CIP Deviations After the Benchmark Reform*

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Abstract

Since 2021, many major markets have transitioned their money market benchmarks from Interbank Offered Rates (IBOR) to alternative benchmarks, such as the Secured Overnight Financing Rate (SOFR) in the United States. We show that deviations from covered interest rate parity (CIP) remain significant for these new money market benchmarks, which are more robust to many money market frictions. Additionally, by using cross-currency and interest rate derivatives linked to the new benchmarks, we create a new dataset (to be made publicly available) and bring current calculations of CIP deviations between U.S. government bond yields and those of other countries, also referred to as the "U.S. Treasury premium" following Du, Im and Schreger (ISOM JIE, 2018). This analysis reveals several key findings: (1) the U.S. Treasury premium is largely unaffected by the benchmark transition, indicating that money market frictions are not a primary factor in government bond CIP deviations; (2) the long-term U.S. Treasury premium has continued its secular decline, becoming strongly negative; (3) for the first time, the short-term (3-month and 1-year) U.S. Treasury premium is persistently negative; and (4) the pricing of local currency government bonds from emerging markets has become less correlated with their sovereign credit default swap spreads, suggesting a decline in market integration between domestic and external fixed-income markets for emerging markets.

JEL Classifications:
Keywords: Safe Assets, covered interest parity, order book, transaction costs

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1 Introduction

The breakdown of covered interest rate parity (CIP) is a significant development in international finance and macroeconomics. CIP deviations, particularly in interbank rates, have provided a lens for analyzing how financial market frictions and regulatory factors can disrupt arbitrage in one of the world's largest and most liquid markets.

CIP deviations are most often calculated based on Interbank Offered Rates (IBORs), as noted by Du, Tepper, and Verdelhan (2018). However, IBORs are typically indicative quotes that may not reflect actual transaction rates. They are also susceptible to manipulation and carry credit risk tied to the banks in the IBOR panels. As a result, IBOR-based CIP deviations are confounded by these inherent money market frictions.

Since 2021, many major markets have implemented reforms to benchmark money markets, adopting alternative benchmarks with reduced credit risk that more accurately represent actual transactions. The most common choice has been an overnight repo rate, which reflects the average rate on money market transactions collateralized by government bonds. In the United States, the Secured Overnight Financing Rate (SOFR) serves as this new benchmark rate, replacing the U.S dollar Libor Interbank Offer Rate (LIBOR).

We calculate CIP deviations for the new alternative benchmark money market rates and for interest rate swaps linked to these updated floating rate benchmarks. Our findings indicate that CIP deviations remain substantial even with these alternative benchmarks. Moreover, the magnitude of CIP deviations is generally greater for the alternative benchmarks compared to Libor. These CIP deviations after the benchmark reform suggest that the observed discrepancies are not solely due to frictions in the IBOR market, providing additional evidence that they represent no-arbitrage violations.

In addition to CIP deviations for bank rates, CIP deviations between government bond yields are also an important empirical measure, as they offer insights into convenience yields, the default risk on local currency government bonds, and the perceived risk of capital controls (see Du and Schreger (2022) for a comprehensive literature review). However, research in this area has faced challenges in recent years due to the global financial market's transition from benchmark reforms, which necessitated a new set of cross-currency and interest rate derivatives to measure CIP deviations.

This paper addresses the challenge by constructing a new dataset of CIP deviations for 29 currencies, capturing the transition from IBOR to SOFR-like alternative benchmarks and extending the estimates from Du and Schreger (2016) and Du, Im, and Schreger (2018) to include the period after the benchmark reform. A key contribution of this paper is providing researchers with an updated, publicly available dataset that brings current CIP deviation calculations for both bank rates and government bond yields, along with detailed guidelines on constructing these measures under the new reference rate regime. Although a substantial body of literature has relied on the dataset from Du, Im, and Schreger (2018), researchers lacked data since 2021 post the benchmark reform until this update.

With this new dataset, we document several new stylized facts. First, we note that, despite shifts in benchmark rates, CIP deviations between government bonds remain largely unaffected by the transition. We then demonstrate that the relative convenience yield of U.S. Treasury securities, or the "U.S. Treasury Premium," has continued its secular decline since the Global Financial Crisis, now strongly negative vis-à-vis government bonds denominated in G10 currencies. Notably, for the first time, the short-term (3-month and 1-year) U.S. Treasury Premium is persistently negative. This does not imply that the U.S. dollar has lost its distinct status; rather, it suggests that U.S. Treasury securities are no longer inherently

more "special" within the class of dollar assets than other government bonds are within their respective currencies.

Next, we show that long-term benchmark and government CIP deviations have decoupled. We further observe that CIP deviations for emerging market government bonds have become less correlated with sovereign CDS spreads than they were in the 2000s and early 2010s. In our previous work, Du and Schreger (2016), we described this CIP failure between emerging market government bonds and U.S. Tresaury bonds as the "local currency credit spread," as, without financial market frictions, CIP failures between government bonds serve as a credit spread on local currency government bonds. The reduction in correlation between the "local currency credit spread" and sovereign CDS spread aligns with the ongoing development of emerging markets, where market frictions are now a more significant risk factor than explicit credit risk on local currency sovereign debt. We also show that government CIP deviations have become markedly negative for emerging markets with capital controls, such as Russia and Turkey, and discuss how segmentation via capital controls can create this negative basis.

In ongoing work, we are reexamining the relationship between CIP deviations and spot exchange rate determination using our new dataset.

1.1 Related Literature

This paper relates to the large literature studying the failure of CIP across markets. Relative to Du, Tepper, and Verdelhan (2018), it introduces the measurement of CIP deviations to a world where there benchmark rate is a secured overnight rate and documents the changing nature of CIP deviations across the transition. See, for instance, Avdjiev et al. (2019), Cerutti, Obstfeld, and Zhou (2021), Levich (2017), Liao (2020), Popper (1993), Rime, Schrimpf, and Syrstad (2019), Viswanath-Natraj (2020), Keerati (2020), Bahaj and Reis (2022b), Bahaj

and Reis (2022a), Augustin et al. (2024).

The paper also relates to work on the failure of CIP in government rates (Du and Schreger (2016), Du, Im, and Schreger (2018)) by using this new SOFR-based measure to construct the failure of CIP between government bonds. This should allow the literature using the failure of CIP as a measure of convenience yields to continue into this new interest rate regime. See, for instance, Jiang, Krishnamurthy, and Lustig (2021), Engel and Wu (2018), Kekre and Lenel (2021).

More broadly, the measurement relates to the long literature on understanding the drivers and measurement of convenience yields (Krishnamurthy and Vissing-Jorgensen (2012), Diamond and Van Tassel (2022), Van Binsbergen, Diamond, and Grotteria (2022), Nagel (2016), Valchev (2020), He, Nagel, and Song (Forthcoming)).

2 Background on SOFR Transition

In this section, we describe the process of SOFR transition and examine empirical evidence related to the transition process.

2.1 SOFR Transition Process

The transition from IBOR to SOFR was a complex, multi-year process. After the limitations of London Interbank Offered Rate (LIBOR)—namely, that it was not anchored in market activity and was susceptible to manipulation—came to light during the global financial crisis, the United States formed the Alternative Reference Rates Committee (ARRC) in 2014 to review alternative benchmarks.[1] The announcement by the United Kingdom's Financial

[1]The ARRC is comprised of a group of market participants convened by the Board of Governors of the Federal Reserve System, the Federal Reserve Bank of New York, the U.S. Department of the Treasury, the U.S. Commodity Futures Trading Commission (CFTC), and the U.S. Office of Financial Research (OFR).

Conduct Authority, LIBOR's regulator, in 2017, stating that it could not guarantee LIBOR's existence beyond 2021 further accelerated the transition process. In the same year, the committee selected SOFR as the benchmark rate replacement and developed the Paced Transition Plan to ensure a smooth transition.

SOFR is a more robust alternative to LIBOR for several reasons. Published daily by the Federal Reserve Bank of New York, SOFR measures the cost of overnight borrowing collateralized by U.S. Treasury securities, based on transaction data from tri-party, General Collateral Finance (GCF), and bilateral repos cleared through Fixed Income Clearing Corporation (FICC). With daily transaction volumes of close to $1 trillion in June 2021, when SOFR was chosen as the alternative benchmark rate, and more than $2 trillion as of November 2024, far surpassing those in any other U.S. money market, SOFR is fully transaction-based and closely correlated with other money market rates. As a result, SOFR reliably reflects general funding conditions for a broad range of participants, including broker-dealers, asset managers, money market funds, insurance companies, securities lenders, and pension funds.

Based on the Paced Transition Plan, the transition from LIBOR to SOFR entailed several steps. In 2018 and early 2019, efforts focused on ensuring sufficient liquidity in SOFR-linked derivatives to support hedging activities. As liquidity grew in 2019, central counterparties (CCPs) were expected to provide a choice of clearing instruments using SOFR-based discounting curves and paying SOFR interest rates on collateral posted by the first quarter of 2020. Once liquid derivatives markets referencing SOFR were developed, the final step involved creating a forward-looking term rate based on SOFR-linked derivative markets and transitioning cash products to SOFR by the end of 2021.

