Deciphering CIP Deviation: Who Moves It and Why It Matters?*

Jihyun Kim† Min Kim‡

April 28, 2025

*Latest version available **here***

Abstract

This paper studies both supply and demand driving forces for the covered interest parity deviations (CIPD) using participant-position level monthly data for the Korean FX derivative market from 2015 to 2024. Applying the granular instrumental variables method, we decompose CIPD into contributions from 12 groups of domestic and foreign market participants. We find that supply forces of foreign investors' account for 61% of CIPD throughout the sample period, while the demand forces of domestic agents' are responsible for the rest. During stress periods, foreign investors' reduced supply is intensified as all domestic agents dash for dollar. The paper also examines the impact of CIPD on the spot exchange rate and capital flows. Using the decompositions as instruments in local projections, we show that CIPD increases foreign inflows and reduces domestic outflows. Furthermore, CIPD appreciates the spot exchange rates when instrumented with non-deliverable forward. Our findings highlight the importance of identifying the underlying micro-level forces of CIPD to find its macro-level implications.

Keywords: Covered Interest Parity Deviation; FX Hedging; Bank; Non-bank Financial Institution; Exchange Rate; Non-deliverable forward; Capital Flow; Micro to Macro
JEL codes: E44, F31, F32, F41, G11, G21, G23

---

*This paper is based on a related internal project at International Department of the Bank of Korea. We thank colleagues at the Bank of Korea who provided valuable comments on this project, especially Kyoungsoo Yoon, Ki-Dok Park, Seunghwa Son, Jaeyoung Lee, and Jaewon Lee for their helpful comments. The views expressed herein are those of the authors and do not necessarily reflect the official views of the Bank of Korea.

†International Department, Bank of Korea. E-mail: jihyun@bok.or.kr
‡International Department, Bank of Korea. E-mail: min.kim@bok.or.kr

1. Introduction

Covered Interest Parity (CIP) is a foundational no-arbitrage condition in international finance. Yet, persistent deviations from CIP (referred to as CIPD) have been observed, particularly following the 2008 Global Financial Crisis. Most of the previous literature has focused on CIPD for advanced economies, explaining it from the supply side perspective (e.g., risk-bearing capacity of global banks) with macro aggregates.[1] The micro-level heterogeneity within foreign exchange (FX) derivative market participants in driving CIPD remains underexplored.

In this paper, we provide a novel decomposition of CIPD taking into account both supply and demand forces. We further leverage the decomposed CIPD as instrumental variables to explore the causal implications on the spot exchange rates and capital flows. To decompose CIPD into the market participant level, we exploit participant-position level data (January 2015 – December 2024) obtained from the Bank of Korea. The data is constructed from the unique regulatory dataset based on local banks' FX derivative trading reports. Using the granular instrumental variables (GIV) methodology (Gabaix and Koijen, 2024; Chaudhary, Fu, and Zhou, 2024), we attribute observed CIPD to 12 distinct groups of participants – local banks, domestic non-bank financial institutions (NBFIs), and foreign investors, among others.

Our decomposition reveals that most CIPDs are driven by foreign investors (61%), while the rest are driven by domestic agents (39%). In particular, during market stress periods such as COVID-19 and the late 2024, the dollar funding supply by foreign investors accounts for more than 80% of the CIPD dynamics. The time-varying contribution of each group highlights the importance of participant-specific drivers in shaping apparent deviations from the no-arbitrage condition.

CIPD is more than an indicator of the US dollar funding shortage. Depending on the

[1] See a comprehensive survey in Du and Schreger (2022).

shocks at play, CIPD brings divergent consequences that go beyond the FX derivative market. The participant-level decomposition of CIPD allows us to identify exogenous sources of shocks and establish causal links to the spot exchange rates and captial flows. Using Jordà (2005)'s local projections with IV (LP-IV), we show that increases in CIPD lead to net debt inflows. In particular, the 10bp increase in CIPD driven by domestic demand leads to 0.7% increase in foreign debt inflows. When driven by foreign supply, 10bp CIPD decreases domestic debt outflows by 1.48%. This result demonstrates that CIPD stands for an arbitrage investment opportunity for foreign investors, while it represents dollar funding costs for domestic agents. Furthermore, when instrumented with non-deliverable forwards, 10bp increase in CIPD leads to 0.79% appreciation of the domestic currency.

Related literature. Our paper contributes to the literature on CIP deviations (Avdjiev et al., 2019, Du, Tepper, and Verdelhan, 2018, Du and Schreger, 2022 among others), in particular, those studies focusing on emerging markets (Cerutti and Zhou, 2024; Dao and Gourinchas, 2025) and emphasizing the demand side (Borio et al., 2018; Alfaro, Calani, and Varela, 2021; Keller, 2024; Zeev and Nathan, 2024; Chen and Zhou, 2025). Among others, our paper shares the same spirit as De Leo, Keller, and Zou (2024) and Jung (2025) who highlight the role of local banks in connecting FX derivative and spot markets. Our contribution to this literature is twofold. Firstly, we provide a comprehensive analysis on CIPD determination taking into account both the supply and demand forces. The unique regulatory data set allows us to collect FX derivative transactions where Korean Won (KRW) and US dollar (USD) are involved. [2] We treat CIPD as an equilibrium price in the dollar funding market where the local banks intermediate between the supply of foreign investors and the demand of domestic agents. Our approach is novel in the sense that it

[2] KRW is not a fully internationalized currency. Any KRW-involving spot and derivative transactions must have residents as counterparties, often the local banks. Thus, the local FX market is the "clearing house" that determines the market equilibrium prices.

takes into account heterogeneous price elasticities and idiosyncratic trading motives among the market participants. Secondly, we shed light on the mechanism through which shocks to CIPD propagate to the spot exchange rate and capital flows. With local banks being at the core of the mechanism, our participant-level CIPD decomposition allows us to identify exogenous sources of shocks to derive causal implications.

Our paper is related to the literature on the role of CIPD in shaping capital flows. Hong et al. (2021) find the effects of CIPD on government bond yields depending on the country's net foreign asset position. The closest work to ours is Kubitza, Sigaux, and Vandeweyer (2025) who exploit Euro area investor level data to find that a wider CIPD induces portfolio rebalancing from USD to EUR bonds. Despite similarities, the distinctive feature of our paper is that we provide a complete decomposition of CIPD and put local banks hedging behavior at the core of the mechanism. In addition, we examine the impact of CIPD not only on capital flows but also on exchange rates.

Our paper is also related to the literature on the role of CIPD in the determination of the spot exchange rate. Jiang, Krishnamurthy, and Lustig (2021) show that a rise in the convenience yield (i.e., CIPD computed using government bond yields) is an important driving force for US dollar to appreciate. Du and Schreger (2022) and Engel and Wu (2024) further document this relationship with bilateral G10 exchange rates with respect to US dollar. Along this line, we show that the underlying shocks matter in examining the impact of CIPD on the spot exchange rate. A widen CIPD is associated with a domestic currency appreciation, not depreciation, depending on the shocks at play.

Outline. The remainder of the paper is organized as follows. Section 2 describes CIPD in Korea and the institutional background. Section 3 describes the data. Section 4 describes the empirical model for CIPD decomposition whose results are illustrated in Section 5. Section 6 examines the impact of CIPD on the spot exchange rates and capital flows. Finally, Section 7 concludes.

