Covered Interest Parity: The Long Run Evidence [*]

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Abstract

This paper examines the economic significance and causal drivers of covered interest parity (CIP) deviations over the past century. We construct a comprehensive daily dataset of bid and ask quotes for spot and FX swap rates, as well as eurocurrency deposit and prime bank bill interest rates, covering 19 advanced economy currencies from 1921 to 2025. Accounting for capital controls and transaction costs, we show that economically significant CIP deviations have been far more prevalent than commonly assumed—representing the norm rather than the exception. We also document pronounced quarter-end effects on CIP deviations during the 1980s and 1990s, suggesting that intermediary constraints associated with tighter banking regulation were binding well before the Global Financial Crisis.

JEL Classification: F31, G15, N10, N20

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1 Introduction

The collapse of the covered interest parity condition (CIP) has been one of the most significant phenomena of the last fifteen years on global financial markets. Considered a pillar of international finance, CIP is a fundamental no-arbitrage condition relating the foreign exchange and money markets. It states that, for arbitrage opportunities to be annihilated, the forward premium of a foreign currency relative to the U.S. dollar (USD) equals the interest rate differential between the two currencies. Economists and finance scholars have long considered the CIP condition as empirically valid (Frenkel and Levich, 1975, 1977; Akram et al., 2008). However, since the Global Financial Crisis (GFC) of 2007-2009, numerous papers have documented the presence of large and persistent CIP deviations and researchers have attempted to uncover their determinants (Borio et al., 2018; Du et al., 2018; Avdjiev et al., 2019; Du and Schreger, 2022; Rime et al., 2022; Du and Huber, 2023).

This paper provides long-term evidence on the CIP condition. We construct a comprehensive dataset of daily quoted (bid and ask) spot and forward exchange rates (and FX swap points), as well as money market interest rates, for 19 advanced economies spanning over a century (1921–2025). These data are sourced from newspaper archives, other historical records, and modern electronic databases.

Our data contribution extends beyond collecting historical data; we also systematically clean and validate modern data samples through cross-checks across multiple historical and modern sources, addressing data errors and inconsistencies. Notably, modern electronic databases on exchange rates are not well suited for daily-frequency analysis except for G10 currencies after 2000. By overcoming these limitations, our dataset ensures greater accuracy and reliability for long-term analysis of CIP deviations.

Our first main finding is that, over the last century, economically significant deviations from CIP have been more prevalent for advanced currencies than commonly assumed, representing the norm rather than the exception. The only period during which CIP deviations were economically insignificant was pre-GFC years from the mid-1990s to 2006. This long-term pattern of CIP deviations is illustrated by the plot of the USD basis of the British Pound (GBP), the Swiss Franc (CHF), the French franc (FRF) and the Euro (EUR) over the periods 1921-1939 and 1963-2025 (Figure 1). The intervening years of missing observations are attributable to war and comprehensive capital controls. The absolute magnitude of the USD basis was substantial throughout our sample, except during the years immediately preceding the GFC (2000-2006). In the paper, we demonstrate that a similar pattern can be observed for all advanced currencies in our sample.

Since its formulation by Keynes (1923) in the context of the emergence of a large-scale forward exchange market in London during the 1920s, the CIP condition has been the focus of a vast empirical literature. Researchers have sought to test the validity of the condition in various periods using relatively short data samples, typically spanning from a few weeks to a decade (Aliber, 1973; Frenkel and Levich, 1975, 1977; McCormick, 1979; Bahmani-Oskooee and Das, 1985; Clinton, 1988). While these studies have consistently documented evidence of CIP deviations before 2000, a central debate in this literature has been whether these deviations remain economically significant after accounting for transaction costs. Scholars have explored this question using various methodologies, applying them to different samples, and have reported mixed results.

We develop a simple and comprehensive framework to integrate these methodologies and evaluate their implications for conclusions about the CIP condition. This approach enables us to compare our findings with prior empirical studies and assess the economic significance of CIP deviations across currencies and over time. Our results confirm that the pattern of CIP deviations observed in the USD basis (Figure 2) remains even after accounting for transaction costs. In other words, variations in transaction costs alone cannot explain the observed differences in CIP deviations over time.

Nonetheless, our findings also underscore the importance of methodology and data choices in evaluating the economic significance of CIP deviations. Traders implementing CIP arbitrage through FX swaps are more likely to identify profit opportunities from economically significant deviations, whereas those relying solely on outright forward and spot transactions are less likely to do so. Empirically, we find stronger evidence of economically significant CIP deviations in the same sample as Frenkel and Levich (1977) when using no-arbitrage bands derived from FX swaps (Table 3). In contrast, deviations appear less economically significant in the Du et al. (2018) sample, where no-arbitrage bands are based on outright forwards (Table 4). This contrast becomes even more striking when no-arbitrage bands are estimated using the transaction cost measures from Frenkel and Levich (1977). Under such an approach, economically significant CIP deviations would have appeared virtually nonexistent since the 1960s, including during and after the Global Financial Crisis.

While CIP arbitrage trades entail no currency risk, deviations from CIP may still arise due to counterparty credit risk or political risk (the risk that governments impose capital controls before the maturity of the money market and FX forward or swap contracts). For the post-WWII period, we account for these two types of risks by assessing CIP using interest rates on eurocurrency deposits. As an offshore market, the eurocurrency deposit market was free from capital and interest rate controls, which were widespread during the period from 1945 to 1979. Furthermore, eurocurrency deposits issued in different currencies had comparable credit risks, as the market was dominated by the same group of large multinational banks operating branches in London (Schenk, 1998). While we cannot rule out the possibility that interwar CIP deviations were caused by credit or political risk, in the case of the USD/GBP market, we are able to splice eurocurrency deposit rates with daily interest rates on USD and GBP prime money market instruments for the periods 1920-1939. These instruments, known as bankers' acceptances, were short-term assets backed by first-class financial institutions in London and New York and were relatively comparable in terms of credit risk. Moreover, during this period, governments did not impose capital controls that could have prevented investors from engaging in CIP arbitrage in the GBP/USD market.

We then investigate the determinants of CIP deviations over the last century. Recent literature has attributed the CIP deviations observed since 2008 to increased constraints on financial intermediaries driven by the tightening of macroprudential banking regulations in the post-GFC period (Borio et al., 2018; Du et al., 2018). In this context, we review the regulations governing banks' activities in the United States and United Kingdom during the post-1945 period. Our analysis reveals that, throughout most of this time, financial intermediaries faced substantial regulatory constraints affecting their ability to arbitrage CIP, with the short period from the late 1990s to the onset of the GFC standing as an exception. From 1945 to 1979, banks operating in the UK and US were subject to a series of regulations that effectively limited their capacity to take positions on the FX market. These measures were part of broader policies designed to manage balance-of-payments in the fixed exchange rate regime of the Bretton Woods era. Although these regulations were dismantled at the end of the 1970s, they were soon replaced by prudential regulations in the form of capital requirements. Starting in the early 1980s, US and UK regulatory authorities introduced capital requirements

that anticipated those later formalized in the international Basel I agreements of 1988. From 1997 onwards, however, financial intermediaries' capital reserve requirements were progressively relaxed as the Market Risk Amendment to the Basel I Accord allowed banks to determine their capital requirements based on their own internal models. The removal of non-risk-weighted capital requirements effectively lifted constraints on financial intermediaries' capacity to arbitrage CIP deviations, as they could exclude assets arising from arbitrage from those that needed to be covered by capital, since the exchange risk was mitigated by FX derivative contracts.