Note that around the same period, other countries outside the United States similarly

The committee initially consisted of representatives from fifteen large global dealers in U.S. dollar interest rate derivatives and was late expanded to include several CCPs and other organizations.

selected their own alternative benchmark rates to replace their local versions of IBOR and developed their own transition processes. For instance, the Euro Short-Term Rate (€STR or ESTER), the Tokyo Overnight Average Rate (TONAR), and the Sterling Over Night Indexed Average (SONIA) were chosen or created to replace EURIBOR, TIBOR, and GBP LIBOR, respectively. Table 1 lists IBORs and alternative benchmark rates for G10 currencies and certain EME currencies that have introduced such alternative rates. Note that some emerging market countries——such as Indonesia, Israel, Malaysia, Poland, Turkey, and South Africa——have introduced alternative benchmark rates, with local interest rate swaps referencing these rates now trading, but we have not yet observed cross-currency basis swaps that reference local alternative benchmark rates in these currencies. Other countries continue to use local IBORs as their benchmark interest rates. Also, while SOFR (USD), CORRA (CAD), SARON (CHF), KOFR (KRW), THOR (THB) and TLREF (TRY) are secured rates, the other rates in Table 1 are unsecured.

Table 1: IBOR and Alternative Benchmark Rates

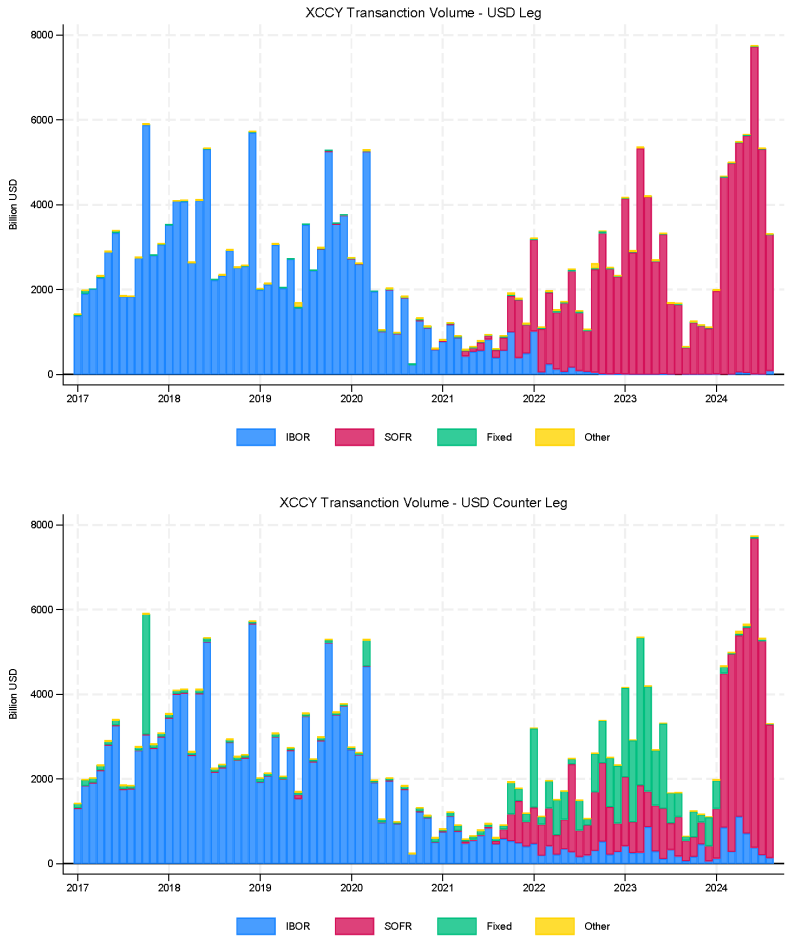
Currency	IBOR Rate	Alternative Benchmark Rate
G10		
USD	US London Interbank Offered Rate (LIBOR)	Secured Overnight Financing Rate (SOFR)
CAD	Canada Bankers Acceptances (CDOR)	Canadian Overnight Repo Rate Average (CORRA)
CHF	CHF LIBOR	Swiss Average Rate Overnight Fixing (SARON)
EUR	Euro Interbank Offered Rate (EURIBOR)	Euro Short Term Rate (€STR)
GBP	GBP LIBOR	Sterling Overnight Index Average (SONIA)
JPY	JPY LIBOR	Tokyo Overnight Average Rate (TONAR)
EME		
IDR	Bank Indonesia Jakarta Interbank Offering Rate (JIBOR)	Indonesia Overnight Index Average (IndONIA)*
ILS	Bank Of Israel Tel Aviv Interbank Offered Rate (TELBOR)	Shekel Overnight Interest Rate (SHIR)*
KRW	KRW Certificate Of Deposit Rate	Korea Overnight Financing Repo Rate (KOFR)
MYR	Kuala Lumpur Interbank Offered Rate (KLIBOR)	Malaysia Overnight Rate (MYOR)*
PLN	Warsaw Interbank Offered Rate (WIBOR)	Warsaw Interest Rate Overnight (WIRON)*
RUB	NFEA Moscow Prime Offered Rate (MosPrime Rate)	Ruble Overnight Index Average (RUONIA)
THB	Bangkok Interbank Offered Rate (BIBOR)	Thai Overnight Repurchase Rate (THOR)
TRY	Turkish Lira Interbank Offer Rate (TRLIBOR)	Turkish Lira Overnight Reference Rate (TLREF)*
ZAR	Safe South Africa Johannesburg Interbank Agreed Rate (JIBAR)	South African Rand Overnight Index Average (ZARONIA)*

Notes: This table lists IBOR rates and alternative benchmark rates for countries that have introduced them. * denotes alternative benchmark rates that have been introduced, though cross-currency basis swaps referencing these rates have not yet been observed.

2.2 Transaction Volumes during the Transition Period

To explore how the transition unfolded, we analyze cross-currency basis swap transaction volumes to observe the shift from IBOR to alternative benchmark rates. Figure 1 shows the volume composition of cross-currency basis swaps that convert U.S. dollars into other currencies. The figure presents the composition for the U.S. dollar leg (top panel) as well as for the other currency leg (bottom panel).

Figure 1: Benchmark Rate Composition of USD Cross-currency Swap Transaction Volumes



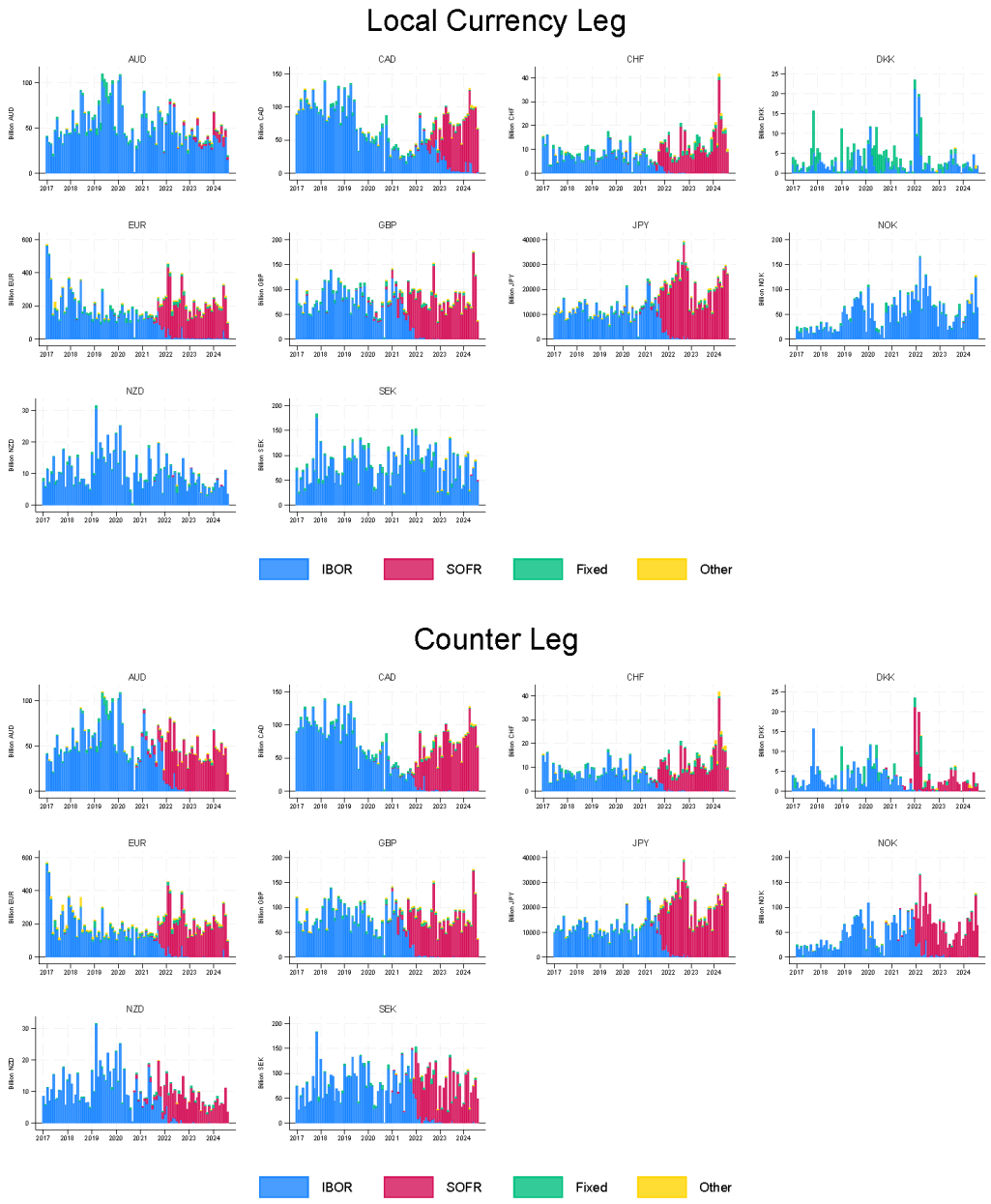
Notes: This figure plots the transaction volume of cross-currency basis swaps for all swaps converting U.S. dollars to other currencies across all tenors. The top panel displays the benchmark rate composition on the U.S. dollar leg, while the bottom panel shows the benchmark rate composition on the non-U.S. dollar legs. In the bottom panel, "SOFR" denotes all alternative benchmark rates in other currencies.

As Figure 1 shows, cross-currency basis swap transactions referencing SOFR were first recorded in mid-2019, but significant volumes did not appear until early 2021. SOFR-referenced swap transactions make up the majority of all U.S. dollar cross-currency basis swap volume in late 2021, and by early 2022, virtually all transaction volume was SOFR-

based.

Outside the United States, the transition from LIBOR to alternative benchmark rates progressed at a different pace. Among G10 currencies, cross-currency basis swap transactions for CAD, EUR, GBP, and JPY transitioned to alternative benchmark rates around the same time as the shift from LIBOR to SOFR on the U.S. dollar legs, with reference rates on both legs switching to alternative benchmarks relatively concurrently. However, for AUD, DKK, NOK, NZD, and SEK, cross-currency basis swaps that convert U.S. dollar to these currencies continue to reference local IBOR for their own-currency legs, even as the U.S. dollar legs have switched to SOFR. Figure 2 shows the volume composition of cross-currency basis swaps that convert U.S. dollars into other G10 currencies

Figure 2: Benchmark Rate Composition of G10 Cross-currency Swap Transaction Volumes



Notes: This figure plots the transaction volume of cross-currency basis swaps for all swaps converting specific G10 currencies to other foreign currencies. The top panel displays the benchmark rate composition on the G10 currency's own leg, while the bottom panel shows the benchmark rate composition on the opposite foreign currency leg. In both panels, "SOFR" denotes all alternative benchmark rates.

For EME currencies in our sample, although several emerging market countries have introduced alternative benchmark rates for their local markets, most cross-currency basis swaps that convert U.S. dollars to these currencies continue to reference either the local IBOR or a fixed rate for their own currency legs, even as the foreign currency leg shifts to alternative benchmark rates (primarily SOFR or ESTER). In fact, only THB cross-currency basis swaps have switched their local currency leg to an alternative benchmark rate (THOR). For most EM currencies, the transition to alternative benchmark rates on the foreign currency legs occurred around early 2022.

3 Measure CIP Deviations after the Benchmark Reform

3.1 CIP Deviations for Bank Rates

Following Du, Tepper, and Verdelhan (2018) and Du and Schreger (2022), we calculate the log n-year cross currency basis or CIP deviation, $x^k_{i,n,t}$, as the difference between the direct dollar interest rate from the cash market and the synthetic dollar rate from the FX swap market:

$$x^k_{i,n,t} = \underbrace{y^k_{\$,n,t}}_{\text{Cash Market Dollar Rate}} - \underbrace{\left(y^k_{i,n,t} - \rho_{i,n,t}\right)}_{\text{FX Swap Market Dollar Rate}}, \tag{1}$$

where

$$\rho_{i,n,t} = \frac{1}{n}\left(\log(F_{i,n,t} - \log(S_{i,t})\right) \tag{2}$$

is the annualized forward premium of selling foreign currency i in exchange for the U.S. dollar. The interest rate $y^k_{\$,n,t}$ denotes n-year dollar interest rate and $y^k_{i,n,t}$ denotes n-year interest rate in currency i. Both interest rates have the superscript k, which indicates the specific type of the interest rate. For a long-term interest rate, the plain-vanilla fixed-for-

floating interest rate swap indexed to the floating rate benchmark k is used. A negative cross-currency basis ($x^k_{i,n,t} < 0$) implies that the direct dollar interest rate is lower than the the synthetic dollar interest in the FX swap market, and a positive cross-currency basis ($x^k_{i,n,t} > 0$) means that the direct dollar rate is higher than the synthetic rate.

Prior to the benchmark reform, the most commonly used benchmark rates are LIBOR, so the LIBOR CIP deviations are given by

$$x^{\text{LIBOR}}_{i,n,t} = y^{\text{LIBOR}}_{i,n,t} - y^{\text{LIBOR}}_{\$,n,t} - \rho_{i,n,t}. \tag{3}$$

The textbook no-arbitrage condition requires that the dollar interest rate in the cash market match the implied dollar interest rate in the swap market. In frictionless markets, if the CIP condition fails, an arbitrageur could profit risk-free by borrowing at the lower rate and lending at the higher rate, thereby arbitraging away the gap between the two rates. However, the natural concern using LIBOR-based CIP deviations as proxy for no-arbitrage violations and intermediary constraints is that LIBORs are indicative, subject to manipulations, and can include sizable credit risk associated with bank defaults.

After the benchmark reform, the cross-currency basis can be calculated for alternative benchmark rates if country i has adopted an alternative benchmark rate for money market rates,

$$x^{\text{Alt}}_{i,n,t} = y^{\text{Alt}}_{i,n,t} - y^{\text{Alt}}_{\$,n,t} - \rho_{i,n,t}, \tag{4}$$

Compared to IBOR, alternative money market benchmarks are generally more resilient to various market frictions, as SOFR-like benchmarks are based on actual transaction rates for collateralized borrowing and lending. Thus, any significant CIP deviations with alternative benchmarks would further confirm that such deviations represent no-arbitrage violations.

3.2 Calculating the Forward Premium with Different Benchmarks

Besides the choice of domestic and foreign interest rates, the benchmark reform may also affects the calculation of forward premium, $\rho_{i,n,t}$, as long-term forward premium is constructed from a collection of interest rate and cross-currency derivatives linked to the floating rate benchmark. We now explain how the forward premium is calculated.

For short-term maturities less than one year, we calculate the market implied forward premium directly from the forward and spot exchange rates as described in Eq. 2, since the outright forward $F_{i,n,t}$ is directly quoted in the market. The benchmark reform does not affect the calculation of short-term forward premium.

For maturities of one year or longer, we follow the market convention of quoting the forward premium using a combination of interest rate swaps and cross-currency basis swaps, based on the following formula:

$$\rho^k_{i,n,t} = irs^k_{i,n,t} + bs^k_{i,n,t} - irs^k_{\$,n,t} \tag{5}$$

where $irs^k_{i,n,t}$ denotes the n-year interest rate swap rate that exchanges fixed currency i cash flows into the floating interest rate benchmark k (referred to as the benchmark interest rate swap) in country i, $bs^k_{i,n,t}$ is the n-year cross-currency basis swap that exchanges the benchmark rate in country i for U.S. benchmark rate, and $irs^b_{\$,n,t}$ is the U.S. benchmark interest rate swap rate that exchange fixed dollar cash flows into U.S. benchmark rate.[2] We calculate the forward premium for both IBOR and SOFR benchmarks.

[2]For some currencies—notably CNH, KRW, and TRY in our sample—we calculate the forward premium using cross-currency basis swaps that exchange fixed cash flows in those currencies for U.S. benchmark rates, as these swaps are more actively traded than floating-to-floating cross-currency basis swaps. For emerging market currencies with capital controls, dollar investors can still hedge foreign currency exposure via non-deliverable swap markets, and we similarly calculate the forward premium based on these swaps.

3.3 CIP Deviations for Government Bond Yields

Similarly, we can also calculate the cross-currency basis between government bond yields as

$$x_{i,n,t}^{\text{Govt}} = y_{i,n,t}^{\text{Govt}} - y_{\$,n,t}^{\text{Govt}} - \rho_{i,n,t}. \tag{6}$$

Following Du, Im, and Schreger (2018), we flip the sign of the cross-currency basis for government bonds, and define the U.S. Treasury premium as the difference between the synthetic dollar interest rate from foreign government bonds and the U.S. Treasury yield:

$$\Phi_{i,n,t} \equiv -x_{i,n,t}^{Govt} = y_{i,n,t}^{Govt} - \rho_{i,n,t} - y_{\$,n,t}^{Govt}, \tag{7}$$

where $\rho_{i,n,t}$ is the n-year market-implied forward premium for hedging currency i against the U.S. dollar.

Unlike with benchmark rates, where a failure of CIP indicates an arbitrage opportunity, there are several reasons why covered interest rate parity may fail between government bonds. First, the convenience yields of the bond may be different than that of U.S. Treasuries in dollar markets. Second, the sovereign bond may carry a risk of default that differs from U.S. Treasuries. Third, financial market frictions may contribute to a failure of CIP between the two bonds. This could occur because of the failure of CIP between benchmark rates or because of other financial market frictions such as capital controls.

We begin by defining each of these components in turn. Beginning with convenience yields, let $\Lambda_{i,t+1}$ denote the convenience benefit of the government bond of country i realized at $t+1$, and let $y_{i,t}^{rf}$ denote the risk-free rate in currency i. Then we can price a one-period Treasury bond in country i is $P_{i,t}^{Govt} = \exp(-y_{i,t}^{rf})\mathbb{E}_{i,t}[(1+\Lambda_{i,t+1})]$ where $\mathbb{E}_{i,t}$ refers to the

risk-neutral expectation in country i. In logs, we have

$$\lambda_{i,t} = y_{i,t}^{rf} - y_{i,t}^{Govt}. \tag{8}$$

where $y_{i,t}^{Govt} = -\log(P_{i,t}^{Govt})$ is the yield on the government bond, and $\lambda_{i,t} \equiv \ln \mathbb{E}_{i,t}(1 + \Lambda_{i,t+1})$ is the Treasury convenience premium in country i at time t. Therefore, the convenience yield in country i is equal to the spread between the risk-free rate and the government bond yield. In this case, the government bond yield can be lower than the risk-free rate if there is a positive convenience benefit associated with holding government bonds.

We can define the convenience yield of the U.S. Treasury, $\lambda_{USD,t}$, equivalently as the spread between the U.S. risk-free rate, $y_{USD,t}^{rf}$, and U.S. Treasury yield, $y_{USD,t}^{Govt}$: $\lambda_{USD,t} = y_{USD,t}^{rf} - y_{USD,t}^{Govt}$. Then the difference in the convenience yield between U.S. Treasuries and the government bonds of i in its local currency is given by

$$\hat{\lambda}_{i,t} \equiv \lambda_{USD,t} - \lambda_{i,t} = (y_{USD,t}^{rf} - y_{USD,t}^{Govt}) - (y_{i,t}^{rf} - y_{i,t}^{Govt}). \tag{9}$$

The next component we turn to is default risk. Here, we use $\hat{l}_{i,n,t}$ to denote the difference between the expected default loss of the U.S. Treasury bond, $l_{USD,n,t}$, and the expected default loss of the Treasury bond in country i, $l_{i,n,t}$, .

$$\hat{l}_{i,n,t} \equiv l_{USD,n,t} - l_{i,n,t}. \tag{10}$$

Finally, for financial market frictions market frictions, we define a wedge $\tau_{i,n,t}$ that is equal to the difference between the hypothetical premium, $\tilde{\rho}_{i,n,t}$, and the observed forward

premium, $\rho_{i,n,t}$:

$$\tau_{i,n,t} \equiv \tilde{\rho}_{i,n,t} - \rho_{i,n,t}. \tag{11}$$

In the presence of these three potential sources of frictions, the failure of CIP between government bonds becomes a collection of the convenience yield differential, differential default risk, and financial market frictions:

$$\Phi_{i,n,t} = \hat{\lambda}_{i,n,t} - \hat{l}_{i,n,t} + \tau_{i,n,t}. \tag{12}$$

where $\hat{x}_{i,n,t} \equiv x_{USD,n,t} - x_{i,n,t}$.

Special Case: Government CIP Deviation as a Relative Convenience Yield If there were frictionless international financial markets and governments had no risk of default on their local currency government bonds, then the CIP failure of government bonds would measure the the Treasury convenience yield differential between the United States and country i:

$$\Phi_{i,n,t} = \hat{\lambda}_{i,n,t}, \tag{13}$$

where $\hat{\lambda}_{i,n,t} \equiv \lambda_{USD,n,t} - \lambda_{i,n,t}$. This case was the focus of Du, Im, and Schreger (2018) in a study of only G10 currencies and termed "The U.S. Treasury Premium."

Special Case: Government CIP Deviation as a Sovereign Default Risk If we instead assume that there are no convenience yields or financial market frictions, then the failure of CIP between government bonds measures the differential credit risk on the two

bonds, measured in the local currency:

$$\Phi_{i,n,t} = -\hat{l}_{i,n,t}. \tag{14}$$

This case was the focus of Du and Schreger (2016), measuring the risk of sovereign default in emerging market currencies and termed the "Local Currency Credit Spread."

Of course, neither special case is likely to hold exactly. However, G10 currencies are less likely to be affected by sovereign default risk, and convenience yields were likely to be much smaller than credit risk in emerging markets in the early 2000s. However, we do not impose either of these assumptions here, and they are presented to provide intuition.

4 Data

In this section, we briefly discuss data sources used in the measurement of CIP deviations and the construction of the U.S. Treasury Premium, as well as some measurement issues. The tickers of all Bloomberg and Thomson Reuters data used are listed in the internet appendix.

4.1 Bond Yields and the Market-Implied Forward Premium

We use Bloomberg BVAL curves for government bond yields in the United States and other countries; BVAL curves are a weighted blend of direct observations and fitted par yield curves based on secondary market bond prices.[3] We also use Bloomberg data for yields on interest rate swaps and cross-currency basis swaps, supplemented by data from Thomson Reuters when Bloomberg data is unavailable.

[3] Du and Schreger (2016); Du, Im, and Schreger (2018); Du and Schreger (2022) use Bloomberg BFV curves for government bond yields, which only capture fitted par yield curves based on secondary market bond prices estimated by Bloomberg. BFV curves were discontinued as of May 1, 2014. Differences between BVAL curves and BFV curves are minimal.

4.2 Sovereign Credit Risk

We measure sovereign credit risk using CDS spreads from Markit. The data reflect spreads on senior unsecured credit default swap contracts denominated in U.S. dollars, except for CDS spreads on the United States, which are denominated in euros. We obtain the data for the six-month, and one to ten-year contracts. Because data on the three-month contract is limited, we use the six-month contract for the three-month contract instead.

4.3 Cross-currency Swap Transaction Data

We obtain data on cross-currency swap transactions from Bloomberg's Swap Data Repository (SDR), which aggregates transaction-level data on swaps reported to the Depository Trust and Clearing Corporation (DTCC). Although other SDRs, such as Intercontinental Exchange (ICE) and Chicago Mercantile Exchange (CME), are also registered with the U.S. Commodity Futures Trading Commission (CFTC), transactions reported to the DTCC currently capture the majority of the overall volume. We estimate that Bloomberg SDR captures approximately 75 percent of the overall swap transaction volume reported to the CFTC based on data from October 2018 to January 2024. Based on this data, we focus on cross-currency basis swap transactions, allowing us to observe transactions by currency and tenor, and to identify the reference interest rates on both legs of the swaps.

5 Main Results

5.1 CIP Deviations since Benchmark Reform

Next, we explore how the transition from IBOR to alternative benchmark rates affected CIP deviations for benchmark money market rates and for government bond yields. Table 2 and

Table 3 provide summary statistics of CIP deviations in benchmark rates and in government bond yields at the one-year (top panel) and the ten-year (bottom panel) tenors, respectively, during overlapping periods when deviations under both bases were observed. Note that in Table 2, we show benchmark CIP deviations only for currencies that have switched both legs of the cross-currency basis swaps to reference alternative benchmark rates. Additionally, we do not observe CIP deviations in the benchmark rates of currencies from emerging market economies with capital controls. Based on these results, we highlight a few key takeaways.

Table 2: Summary statistics of benchmark CIP deviation during transition period

3-month tenor

	$\overline{x_t^{\text{SOFR}}}$	$\overline{x_t^{\text{IBOR}}}$	$\overline{\hat{x}_t}$	$\hat{x}_t^{5\text{th}}$	$\hat{x}_t^{95\text{th}}$	$\sigma_{\hat{x}_t}$	$\rho(x_t^{\text{SOFR}}, x_t^{\text{IBOR}})$	$\frac{\sigma_{x_t^{\text{SOFR}}}}{\sigma_{x_t^{\text{IBOR}}}}$	First SOFR	Last IBOR	Days
G10											
CAD	-21.82	-35.04	13.22	-4.90	35.70	13.02	0.23	0.69	04/02/18	06/28/24	2,279
CHF	-31.78	-9.55	-22.23	-50.42	-8.81	17.61	0.38	1.20	04/02/18	12/31/21	1,369
EUR	-21.31	-5.42	-15.87	-35.25	-0.59	13.94	0.59	0.98	04/03/18	07/31/24	2,311
GBP	-17.34	-4.35	-12.96	-26.78	-0.14	10.37	0.44	1.16	04/03/18	03/28/24	2,186
JPY	-43.28	-19.12	-24.15	-45.59	-11.11	16.77	0.67	1.47	04/02/18	12/30/22	1,733
EMs											
THB	-31.05	-21.81	-9.18	-29.62	5.99	10.63	0.78	0.98	09/04/20	07/31/24	1,426

1-year tenor

	$\overline{x_t^{\text{SOFR}}}$	$\overline{x_t^{\text{IBOR}}}$	$\overline{\hat{x}_t}$	$\hat{x}_t^{5\text{th}}$	$\hat{x}_t^{95\text{th}}$	$\sigma_{\hat{x}_t}$	$\rho(x_t^{\text{SOFR}}, x_t^{\text{IBOR}})$	$\frac{\sigma_{x_t^{\text{SOFR}}}}{\sigma_{x_t^{\text{IBOR}}}}$	First SOFR	Last IBOR	Days
G10											
CAD	-13.73	-27.49	13.81	7.50	19.75	4.10	0.20	0.57	06/06/22	07/26/22	50
CHF	-22.46	-6.88	-15.58	-19.29	-10.94	2.63	0.71	1.72	06/17/21	12/31/21	197
EUR	-16.42	-8.10	-8.32	-12.86	-5.48	2.38	0.64	1.51	02/23/21	12/31/21	311
GBP	-10.04	-3.67	-6.36	-11.60	-2.32	3.21	0.31	1.46	02/19/21	12/29/21	313
JPY	-32.43	-18.38	-14.12	-21.68	-7.96	4.32	0.80	2.15	02/19/21	12/30/21	314
EMs											
THB	-31.34	-1.80	-32.66	-39.00	-18.50	6.77	0.71	4.44	01/21/22	06/09/22	139

