (-3.57)	9.991** (2.93)
America × LRI		-10.53** (-2.74)
Asia × LRI		-35.74*** (-4.43)
Australia × LRI		-51.88*** (-3.50)
Europe × LRI		-10.36** (-3.04)
Constant	0.532*** (53.70)	-0.00822 (-0.05)
R-squared	0.747	0.747
Observations (N)	36511	36511
F-statistic	12.769	8.501

t-statistics in parentheses
** p<0.05, ** p<0.01, *** p<0.001*

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Appendix: Capital Control Index Definitions

Symbol	Description
$ka_{i,t}$	Overall restrictions index
$kai_{i,t}$	Overall inflow restrictions index
$kao_{i,t}$	Overall outflow restrictions index
$de_{i,t}$	Average derivatives restrictions
$dei_{i,t}$	Derivatives inflow restrictions
$deo_{i,t}$	Derivatives outflow restrictions
$de\_plbn_{i,t}$	Purchase locally by nonresidents (derivatives)
$di_{i,t}$	Average direct investment restrictions
$dii_{i,t}$	Direct investment inflow restrictions
$dio_{i,t}$	Direct investment outflow restrictions

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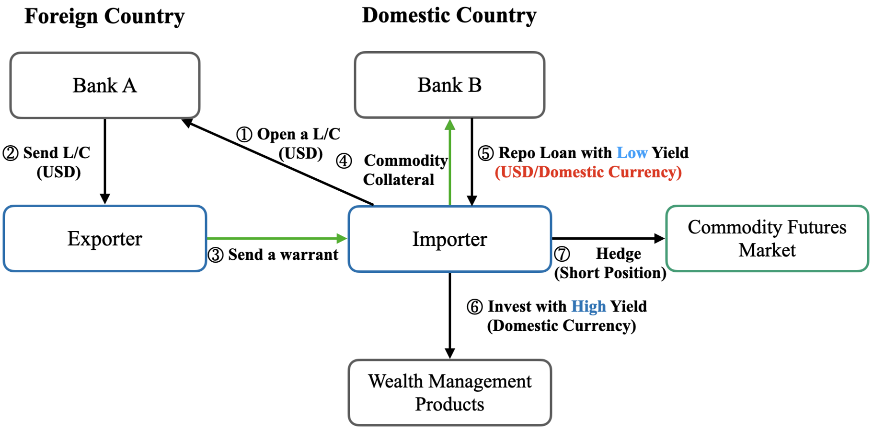
Carry Trade in Commodity Futures Markets? ((Tang and Zhu, 2016))

Starting of carry trade in commodity market:



Carry Trade in Commodity Futures Markets? ((Tang and Zhu, 2016))

By the end of maturity: