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IMPACT OF EXCHANGE RATE RISK ON THE VOLATILITY OF EMERGING MARKET BOND FUND FLOWS: DOES CURRENCY DENOMINATION MATTER?

Key Points:

- *This study examines the impact of exchange rate risk on EME bond fund flow volatility against the backdrop of considerable growth in local currency (LC) bond funds among emerging market economies (EMEs) over the past decade.*

- *We find that exchange rate volatility triggers a significantly larger increase in fund flow volatility of LC bond funds over hard currency (HC) bond funds in EMEs. This finding has two important policy implications. First, it may reflect a lack of tools for foreign investors to hedge against foreign exchange risk, thus forcing them to move their funds in and out of EMEs in times of volatile exchange rate movements. Second, more rapid growth of LC bond funds among EMEs in recent years means these economies are likely to experience more volatile capital flows than in the past.*

- *The implications point to the pressing need for EMEs to develop effective tools for foreign investors to manage their exchange rate risk and to deepen the domestic investor base to contain the impact of the exchange rate on fund flow volatility.*

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I. INTRODUCTION

Local currency (LC) bonds of emerging market economies (EMEs) have experienced substantial growth over the past decade. The increasing popularity of these bonds among foreign investors, notably in the aftermath of the global financial crisis (GFC), is remarkable. EPFR Global data show that EME bond funds investing mainly in LC EME bonds saw their total net assets skyrocket from US$6.2 billion at the end of 2006 to US$174.1 billion at the end of 2018, a compound annual growth rate of 32.1%.[1] LC bonds have the appeal of higher yields, on average 51 basis points more than bonds denominated in hard currencies (HC) during this period.[2] These yield differentials mean a lot more now to global investors searching for yields in a low interest rate environment. This partly explains why the growth in LC bond funds has been faster than the corresponding 20.0% growth rate for total EME bond funds.

At first glance, the rise in LC bonds should be good news for EME bond issuers as the problem of currency mismatch can be alleviated, particularly for issuers with the bulk of their revenue sources in domestic currencies. The rise also suggests that EMEs might finally overcome their ‘original sin’, a concept first proposed by Eichengreen and Hausmann (1999) that EMEs are unable to borrow abroad in their own currencies. However, it is important to note that denomination in local currencies *per se* does not eliminate exchange rate risk. It means foreign investors now bear more exchange rate risk than before, making them more responsive to exchange rate movement and volatility. Thus, with the increasing participation of foreign investors in LC bond markets through mutual bond funds, EME bond fund flows have become more sensitive to exchange rate risk.

Indeed, an incident in the summer of 2018 suggests the dynamics between EME fund flows and EME exchange rate volatility are closely related. Between April and October, overall EME currencies depreciated by 14.9% amid heightened geopolitical tensions, with a much sharper depreciation in some currencies, such as the Argentine peso (45.4%), the Turkish lira (27.7%), the South African rand (17.6%), the Indian rupee (11.2%) and the Indonesian rupiah (9.2%).[3] At the same time, there were significant outflows from EME bond funds, with LC

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[1] EPFR Global defines EME bond funds mainly investing in LC EME bonds as those funds with more than 75% of their portfolios allocated to LC EME bonds. It does not provide data on EME bond funds that exclusively invest in LC EME bonds.

[2] Local currency and hard currency bond yields are based on JP Morgan GBI-EM Global Diversified Traded Index and JP Morgan EMBI Plus Index, respectively.

[3] The overall depreciation of EME currencies is measured by the JP Morgan Emerging Market Currency Index.

bond funds experiencing more severe outflows than HC bond funds. This incident seems to suggest that LC bonds are more prone to exchange rate risk than HC bond funds. Another example of a currency crunch and massive fund outflows was the "taper tantrum" of 2013 triggered by a sharp depreciation of EME currencies combined with massive fund flows amid heightened concerns that the US Fed would kick start the monetary normalisation process much earlier than thought.