10-year tenor

	$\overline{x_t^{\text{SOFR}}}$	$\overline{x_t^{\text{IBOR}}}$	$\overline{\hat{x}_t}$	$\hat{x}_t^{5\text{th}}$	$\hat{x}_t^{95\text{th}}$	$\sigma_{\hat{x}_t}$	$\rho(x_t^{\text{SOFR}}, x_t^{\text{IBOR}})$	$\frac{\sigma_{x_t^{\text{SOFR}}}}{\sigma_{x_t^{\text{IBOR}}}}$	First SOFR	Last IBOR	Days
G10											
CAD	-4.84	-10.81	5.90	4.43	7.00	0.78	0.96	0.86	06/06/22	07/26/22	50
CHF	-39.16	-15.92	-23.21	-26.49	-18.82	2.30	0.86	1.32	06/17/21	12/30/21	196
EUR	-21.55	-10.87	-10.65	-13.66	-7.62	1.80	0.85	1.54	02/23/21	12/30/21	310
GBP	-10.75	1.71	-12.39	-13.50	-11.43	0.73	0.90	1.14	02/19/21	12/30/21	314
JPY	-59.04	-37.68	-21.34	-25.13	-16.76	3.23	0.62	1.39	02/19/21	12/30/21	314
EMs											
THB	-94.70	-47.44	-46.14	-62.00	-32.50	10.25	0.51	0.65	01/21/22	06/09/22	139

Notes: This table provides summary statistics of benchmark CIP deviations (x_t) for the period during which deviations for both IBOR-based and alternative benchmark rates-based are observable. Note that $\hat{x}_t = x_t^{\text{SOFR}} - x_t^{\text{IBOR}}$, and the average difference may not equal the difference in averages if there is missing data in one of the series.

Table 3: Summary statistics of government CIP deviation during transition period

1-year tenor

	$\overline{\Phi_t^{\text{SOFR}}}$	$\overline{\Phi_t^{\text{IBOR}}}$	$\overline{\hat{\Phi}_t}$	$\hat{\Phi}_t^{5\text{th}}$	$\hat{\Phi}_t^{95\text{th}}$	$\sigma_{\hat{\Phi}_t}$	$\rho(\Phi_t^{\text{SOFR}}, \Phi_t^{\text{IBOR}})$	$\frac{\sigma_{\Phi_t^{\text{SOFR}}}}{\sigma_{\Phi_t^{\text{IBOR}}}}$	First SOFR	Last IBOR	Days
G10											
AUD	-7.30	-6.14	-1.16	-2.93	0.83	1.31	0.99	0.99	10/05/21	07/26/22	294
CAD	20.02	24.71	-4.46	-10.05	-0.61	3.01	0.86	1.08	06/06/22	07/26/22	50
CHF	13.83	12.88	0.95	-2.41	5.61	3.03	0.73	0.93	06/17/21	12/31/21	197
DKK	6.09	7.78	-1.46	-8.08	2.13	2.97	0.79	0.90	10/27/21	03/16/22	140
EUR	-6.12	-4.86	-1.25	-2.40	-0.51	0.64	0.99	1.00	02/23/21	12/31/21	311
GBP	-14.09	-13.58	-0.40	-2.25	0.71	0.91	1.00	1.04	02/19/21	12/29/21	313
JPY	19.22	20.26	-1.02	-4.19	4.31	2.66	0.93	1.27	02/19/21	12/30/21	314
NOK	17.72	19.26	-1.57	-4.07	1.34	1.82	1.00	0.97	10/06/21	07/26/22	293
NZD	-9.70	-6.01	-3.73	-9.54	1.89	3.41	0.97	0.94	09/28/21	06/08/22	253
SEK	-2.82	0.23	-0.50	-2.95	3.41	2.01	0.99	0.95	11/08/21	07/26/22	260
EMs											
CLP	60.46	44.38	7.02	-15.23	43.36	13.98	0.82	0.89	02/17/22	03/25/22	36
CNH	-33.52	-32.16	-1.38	-3.96	2.08	1.93	1.00	1.02	01/05/22	05/09/22	124
COP	-89.02	34.32						0.13	02/17/22	06/30/23	498
HUF	-99.49	-96.21	-3.29	-12.13	7.00	7.57	0.98	0.90	10/27/21	12/31/21	65
IDR	-92.40	-92.63	0.23	-3.10	4.56	3.32	0.98	1.09	02/24/22	03/07/22	11
INR	-29.99	-30.21	-9.24	-31.58	9.99	12.92	0.97	1.05	02/24/22	09/09/22	197
KRW	70.92	81.35	-10.43	-21.48	4.70	9.61	0.58	0.88	01/18/22	03/07/22	48
MXN	-61.48	-55.22	-6.25	-7.85	-4.04	1.52	0.94	0.91	03/18/22	03/28/22	10
MYR	57.64	51.06	5.01	-16.93	21.13	10.98	0.62	1.61	11/24/20	03/07/22	468
PHP	-101.94	-35.93	-18.15	-26.12	-5.79	8.72	1.00	0.93	02/24/22	06/30/23	491
PLN	-68.23	-66.24	-1.99	-10.53	5.52	4.77	0.98	1.07	10/27/21	12/31/21	65
THB	38.26	53.39	-2.18	-12.84	4.66	5.56	0.99	0.94	01/21/22	06/09/22	139
TRY	-1009.29	-1010.61	1.32	-22.48	43.31	19.49	1.00	0.99	01/25/22	03/07/22	41
ZAR	29.32	40.30	-10.79	-32.56	1.34	11.18	0.95	1.01	02/08/22	06/30/23	507