Motivated by the historical tightening of banking regulations in the 1980s and 1990s, we extend the difference-in-differences test in Du et al. (2018) to examine whether quarter-end effects on CIP deviations were present during this period. Stricter regulations increased banks' balance sheet costs, constraining their ability to engage in CIP arbitrage. These constraints should be particularly pronounced for contracts spanning quarter-ends, as they appear on banks' balance sheets at quarterly reporting dates.

Our findings confirm that quarter-end effects on CIP deviations were indeed more pronounced during this period than at other times outside the 1988–1995 and post-2007 periods. Specifically, quarter-end CIP deviations, relative to the average non-quarter-end level, were 7 basis points (bps) higher in the 1988–1995 sample compared to the remainder of the dataset, excluding the post-2007 period. This evidence suggests that regulatory constraints on banks restricted CIP arbitrage long before the onset of the Global Financial Crisis, highlighting the persistent role of financial regulation in shaping arbitrage activity.

The remainder of the paper is organized as follows. Section 2 describes the data sources and construction. Section 3 defines the US Dollar basis and presents descriptive statistics of USD basis based on our long-span data. Section 4 introduces an analytical framework to evaluate the economic significance of CIP deviations. Section 5 examines the quarter-end effects on CIP deviations, motivated by a long-run view of intermediary constraints.

2 A long run dataset of CIP deviations

Our dataset comprises forward exchange rates, spot exchange rates and three-month money market interest rates for 20 advanced countries' currencies at daily frequency over the period 1921-2024. The number of currencies in our sample rises from a minimum of 3 in 1921 to a total of 8 in 1928, reaching a peak of 19 in 1995 before converging to 11 in 1999 due to the introduction of the euro. Figure A1 in the Appendix plots the cross-section of currencies over time.

Our spot and forward exchange rates are closing quotations of bid and ask prices in London, which we hand-collected from the daily newspaper archives of the *Financial Times* and *Manchester Guardian* for the period 1921-1975. From 1976 to 2025, we systematically clean and validate these modern data samples through cross-checks across multiple historical and modern sources including WM/Reuters, LSEG/Refinitiv, Bloomberg, HSBC, Barclays Bank, and Financial Times. Notably, these modern electronic databases on exchange rates are not well suited for daily-frequency analysis except for G10 currencies after 2000. By overcoming these limitations, our dataset ensures greater accuracy and reliability for long-term analysis of CIP deviations.

For interest rates, we use bid and ask eurocurrency deposit rates. The eurocurrency market is an ideal testing ground for the CIP arbitrage condition because, as an offshore market, it is free of capital or interest rate controls, which were widespread during the post-1945 period and makes the eurocurrency deposits a better instrument than alternative

money market instruments in measuring USD basis (Figure A2) [1] In addition, eurocurrency deposits denominated in different currencies are relatively comparable in terms of credit risk since they are all issued by the same group of large multinational banks based in London (Schenk, 1998). Eurocurrency deposit interest rates (bid and ask) are sourced from FT/Refinitiv and a previously untapped database maintained by the Bank for International Settlements (BIS), which reports representative daily rates as of approximately 11:00 a.m. Swiss time.

Daily quotations of eurocurrency deposit rates are only available starting in 1963 and not for all currencies in our sample (A1). For the interwar period (1921-1939), where offshore interest rates are unavailable, we use three-month, onshore interest rates on standard money market instruments. During this period, the reference money market interest rate was the private discount rate on prime money market instruments. We collected these interest rates data for 1921-1939 from central banks' statistical reports, financial newspapers, and central bank archives. [2]

One concern with using such onshore interest rates is that they may be subject to capital controls and may not always be strictly comparable in terms of credit risk. While we cannot entirely rule out that these risks partly explain CIP deviations in the earlier years of our sample (i.e., 1921-1939), they are unlikely to have significantly affected deviations for the USD/GBP pair because a) foreign exchange transactions and interest arbitrage in the GBP/USD market were not subject to government controls during the 1920s and 1930s, and b) we are able to splice eurocurrency deposit rates with daily interest rates on high-quality money market instruments, guaranteed by first-class US and UK banks, which were comparable in terms of credit risk (see (Einzig, 1937; Kindleberger, 1939)).[3] Therefore, we consider CIP deviations for the USD/GBP pair as our baseline result for the 1921-1939 period, and we present results for other currency pairs as indicative of the economic significance of CIP deviations.

3 The long run US dollar basis

3.1 The US dollar basis: definition

To track CIP deviations across various currencies over time, we compute their USD basis. We denote the continuously compounded, annualized, risk-free interest rate in USD as $y_{\$}$ and the corresponding interest rate in currency i as y_i. The spot exchange rate, S_i, represents the USD price of one unit of currency i. The continuously compounded, annualized forward premium over a maturity of τ years is defined as $\phi_i = \tau^{-1} \ln(1 + FP_i/S_i)$ where FP_i represents the difference between the outright forward exchange rate and spot exchange rate in FX swap points,. ie. $FP_i = F_i - S_i$. Accordingly, the outright forward exchange rate can be expressed in terms of the forward premium as $F_i = e^{f_i} = S_i + FP_i = S_i e^{\phi_i \tau}$. The logs of the spot and forward exchange rates are denoted as s_i and f_i, respectively.

The CIP condition states that, in the absence of credit and counterparty risk, the return on holding a risk-free USD deposit should equal the return on investing in a risk-free foreign currency deposit while hedging the exchange

[1] By focusing on the eurocurrency market, we can also rule out "political risk" as a potential source of CIP deviations. Political risk refers to the risk that capital controls might be imposed between the date a foreign investment is made, and the date when repatriation is expected. As shown by Aliber (1973), political risk was often priced in CIP deviations measured between onshore markets.

[2] We thank Angelo Riva and Eric Monnet for sharing their interest rate data collected from the Bank of France archives. We rely on these data for part of our interwar sample.

[3] For a detailed description of these instruments, see Accominotti and Ugolini (2020). Interest rates on US and UK bankers' acceptances are also used by Peel and Taylor (2002) in their study of CIP deviations during the interwar period.

rate risk through an FX swap contract:

$$e^{y_\$ \tau} = e^{y_i \tau} F_i / S_i \tag{1}$$

Or, alternatively:

$$y_\$ = y_i + \phi_i \tag{2}$$

We define the USD basis as the difference between the annualized USD interest rate $y_\$$ and the synthetic USD interest rate (the return on an FX-hedged currency-i deposit):

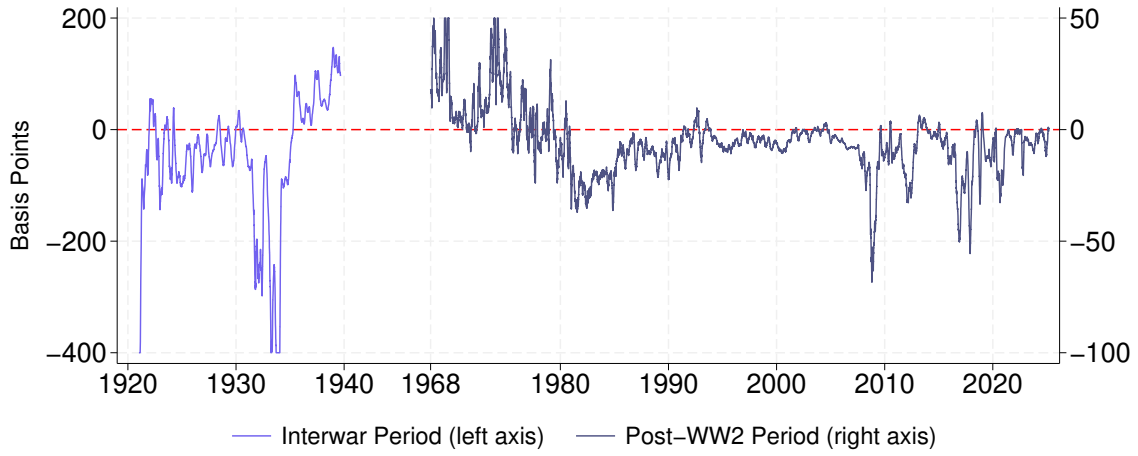
$$x_i = -\frac{1}{\tau} \ln \left(\frac{F_i}{S_i} e^{y_i \tau} / e^{y_\$ \tau} \right) = y_\$ - (y_i + \phi_i) \ . \tag{3}$$

The USD basis measures deviations from the CIP condition. Indeed, in frictionless FX and money markets, a non-zero USD basis creates profitable CIP arbitrage opportunities. Specifically, ignoring transaction costs, when the USD basis is negative ($x_i < 0$), an arbitrageur can borrow one USD in the cash market, convert it into currency i, and invest in a currency-i deposit while hedging the exchange rate risk through an FX swap contract. This strategy secures an arbitrage profit of $\pi_i^0 = e^{y_i \tau} F_i / S_i - e^{y_\$ \tau} \simeq -x_i \tau > 0$. Conversely, when the USD basis is positive ($x_i > 0$), the arbitrageur can borrow one USD synthetically - by taking a FX-hedged currency-i loan and invest in a USD deposit, yielding a profit of $\pi_i^0 = e^{y_\$ \tau} - e^{y_i \tau} F_i / S_i \simeq x_i \tau > 0$. In the absence of credit risk on USD and currency-i deposits and counterparty risk on the FX swap contract, these arbitrage strategies are risk-free. Therefore, any nonzero USD basis represents an anomaly.

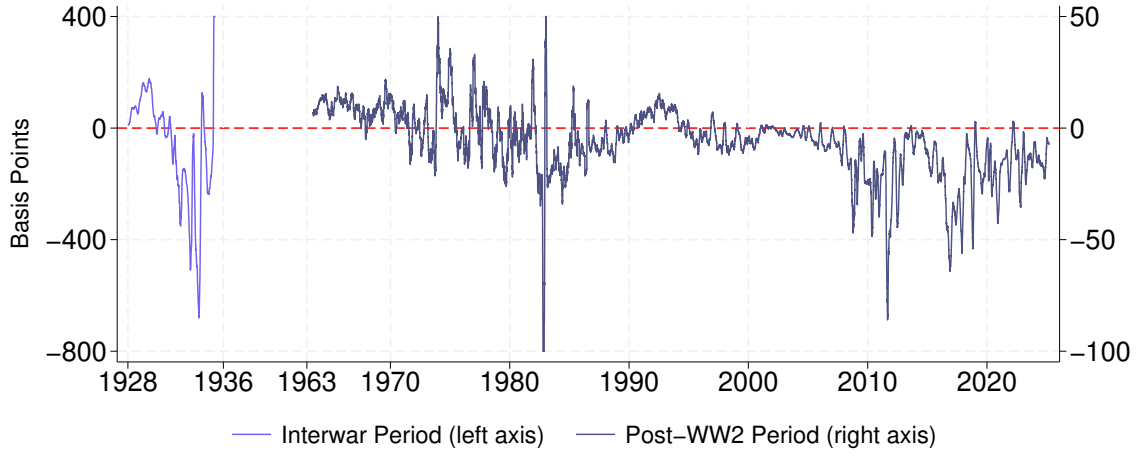
3.2 The US dollar basis: evidence

Figure 1 plots the USD basis of the British pound (GBP), Swiss franc (CHF) and French franc (FRF) from 1999 the euro (EUR) over our long sample. While the precise sample dates vary depending on exchange rate and interest rate data availability, these series cover the period from the 1920s to the 1930s and from the 1960s to 2024. The intervening years from the 1940 to the early 1960s of missing observations are due to war and comprehensive capital controls that prevented covered interest arbitrage. For all three currencies, the absolute magnitude of the USD basis was substantial throughout the sample. CIP deviations were especially pronounced during the 1920-1939 period while they were of comparable magnitude in 1963-1995 and in the post-2007 period. The only time when CIP deviations are minimal is during the pre-GFC years from the mid-1990s to 2006.

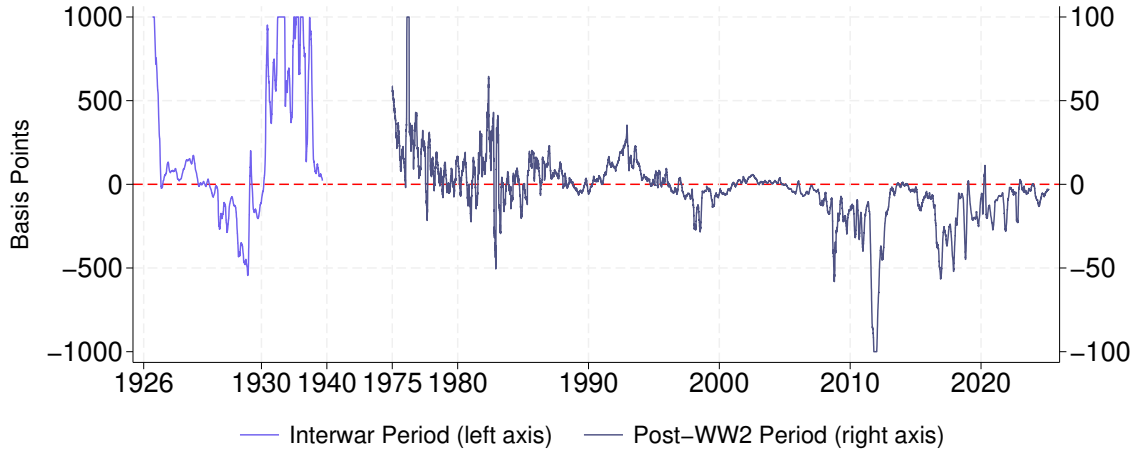
Figure 1: The time series of CIP deviations



(a) GBP



(b) CHF



(c) FRF and EUR

Notes: This figure plots the time series of CIP deviations, measured by dollar basis, for the British pound (GBP) in panel (a), the Swiss franc (CHF) in panel (b), and the French franc (FRF) and the Euro (EUR) in panel (c). The left-column graphs show the interwar period (10-day moving average) and the right-column graphs show the post-WWII period (30-day moving average). All plots are trimmed to improve visual presentation.

Table 1: Descriptive Statistics of CIP Deviations

		1921-1939	1963-1972	1973-1998	1999-2006	2007-2009	2010-2025
All AE	Number of Observations	22441	7914	87746	20840	5230	42230
	Fraction of Negative Basis	0.55	0.28	0.46	0.51	0.71	0.74
	Mean Basis	28	9	7	0	-8	-11
	Mean Absolute Basis	188	17	26	6	15	16
BEF	Mean Basis	-64		-5			
	Mean Absolute Basis	151		28			
CHF	Mean Basis	-45	7	-2	-4	-13	-20
	Mean Absolute Basis	175	15	19	5	16	21
DEM	Mean Basis	-115	6	-2			
	Mean Absolute Basis	117	15	16			
EUR	Mean Basis				-1	-14	-17
	Mean Absolute Basis				4	15	19
FRF	Mean Basis	229		7			
	Mean Absolute Basis	354		22			
GBP	Mean Basis	-47	16	-6	-4	-21	-11
	Mean Absolute Basis	86	25	18	6	21	14
ITL	Mean Basis	106		9			
	Mean Absolute Basis	402		25			
NLG	Mean Basis	44	10	1			
	Mean Absolute Basis	109	17	18			

Notes: This table reports descriptive statistics of CIP deviations for 19 advanced market currencies. The statistics include the number of observations, the fraction of negative USD basis, the mean of USD basis and its absolute value. The USD basis is measured by the difference between the interest rate on USD cash and the synthetic USD interest rate implied from an FX swap, with a 3-month maturity. The descriptive statistics are presented for four subsample periods: 1921-1939, 1963-1999, 1999-2006, and 2007-2025. For each subsample period, these statistics are reported for the 21 advanced market currencies as a whole, and for a subset of eight currencies individually.