Against this backdrop, we aim to investigate the impact of the exchange rate risk on the flow of EME bond funds. Specifically, our focus is on fund flow *volatility*, which is relatively less covered in research literature than fund flow *level*. This investigation is important for two reasons. First, EME bond markets generally lack depth and liquidity compared with advanced economies (CGFS (2019)), hence making them more vulnerable to sudden and massive withdrawals of capital inflows. For example, volatile fund flows cause uncertainties over the availability and stability of funding sources, making it more difficult for EME governments or corporations to plan their debt issuance programmes (Neanidis (2019)). For the sake of financial market stability, a better understanding of the drivers behind fund flow volatility is paramount. Second, a crucial step for EMEs to develop their bond markets is to diversify their investor base by attracting foreign investors. If exchange rate risk is one of the key factors driving fund flow volatility, an appropriate policy response is to help foreign investors manage their exchange rate risk by developing complementary markets, such as currency futures and options markets (CGFS (2019)).

In our empirical analysis, we differentiate LC EME bond funds from funds mainly invested in HC EME bonds, which allows us to compare the impact of exchange rate risk on their volatility.[4] If the volatility spillover effect is significantly stronger for LC bond funds than for HC bond funds, it is likely that LC bond markets in EMEs are more vulnerable to exchange rate risk. As such, certain market infrastructure (e.g. foreign exchange derivatives markets) may be needed if EMEs wish to further develop their LC bond markets without taking a greater financial stability risk.

This paper is organised as follows. In the next section, we review the research literature, noting that while much has been conducted on the determinants of fund flows, there is relatively less on fund flow volatility and its relationship

[4] EPFR Global defines EME bond funds mainly investing in HC EME bonds as those funds with more than 75% of their portfolios allocated to HC EME bonds. It does not provide data about EME bond funds that exclusively invest in HC EME bonds.

with currency volatility, which is the focus of this study. Section III discusses the econometric models used in this study, namely quantile regression and bivariate VAR-GARCH with BEKK representation. The former model is able to capture the impact of the exchange rate on bond fund flows during market distress whereas the latter can identify the average impact under normal market conditions. Section IV provides details of our dataset and their descriptive statistics. Section V presents the empirical findings. Section VI concludes.

II. LITERATURE REVIEW

Capital flows to EMEs have been the subject of extensive research.[5] Most of it focuses on capital flow drivers, which can be broadly classified into pull and push factors. The pull factors include GDP growth (Gossel and Biekpe (2015); Koojarroenprasit (2013), Ranjan and Agrawal (2011)); openness to trade (Gossel and Biekpe (2015), Anyanwu (2011)) and inflation stability (Koojarroenprasit (2013), Ranjan and Agrawal (2011), Hara and Razafimahefa (2005)). The push factors refer to such issues as the unconventional monetary policy of major advanced countries (Fratzscher et al (2013)), and global liquidity supply and risk aversion (Milesi-Ferretti and Tille (2011)).

Studies on the relationship between exchange rate volatility and capital flows are relatively scant. The research interest also differs from ours in that their primary concern is how capital flows affect the exchange rate. On the other hand, our focus on the impact of the exchange rate on capital flows is often overlooked. These studies generally found an “appreciation effect”, i.e. capital inflows lead to a rise in exchange rate. For example, Combes et al (2012) found that the appreciation effect is highest for portfolio investment, followed by foreign direct investment and bank loans, whereas private transfers had the smallest effect. Li et al (2018) found that the appreciation impact is significant for both equity and bond inflows. Some studies examine the impact of fund flows on exchange rate volatility. For example, Caporale et al (2017) found that equity and bond portfolio inflows affected exchange rate volatility significantly in six Asian developing and emerging countries in 1993-2015.

To the best of our knowledge, Caporale et al (2015) is the only study in the literature with a focus similar to ours, examining the impact of exchange rate uncertainty on equity and bond flows. They analysed US portfolio flows to six

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[5] Hannan (2018) provides a review of the more recent studies on the determinants of capital flows to emerging markets.

developed markets, Australia, Canada, the euro area, Japan, Sweden, and the UK over the period from 1988 to 2011. Using bivariate VAR-GARCH with BEKK representation, they found the exchange rate volatility had a significant impact on bond flow volatility. In particular, there were volatility spillovers from exchange rate changes to bond flows in Canada, Japan, the euro area and the UK.