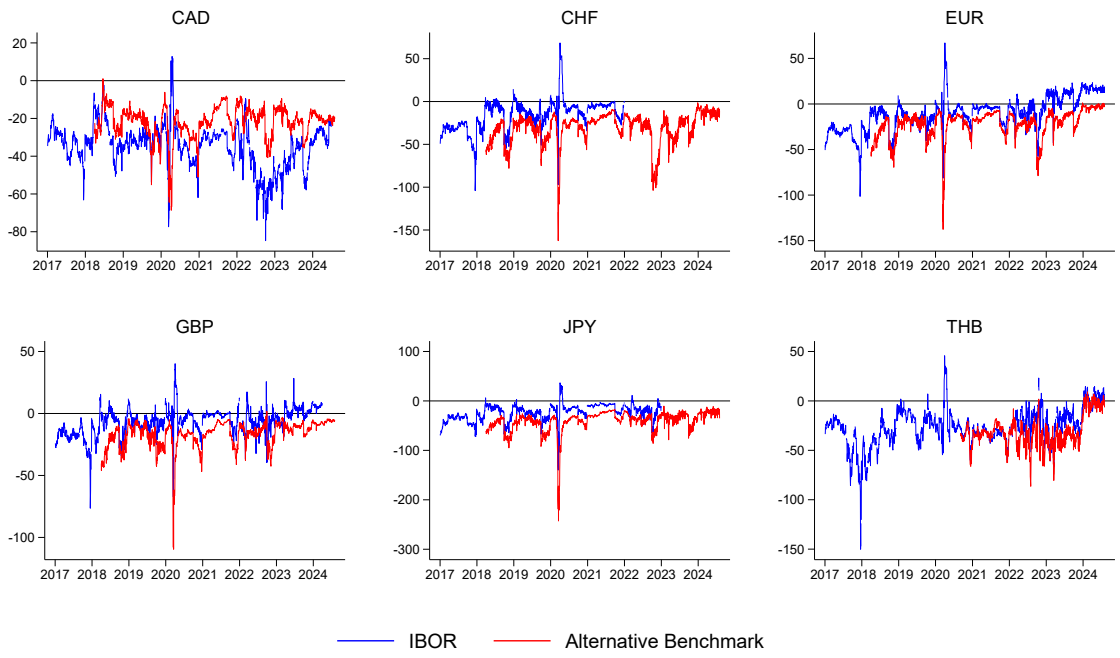
10-year tenor

	$\overline{\Phi_t^{\text{SOFR}}}$	$\overline{\Phi_t^{\text{IBOR}}}$	$\overline{\hat{\Phi}_t}$	$\hat{\Phi}_t^{5\text{th}}$	$\hat{\Phi}_t^{95\text{th}}$	$\sigma_{\hat{\Phi}_t}$	$\rho(\Phi_t^{\text{SOFR}}, \Phi_t^{\text{IBOR}})$	$\frac{\sigma_{\Phi_t^{\text{SOFR}}}}{\sigma_{\Phi_t^{\text{IBOR}}}}$	First SOFR	Last IBOR	Days
G10											
AUD	-54.19	-52.10	-2.08	-2.78	-0.98	0.58	1.00	1.01	10/05/21	07/26/22	294
CAD	-28.38	-26.73	-1.65	-3.22	0.01	0.90	0.97	1.04	06/06/22	07/26/22	50
CHF	-0.47	1.72	-2.19	-6.39	2.40	2.51	0.88	1.18	06/17/21	12/30/21	196
DKK	-8.84	-7.77	-1.69	-3.52	0.50	1.39	0.99	1.14	10/27/21	03/16/22	140
EUR	-24.53	-22.91	-1.62	-2.26	-1.10	0.50	1.00	0.99	02/23/21	12/30/21	310
GBP	-6.64	-4.89	-1.78	-2.82	-1.06	0.68	0.99	0.97	02/19/21	12/30/21	314
JPY	36.92	40.18	-3.31	-7.36	0.17	2.91	0.90	1.34	02/19/21	12/30/21	314
NOK	-6.47	-4.84	-1.79	-2.84	-0.23	1.54	0.97	0.98	10/06/21	07/19/22	286
NZD	-57.46	-53.61	-3.55	-6.55	-0.72	2.07	0.97	1.04	09/28/21	06/08/22	253
SEK	-75.41	-71.96	-2.18	-2.97	-1.45	0.50	1.00	1.05	10/18/21	07/19/22	274
EMs											
CLP	29.95	-3.57	33.52	25.84	38.29	5.18	0.94	0.99	02/17/22	03/28/22	39
CNH	21.31	22.55	-1.24	-8.62	5.94	4.23	0.99	0.99	01/05/22	05/09/22	124
CNY	-11.32	79.18	-90.16	-91.58	-85.36	1.99	0.57	1.36	02/22/22	03/04/22	10
COP	183.73	152.02	33.39	13.51	40.79	44.34	0.66	0.57	02/17/22	06/30/23	498
HUF	31.49	30.07	1.42	-5.62	9.30	4.18	0.94	1.00	10/27/21	12/31/21	65
IDR	134.25	133.23	1.02	-15.40	25.27	13.48	0.16	0.42	02/24/22	03/07/22	11
INR	28.78	41.50	-10.36	-37.17	1.65	12.07	0.82	1.19	02/23/22	10/12/22	231
KRW	91.59	87.99	3.18	2.60	8.45	9.36	0.71	0.78	01/11/22	03/07/22	55
MXN	63.68	44.92	18.76	17.77	19.86	0.88	0.97	0.93	03/18/22	03/28/22	10
MYR	114.35	110.48	5.91	-18.22	21.37	11.70	0.68	0.72	11/24/20	03/07/22	468
PEN	50.57	37.02	13.55	-2.91	23.88	7.27	0.69	0.69	03/10/22	03/25/22	15
PHP	96.74	111.44	-21.45	-32.44	-15.18	5.44	0.99	1.20	02/24/22	06/30/23	491
PLN	-8.77	-7.01	-1.76	-3.11	-0.37	0.78	0.99	1.02	10/27/21	12/31/21	65
THB	80.29	94.08	-14.97	-28.18	-1.97	8.83	0.80	0.73	01/21/22	06/09/22	139
TRY	-374.01	-395.19	21.18	-40.37	55.46	26.49	0.98	1.04	01/25/22	03/07/22	41
ZAR	185.37	198.60	-13.73	-38.12	-3.82	12.24	0.91	0.90	02/08/22	06/30/23	507

Notes: This table provides summary statistics of government CIP deviations (Φ_t) for the period during which deviations for both IBOR-based and alternative benchmark rates-based are observable. Note that $\hat{\Phi}_t = \Phi_t^{\text{SOFR}} - \Phi_t^{\text{IBOR}}$, and the average difference may not equal the difference in averages if there is missing data in one of the series. Also, there is no difference between IBOR-based and alternative benchmark-based government CIP deviations, since the forward premium is determined solely by the FX market and not the swap market.

First, there are strong correlations between benchmark CIP deviations measured with IBOR and alternative benchmark rates for most currencies, though with a significant level shift. As shown in Table 2, among the currencies in our sample, alternative benchmark CIP deviations are generally more negative than IBOR-based deviations——by approximately 6–33 basis points at the one-year tenor and by 11–46 basis points at the ten-year tenor. An exception is CAD, where alternative benchmark CIP deviations are less negative than those based on IBOR by about 6–14 basis points. For most currencies, alternative benchmark and IBOR CIP deviations are also highly correlated, particularly at longer tenors. Notable exceptions include CAD and GBP, which show only 20–30 percent correlations at the one-year tenor, although correlations remain strong at longer tenors. With the exception of CAD, alternative benchmark CIP deviations are also more volatile than IBOR-based deviations, with standard deviation ratios greater than one. Figure 3 also plots IBOR-based versus alternative benchmark CIP deviations during overlapping periods.

Figure 3: Benchmark CIP Deviations: 3-Month IBOR-based vs. Alternative Rate-Based



Notes: This chart plots 3-month IBOR-based and alternative benchmark CIP deviations during overlapping periods for currencies that have switched both legs of their cross-currency basis swaps to reference alternative benchmark rates. Three-month IBOR rates are used to calculated the IBOR-based basis, and three-month interest rate swap rates linked to the new secure rates are used to calculate the basis based on the alternative benchmark. The details of the benchmark rates are given in Table 1.

Second, CIP deviations in government bond yields are largely unaffected by the transition. As shown in Table 3, we observed minimal differences in government CIP deviations based on SOFR and IBOR reference rates. For instance, at the 1-year tenor, the average difference in CIP deviations during the overlapping periods—the time when we observed the deviations under both bases—is less than 5 bps for each G10 currency, all with small standard deviations. For EM currencies, the average difference is mostly below 10 bps, with a few exceptions where they are slightly wider but still under 20 bps. Government CIP de-

viations under both bases also exhibit similar degrees of volatility, with standard deviation ratios mostly close to one, and are strongly correlated during the overlapping period, with correlations generally close to one, except for a few currencies. Appendix Figures A1 and A2 plot the 5-year government CIP deviations for G10 curerncy countries and emerging market countries, respectively, during overlapping periods.

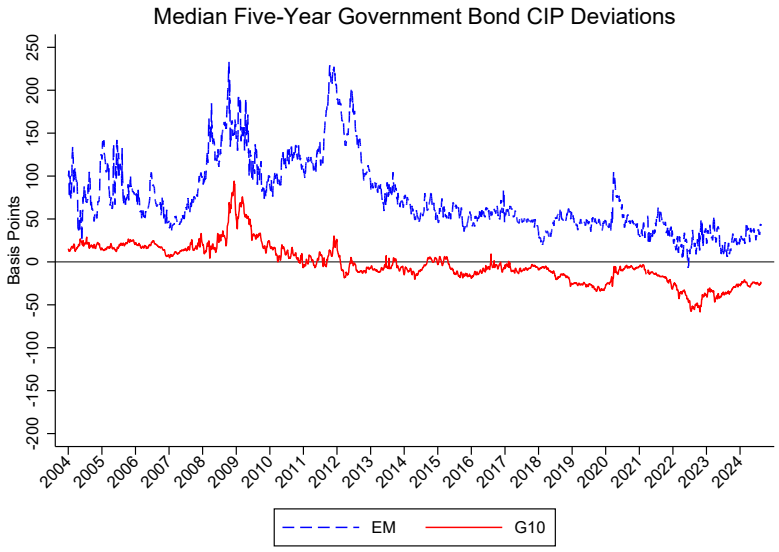
Third, the transition from LIBOR to SOFR included transition periods. For G10 currencies, these transition periods lasted about a year. For emerging market (EME) currencies, however, the transition pace depended on transaction volumes. Currencies with higher transaction volumes transitioned more quickly, while those with lower volumes experienced a longer overlap period, during which cross-currency basis swaps referenced both LIBOR and the alternative benchmark rates were observed. For G10 currencies, cross-currency basis swaps referencing SOFR began trading in 2021, with the final LIBOR day occurring roughly a year later. For EME currencies, the first SOFR-referenced transactions generally appeared in early 2022. In lower-volume EME currencies——such as COP, IDR, INR, MYR, PHP, THB, and ZAR——LIBOR-referenced swap transactions continued to occur more than a year after the initial SOFR transactions were seen. Conversely, for high-volume currencies—such as CLP, CNY, HUF, KRY, MXN, PLN, and TRY—IBOR-based transactions ceased within two months of the first SOFR transactions.

5.2 New stylized facts on the U.S. Treasury Premium

We now highlight several key stylized facts on the U.S. Tresaury premium. First, the long-term U.S. Treasury Premium continued its secular decline, with the median U.S. Treasury Premium of G10 currency countries at medium and long horizons becoming strongly negative. Figure 4 illustrates this result. It shows that the median U.S. Treasury Premium for G10

currencies turned negative in 2012 and has become even more negative since 2021, with the average 5-year U.S. Treasury Premium for G10 currencies of -26 bps since 2021, compared to -7 bps during 2012-2020. The decline in U.S. Treasury Premium is more pronounced for most European currencies (CHF, DKK, EUR, GBP, and SEK) as well as for JPY. For EMEs, the median U.S. Treasury Premium has also declined, although it remains positive.

Figure 4: The U.S. Treasury Premium: Updated and Extended

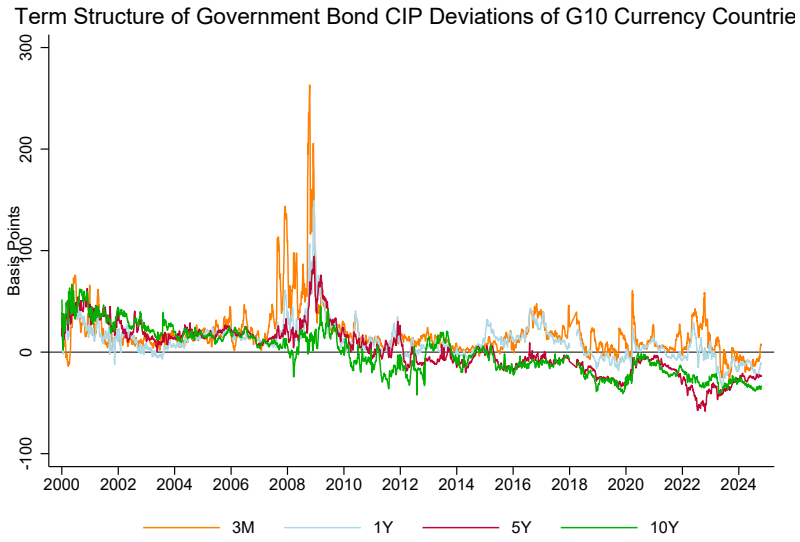


Notes: This chart plots the median government CIP deviations for G10 currency countries at different tenors.