4 The economic significance of CIP deviations

4.1 Accounting for transaction costs

The evidence presented above suggests that deviations from CIP were common in the pre-GFC period. However, higher transaction costs in both the cash and FX markets may explain such deviations in the earlier part of our sample. In this section, we examine whether CIP deviations in the pre-GFC period remain significant even after accounting for transaction costs. Our goal is not to precisely measure the profitability of CIP arbitrage trades at different points in time but rather to compare the *economic significance* of CIP deviations over time after adjusting for transaction costs.

Since its emergence in the 1920s, the question of how to account for transaction costs has been central to the CIP literature. Scholars have proposed various methods to incorporate these costs (for a comprehensive survey, see Sarno and Taylor (2003, Chapter 2) and Levich (2017)). We develop a simple analytical framework that enables us to compare these methods and analyze their implications for assessing the magnitude of CIP deviations over time. This framework allows us to - directly compare the results obtained from our data with those of previous studies based on smaller samples and - provide a comprehensive approach to evaluating the economic significance of CIP deviations in the presence of evolving transaction costs.

We denote the quoted proportional bid-ask spread on currency i's deposits as d_i^y and the corresponding bid-ask spreads on spot exchange rate contracts, FX swap contracts, and outright forward exchange contracts as d_i^s, d_i^w, and d_i^f, respectively. Specifically, bid-ask spreads on the money market, spot exchange market and FX swap markets are defined as, $d_i^y = y_i^{Ask} - y_i^{Bid}$, $d_i^s = \left(S_i^{Ask} - S_i^{Bid}\right)/S_i \simeq s_i^{Ask} - s_i^{Bid}$, and $d_i^w = \tau^{-1}\left(FP_i^{Ask} - FP_i^{Bid}\right)/S_i \simeq \phi_i^{Ask} - \phi_i^{Bid}$. The bid-ask spread on an outright forward contract, defined as $d_i^f = \left(F_i^{Ask} - F_i^{Bid}\right)/F_i \simeq f_i^{Ask} - f_i^{Bid}$, can be inferred from the spreads in the spot and FX swap markets as $d_i^f \simeq d_i^s + d_i^w\tau$.

We assume that the actual transaction cost paid by investors in each market c_i^z is a linear function of the quoted bid-ask spread, where $z \in \{y, s, w, f\}$: $c_i^z = \frac{1}{2}\kappa^z d_i^z$, with $\kappa^z \in [0, 1]$. Our analysis focuses on the most conservative choice of $\kappa = 1$ which maximizes the likelihood that observed CIP deviations are explained by transaction costs. However, smaller values of κ have been used in in the recent literature on the impact of transaction costs on the profitability of currency trading strategies.[4]

The total transaction cost of a CIP arbitrage trade includes both the costs incurred in the money market and the costs associated with the FX hedging transaction. If currency i exhibits a negative USD basis, the arbitrageur will borrow USD on the cash market at $y_\$ + c_\$^y$ and lend in currency i at $y_i - c_i^y$. Conversely, to arbitrage a positive USD basis, an investor will borrow currency i at $y_i + c_i^y$ and lend USD at $y_\$ - c_\$^y$. In both cases, the investor will incur a transaction cost of $c_\$^y + c_i^y$ on the money market.

To hedge the FX risk, the investor can either enter into an FX swap contract or use a combination of an outright forward transaction and of a spot exchange transaction. Each of these two options involves distinct transaction costs. Specifically, when currency i's USD basis is negative, an arbitrageur employing an FX swap contract will buy currency i at any agreed reference spot exchange rate $\widehat{S}_i$ at time t and commit through the FX swap contract to reverse the transaction by selling currency i at a pre-agreed forward rate $\widehat{S}_i e^{\phi_i\tau - c_i^w\tau}$ at maturity $t + \tau$. Conversely, when the USD basis is positive, the arbitrageur will sell currency i at any agreed reference spot rate $\widehat{S}_i$ at time t and commit to reverse the

[4] For instance, Menkhoff, Sarno, Schmeling and Schrimpf (2012) use $\kappa = 0.50$ and Chernov, Dalhquist and Lochstoer (2024) use $\kappa = 0.25$.

transaction by repurchasing currency i at a pre-agreed forward rate $\widehat{S}_i e^{\phi_i \tau + c_i^w \tau}$ at maturity $t+\tau$. While the reference spot exchange rate $\widehat{S}_i$ may take any value agreed between the investor and the market maker, it is most natural to assume that the investor will pay the spot ask exchange rate, $\widehat{S}_i = S_i e^{c_i^s}$, in the spot leg of a long FX swap position, and will receive the bid spot exchange rate, $\widehat{S}_i = S_i e^{-c_i^s}$, in the spot leg of a short FX swap position. However, regardless of the choice of $\widehat{S}_i$, the total transaction cost incurred by the investor on the FX swap transaction will always be equal to $c_i^w \tau$.[5]

By contrast, if the arbitrageur hedges the FX risk by employing a combination of an outright forward transaction and a spot exchange transaction, they will incur costs on both these transactions. Specifically, arbitraging a negative USD basis will involve buying currency i on the spot market at the exchange rate of $S_i e^{c_i^s}$ and selling it on the outright forward market at the exchange rate of $F_i e^{-c_i^f} = S_i e^{\phi_i \tau - c_i^s - c_i^w \tau}$. Conversely, arbitraging a positive USD basis will involve selling currency i on the spot market at an exchange rate of $S_i e^{-c_i^s}$ and selling it on the outright forward market at an exchange rate of $F_i e^{c_i^f} = S_i e^{\phi_i \tau + c_i^s + c_i^w \tau}$. Thus, by hedging the FX risk with a combination of spot and outright forward contracts, the investor incurs a total transaction cost of $2c_i^s + c_i^w \tau$, which is higher than the transaction cost $c_i^w \tau$ of hedging with an FX swap contract.

An investor considering arbitraging CIP deviations will do so only if the arbitrage profit exceeds the transaction cost. Hence, the USD basis of any currency i should fluctuate within a band whose width, denoted by $[-\delta_i, \delta_i]$ reflects the costs of arbitrage. In the remainder of this section, we introduce a range of threshold values for δ, each derived from no-arbitrage or equilibrium conditions. These values serve a dual purpose: they establish benchmarks for evaluating the economic significance of CIP deviations and help extract precise signals from CIP deviations to identify the sources of any market dislocations.

4.1.1 The no-arbitrage band using outright forwards

Let us first consider the case of an investor that employs a combination of spot exchange and outright forward contracts to arbitrage CIP deviations. A CIP arbitrage trade conducted through this method will only be profitable if the absolute value of currency i's USD basis exceeds the threshold δ_i^{FW}:

$$\delta_i^{FW} = c_\$^y + c_i^y + \frac{1}{\tau}(c_i^s + c_i^f) = c_\$^y + c_i^y + c_i^w + \frac{2}{\tau} c_i^s \tag{4}$$

Indeed, if $x_i \in [-\delta_i^{FW}, 0)$, the profit from arbitraging CIP deviations, denoted as π_i^{FW}, does not exceed zero after transaction costs:

$$\pi_i^{FW} = \frac{F_i e^{-c_i^f}}{S_i e^{c_i^s}} e^{\tau(y_i - c_i^y)} - e^{\tau(y_\$ + c_\$^y)} \leq 0\,. \tag{5}$$

Arbitraging the negative USD basis of currency i - ie. borrowing in USD to invest in currency i while hedging the FX risk - only becomes profitable when $x_i < -\delta_i^{FW}$, in which case the arbitrage profit after transaction costs is $\pi_i^{FW} \simeq \left(-x_i - \delta^{FW}\right)\tau > 0$.