2. CIP deviation, Institutional Details in Korea

2.1. CIP deviation in Korea

Covered interest parity(CIP) is a no-arbitrage condition indicating that the cost of dollar funding should not be different between two strategies: direct funding from the cash market and synthetic funding through FX derivatives. We define a deviation from the CIP in logs (referred to as CIPD) as below.[3]

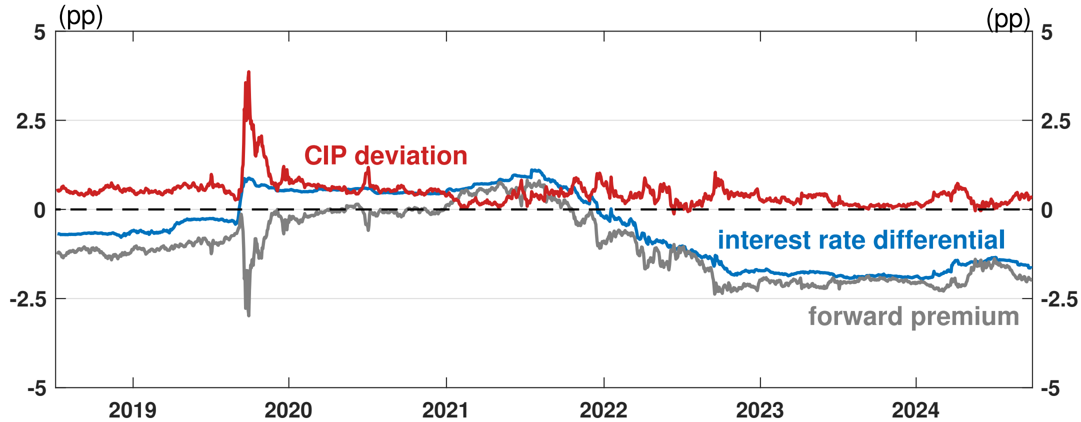
$$CIPD = \underbrace{(i - i^*)}_{\substack{\text{interest rate}\\ \text{differential}}} - \underbrace{(f - s)}_{\text{forward premium}} \tag{1}$$

where i and i^* are interest rates for KRW and USD denominated bonds, f and s are forward and spot rates for USD/KRW (i.e., the price of USD in units of KRW). Hence, a positive CIPD is interpreted as (i) an arbitrage opportunity for USD-based foreign investors, (ii) a dollar funding cost for KRW-based domestic agents.

Despite Korea's open and deep FX markets, positive CIPDs have been observed. Figure 1 shows the interest rate differential, forward premium, and CIPD at the 3-month tenor, using daily data from 2019 to 2024. The average CIP deviation (CIPD) of Korea during this period is 47 basis points, remaining mostly positive throughout, while the signs for rate differentials and swap rates turn negative during certain periods. Specifically, only 0.65% of the observations show negative CIPDs, indicating that the deviations are positive in nearly all cases. Notably, the CIPD surged to as high as 386 basis points during the COVID-19 liquidity crunch.

[3] This definition is equivalent to the cross-currency basis but with the opposite sign.

FIGURE 1. CIP deviations in Korea



Notes: The interest rate differential is calculated as the difference between the 3-month SOFR and the 3-month Korean MSB (monetary stabilization bond) rate. The forward premium is the annualized difference between the 3-month forward rate and the spot rate.

Source: Bank of Korea

2.2. Korea's FX derivative market

Korea has a well-established FX derivative market. The average daily turnover is $43.3 billion in 2024, which is almost twice as large as spot market ($25.7 billion). Specifically, FX swap is the most actively traded derivative ($28.4 billion, 65.6%) followed by FX forward ($13.4 billion, 30.9%) and cross-currency swap and option ($1.4 billion, 3.2%). Most of the derivative transactions are KRW-USD involved (78.4%). Non-residents (e.g., foreign investors) are the most active market participants, accounting for 45.2% of the overall FX derivative turnover. Their frequent counterparties are the local foreign banks whose within-group turnover is 33.9% of the total. The rest (20.9%) represents domestic agents' trades with the local banks.

NDF market. Non-deliverable forward (NDF) accounts for 81.3% of forwards turnover, whereas onshore deliverable forward (DF) accounts for the rest (only 18.7%). Note that this is the amount not including NDF contracts without the local banks involved. Offshore NDF market for KRW is so liquid and deep that it accounts for 20% ($50 billion) of the overall global NDF turnover, according to the BIS 2019 Triennial Survey.[4] One distinctive feature of KRW NDF market is that onshore residents (often the local banks) are allowed to freely trade with non-residents in the offshore market as part of deregulations implemented after the 1997 Asian Financial Crisis. Since notionals are not exchanged between the parties at maturity date, ND trades are more frequently used for speculation than curreny hedge purposes.

Local banks' FX hedging. Forwad transaction both non deliverable or deliverable make local bank being exposed to risk in change in exchange rates. Both NDF and DF trading result in local banks being exposed to open FX positions. Local banks hedge FX risks (i.e., unwind the positions) by engaging in FX swap and spot tradings.[5] Consider the case where foreign investors enter into a NDF contract with local banks. When a strong dollar is anticipated, foreign investors buy NDF, leaving the counterparties (i.e., local banks) exposed to short FX position at far date. To cover this position exposure, banks buy dollar in the spot market, and at the same time, engage in Sell&Buy FX swap. This series of tradings allows banks not only to hedge against FX risks, but also to enjoy arbitrage (i.e., CIPD) by supplying dollar funding when it is in shortage. Hence, foreign investors' NDF purchase is one of the important sources to provide dollar funding supply in the FX derivative market. Likewise, forward shorts by domestic agents (e.g., exporters) inducing banks to demand dollar funding (Buy&Sell FX swap) and sell spot to cover the long position at near date.

Supply and demand for dollar funding. CIPD is an equilibrium price determined in the dollar funding market (Du and Schreger, 2022). To classify supply and demand, we

[4]NDF market is the largest for Asian currencies among which KRW accounts for the biggest share followed by Indian rupee (INR), and New Taiwan dollar (TWD). See for details Schmittmann and Teng (2020).

[5]The regulation requires the net long and short position on both on- and off-balance sheets to be below 50 percent of the capital.

define *the change in the short (long) position at far date as a demand for (supply of) dollar funding*. Under this definition, Sell&Buy swap and forward long are considered supply, while Buy&Sell swap and forward short are considered demand. Any soure of shock that increases (decreases) supply (demand) would widen CIPD in equilibrium.

3. Data

Overview. All local banks in Korea must report about their FX derviative transactions to the Bank of Korea. The monthly report includes detailed information about both newly signed contracts and remaining obligations, including the trading date, derivative type, currencies, notional amount, maturity, and the counterparty. Since the data are collected for regulatory purposes and cover all derivative transactions conducted by local banks, they are considered comprehensive and highly reliable to analyze the Korean FX derivative market.

We use the monthly reports by 52 local banks (17 domestic banks and 45 foreign subsidiaries) from January 2015 to December 2024 to construct a panel dataset capturing *excess demand* for dollar funding across market participants. In particular, the key variable is the *net position*, which indicates each participant's outstanding net *short* position in far-leg dollar obligations (or equivalently, the net *long* position in near-leg dollar obligations) vis-à-vis the local banks. We aggregate the net positions along counterparty-level at a monthly frequency, encompassing all types of derivative contracts including both deliverable and non-deliverable outright forward, swap and option contracts. Each participant's *net position* records an outstanding net *short (long)* position in far-leg as a *positive (negative)* value.

From net position to excess dollar funding demand. We define each market participant's *excess demand* for the synthetic dollar funding as the *increase* in the net position. How can this interpretation be justified? Since the net position encompasses both swap and forward transactions, we explain our interpretation by transaction type.

First, consider swap transactions. For a given market participant, an increase in net position indicates the net amount of dollar receiving today in exchange for KRW, with a commitment to reverse it at maturity.[6] Since those KRW-based domestic agents in need for dollar enters this contract, we interpret the net position increment as a demand for dollar funding.

A similar interpretation implies to forward transactions. Consider a forward transaction between foreign investors and local banks. A reduction of net position of foreign investors due to forward shorts is mirrored by an increase in net positions of local banks. Local banks are then exposed to FX risks due to the obligation to deliver dollar at a promised rate in the future. To hedge this FX risk, as described in Section 2, local banks purchase dollar in the spot market. In addition, they enter into a Sell&Buy swap using the dollar they have acquired and enjoy the arbitrage profit of CIPD. This sequence of transactions results in a squared FX position for local banks in both near and far legs. As a result of this series of contracts, what is observed in the data is a decline in foreign investors' net position and a corresponding increase in the net position of domestic agents, while the net position of local banks remains unchanged. Therefore, an increase in net position based on forward transactions can also be interpreted as excess demand for synthetic dollar funding—driven by the follow-up transactions initiated by local banks acting as counterparties to the original forward trades.

Taken together, an increase in net position from the previous period can be interpreted as excess demand for synthetic dollar funding in each period. A rise in net position indicates an increase in these in the demand for dollars through FX derivatives, while a decline in net position a reduction in demand or an increase inand

[6]This is known as a Buy&Sell swap contract.

or an increase in supply. Furthermore, following the same intepretation, the sign of the net position can tell whether the given market participant is on the supply or demand side. For a given period, a market participant who has a positive (negative) net position is considered a demander (suppler) in the dollar funding market.

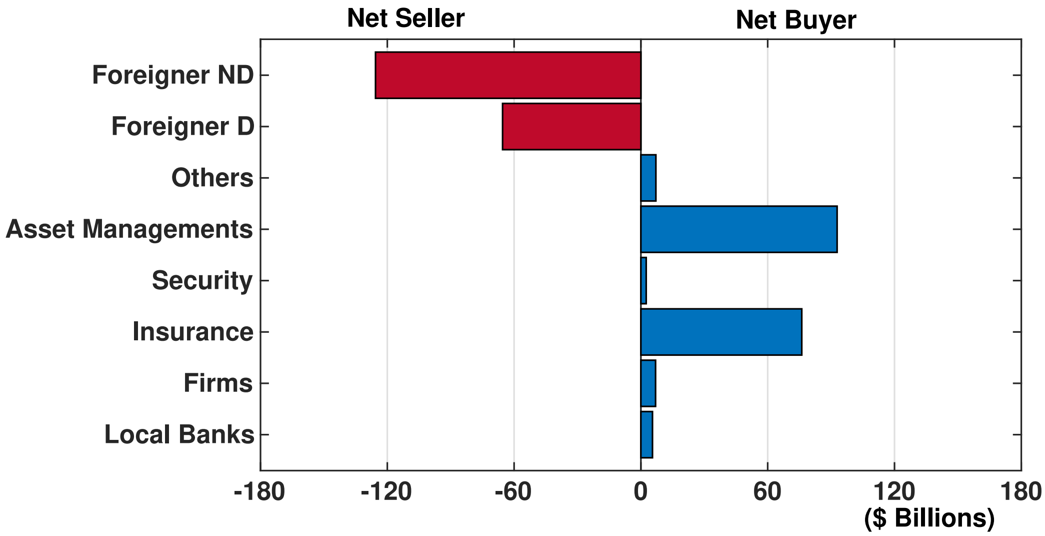
Sectors. We classify market participants into twelve groups of sectors: local banks, non-bank financial institutions (including securities firms, insurance companies, pension funds, etc.), local firms, foreign exchange authorities, and foreign investors. In particular, foreign investors are further divided into two groups, depending on whether the transaction is deliverable.[7] This classification allows us to treat each group as a representative agent sharing the same trading motives.

A sub-categorization of foreign investors in terms of the contract type is motivated by two key differences in deliverable and non-deliverable contracts. The first key distinction lies on the contract characteristics. In contrast to deliverables, ND contracts require only the resulting losses are paid as the settlement, and hence, tend to be more leveraged and even speculative. The second distinction relates to the fact that most ND contracts require local banks to squre FX position, since 60% of it is forwards. This implies that, in contrast to deliverable contracts (97% of which are swaps), ND contracts build a close link between the derivative and spot markets. Given these, foreigners who are conducting deliverable contracts are treated differently from the ones who are based on non-deliverable contracts in our analysis.

Net position by sectors. We first look at the net positions across sectors. Foreign investors are classified as net supplier of dollar funding, while residents are primarily classified as net demanders (see Figure 2). The fact that local banks' net positions are

[7]The number of market participants categorized in each sector is as follows: local firms (8,493); insurance companies (39); securities firms (40); asset management firms (326); credit-specialized financial companies (43); and foreign investors (644).

FIGURE 2. Net Position in Far-Leg Forwards by Sectors



Notes: The figure shows the 2024 average net short position in far-leg forwards by sector. "Foreign ND" refers to the net short position of foreigners through non-deliverable transactions, while "Foreign D" indicates the net short position of foreigners through deliverable transactions. "Others" include non-bank financial institutions, foreign exchange authorities, and pension funds. The position of local banks excludes interbank transactions.

Source: Bank of Korea

nearly squared highlights their role as intermediaries in the market, channeling dollar funding from who are in abundant (foreign investors) to who are in need (domestic agents). Among domestic agetns, asset management companies and insurance firms stood out with notably higher demand, which is aligned with Korea's recent increasing trend in oversea portfolio investment.

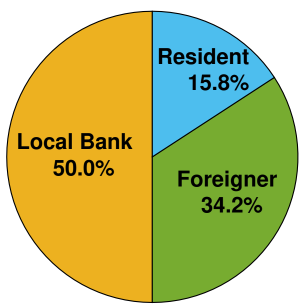
Market shares by sectors. Based on transaction volume, measured as the sum of buy and sell positions, we calculate each sector's market share as the long-run average of its relative market size to the total market size, as follows:

$$S_i = \frac{1}{T}\sum_{t=1}^{T}\frac{Size_{it}}{Size_t} \tag{2}$$

where $Size_{it} = Buy_{it} + Sell_{it}$, and $Size_t = \sum_i Size_{it}$.

Local banks account for about half of the total trading volume, with domestic banks and foreign bank branches representing 20.7% and 29.3%, respectively. This reflects the intermediary role local banks play in connecting the supply of dollar funding from foreign investors to the demand from domestic residents. Looking in more detail, foreign investors account for a larger share of the market at 34.2%, compared to 15.8% for residents. Among resident entities, the shares of insurance companies, securities firms, and asset management companies are each around 3%. For non-residents, the share of non-deliverable transactions (19.0%) is higher than that of deliverable transactions (15.2%). Figure 6 provides a detailed breakdown of these shares.

FIGURE 3. Market Share by Sectors



Sectors		Share (%)
Local bank	Domestic bank	20.7
	Foreign bank branch	29.3
Resident	Insurance	3.1
	Security	3.1
	Asset managements	2.5
	Firms	4.5
	Others	2.6
Foreigner	Foreign D	15.2
	Foreign ND	19.0

Notes: The market share is defined as each sector's relative market size to total market size, where market size is measured as the sum of buy and sell positions in far-leg forwards. "Local banks" include both domestic banks and foreign bank branches. "Foreign D" and "Foreign ND" refer to the market size share of foreigners through deliverable and non-deliverable transactions, respectively. "Others" include credit finance companies, other financial institutions, foreign exchange authorities, and pension funds.
Source: Bank of Korea

4. Methodology

In this section, we propose a framework in the spirit of an equilibrium model of synthetic dollar funding. Leveraging the fact that we observe all FX derivative transactions in the Korean market—which clears in equilibrium—we can link the observed CIP deviations to the underlying demand and supply behavior of each sector. Specifically, because we observe changes in net positions at the sector level, we are able to infer which sectors acted as demanders or suppliers of synthetic dollar funding at each point in time, and how their behavior collectively determined the equilibrium CIPD.

4.1. An Equilibrium Model

Notation. We index sectors by i, dividing them into 12 groups: domestic banks, foreign bank branches, insurance firms, securities firms, asset management firms, local firms, credit finance companies, other financial institutions, foreign exchange authorities, pension funds, and foreign investors (further disaggregated into deliverable and non-deliverable transactions). Note that foreign investors are classified more finely based on the type of transaction. The term *net position*, denoted as f_{it}, refers to the net dollar purchase position of sector i—representing dollar buying in the near leg and dollar selling in the far leg. Thus, change in *net position* captures sector i's excess demand for dollar funding through the FX derivatives market in period t. The CIP deviation (CIPD) is determined at the point where the sum of excess demands across all sectors clears—that is, where market equilibrium is achieved.

Excess demand for dollar synthetic funding. It is challenging to build a framework that can incorporate the heterogeneity in how each sector conducts transactions in the FX derivatives market by either demanding or supplying dollar funding. For example, local insurance companies demand dollar funding to invest abroad while hedging exchange rate risk, whereas foreign investors supply dollar funding when purchasing Korean financial assets. Furthermore, local banks may demand additional dollar funding due to dollar liquidity needs, such as for regulatory purposes.

To flexibly capture these heterogeneous behaviours across sectors, we define each sector's excess demand for dollar funding as follows,

$$q_{it} = -\zeta_i \Delta CIPD_t + \nu_{it} \tag{3}$$

where q_{it} denotes the percentage change in the net position of sector i in period t, ΔCIPD is the change in CIP deviation in period t, and ζ_i is the semi-price elasticity of sector i, capturing how the sector's net position changes in percentage terms in response to a one-percentage-point change in the CIP deviation. ν_{it} represents a sector-specific demand shifter.