In summary, previous studies cover the relationship between fund flows and exchange rate changes, as well as the volatility spillover between exchange rate changes and assets return volatility. However, the linkage between bond fund flow volatility, especially those of EMEs, and exchange rate volatility has attracted much less attention in the literature than it deserves. The present study, by implementing the same method in volatility spillover, aims to fill the gaps by examining the relationship between exchange rate volatility on bond flow volatility in EMEs.

III. ECONOMETRIC MODEL

Broadly speaking, EME exchange rates can impact EME bond fund flows through three channels. Two of them are concerned with the impact on the *level* of fund flows and the remaining one with the impact on the *volatility* of fund flows. Specifically, these channels are defined as follows:

- Mean effect: the impact of a change in the exchange rate (i.e. appreciation or depreciation) on the *level* of fund flows;
- Volatility effect: the impact of exchange rate *volatility* on the *level* of fund flows; and
- Volatility spillover: the impact of exchange rate *volatility* on fund flow *volatility*;

To identify these channels we employ two econometric models. The first is the quantile regression model, which compared to the ordinary least square (OLS) regression, benefits from being able to evaluate the estimated functional relationship at a very high quantile. As a result, it can clearly capture the impact when the market suffers considerable distress, which is defined in this study as the impact at the 10th percentile in the level of fund flows or 90th percentile in fund flow volatility.

The second model is the bivariate VAR-GARCH(1,1) with BEKK representation, which is able to estimate the average impact for the whole period.

This model, which allows for in-mean effects of Engle and Kroner (1995), is commonly used in the market spillover literature.[6] As noted by Caporale et al (2017), the model's quadratic forms have the advantage of its covariance matrices being positive definite, which might not be the case for other multivariate GARCH models. The model consists of a conditional mean equation and a conditional variance equation. The conditional mean equation is specified as follows:

$$y_t = \mu + \Psi_i y_{t-1} + \Phi_i h_t + \varepsilon_t$$

$$y_t = \begin{bmatrix} FX_t \\ BF_t \end{bmatrix};\ \Psi_i = \begin{bmatrix} \psi_{11} & \psi_{12} \\ \psi_{21} & \psi_{22} \end{bmatrix};\ \Phi_i = \begin{bmatrix} \phi_{11} & \phi_{12} \\ \phi_{21} & \phi_{22} \end{bmatrix};\ h_t = \begin{bmatrix} h_{11,t} \\ h_{22,t} \end{bmatrix};\ \varepsilon_t = \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix}$$

where FX_t and BF_t indicate exchange rate changes and bond fund flows. $h_{11,t}$ and $h_{22,t}$ represent the conditional variances of exchange rate changes and bond fund flows respectively.

The conditional variance equation of the model is specified as follows:

$$H_t = C'C + A'\varepsilon_{t-1}\varepsilon'_{t-1}A + B'H_{t-1}B$$

In matrix form, it can be specified as:

$$\begin{bmatrix} h_{11,t} & h_{12,t} \\ h_{21,t} & h_{22,t} \end{bmatrix} = C'C + A' \begin{bmatrix} \varepsilon^2_{1,t-1} & \varepsilon_{1,t-1}\varepsilon_{2,t-1} \\ \varepsilon_{2,t-1}\varepsilon_{1,t-1} & \varepsilon^2_{2,t-1} \end{bmatrix} A + B' \begin{bmatrix} h_{11,t-1} & h_{12,t-1} \\ h_{21,t-1} & h_{22,t-1} \end{bmatrix} B,$$

$$C = \begin{bmatrix} c_{11} & 0 \\ c_{21} & c_{22} \end{bmatrix}, A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}, B = \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}$$

C is constrained to be a lower triangular matrix and A and B are respectively ARCH and GARCH parameter matrices.

Our research focus is the following parameters that capture the impact of exchange rate on fund flows through the three channels discussed above:

- ψ_{21} captures mean effect from exchange rate changes to bond fund flows;

[6] The VAR-GARCH-in-mean model with a BEKK representation is widely used in analysing the volatility spillover in equity markets. For example, Caporale, Spagnolo and Spagnolo (2016) found that positive news has significant positive effects on stock returns in eight countries in the euro area for the period 1994-2013. Mohammadi and Tan (2015) found a unidirectional volatility spillover on stock returns from the US to Hong Kong, from Hong Kong to Shanghai and from Shanghai to Shenzhen over the period 2001 to 2013. Agirman, Bozma and Ahmid (2018) show that the volatility spillovers of stock returns in Turkey, Egypt, Tunisia and Morocco are insignificant from 2010 to 2017. However, few studies have used this model for other asset markets.