[5] DeRosa (2014, pp. 21-22) provides a detailed example of how FX swap contracts can be used by investors to avoid paying the spot bid-ask spread

Similarly, if $x_i \in (0, \delta_i^{FW}]$, arbitraging CIP deviations will be unprofitable as:

$$\pi_i^{FW} = e^{\tau(y_\$ - c_\$^y)} - \frac{F_i e^{c_i^f}}{S_i e^{-c_i^s}} e^{\tau(y_i + c_i^y)} \leq 0\,. \tag{6}$$

Thus, arbitraging a positive USD basis in currency i - ie. borrowing in currency i to invest in USD while hedging the FX risk - is only profitable if $x_i > \delta_i^{FW}$, in which case the arbitrage profit after transaction costs is $\pi_i^{FW} \simeq \left(x_i - \delta_i^{FW}\right)\tau > 0$.

The $[-\delta_i^{FW}, \delta_i^{FW}]$ range corresponds to the band defined in the seminal paper by **?** that first analyzed the signficance of CIP deviations using the concept of no-arbitrage bands. However, while **?** estimated the transaction costs $c_i^{(\cdot)}$ indirectly, we directly measure them using our data on quoted bid-ask spreads.

4.1.2 The no-arbitrage band using FX swaps

We now consider the case of an investor using FX swaps rather than outright forwards to hedge FX risk. For such an investor, a CIP arbitrage trade will be profitable when the absolute value of currency i's USD basis exceeds the threshold δ_i^{SW}:

$$\delta_i^{SW} = c_\$^y + c_i^y + c_i^w\,. \tag{7}$$

Arbitraging a USD basis of $x_i < -\delta_i^{SW}$ will yield a profit of:

$$\pi_i^{SW} = \frac{\widehat{S}_i e^{\phi_i \tau - c_i^w \tau}}{\widehat{S}_i} e^{\tau(y_i - c_i^y)} - e^{\tau(y_\$ + c_\$^y)} > 0\,. \tag{8}$$

while arbitraging a USD basis of $x_i > \delta_i^{SW}$ will yield:

$$\pi_i^{SW} = \frac{\widehat{S}_i}{\widehat{S}_i e^{\phi_i \tau - c_i^w \tau}} e^{\tau(y_\$ - c_\$^y)} - e^{\tau(y_i + c_i^y)} > 0\,. \tag{9}$$

The corresponding no-arbitrage band $[-\delta_i^{SW}, \delta_i^{SW}]$ aligns with the methodology used in the recent literature on CIP deviations (Clinton, 1988; Du et al., 2018) that accounts for the effect of transaction costs on CIP arbitrage profits. In particular, it is on the basis of these threshold values that recent scholars have concluded that the CIP deviations observed since the GFC remain significant even after accounting for transaction costs.

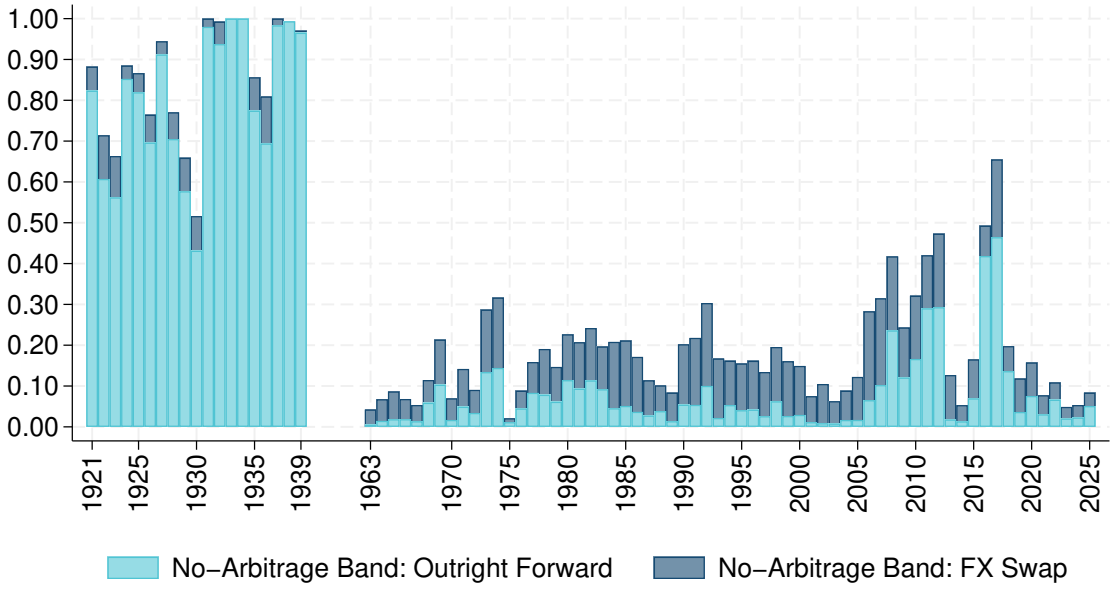
4.2 Empirical assessment of the economic significance of CIP deviations

Table 2: Economic Significance of CIP Deviations

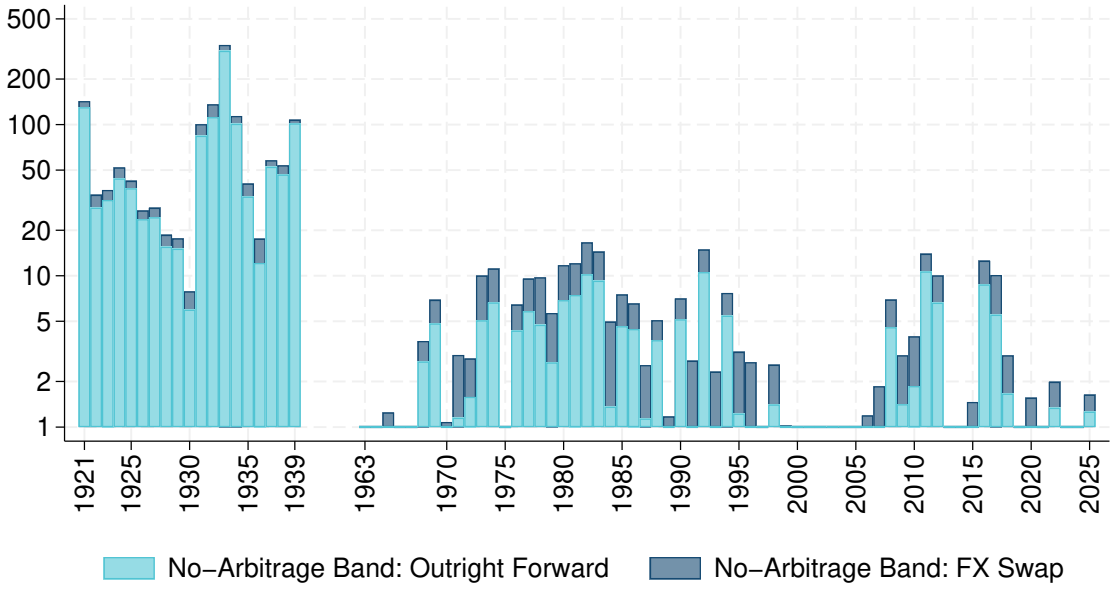
	1921-1939 GBP	1921-1939 excl. GBP	1963-1972 All AE	1973-1998 All AE	1999-2006 All AE	2007-2009 All AE	2010-2025 All AE
Panel A. Fraction of economically significant basis:							
No-Arbitrage Bands:							
FX swap	0.86	0.83	0.10	0.18	0.13	0.37	0.23
Outright Forward	0.80	0.72	0.04	0.06	0.02	0.17	0.14
Frenkel-Levich Proxy	0.41	0.36	0.00	0.01	0.00	0.01	0.01
Keynes: 50 bps	0.54	0.69	0.04	0.11	0.00	0.06	0.04
Equilibrium Bands:							
USD Money Market	0.95	0.90	0.30	0.41	0.55	0.70	0.66
Foreign Money Market	0.95	0.90	0.30	0.61	0.93	0.91	0.97
Forward Market	0.95	0.98	0.99	0.72	0.29	0.62	0.30
Spot Market	0.86	0.83	0.10	0.18	0.13	0.37	0.23
Clinton	0.98	0.98	0.99	0.92	0.94	0.93	0.97
Panel B. Magitude of economically significant basis (in basis points):							
No-Arbitrage Bands:							
FX swap	68	182	2	6	1	4	4
Outright Forward	60	161	1	4	0	3	2
Frenkel-Levich Proxy	26	97	0	1	0	0	0
Keynes: 50bp	46	177	2	8	0	2	1
Equilibrium Bands:							
USD Money Market	78	191	5	10	3	9	10
Foreign Money Market	78	191	5	14	5	14	15
Forward Market	81	217	17	22	1	8	5
Spot Market	68	182	2	6	1	4	4
Clinton	83	217	17	25	5	14	15