We model the demand shifters, ν_{it}, to be divided into a common component, η_t, whose loading differs across sectors, and an idiosyncratic component, μ_{it}. The idiosyncratic component, μ_{it}, captures demand shifts specific to sector i and is assumed to be orthogonal to the common factor, η_t. Therefore, we can rewrite Equation 4 as follows:

$$q_{it} = -\zeta_i \Delta CIPD_t + \underbrace{\lambda_i \eta_t + \mu_{it}}_{\nu_{it}} \tag{4}$$

Equilibrium. The market clears in each period, meaning that the increase in net positions across all entities sums to zero. Let q_{it} denote denote the increase in entity-i net position, scaled by its market size, which is defined as the total market size multiplied by its market share S_i. Note that the market share $\S_i$ and *Size* is defined in Equation 2.

$$q_{it} \equiv \frac{\Delta f_{it}}{S_i Size_{t-1}} \tag{5}$$

Then market clearing condition is expressed as follows,

$$\sum_{i=1}^{N} S_i q_{it} = 0 \tag{6}$$

We solve for the change in the CIPD by substituting the demand equation specified in Equation 4 into the market clearing condition in Equation 6 and rearranging the terms. The resulting expression for the change in the CIPD is given by:

$$\Delta CIPD_t = \frac{1}{\sum_i S_i \zeta_i} \left(\eta_t \sum_i S_i \lambda_i + \sum_i S_i \mu_{it} \right) \tag{7}$$

Changes in dollar funding demand driven by global factors and idiosyncratic shocks at the individual sector level lead to fluctuations in the CIPD. However, as the market clears, the impact on the CIPD is adjusted according to each sector's market share and the overall market elasticity. For example, even if a specific sector's demand increases significantly and initially pushes up the CIPD, the overall impact may be offset if the aggregate demand in the market is highly elastic, causing other sectors to reduce their dollar funding deman

4.2. Identification

Market elasticity ζ_i**.** The key challenge in estimating the model lies in addressing the endogeneity between each sector's decision to demand or supply dollar funding and the CIPD. A standard approach in the literature, as in Gabaix and Koijen (2024) and Baumeister and Hamilton (2023), is to identify idiosyncratic demand shifters from one sector and use them as instruments for the price variable in another sector's demand equation. These instruments are valid provided that a sector's idiosyncratic shifters are uncorrelated with both the price and the common factors, and critically, are not correlated with idiosyncratic shocks from other sectors. They are also relevant if the idiosyncratic shocks are sufficiently large to have a substantial effect on prices.

We leverage an optimal weighting strategy for the moment conditions, following

Chaudhary, Fu, and Zhou (2024):

$$\hat{\mathbb{E}}[\hat{\mu}_{i,t}\left(\hat{\zeta}_i\right)\underbrace{\sum_{j\neq i} S_j\,\mu_{j,t}\left(\hat{\zeta}_j\right)}_{\hat{u}_{S(-i),t}(\hat{\zeta})}] \equiv \hat{\mathbb{E}}\left[\left(q_{i,t}+\hat{\zeta}_i\Delta CIPD_t\right)\sum_{j\neq i} S_j\left(q_{j,t}+\hat{\zeta}_j\,\Delta CIPD_t\right)\right] = 0. \quad (8)$$

where, $\hat{\mathbb{E}}$ indicates a sample mean. The moment conditions imply that the estimator based on these conditions assigns greater weight to moments derived from sectors with larger market shares. The intuition is straightforward: larger sectors generate idiosyncratic shocks that have stronger effects on prices, making them more powerful instruments. We refer to this size-weighted strategy as the optimal GIV estimator.

The optimal GIV estimator is both intuitive and convenient, particularly when viewed as an extension of the bias-corrected OLS framework. Using the market clearing condition specified in Equation 6, we have:

$$\sum_{j\neq i} S_{j,t}\left(\Delta q_{j,t}+\hat{\zeta}_j\,\Delta CIPD_t\right) = \hat{\zeta}_S\Delta CIPD_t - S_i\hat{u}_i\left(\hat{\zeta}_i\right). \quad (9)$$

If we plug the condition in 9 into the sample moment condition 8, we can derive the estimator for ζ_i as follows:

$$\hat{\zeta}_i = -\frac{\hat{\mathbb{E}}\left[q_i\Delta CIPD_t\right] - \frac{1}{\zeta_s}S_i\hat{\sigma}_i^2}{\hat{\mathbb{E}}\left[\Delta CIPD_t^2\right]} \quad (10)$$

where, $\hat{\sigma}_i^2 \equiv \hat{\mathbb{E}}\left[\hat{\mu}_i\left(\hat{\zeta}_i\right)^2\right]$ is the sample variance of idiosyncratic shocks.

This shows that the optimal GIV estimator can be obtained by regressing quantities on prices and adjusting for the bias arising from the impact of sector i's demand shift on prices, captured by $\mathbb{E}(\mu_{it}\Delta CIPD_t) = \frac{1}{\zeta_s}S_i\hat{\sigma}_i^2$, which can be derived from Equation 7.

Loading for global shocks λ_i. Given the estimates of market elasticity, ζ_i, we can recover the loading for global shocks, λ_i. Let λ_i^q denote the estimator obtained by regressing q_{it} on the global factors. Given that $E(u_{it}\eta_t) = 0$, estimator for λ_i^q is follows:

$$\hat{\lambda_i^q} = \frac{E(q_{it}\eta_t)}{E(\eta_t^2)} = \frac{E\left(\left(-\zeta_i \Delta CIPD_t + \lambda_i\eta_t + u_{it}\right)\eta_t\right)}{E(\eta_t^2)} = \lambda_i - \zeta_i \underbrace{\frac{E(\eta_t \Delta CIPD_t)}{E(\eta_t^2)}}_{\lambda^{CIPD}} \tag{11}$$

where λ^{CIPD} is the loading of $\Delta CIPD$ to global shocks.

Estimation procedure. The estimation procedure is as follows. We first regress q_{it} and ΔCIPD_t on the global shocks, η_t, and use the residuals to estimate the elasticity, ζ_i, by solving the system of N equations specified in Equation 10. Given the estimates for ζ_i, we then recover the loadings for global shocks as specified in Equation 11.

5. Estimation Results

5.1. Market Elasticity

The last row of Table 2 reports the aggregate price elasticity of the Korean dollar funding market. Our estimate for the aggregate market elasticity is 5.99, which implies a macro multiplier of 0.17 — the reciprocal of the elasticity — indicating how much the CIPD responds to a 1% increase in demand. Specifically, a 1% increase in the demand shock raises the CIPD by 17 basis points, which is approximately half the standard deviation of the CIPD (36 basis points)

Table 2 reports the price elasticity of demand for each sector and shows each sector's contribution to the aggregate elasticity. This contribution, labeled as "ζ share" in the table, is calculated as ζ share $\equiv \frac{\zeta_i \times S_i}{\zeta_S}$, where ζ_i is the sector's elasticity, S_i is its market share, and ζ_S is the aggregate elasticity. Sectors with high contributions are either highly

TABLE 1. Price Elasticities by Sector

Sector	Share (S_i, %)	Elasticity ζ	ζ Share (%)
Domestic banks	20.74	1.09	3.77
		(-0.15, 2.33)	
Foreign bank branches	29.26	1.62	7.90
		(0.81, 2.43)	
Local firms	4.52	4.29	3.24
		(0.07, 8.51)	
Insurance companies	3.11	3.01	1.56
		(-1.19, 7.21)	
Securities companies	3.10	4.62	2.40
		(0.42, 8.82)	
Asset managements	2.47	4.74	1.96
		(-0.02, 9.50)	
Foreign Non-delivery	19.01	22.92	72.80
		(11.78, 34.06)	
Foreign Delivery	15.17	0.77	1.96
		(-0.06, 1.61)	
Aggregate	100.00	5.99	100.00
		(3.81, 8.16)	

Notes: Table reports the aggregate price elasticity, sector-specific price elasticity of excess demand for the 12 sectors, ζ_i. The price elasticities are identified using the optimal GIV estimator developed in Section 4. Share, $\S_i$ refers to the size weight used in the estimation, defined as the average relative market size of each entity to total market size through the whole sample period. ζ share denotes the (size-weighted) fraction of aggregated elasticity accounted for by each sector. 95% confidence intervals are reported, with the standard errors specified in Appendix. The sample period covers January 2015 to December 2024.

elastic—responding strongly to price changes and absorbing demand shocks—or have large market shares, enabling them to absorb large demand shocks due to their size.

Looking more closely by sector, foreign investors with non-deliverable transactions are highly elastic and have a large market share, leading to a higher ζ share. This suggests that when the CIPD widens, foreign investors respond by supplying dollar funding, which helps reduce the CIPD overall.