- ϕ_{21} captures volatility effect from exchange rate changes to bond fund flows; and
- b_{12} captures volatility spillover from exchange rate to bond flows;

The last channel is represented by the off-diagonal parameters in the GARCH matrix. Volatility spillover from exchange rate changes to bond fund flows can be analysed by conducting t tests for the null hypothesis $b_{12} = 0$.

IV. DATA DESCRIPTION AND PRELIMINARY ANALYSIS

The EME bond fund flows data used in this study are obtained from the EPFR Global, which has data on mutual funds domiciled around the world. Weekly data, the highest frequency available, are used to capture market dynamics. Subject to data availability, our sample period runs from 7 January 2004 to 31 July 2019. Fund flow is defined as the weekly change of a fund's total net assets (TNA) adjusted for fund performance, with fund performance measured by the weekly change of a fund's per unit net asset value (NAV) in US dollar terms. These fund flows are then aggregated for all the EMEs covered by this study. To facilitate comparability, fund flows are expressed in percentage terms, i.e. dividing the value of total fund flows by their TNA of the preceding period. Positive (negative) numbers imply net bond fund inflows (outflows). EME bond funds are sub-divided into LC bond funds and HC bond funds. Note that very few EME bond funds exclusively invest in LC or HC bonds. As such, EPFR Global has the following classification: LC bond funds invest 75% or more in local currency debt, and HC bond funds invest 75% or more in debt denominated in hard currencies (e.g. US Dollar, euro).

The J.P. Morgan Emerging Market Currency Index is used as a proxy indicator for the exchange rates of the EMEs as a whole. This index tracks the average level of 10 major EME currencies vis-à-vis the US dollar. Exchange rate change is calculated as $FX_t = 100 \times (P_{E,t} - P_{E,t-1})$ where $P_{E,t}$ stands for the log of the index at time t. A positive (negative) reading means that EME currencies, as a whole appreciate (depreciate) against the US Dollar.

Table 1 presents the descriptive statistics of bond fund flows and exchange rate changes. There are some of the salient features. First, aggregate bond fund flows to EMEs was positive on average except for the GFC period, indicating a long term trend of funds inflow to EME bond funds. In particular, LC EME fund flows are larger than HC EME fund flows for most of the periods. Second, EME currencies have become more volatile than EME bond fund flows since the GFC. Third, the LC EME bond fund flows are more volatile than the HC EME fund flows in all the sub-periods.[7]

Table 1: Descriptive statistics

Statistics	Variable	Pre GFC	GFC	Post GFC
Mean	FX_t	0.057	-0.08	-0.08
	$BF_{lc,t}$	0.704	-0.235	0.234
	$BF_{hc,t}$	0.284	-0.38	0.18
St. Dev	FX_t	0.979	1.767	1.015
	$BF_{lc,t}$	1.752	1.535	0.777
	$BF_{hc,t}$	0.814	0.709	0.612
Max	FX_t	6.668	6.103	3.449
	$BF_{lc,t}$	10.321	1.971	4.237
	$BF_{hc,t}$	4.581	1.132	2.73
Min	FX_t	-6.517	-8.793	-4.293
	$BF_{lc,t}$	-3.842	-6.168	-3.04
	$BF_{hc,t}$	-3.788	-2.768	-2.389

Note:

1. GFC stands for global financial crisis. The sub-periods are defined as: Pre-GFC (7 Jan 2004 to 1 Aug 2007), GFC (8 Aug 2007 to 24 June 2009) and post-GFC (1 July 2009 to 31 Jul 2019).
2. FX stands for weekly percentage change of J.P. Morgan Emerging Market Currency Index. BF stands for emerging market bond fund flows (as a percent of total net assets of the preceding period.) The subscripts lc and hc stand for local currency and hard currency respectively.