Notes: This table presents two statistics measuring the economic significance of CIP deviations for a sample of 20 advanced market (AE) currencies from from January 8, 1921 to March 10, 2025. **Panel A** reports the fraction of currency-day observations with an economically significant USD basis, computed as $\frac{1}{N}\sum \mathbb{I}\{|x| > \delta\}$ for each of the six subsample periods: 1921-1939, 1963-1972, 1973-1998, 1999-2006, 2007-2009, and 2010-2025. **Panel B** reports the average magnitude of economically significant USD basis defined as $\frac{1}{N}\sum \max\{0,\ |x| - \delta\}$. For the 1921-1939 period, the currency universe is divided into two sub-groups: GBP and all other currencies. Each USD basis observation is evaluated against four different no-arbitrage bands and five market equilibrium bands to determine its economic significance.

Figure 2: Time-Varying Economic Significance of CIP Deviations



(a) Fraction of Economically Significant Basis in Each Year



(b) Magnitude of Economically Significant Basis in Each year

Notes: This figure illustrates the time-varying economic significance of CIP deviations for a sample of 20 advanced market (AE) currencies from January 8, 1921 to March 10, 2025. Panel (a) reports the fraction of currency-day observations with an economically significant USD basis, computed as $\frac{1}{N}\sum \mathbb{I}\{|x| > \delta\}$ for each year. Panel (b) reports the average magnitude of economically significant USD basis defined as $\frac{1}{N}\sum \max\{0,\ |x| - \delta\}$ for each year. Each USD basis observation is evaluated against the two on-arbitrage bands, using outright forward and FX swap, respectively, to determine its economic significance. For the interwar period (1921-1939), only GBP is considered to isolate the effects of capital controls and interest rate regulations tha were prevalent for other currencies during the 1930s.

Table 3: Fraction of Economically Significant CIP Deviations in the Frenkel and Levich (1977) Sample.

	Monday	Tuesday	Wednesday	Thursday	Friday	Weekly Average	Daily
Panel A. January 1, 1968 – December 31, 1969							
Original Frankel-Levich: 166 bps	0.03	0.04	0.04	0.04	0.02	0.00	0.04
No-Arbitrage Bound, Forward	0.24	0.20	0.38	0.22	0.24	0.23	0.26
No-Arbitrage Bound, FX Swap	0.36	0.31	0.58	0.49	0.38	0.34	0.42
Panel B. July 1, 1973 – May 31, 1975							
Original Frankel-Levich: 474 bps	0.00	0.00	0.01	0.00	0.00	0.00	0.00
No-Arbitrage Bound, Forward	0.46	0.36	0.56	0.45	0.43	0.42	0.45
No-Arbitrage Bound, FX Swap	0.66	0.51	0.77	0.68	0.64	0.64	0.65

Notes: This table reports the fraction of economically significant CIP deviations, computed as $\frac{1}{N}\sum \mathbb{I}\{|x| > \delta\}$, for the same sample periods analyzed in Frenkel and Levich (1977): **Panel A** covers January 1, 1968 to December 31, 1969, while **Panel B** covers July 1, 1973 to May 31, 1975, for the USD basis of GBP. However, we use our own data measure the USD basis and the corresponding no-arbitrage bands. The original analysis in Frenkel and Levich (1977) was conducted using a weekly dataset. To enhance comparability, we construct five distinct sub-samples by selecting data from each of the five week days separately and estimate the fraction of economically significance USD basis for each subsample. Additionally, we report results based on a weekly sample using weekly average values and on the full daily dataset for GBP. The economic significance of each USD basis observation is assessed against the no-arbitrage bands. We consider both the Frankel-Levich no-arbitrage bands (defined by a constant of 166 basis points (bps) for the 1968-1969 sample and 474 bps for the 1973-1975 sample) as well as two alternative no-arbitrage bands, based outright forward and FX swap, respectively, using our daily dataset. These two no-arbitrage bands are therefore currency-specific and time-varying. Frenkel and Levich (1977) reported that in the 1968-1969 sample, 3% of weekly USD basis observations had absolute values exceeding 166 bps, whereas in the 1973-1975 sample, virtually no observations (0%) exceeded the 474 bps band. We find the same results when comparing the absolute value of USD basis measured by our data with the original constant bands.

Table 4: Fraction of Economically Significant CIP Deviations in the Du et al. (2018) Sample

	FX Swap	Forward	FL: Proxy	FL: 166bp	FL: 474bp
Panel A. January 1, 2007 - December 31, 2009					
AUD	0.17	0.05	0.00	0.00	0.00
CAD	0.19	0.04	0.00	0.00	0.00
CHF	0.34	0.09	0.00	0.00	0.00
DKK	0.33	0.23	0.01	0.00	0.00
EUR	0.45	0.32	0.02	0.00	0.00
GBP	0.55	0.32	0.01	0.00	0.00
JPY	0.50	0.28	0.01	0.00	0.00
NOK	0.16	0.04	0.00	0.00	0.00
NZD	0.23	0.04	0.00	0.00	0.00
SEK	0.34	0.13	0.01	0.00	0.00
Panel B. January 1, 2010 - September 15, 2016					
AUD	0.15	0.06	0.00	0.00	0.00
CAD	0.11	0.05	0.00	0.00	0.00
CHF	0.36	0.17	0.00	0.00	0.00
DKK	0.38	0.28	0.03	0.00	0.00
EUR	0.40	0.32	0.08	0.00	0.00
GBP	0.20	0.12	0.00	0.00	0.00
JPY	0.35	0.21	0.02	0.00	0.00
NOK	0.23	0.12	0.01	0.00	0.00
NZD	0.15	0.03	0.00	0.00	0.00
SEK	0.31	0.13	0.00	0.00	0.00

Notes: This table reports the fraction of economically significant CIP deviations, computed as $\frac{1}{N}\sum \mathbb{I}\{|x| > \delta\}$, for the same sample periods analyzed in Du et al. (2018): **Panel A** covers January 1, 2007 to December 31, 2006, while **Panel B** covers January 1, 2010 to September 15, 2016, for the USD basis of G10 currencies. However, we use our own data measure the USD basis and the corresponding no-arbitrage bands. The economic significance of each USD basis observation is assessed against the no-arbitrage bounds. We consider both the Frankel-Levich no-arbitrage bands (defined by a constant of 166 bps and 474 bps, respectively) as well as two alternative no-arbitrage bands, based outright forward and FX swap, respectively, using our daily dataset. Furthermore, since the two constant no-arbitrage bands used by Frenkel and Levich (1977) were not calibrated for this sample period, we also introduce a time-varying and currency-specific proxy for the Frenkel-Levich band measured as three times the Forward-based no-arbitrage band.