You can note that the estimator for market elasticity (see equation 10) is biased when using OLS estimates, because each sector's increase in excess demand itself contributes to the increase in the CIPD. To address this, we compares the estimates obtained using our identification strategy—instrumenting with idiosyncratic shocks from other sectors—with the OLS estimates, focusing on four sectors with higher shares. See Figure 4. In the figure, OLS estimates are labeled as "observed," while instrumented estimates are labeled as "instrumented."

For example, in the case of foreign investors engaged in non-deliverable transactions, their increase in demand for dollar funding raises the CIPD, which we observe in the data. However, when using the instrumented approach, we find a negative relationship: an increase in the CIPD leads to an increase in their supply (i.e., a decrease in excess demand).

5.2. Sensitivity to global risk factors

During global risk-off periods, heightened global risk factors—reflected in rising excess returns—worsen dollar funding conditions, leading to an increase in CIP deviations. We check whether this mechanism is present in the Korean market by examining the loading on global risk factors in our model. Our estimates suggest that a one standard deviation increase in global risk factors raises the CIP deviation by 17.7 basis points ($\approx 1.06/0.059 \times 100$) during risk-off episodes, which can be derived from the equation 7

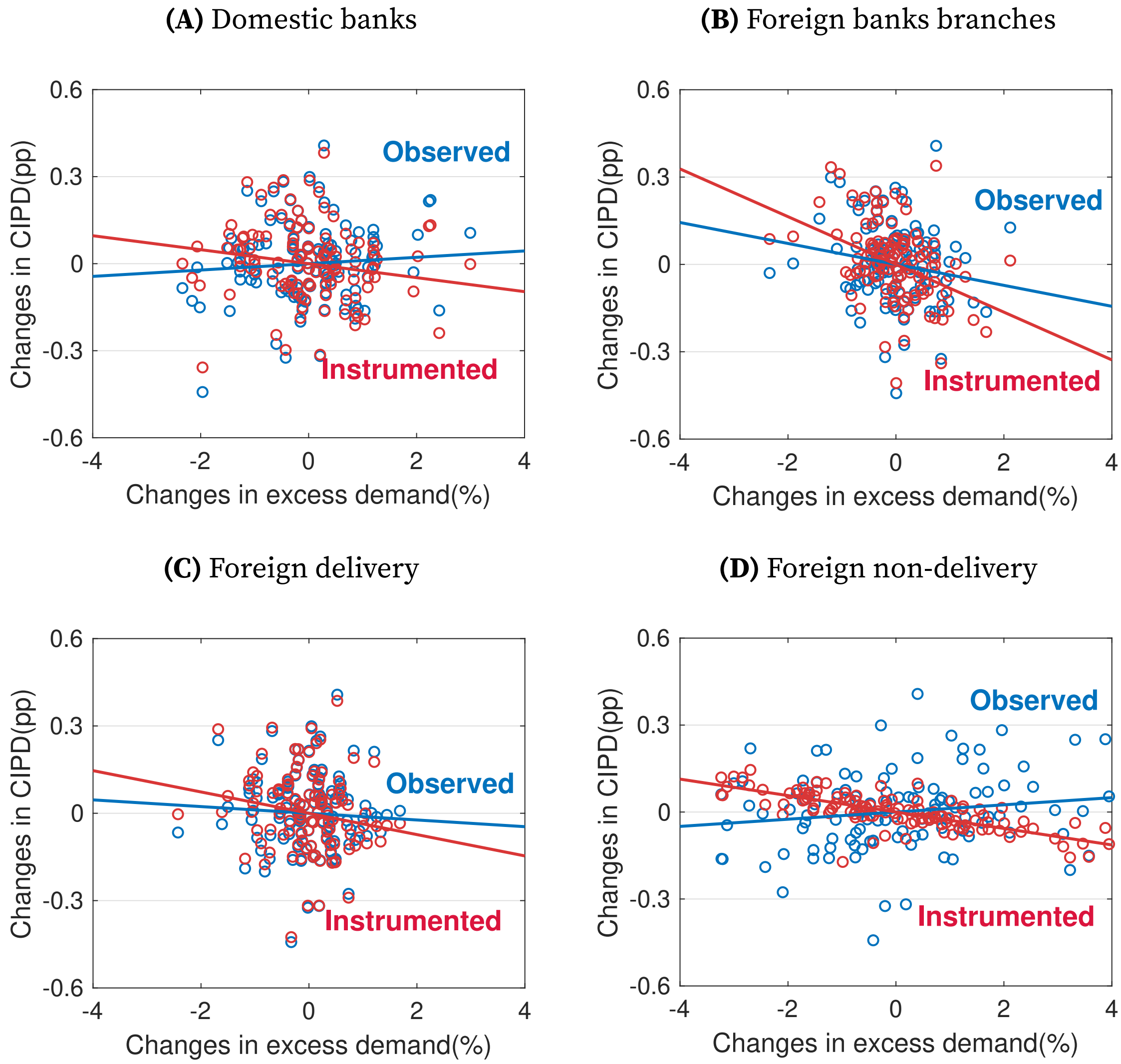
Regarding sectoral contributions, the tightening in dollar funding conditions appears to be primarily driven by foreign non-deliverable forward (NDF) positions, while foreign exchange authorities help alleviate market stress by easing funding pressures. As global risk factors rise, foreign investors reduce their long positions in emerging financial markets by selling emerging market bonds or equities. At the same time, they unwind their associated hedging positions. This deleveraging process reduces the supply of dollar funding in the market, thereby contributing to an increase in CIP deviations.

Table 2. Sensitivy to Global Risk Factors by Sector

Sector	Share (S_i, %)	λ_i to ϵ_{risk}	λ_i Share (%)
Domestic banks	20.74	-0.07	-1.46
		(-0.41, 0.26)	
Foreign bank branches	29.26	0.14	3.95
		(-0.07, 0.35)	
Local firms	4.52	-0.61	-2.62
		(-1.71, 0.48)	
Insurance companies	3.11	-0.94	-2.77
		(-2.10, 0.21)	
Securities companies	3.10	-0.06	-0.16
		(-1.19, 1.08)	
Asset managements	2.47	1.59	3.71
		(0.30, 2.87)	
Foreign exchange authorities	1.45	-3.30	-4.52
		(-5.83, -0.78)	
Foreign Non-delivery	19.01	5.39	96.83
		(3.15, 7.62)	
Foreign Delivery	15.17	0.53	7.60
		(0.31, 0.75)	
Aggregate	100.00	1.06	100.00
		(0.24, 1.88)	

Notes: This table reports the estimated responsiveness to a rise in global risk factors during risk-off episodes. The global risk factor is obtained by running an AR(1) time-series regression of the first principal component of five global risk variables—the Gilchrist and Zakrajšek (2012) spread, Moody's Aaa and Baa spreads over the federal funds rate (FFR) and the 10-year U.S. Treasury yield—and taking the residuals. A risk-off episode is defined as a period when this residual exceeds 0.5 standard deviations. The loadings are identified using the optimal GIV estimator developed in Section 2. S corresponds to the size weight used in the estimation, defined as the average market share of each entity throughout the sample period. λ_i denotes the loading of each sector onto a one-standard-deviation increase in the global risk factor. The λ_i share denotes the size-weighted fraction of the aggregate risk factor loading explained by each sector. The sample period is 2015 January –2023Q4. Ninety-five percent confidence intervals are reported, with the standard errors computed according to equation specified in Appendix. The sample period covers January 2015 to December 2024.