Second, the decline in U.S. Treasury Premium is not confined to longer tenors; for the first time, the median short-term (3-month and 1-year) U.S. Treasury Premiums for G10 currency countries have also turned persistently negative since 2023, as shown in Figure 5. Specifically, the median 3-month and 1-year U.S. Treasury Premiums for G10 currency countries since 2023 were -7 bps and -16 bps, respectively, compared to 11 bps and 6 bps, respectively, in the prior decade. Similar to the decline in U.S. Treasury Premium at longer

tenors, the decline at shorter tenors is also more pronounced among European currencies (CHF, DKK, EUR, and GBP) as well as for JPY. For EMEs, the median short-term U.S. Treasury Premiums have occasionally turned negative but, on average, have remained in positive territory.

Figure 5: Term Structure of the U.S. Treasury Premium of G10 Currency Countries

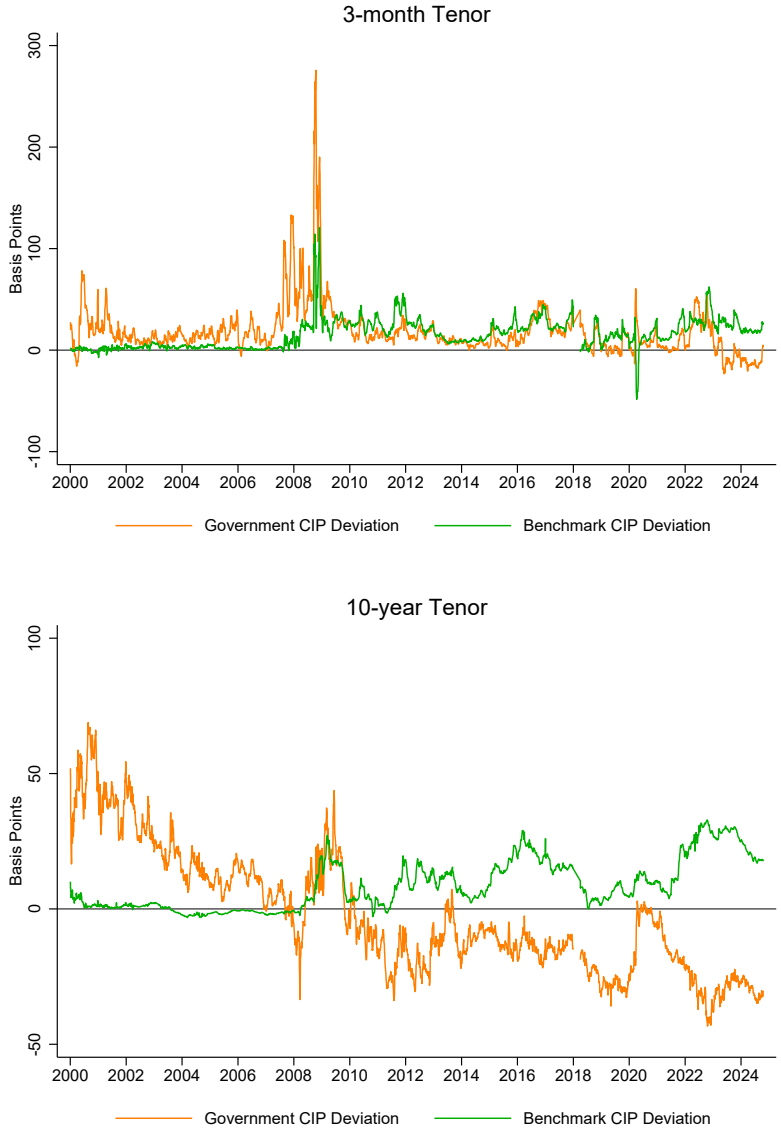


Notes: This chart plots the median 5-year government CIP deviations for G10 and EM currency countries.

Third, there has been a decoupling between long-term benchmark and government CIP deviations. Figure 6 illustrates this by plotting both benchmark and government CIP deviations for the 3-month tenor (top panel) and the 10-year tenor (bottom panel). While the benchmark and government CIP deviations closely align at the 3-month tenor, they diverge significantly at the 10-year tenor. In the aftermath of the Global Financial Crisis, while the 10-year benchmark CIP deviations have shown greater volatility, they have remained positive and been gradually rising. In contrast, the 10-year government CIP deviations have

been steadily declining, turning persistently negative since 2010. This divergence is further underscored by the correlation: since 2010, the correlation between benchmark and government CIP deviations at the 3-month tenor stands at 0.4, whereas for the 3-month tenor it is -0.29.

Figure 6: The Decoupling of Risk-Free and Government CIP Deviations

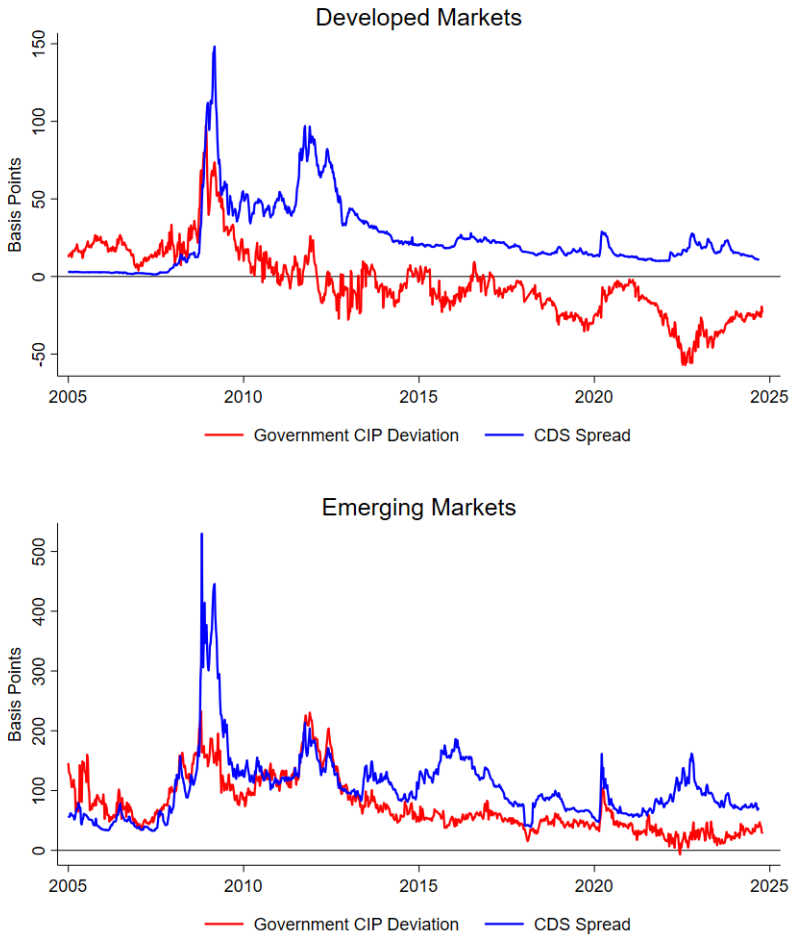


Notes: This chart plots the median government CIP deviations and median benchmark CIP deviations for G10 currency countries at the 3-month tenor (top panel) and the 10-year tenor (bottom panel).

Fourth, the CIP deviations for emerging market government bonds are now less connected with sovereign CDS spreads than they were in the 2000s and early 2010s. As shown in Figure 7, which plots the median government CIP deviations against median CDS spreads for both developed and emerging markets at the 5-year tenor, as well as in our previous work Du and Schreger (2016), government CIP deviations and CDS spreads have consistently been uncorrelated in developed markets. However, our updated results reveal that while these two measures were strongly correlated for emerging markets from the early 2000s until recently, their correlation has weakened since 2021. Specifically, while the correlation between CIP deviations and CDS spreads in emerging markets was 0.55 from 2000 to 2020, it has dropped to -0.26 since 2021.

In our previous study Du and Schreger (2016), we argued that government CIP deviations reflect the local currency credit spread—that is, the credit spread on local currency government bonds. The uncorrelated nature of CIP deviations and CDS spreads in developed markets supports the idea that financial market frictions are the primary source of this spread. The recent decline in correlation between CIP deviations and CDS spreads in emerging markets suggests ongoing development in these markets, where frictions may now play a more quantitatively significant role in risk than explicit credit risk on local currency sovereign debt.