5 CIP deviations and intermediary constraints

Based on the findings from the previous sections, we have established a new empirical pattern regarding the CIP condition: economically significant deviations from CIP have been more pervasive than previously recognized, being present over the past 100 years, even during the decades preceding the Global Financial Crisis (GFC). This raises a fundamental question: how have these violations of CIP persisted in international financial markets? What factors have prevented sophisticated traders from exploiting these arbitrage opportunities?

The recent literature has attributed persistent CIP deviations since the GFC to constraints on financial intermediaries (Borio et al., 2016, 2018; Du et al., 2018; Du and Huber, 2023). In this section, we explore whether intermediary constraints provide a compelling explanation for CIP deviations over our long-run sample.

5.1 Intermediary constraints: a long run view

We start by providing a broad overview of the constraints faced by banks willing to engage in CIP arbitrage from the 1960s to the present day. We focus on regulatory rules in place in the United Kingdom and United States as well as on other constraints that may have affected banks' balance sheets in various periods.

5.2 1920-1939: interwar banking regulation

During the interwar period (1920–1939), banking regulation evolved in response to financial instability, culminating in significant reforms under the New Deal. In the 1920s, U.S. banking remained fragmented and weakly regulated, with state and national banks operating under inconsistent supervision (White, 2009). The banking crises of the early 1930s exposed systemic weaknesses, leading to the Banking Act of 1933. The Banking Act introduced federal deposit insurance and enforced the separation of commercial and investment banking through the Glass-Steagall provisions. It also imposed stricter oversight on banks and limited the total amount of loans a member bank could make secured by stocks or bonds.

5.3 1960-1979: regulatory limits on banks' FX positions

From the 1960s to the late 1970s, the United Kingdom imposed restrictions on banks' foreign exchange (FX) positions. The primary objective of these restrictions was to manage the balance of payments within the context of the fixed exchange rate system under Bretton Woods. However, these measures also effectively limited banks' ability to engage in arbitrage-related trades.

In particular, under Exchange Control Notice EC 54, UK-based banks (including the UK branches of foreign banks operating in the eurocurrency market) were subject to a cap on their "spot-against-forward position." This regulation restricted the volume of net spot assets that banks could hold to cover their net forward liabilities (Bank of England Bulletin, 1975). The purpose of this regulation was to prevent arbitrage operations from leading to large foreign exchange holdings by commercial banks, which could otherwise result in a dispersal of foreign currency reserves across the banking system and reduce the resources held within the official FX reserves (Bank of England Bulletin, 1975).

To illustrate how this regulation could limit banks' ability to allocate funds to CIP arbitrage, consider the following example, where the spot-against-forward limit is set at GBP 100K. Suppose a bank held GBP 150K of net spot

assets in foreign currencies and GBP 100K of net forward liabilities. In this scenario, the bank's spot-against-forward position amounted to GBP 100K, which was at the regulatory limit (as GBP 100K of the bank's net spot assets effectively covered its net forward liabilities). Now, suppose the DEM-GBP interest rate differential exceeded the DEM's forward discount in the FX market. This presented a CIP arbitrage opportunity, which could be exploited by taking a long DEM spot position and a corresponding short forward position. Let us further assume that the bank wanted to allocate GBP 50K to the arbitrage trade. To execute this trade, the bank would need to increase its net spot position to GBP 200K and its net forward liabilities to GBP 150K. This adjustment would result in a spot-against-forward position of GBP 150K. Since this exceeded the regulatory limit, the bank would be unable to engage in the arbitrage opportunity.

5.4 1980-1996: the rise of capital requirements

At the end of the 1970s, restrictions on banks' foreign exchange positions aimed at managing the balance of payments were lifted along with the abolition of the Exchange Control.[6]. However, regulatory authorities shifted their focus to banks' capital adequacy ratios. In December 1981, U.S. regulatory agencies introduced non-risk-weighted primary capital requirements for banks. The minimum capital-to-asset ratio was set at 6 per cent for banks with assets under USD 1 billion and 5 per cent for banks with assets exceeding USD 1 billion. Initially, multinational banks were exempt from this requirement due to their low levels of capital at the time. However, regulators required these banks to progressively strengthen their capital positions, and the 5 per cent capital requirement was extended to them by June 1983. By June 1985, a unified capital ratio of 5.5 per cent was implemented for all U.S. banks, regardless of their size. The introduction of these regulations was followed by a significant increase in US banks' capital-asset ratios in the following years (Keely, 1988). While no legal minimum capital ratio was defined in the UK, the Bank of England also closely monitored UK banks' capital position.[7] These national regulations anticipated the international Basel Accord of 1988, which introduced an international minimum ratio of capital to risk-weighted assets of 8 per cent.

During the 1980s, US and UK banks operating on the Eurodollar market also faced significant pressure as a consequence of their exposure to Latin American loans. In the summer of 1982, Mexico's government debt default triggered a wave of sovereign debt restructurings across emerging market economies. Most of the defaulted debts consisted of loans extended by international banks, particularly those based in the United States and United Kingdom. At the height of the financial crisis in 1985, the average exposure of the eight largest US money-center banks to so-called Least Developed Country (LDC) loans amounted to 200 per cent of their capital and reserves (Federal Deposit Insurance Corporation, 1997, chapter 5, table 5.1.a). While US regulatory authorities did not require banks to provision these loans with additional reserves, both US and UK banks had to allocate a significant portion of their capital to absorb losses on restructured LDC debts. This situation placed significant constraints on financial intermediaries until the implementation of the Brady plan in March 1989 allowed banks to exchange these loans for lower-principal bonds, guaranteed by the US government, that could be sold to third parties.

[6] See Financial Times, 25 October 1979, "Sour note at the celebration"

[7] See, for example, *The Economist*, "Right angles", 13 October 1984. This article refers to the "free capital ratio" as "the ratio most closely scrutinised by the Bank of England in judging whether a bank is backed by sufficient capital."

5.5 1996-2007: reduction in intermediary constraints

While the regulatory framework that emerged in the 1980s largely remained in place until the GFC, several factors suggest that financial intermediary constraints became less binding from the 1990s onwards.

Firstly, regulatory authorities' approach towards capital requirements evolved during this period, as banks were increasingly allowed to rely on their own risk assessment frameworks and rating systems to determine their capital requirements. The 1996 Market Risk Amendment to the Basel Accord explicitly authorized financial intermediaries to "use risk measures derived from their own internal risk management models" to determine the capital charges on their trading book (Committee on Banking Regulations and Supervisory Practices, 1996, p. 3). While this approach was initially confined to market risk, supervisors increasingly recognized the use of internal risk assessment models as a valid method of determining capital requirements on banks' credit book, a shift that was formally enacted in the Basel II Accord of 1999 (Spong, 2000, p. 95).