[7] F test results suggest that LC bond fund flows are more volatile than HC bond fund flows during the pre-GFC and GFC periods, but their volatilities are not significantly different in the post-GFC period.

V. EMPIRICAL RESULTS

As discussed in Section III, EME exchange rates have an impact on EME bond fund flows or flow volatility through three channels. Table 2 highlights the estimation results of these channels, with more detailed results tabulated in the Appendix. First and foremost, positive mean effects are found from exchange rate changes to bond fund flows, i.e. exchange rate appreciation (depreciation) leads to more (less) EME bond fund flows during the post-GFC period, regardless of whether or not the market is in considerable distress. These results are consistent with the return chasing hypothesis postulated by previous studies (e.g., Bohn and Tesar (1996), Bekaert et al (2002)).[8] However, Z test results suggest that the mean effect of LC funds is not significantly different from that of HC bond funds.[9]

Second, a negative volatility effect is found for LC and HC bond funds, i.e. an increase in EME exchange rate volatility has a negative impact on the level of EME bond fund flows, during market distress in the GFC and post-GFC periods. The results suggest that volatile currency movements might discourage foreign investors from holding these bond funds. In addition, Z test results indicate that the volatility effect of LC bond funds is significantly larger than that of HC bond funds in absolute value only in the GFC period, but not post-GFC.

Third, EME exchange rates are found to have an impact on the *volatility* of EME bond fund flows through the volatility spillover channel. In particular, quantile regression results indicate that during market distress in the GFC and post-GFC periods, volatility spillover is statistically significant for both LC and HC funds. Z test results indicate that post-GFC, the volatility spillover for LC fund flows is significantly larger than that for HC funds. In addition, under normal market conditions, volatility spillover is found only for LC fund flows, but not for HC fund flows in all three periods. These findings suggest that LC fund flows are more susceptible to exchange rate volatility than HC fund flows.

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[8] Return chasing hypothesis states that investors tend to move into markets where returns are expected to be high and retreat from markets when predicted returns are low.

[9] All the Z test results discussed in this section are reported in Table A3 in the Appendix.

Table 2 Summary of estimation results

	LC bond fund flows	HC bond fund flows
Panel A: Pre-GFC (7 Jan 2004 to 1 Aug 2007)		
Market distress		
Mean effect	0.432**	0.147
Volatility effect	-0.04	-0.274
Volatility spillover	6.22*	0.524***
Whole sample period		
Mean effect	-0.073	0.092
Volatility effect	0.301***	-0.071
Volatility spillover	0.101***	0.25
Panel B: GFC (8 Aug 2007 to 24 June 2009)		
Market distress		
Mean effect	0.177	0.178*
Volatility effect	-0.453*	-0.147
Volatility spillover	2.047***	0.647***
Whole sample period		
Mean effect	0.34***	0.122**
Volatility effect	-0.191**	0.189***
Volatility spillover	0.16***	0.25**
Panel C: Post GFC (1 July 2009 to 31 Jul 2019)		
Market distress		
Mean effect	0.095*	0.121^
Volatility effect	-2.309*	-3.007***
Volatility spillover	15.095***	6.474***
Whole sample period		
Mean effect	0.161***	0.115***
Volatility effect	0.27	0.053
Volatility spillover	0.07*	0.25

Notes: (1) ***, **, * and ^ denote the estimated coefficient is statistically significant at 0.1%, 1%, 5% and 10% respectively; (2) Results of market distress and whole sample period are based on quantile regression model and bivariate VAR-GARCH(1,1) models respectively. Detailed results of the latter model are reported in the Appendix.

VI. CONCLUDING REMARKS

In summary, our estimation results suggest that changes in the exchange rate itself or exchange rate volatility have a significant but similar impact on the *level* of both LC and HC bond fund flows during the post-GFC period. However, in response to an increase in exchange rate volatility, fund flow *volatility* for LC bond funds is found to increase significantly more, regardless of whether or not the market is in distress. In other words, the volatility spillover for LC bond funds is significantly larger than that for HC bond funds.