FIGURE 4. Price elasticity: GIV vs OLS

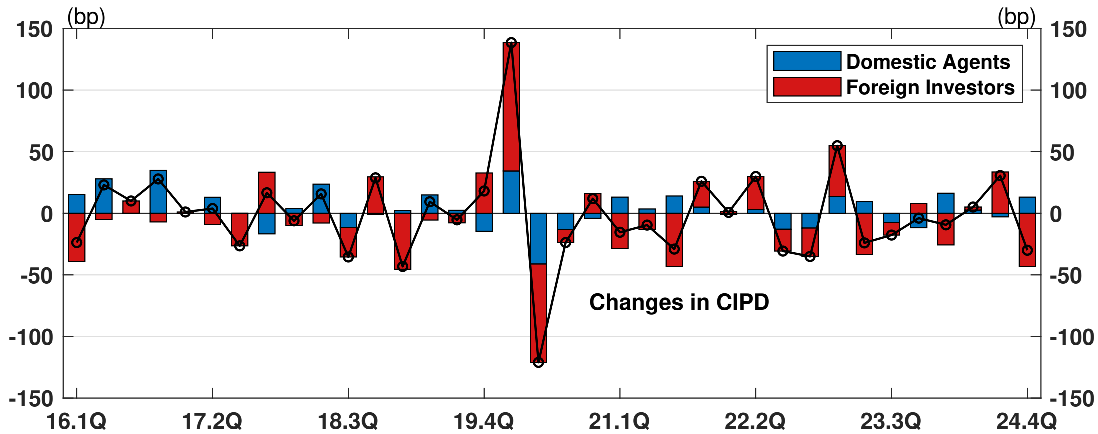


Notes: These plots compare the estimated price elasticities of excess demand using our identification strategy with the OLS estimates, focusing on four sectors with the largest market shares. In both panels, the blue circles relate the sectoral increase in excess demand (or negative supply) to the observed monthly changes in CIP deviations (3-month), with both variables residualized against the global factors included in our baseline specification. For the red circles, the y-axis plots the predicted price changes using size-weighted idiosyncratic shocks estimated from the GMM procedure. These predicted values are used as instruments for changes in CIP deviations to identify the price elasticity.

5.3. Drivers of CIP Deviation in Korean FX Derivatives Markets

Given the estimated model, we are now ready to decompose the change in CIP deviations by sector based on Equation 7. We first decompose the drivers of CIPD fluctuations into

FIGURE 5. CIPD Decomposition by Domestic and Foreign Sectors



Notes: The figure shows the quarterly change in the CIPD. Contributions from domestic agents are indicated by blue bars, and contributions from foreign investors are indicated by red bars. The black line with circles represents the total change in the CIPD for each quarter. The quarterly decomposition is constructed by summing the monthly decomposition results.

resident (demand-side) and foreign (supply-side) factors. The results are depicted in Figure 5. The blue bars represent CIPD fluctuations driven by domestic agents, including local banks, local non-bank financial institutions, firms, and the foreign exchange authority, while the red bars represent fluctuations driven by foreign investors, covering both deliverable and non-deliverable transactions. The black line with circles indicates the total CIPD fluctuation during the period. The figure is plotted by summing the monthly decomposition results over each quarter.

The results show that CIPD movements are the outcome of a combination of both resident and foreign factors. Over the entire sample period, CIPD fluctuations were primarily driven by foreign factors in 61% of the months and by resident factors in 39% of the months. This classification is made based on the following rule: when the directions of the overall CIPD change and the changes attributed to resident and foreign factors are the same, we consider the fluctuation to be driven by the factor with the larger contribution; when the directions differ, we classify the fluctuation as being driven by the factor whose direction matches that of the overall CIPD change.

5.4. Drivers of CIP Deviation during Covid 19 crisis

Next, we decompose the fluctuation of the CIPD during the COVID-19 crisis, when the CIPD increased sharply. In March 2020, the CIPD rose by 165.5 basis points, followed by a gradual decline in the subsequent months.

March 2020. The decomposition results reported in Table 3a show that the primary driver during March 2020 was foreign investors' non-deliverable (ND) transactions, contributing +138.7 basis points, which accounts for 83.9% of the overall increase. During this period, as foreign investors reduced their ND forward long positions alongside broad deleveraging from the Korean stock market, local banks—acting as counterparties to these transactions—were required to square their positions. To do so, they entered into buy-and-sell swaps, thereby increasing their demand for dollar funding. Amid deteriorating global dollar funding conditions, this surge in demand significantly amplified CIP deviations in Korea during this period.

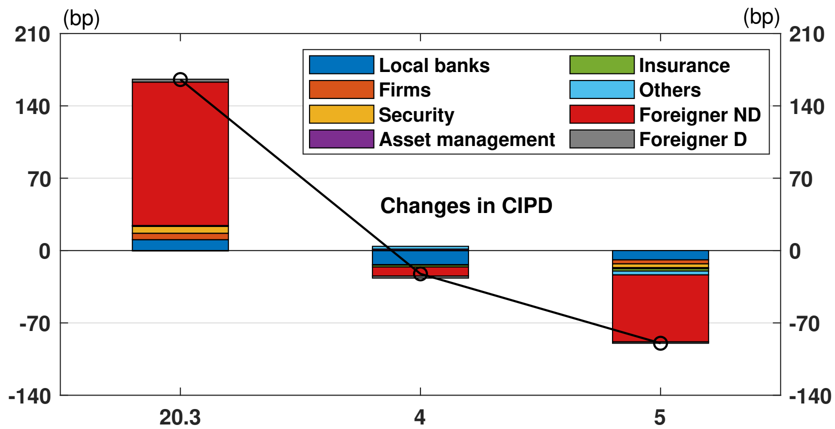
In addition, an increase in dollar funding demand by domestic banks and securities firms also contributed to the rise in the CIPD, by 10.5 basis points and 6.6 basis points, respectively. Especially for securities firms, the sharp decline in major global stock markets led to significant losses. As margin payments were required in U.S. dollars, their demand for dollar funding surged, which further contributed to the widening of CIP deviations during this period.

After March 2020. CIP deviations stabilized rapidly after March, following the U.S. Federal Reserve's aggressive policy response—including large-scale quantitative easing and the establishment of central bank swap lines with 14 countries, including Korea. These developments led to increased NDF purchases by foreign investors and a recovery in dollar funding supply, resulting in a sharp decline in the previously elevated CIP deviations.

However, our decomposition results, reported in Table 3b, suggest that the role of foreign exchange authorities in reducing CIP deviations after the swap line was established was limited, while local banks played a more prominent role in the subsequent normalization. This is mainly because the Bank of Korea, which received dollars through the swap line with the Federal Reserve, provided the funds via direct loans to domestic financial institutions rather than through FX derivatives. By supplying dollar funding to domestic institutions, their demand for synthetic dollar funding through derivatives was dampened, thereby contributing to the decline in CIP deviations. This decline in CIPD contributions from local banks, insurance companies, securities firms, and local firms implies that the normalization was primarily driven by reduced synthetic dollar funding demand among domestic institutions—those that were eligible to receive funding directly from the Bank of Korea.[8]

[8] Yun (2021) provides evidence of liquidity spillovers into Korea by comparing foreign bank branches from countries with Fed swap lines to those from non-swap-line countries, focusing on parent bank funding. Our result implicitly captures this mechanism: among local banks, foreign bank branches, which did not directly receive dollar funding from the Bank of Korea as the central bank provided funding only to domestic financial institutions, contributed to a 12.3 basis point decline in CIPD.

FIGURE 6. Drivers of CIP Deviation during Covid 19 crisis



Notes: The figure presents the decomposition of monthly CIPD fluctuations by sector, based on the estimated model and Equation 7. "Local banks" include both domestic banks and foreign bank branches. "Foreign D" and "Foreign ND" refer to the market size share of foreigners through deliverable and non-deliverable transactions, respectively. "Others" include credit finance companies, other financial institutions, foreign exchange authorities, and pension funds.

TABLE 3. Drivers of CIP Deviation during Covid 19 crisis

(a) March 2020

Sectors	Driver (bp)	Share (%)
Local bank	10.5	6.4
Insurance	0.8	0.5
Security	6.6	4.0
Asset managements	-0.3	-0.2
Firms	6.2	3.8
Others	0.1	0.1
Foreign D	138.7	83.9
Foreign ND	2.8	1.7
Total	165.5	100.0

(b) April and May 2020

Sectors	Driver (bp)	Share (%)
Local bank	-22.6	20.2
Insurance	-4.1	3.6
Security	-3.7	3.3
Asset managements	0.4	-0.3
Firms	-4.3	3.9
Others	-1.0	0.9
Foreign D	-73.5	65.5
Foreign ND	-3.4	3.0
Total	-112.2	100.0

Notes: These tables report the decomposition result of monthly CIPD fluctuations by sector, based on the estimated model and Equation 7. “Driver” refers to the increase in the CIPD attributable to each sector, while “Share” denotes the contribution of each sector’s driver as a percentage of the overall CIPD fluctuation. "Local banks" include both domestic banks and foreign bank branches. "Foreign D" and "Foreign ND" refer to the market size share of foreigners through deliverable and non-deliverable transactions, respectively. "Others" include credit finance companies, other financial institutions, foreign exchange authorities, and pension funds.