Figure 7: Government CIP Deviations and CDS Spreads



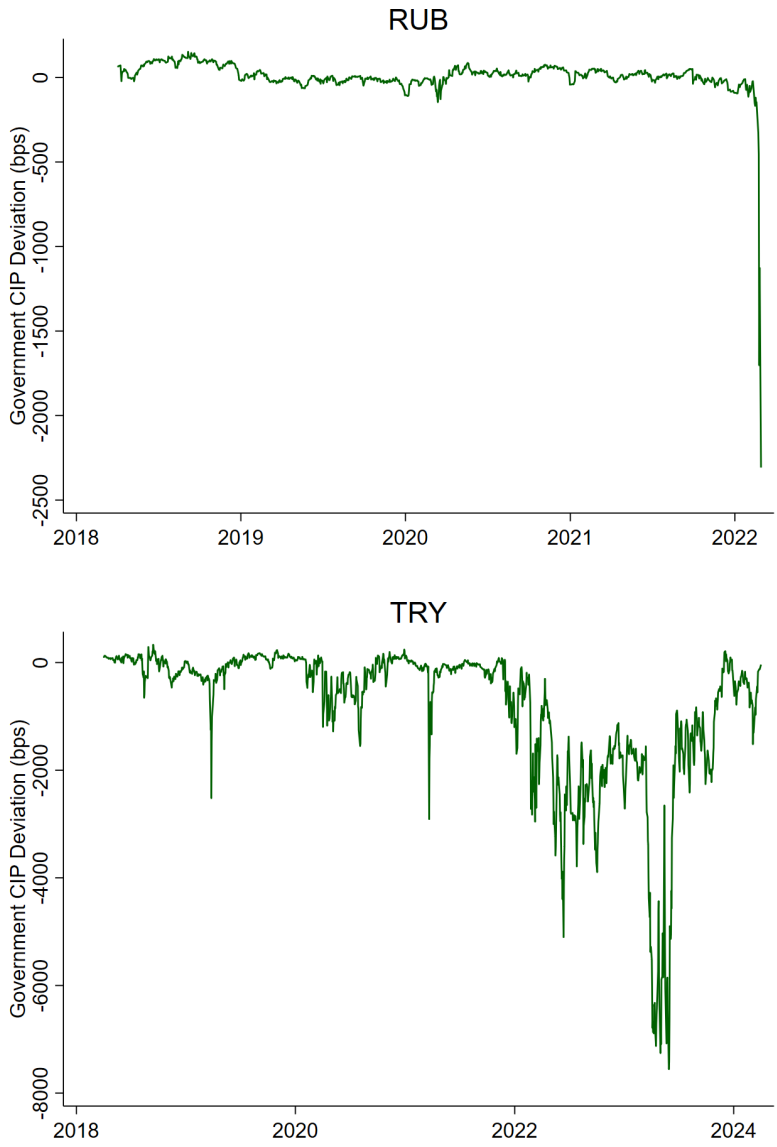
Notes: This chart plots the median government CIP deviations and median CDS spreads at the 5-year tenor for G10 markets (top panel) and emerging markets (bottom panel).

The most extreme form of the segmentation occurs merging markets with capital controls, such as Russia and Turkey. As illustrated in Figure 8, Russia's government CIP deviations turned sharply negative following the introduction of capital controls after the onset of the war with Ukraine and the imposition of U.S. sanctions in March 2022. Similarly, Turkey's government CIP deviations dropped steeply negative after capital controls were implemented

in early 2022. Importantly, even after accounting for widened credit spread differentials, the adjusted government CIP deviations for these countries remained deeply negative post capital controls.

In markets with capital controls, limited access to foreign capital constrained dollar availability, resulting in an artificially low synthetic dollar interest rate relative to cash markets that local investors could not access. This contributed to the deeply negative government CIP deviations. While dollar investors can still hedge some foreign exchange exposure through non-deliverable swap (NDS) markets, the restricted capital flows drive up demand for these NDS, pushing the forward premium deeply negative. If investors perceive the local currency as overvalued, demand for dollars may increase further, amplifying the effects.

Figure 8: Government CIP Deviations and Capital Controls: Russia & Turkey



Notes: This chart plots government CIP deviations for Russia (top panel) and Turkey (bottom panel). For Russia, we observe government CIP deviations only through February 2022, as U.S. financial institutions have been prohibited from participating in the secondary market for Russian sovereign bonds since March 1, 2022.

6 Conclusion

In this paper, we have constructed a new database of CIP deviations for 29 countries around the world, for benchmark and government bond rates, covering transition to SOFR. We hope that this new dataset will be a valuable input for researchers for years to come, and we intend to update it regularly. Using these new data, we have documented a number of new stylized facts on the nature of CIP deviation and convenience yields over the past several years.

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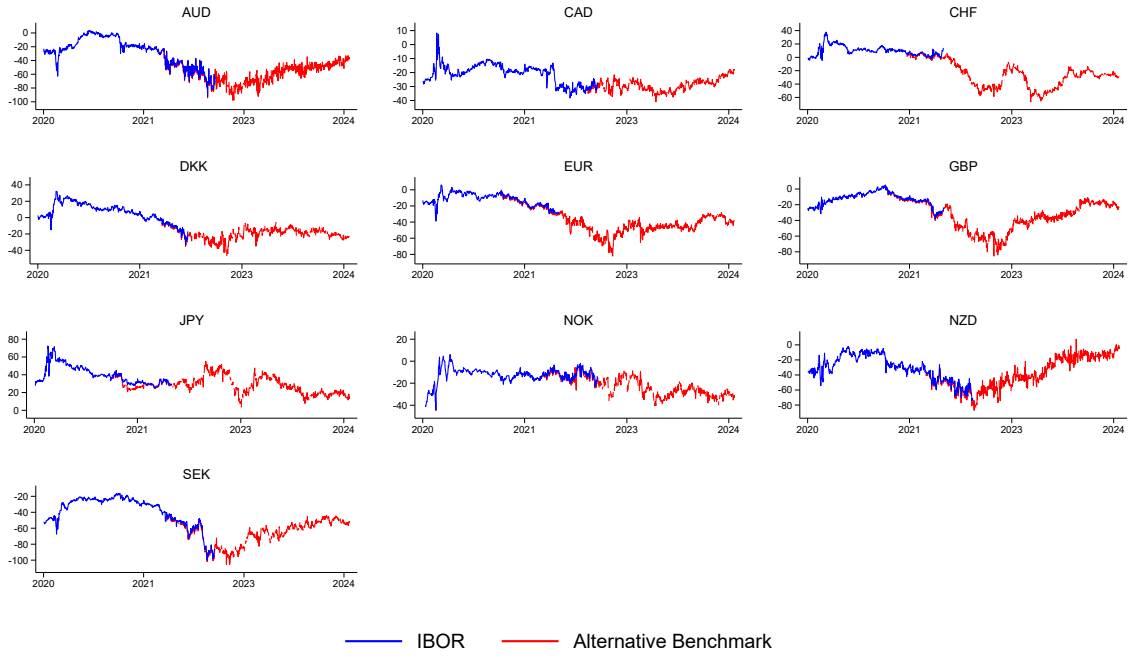
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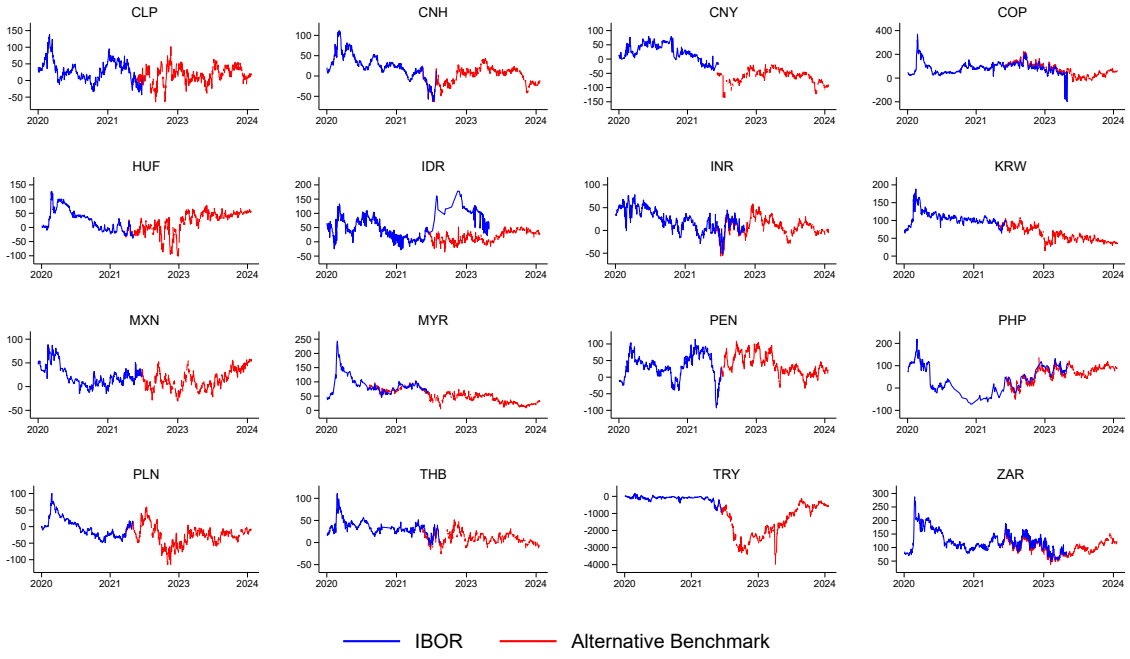
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Figure A1: Government CIP Deviations for G10 Currency Countries: 5-Year IBOR-based vs. Alternative Rate-Based



Notes: This chart plots 5-year IBOR-based and alternative benchmark-based government CIP deviations for G10 currency countries during overlapping periods.

Figure A2: Government CIP Deviations for Emerging Market Countries: 5-Year IBOR-based vs. Alternative Rate-Based



Notes: This chart plots 5-year IBOR-based and alternative benchmark-based government CIP deviations for emerging market countries during overlapping periods.