The finding that volatility spillover is significantly larger for LC bond funds than for HC bond funds has two important policy implications. First, it may reflect a general lack of effective instruments for foreign investors to hedge against foreign exchange risk while maintaining their positions in local currency bonds. As a result, they are forced to move their funds in and out of EMEs in times of elevated exchange rate risk, thus leading to an escalation in fund flow volatility. Second, more rapid growth of LC bond funds among EMEs in recent years means these economies are likely to experience more volatile capital flows than in the past during large fluctuations in exchange rates. In view of these implications, EMEs should strengthen their market infrastructure by developing a broader array of currency hedging instruments, such as currency derivatives. Therefore, foreign investors would be able to separate exchange rate risks from other risks (e.g. credit risk, interest rate risk) and thus be less inclined to stampede out of EME bonds in response to heightened exchange rate risk.

At the same time, EMEs should also deepen their domestic investor base to contain the exchange rate impact on fund outflows.[10] In particular, institutional investors should be a core part of the domestic investor base as they help create market liquidity and enhance the price discovery process (World Bank (2015)). As many of these investors (e.g. pension funds, endowment funds, sovereign wealth funds) have long term investment horizons, they tend to be less responsive to short term market movements or, indeed, taking a contrarian investment strategy, thus providing a stabilising force for the markets (Fong et al (2018), Timmer (2018) and de Haan and Kakes (2011)).

[10] See CGFS (2019) for more details about deepening the domestic institutional investor base.

Appendix

Table A1 Estimation results of VAR-GARCH model for LC bond fund flows

	Pre-GFC	GFC	Post-GFC
	BF_t	BF_t	BF_t
Conditional mean equation:			
μ_1	0.327*	0.371*	0.033
ψ_{21}	-0.073	0.34***	0.161***
ψ_{22}	0.34***	0.036	0.62***
ϕ_{21}	0.301***	-0.191**	0.027
ϕ_{22}	-0.053^	-0.031	0.027
Conditional variance equation:			
c_{22}	1.092	0.377**	0.155
a_{12}	0.118^	-0.5***	0.095
a_{22}	0.711***	0.032	0.682***
b_{12}	0.318***	-0.399***	-0.264*
b_{22}	0.181	0.643***	0.574***

Note: ***, **, * and ^ denote the estimated coefficient is statistically significant at 0.1%, 1%, 5% and 10% respectively.

Table A2 Estimation results of VAR-GARCH model for HC bond fund flows

	Pre-GFC	GFC	Post-GFC
	BF_t	BF_t	BF_t
Conditional mean equation:			
μ_1	0.239	-0.376***	0.05
ψ_{21}	0.092	0.122**	0.115***
ψ_{22}	0.288***	0.384***	0.571***
ϕ_{21}	-0.071	0.189***	0.053
ϕ_{22}	0.013	-0.446***	-0.043
Conditional variance equation:			
c_{22}	0.762***	0.129	0.119
a_{12}	0.5*	0.5^	0.198*
a_{22}	0.328*	0.000001	0.661***
b_{12}	-0.5	-0.5**	-0.5
b_{22}	0.165	0.453**	0.296*

Note: ***, **, * and ^ denote the estimated coefficient is statistically significant at 0.1%, 1%, 5% and 10% respectively.

Table A3 Z-test results of comparing LC bond funds with HC bond funds

	Local currency EME bond funds	Hard currency EME bond funds	Difference	Z Score	Critical value	Significantly different at 5% level.
			Market distress (based on quantile regression)			
Mean effect						
Post GFC	0.095	0.121	-0.026	-0.34	-1.65	No
Volatility effect						
Post GFC	-2.309	-3.007	0.698	0.53	1.65	No
Volatility spillover						
Pre GFC	6.22	0.524	5.696	2.03	1.65	Yes
GFC	2.047	0.647	1.4	2.57	1.65	Yes
Post GFC	15.095	6.474	8.622	5.04	1.65	Yes
			Whole sample period (based on VAR-GARCH model with BEKK representation)			
Mean effect						
GFC	0.34	0.122	0.218	2.41	1.65	Yes
Post GFC	0.161	0.115	0.046	1.48	1.65	No
Volatility effect						
GFC	-0.191	0.189	-0.38	-5.24	-1.65	Yes

Note: The Z test is conducted only when the effect or spillover is statistically significant for both LC and HC funds.

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