6. The implications of CIPD

In this section, we examine the implications of CIPD on the spot exchange rate and capital flows. In particular, we use the decomposition results given in Section 5 as exogenous variations of CIPD to estimate the causal impact of CIPD.

Specifically, imposing the market clearing condition (6) in the excess demand system (4), CIPD is decomposed in the sector level,

$$CIPD_t = \sum_{i=1}^{N} \omega_i CIPD_{i,t}, \tag{12}$$

where $\omega_i \equiv \frac{S_i}{\sum_{i=1}^{N} S_i \xi_i}$ is the weight attached to sector i's contribution to CIPD,

$$CIPD_{i,t} \equiv \lambda_i \eta_t + u_{it}.$$

6.1. LP-IV specification

We employ Jordà (2005)'s local projection with IV (LP-IV) and estimate with 2SLS as below.

$$y_{t+h} = \alpha_h + \beta_h CIPD_t + \gamma_h' \text{Controls}_t + \varepsilon_{t+h} \tag{13}$$

We consider as y_t the log of spot exchange rate (s_t), debt inflow ($inflow_t$) and debt outflow ($outflow_t$). Controls$_t$ contains the lag of dependent variable, the current and the lag of interest rates (3-month for spot exchange rate and 10-year for debt inflow and outflow) and inflation for Korea and US, global risk and the percentage change of dollar index (DXY). We also control for Covid-19 epsidoes (March, April, and May in 2020). In particular, for debt flows, Controls$_t$ includes the quadratic trend and seaonal pattern using monthly dummy and the percentage changes of industrial production for Korea

TABLE 4. Instruments for LP-IV specification in (13)

Dependent Variable (y_t)	**Instrument** ($CIPD_{i,t}$)
Spot exchange rate (s_t)	Foreign Non-Deliverable component of CIPD ($CIPD_{Foreign\ ND,t}$)
Debt inflow ($inflow_t$)	Domestic component of CIPD ($CIPD_{Domestic,t}$)
Debt outflow ($outflow_t$)	Foreign Deliverable component of CIPD ($CIPD_{Foreign\ D,t}$)

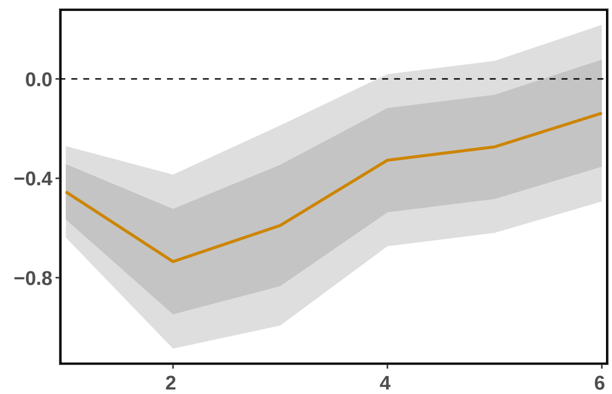
Notes: The figure describes impulse responses of the spot exchange rate to 10bp increase of CIPD instrumented with $CIPD_{Foreign\ ND,t}$. The horizontal axis indicates months after the shock and the vertical axis represents percentage changes. Gray area is 90% and 68% confidence band with Newey-West standard error.

and US. In addition, for debt inflow, the percentage change of Korean government bond issuance is included as a control variable.

On use of instrument. Using the decomposition results given in (12), we instrument $CIPD_t$ with $CIPD_{i,t}$ to estimate (13). Specifically, as summarized in Table 4, for the spot exchange rate (s_t), CIPD is instrumented with the one contributed by foreign investors trading ND forward and swap. For debt inflow ($inflow_t$) and debt outflow ($outflow_t$), the domestic component ($CIPD_{Domestic,t}$) and foreign deliverable component ($CIPD_{Foreign\ D,t}$) are used as instruments, respectively.

There are two reasons for employing decomposition results as instruments. First, a strong dollar induces both widening CIPD and domestic currency depreciation. Using ND component of CIPD as an instrument, we isolate exogenous variations in CIPD driven by banks' position covering that would affect spot exchang rates. Second, the participant-level CIPD decomposition allows us to solve the reverse causality problem between CIPD and debt flows. CIPD is an arbitrage investment return for foreign investors, but it would attract foreign debt flows only when they have sufficient balance sheet capacity.

FIGURE 7. Impulse responses of spot exchange rate



Notes: The figure describes impulse responses of the spot exchange rate to 10bp increase of CIPD instrumented with $CIPD_{Foreign\ ND,t}$. The horizontal axis indicates months after the shock and the vertical axis represents percentage changes. Gray area is 90% and 68% confidence band with Newey-West standard error.

In other words, CIPD driven from the supply side would not increase debt inflows. Using CIPD driven from the demand side by domestic agents, we estimate the amount of foreign investment increases due to arbitrage. Likewise, we estimate the effect of CIPD on debt outflows using the supply side driven CIPD as instrument.

6.2. Results

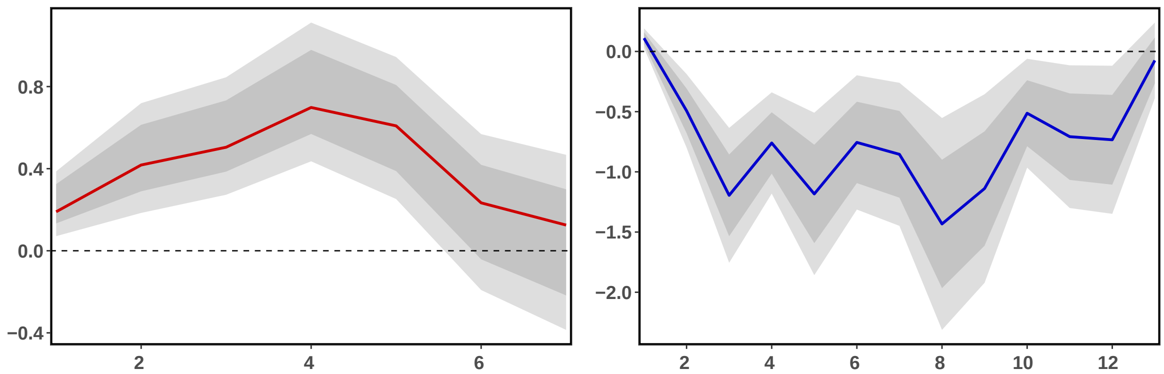
Effects on spot exchange rate. Figure 7 describes impulse responses of the spot exchange rate to 10bp increase in CIPD.

The result reveals that a rise in CIPD leads to a statistically significant appreciation of the domestic currency. The spot exchange rate responds immediately with a decline of approximately 0.6% in the first month following the shock. The appreciation deepens in the subsequent month, reaching a trough of 0.78%, indicating the peak effect of the shock. Thereafter, the exchange rate gradually recovers, with the magnitude of the response diminishing over the following months, though it remains negative up to six months post-shock.

The interpretation of the results is as follows. The shorts of NDF by foreign investors

FIGURE 8. Impulse reponses of debt inflow and outflow

(A) Debt inflow **(B)** Debt outflow



Notes: The figure describes impulse responses of the debt inflow (left panel) and debt outflow (right panel) to 10bp increase of CIPD instrumented with $CIPD_{Domestic,t}$ (left panel) and $CIPD_{Foreign\ D,t}$ (right panel). The horizontal axis indicates months after the shock and the vertical axis represents percentage changes. Gray area is 90% and 68% confidence band with Newey-West standard error.

expose local banks to an open long FX position at far leg. Local banks provide dollar funding by engaging in Buy&Sell swap, covering far-leg position. At the same time, they sell dollar in spot market using the funds from the swap, covering the near-leg position as well. Hence, NDF contract initiates a series of spot and derviative transactions, inducing CIPD to decrease and domestic currency to appreciate.[9]

Effects on capital flows. Figure 8 describes impulse responses of of capital flows – specifically, debt inflow (panel A) and outflow (panel B) – to a 10bp increase of CIPD.

The result indicates that an increase in CIPD is associated with a rise in debt inflows. Debt inflows increase steadily during the first few months, peaking around month 4 with an estimated increase of 0.7%, before declining and turning to zero by month 6. This pattern suggests that CIPD attracts foreign investors looking for arbitrage investment profits arising from tighter dollar funding conditions in the domestic market.

In contrast, debt outflows exhibit a more persistent and pronounced decline in

[9]It is worth mentioning that the same regression without instrument results in domestic currency depreciations (or appreciations but no statistical significance). The results are available upon request.

response to the same shock, with the largest effect around month 9, where outflows fall by 1.48%. The negative response is statistically significant throughout most of the 12-month horizon. This sustained contraction in outflows reflects reduced willingness of domestic agents to invest in foreign bonds due to high cost of dollar funding.

Overall, these findings point to asymmetric dynamics between debt inflows and outflows following a CIPD shock. While inflows rise, outflows decline persistently, underscoring the disparate impact of dollar funding pressures on cross-border capital flows. These differential responses along the participant level highlight the importance of distinguishing between gross capital flow components when assessing the transmission of CIPD.

7. Conclusion

This paper presents a comprehensive analysis of CIPD in the Korean FX derivative market using participant-position level data from 2015 to 2024. Leveraging the GIV approach, we decompose CIPD into supply- and demand-side components attributable to 12 categories of market participants. Our results highlight the dominant role of foreign investors—particularly through NDF transactions—in driving CIPD, accounting for 61% of the total variation over the sample period. During stress episodes, the foreign supply shock intensifies as domestic agents simultaneously increase their demand for dollar funding, underscoring the dual-sided nature of CIPD formation.

Beyond decomposition, we exploit these participant-level shocks as instruments in local projections to trace the causal impact of CIPD on spot exchange rate and capital flows. Our findings suggest that a 10bp increase in CIPD leads to a statistically significant appreciation of the local currency, peaking at a 0.8% decline in the spot exchange rate within two months. On the capital flow side, CIPD stimulates debt inflows when driven by domestic demand and curbs debt outflows when driven by foreign supply. Specifically, debt inflows rise by as much as 0.7%, while debt outflows fall persistently, reaching a trough of nearly 1.4% over a 12-month horizon.

Taken together, our results emphasize the importance of identifying the underlying drivers of CIP deviations when interpreting their implications. Treating CIPD as a mere arbitrage wedge masks the heterogeneity in its transmission mechanisms. Our approach offers a tractable framework to isolate exogenous shifts in dollar funding pressures and quantify their consequences. In doing so, this paper broadens our understanding of the meaning and implications of CIPD in emerging markets.

References

Alfaro, L., Calani, M., & Varela, L. (2021). *Granular corporate hedging under dominant currency* (tech. rep.). National Bureau of Economic Research.

Avdjiev, S., Du, W., Koch, C., & Shin, H. S. (2019). The dollar, bank leverage, and deviations from covered interest parity. *American Economic Review: Insights*, *1*(2), 193–208.

Baumeister, C., & Hamilton, J. D. (2023). Uncovering disaggregated oil market dynamics: A full-information approach to granular instrumental variables.

Borio, C. E., Iqbal, M., McCauley, R. N., McGuire, P., & Sushko, V. (2018). The failure of covered interest parity: Fx hedging demand and costly balance sheets.

Cerutti, E., & Zhou, H. (2024). Uncovering cip deviations in emerging markets: Distinctions, determinants, and disconnect. *IMF Economic Review*, *72*(1), 196–252.

Chaudhary, M., Fu, Z., & Zhou, H. (2024). Anatomy of the treasury market: Who moves yields? *Available at SSRN*.

Chen, N., & Zhou, H. (2025). Managing emerging market currency risk. *Available at SSRN 5119836*.

Dao, M., & Gourinchas, P.-O. (2025). Covered interest parity in emerging markets.

De Leo, P., Keller, L., & Zou, D. (2024). Speculation, forward exchange demand, and cip deviations in emerging economies. *Available at SSRN*.

Du, W., & Schreger, J. (2022). Cip deviations, the dollar, and frictions in international capital markets. In *Handbook of international economics* (pp. 147–197, Vol. 6). Elsevier.

Du, W., Tepper, A., & Verdelhan, A. (2018). Deviations from covered interest rate parity. *The Journal of Finance*, *73*(3), 915–957.

Engel, C., & Wu, S. P. Y. (2024). *Exchange rate models are better than you think, and why they didn't work in the old days* (tech. rep.). National Bureau of Economic Research.

Gabaix, X., & Koijen, R. S. (2024). Granular instrumental variables. *Journal of Political Economy*, *132*(7), 2274–2303.

Gilchrist, S., & Zakrajšek, E. (2012). Credit spreads and business cycle fluctuations. *American economic review*, *102*(4), 1692–1720.

Hong, G. H., Oeking, A., Kang, K. H., & Rhee, C. (2021). What do deviations from covered interest parity and higher fx hedging costs mean for asia? *Open Economies Review*, *32*(2), 361–394.

Jiang, Z., Krishnamurthy, A., & Lustig, H. (2021). Foreign safe asset demand and the dollar exchange rate. *The Journal of Finance*, *76*(3), 1049–1089.

Jordà, Ò. (2005). Estimation and inference of impulse responses by local projections. *American economic review*, *95*(1), 161–182.

Jung, H. (2025). Real consequences of shocks to intermediaries supplying corporate hedging instruments. *The Review of Financial Studies*, *38*(1), 39–113.

Keller, L. (2024). Arbitraging covered interest rate parity deviations and bank lending. *American Economic Review*, *114*(9), 2633–2667.

Kubitza, C., Sigaux, J.-D., & Vandeweyer, Q. (2025). The implications of cip deviations for international capital flows.

Schmittmann, J., & Teng, C. H. (2020). Offshore currency markets: Non-deliverable forwards (ndfs) in asia.

Yun, Y. (2021). International spillover of central bank swap lines-evidence from the covid-19 experience of korea. *Finance Research Letters*, *43*, 102003.

Zeev, N. B., & Nathan, D. (2024). The widening of cross-currency basis: When increased fx swap demand meets limits of arbitrage. *Journal of International Economics*, *152*, 103984.

Appendix

Table of Contents

A1. Data description

	Description	Source
DXY	Dollar Index	Bloomberg
s_t	Won per United States Dollar (Basic Exchange Rate, in log)	ECOS
i^{us}_{3m}	U.S. government bond interest rates (3-month)	Bloomberg
i^{kr}_{3m}	Korea monetary stabilization bond rates (91-day)	ECOS
$i^{us}_{10\,yr}$	U.S. government bond interest rates (10-year)	Bloomberg
$i^{kr}_{10\,yr}$	Korea government bond interest rates (10-year)	ECOS
π^{us}	U.S. inflation over the previous 12 months (CPI)	Bloomberg
π^{kr}	Korea monetary stabilization bond rates (91-day)	ECOS
IP^{us}	Industrial Production Index	FRED
IP^{kr}	Korea Industrial Production Index	KOSIS
$inflow_t$	Debt security liabilities	Financial Supervisory Service
$outflow_t$	Debt security assets	ECOS
$GovBondIssuance_t$	Korea Government Bond Issuance	Ministry of Economy and Finance
$RISK$	First principal component of five global risk variables: Gilchrist and Zakrajšek (2012) Spread, Moody's Aaa & Baa spread over FFR and 10-year U.S treasuty yield	FRED, Bloomberg

Notes: Variables are at monthly frequency from January 2015 to December 2024. ECOS is the database of the Bank of Korea.

A2. Control variables in local projection

The LP specification in (13) contains following control variables as Controls_t inlcuding the lag of dependent variable.

(i) LP for Spot exchange rate (s_t):

- 3-month interest rates and inflation for Korea and US (current and lag)
- global risk and p.c. of dollar index (current and alg)
- Covid-19 dummy

(ii) LP for Debt flows ($inflow_t$, $outflow_t$):

- Quadratic trend, Monthly dummy, Covid-19 dummy
- 10-year interest rates, inflation, and p.c. of industral production for Korea and US (current and lag)
- global risk and p.c. of dollar index (current and alg)
- p.c. of Korean government bond issuance (only for debt inflow)

A3. Asymptotic variance

Then asymptotic variance of λ_{ik} can be derived as follows

$$var(\hat{\lambda}_{ik}) = var(\hat{\lambda}^{q}_{ik} + \zeta_i \hat{\lambda}^{p}_{k}) + var(\zeta_i)\hat{\lambda}^{p2}_{k} \tag{A1}$$

where, the first part is equivalent to asymptotic variance of the OLS estimator of regressing $q_{it} + \zeta_i\, p_t$ on η_{ik} and variance of ζ_i is presented in .