In the United States, the banking regulations that had remained in place since the Great Depression era were further dismantled with the repeal of the Glass-Steagall Act in 1999. The Federal Deposit Insurance Corporation Improvement Act of 1991 established a rules-based approach for supervisors to engage mandatory actions towards undercapitalized banks.[8] However, the expansion of securitization from the mid-1990s onward helped lift constraints on financial intermediaries as banks were not required to hold regulatory capital for their off-balance sheet investment entities.

5.6 2008-2024: post-GFC banking regulation

After the Great Financial Crisis, banking regulations tightened significantly (see Du et al. (2018)). Basel III introduced a 3% non-risk-weighted leverage ratio, which did not exist for non-U.S. banks. For U.S. banks, the leverage ratio increased from 3%, prior to the Great Financial Crisis, to 5-6%. This cap on total assets relative to capital made it costlier for banks to expand balance sheets. Basel III also raised risk-weighted capital requirements, forcing banks to hold more high-quality capital against risky assets, reducing their ability to engage in balance sheet-intensive trades. The Volcker Rule prohibited proprietary trading by U.S. banks, further restricting their market-making and arbitrage capacity.

5.7 Quarter-end effects on the level of CIP deviations

To examine how intermediary constraints affect CIP deviations, we extend the empirical analysis of Du et al. (2018) to the entire post-1960 period. The key intuition is that one-month contracts spanning quarter-ends appear on bank balance sheets at quarter-end reporting dates. During these periods, balance sheet costs, driven by stricter regulatory constraints, are most pronounced. As a result, CIP deviations tend to be higher in a more restrictive regulatory environment, with the effect being particularly strong for contracts crossing quarter-ends.

We begin by investigating whether CIP deviations exhibit greater magnitude at quarter-ends compared to other

[8] See Spong (2000, pp. 85-96) and White (2009)

times using our long-term data. To formally test this hypothesis, we estimate the following panel regression:

$$|x_{i,t;1M}| = \alpha_i + \beta_0\, QEnd1M_{i,t} + \beta_1\, QEnd1M_{i,t} \times \mathbb{I}_t[88,95] + \beta_{07}\, QEnd1M_{i,t} \times Post07_t + \beta_{15}\, QEnd1M_{i,t} \times Post15_t + \gamma_{07} Post07_t + \gamma_{15} Post15_t + \varepsilon_{i,t}\,, \tag{10}$$

where $x_{i,t;1M}$ represents the one-month USD basis for currency i at t, and α_i denotes a currency fixed effect. The variable $QEnd1M_{i,t}$ is a dummy that equals one if the one-month contract traded at t for currency i crosses a quarter-end (i.e., the quarter-end date falls between the spot date and the forward maturity date), and zero otherwise. The indicator variable $\mathbb{I}_t[88,95]$ is set to one if the trading date t falls within the period between January 1, 1988 and December 31, 1995. The other indicator variable, $Post07_t$ ($Post15_t$) is a dummy that equals one for trading date t in the period from January 1, 2007 (January 1, 2015) to March 10, 2025. Specifically, the data on precise spot dates and forward settlement dates are sourced from Bloomberg. The regression is estimated using a daily sample spanning January 1, 1986, to March 10, 2025, covering 19 advanced economy (AE) currencies.

Du et al. (2018) documented that quarter-end effects on CIP deviations were more pronounced in the 2007-2016 period compared to 2000-2006. We introduce a pre-GFC period (1988-1995) to examine whether it is also characterized by more pronounced quarter-end effects on CIP deviations. The choice of 1988 is motivated by the implementation of Basel I, which imposed stricter capital requirements on banks. However, regulatory constraints were relaxed in the mid-1990s, allowing banks to determine capital requirements based on their internal models. While we do not directly observe how the internal risk management practices of banks related to CIP arbitrage were affected by regulatory restrictions during 1988-1995 within the historical context of the Basel I framework, this period appears to be a reasonable candidate period for investigating quarter-end effects on CIP deviations. Our results are robust to alternative specification of this window.

Table 5 presents regression results for different specifications of Equation (10). Column (1) focuses on the unconditional effects of the quarter-end on the level of the one-month CIP deviations by setting other coefficients to zero. Columns (2) through (4) extend the specification by incorporating interactions between the quarter-end effect and the indicator variables for the periods characterized by stricter banking regulation compared to other periods.

CIP deviations associated with one-month contracting crossing a quarter end are 2 to 6 bps higher than the average level of non-quarter-end CIP deviations with the effect becoming more pronounced in the post-GFC period, when banks faced tighter regulatory constraints (Columns (2)-(3)). These findings align with those documented in Du et al. (2018).

More importantly, our regression analyses reveal a novel insight: a distinct pre-GFC period emerges during which the quarter-end effects on CIP deviations appear more pronounced than any other time that falls outside the 1988-1995 and post-2007 period. Specifically, the quarter-end CIP deviation relative to the average non-quarter-end level is 7 bps higher in the 1988-1995 sample compared to the remainder of the sample, excluding the post-2007 period. This finding suggests that similar regulatory constraints on banks restricted CIP arbitrage activities long before the onset of the Global Financial Crisis.

Furthermore, once the quarter-end effect is conditioned on the 1988–1995 period, along with interactions with the post-GFC periods, the unconditional quarter-end effect disappears. This finding reinforces the intuition that stricter regulatory constraints impose tighter restrictions on banks' ability to pursue arbitrage activity in anticipation of quarter-ends, leading to larger CIP deviations.

Table 5: Quarter-End Effects on the Level of One-Month CIP Deviations

	(1)	(2)	(3)	(4)	(5)
$QEnd1M_{i,t}$	5.52***	2.89***	2.23***	-0.69	-0.69
	(0.51)	(0.69)	(0.66)	(0.87)	(0.87)
$QEnd1M_{i,t} \times \mathbb{I}_t[1988, 1995]$				7.06***	7.06***
				(1.36)	(1.35)
$QEnd1M_{i,t} \times Post07_t$		5.98***	1.18	10.51***	4.10***
		(1.11)	(1.35)	(1.17)	(1.46)
$QEnd1M_{i,t} \times Post15_t$			11.06***		11.06***
			(1.58)		(1.57)
$\mathbb{I}_t[1988, 1995]$				9.50***	9.50***
				(1.28)	(1.28)
$Post07_t$			-0.39	1.14	2.53*
			(1.32)	(1.11)	(1.37)
$Post15_t$			-2.59*		-2.59*
			(1.49)		(1.46)
Constant	13.21***	13.01***	13.86***	10.79***	10.79***
	(1.56)	(1.56)	(1.64)	(1.67)	(1.67)
Observations	111,638	111,638	111,638	111,638	111,638
R-squared	0.01	0.01	0.02	0.02	0.03

Notes: This table reports regression results on the quarter-end effects for the daily one-month USD bases across 19 advanced economy (AE) currencies in our sample. The dependent variable is the absolute value of one-month USD basis. The variable $QEnd1M_{i,t}$ is a dummy that equals one if the one-month contract traded at t for currency i crosses a quarter-end, and zero otherwise. The variable $QEnd1M_{i,t}$ is a dummy that equals one if the one-month contract traded at t for currency i crosses a quarter-end (i.e., the quarter-end date falls between the spot date and the forward maturity date), and zero otherwise. The indicator variable $\mathbb{I}_t[88, 95]$ is set to one if the trading date t falls within the period between January 1, 1988 and December 31, 1995. The other indicator variable, $Post07_t$ ($Post15_t$) is a dummy that equals one for trading date t that falls within the period from January 1, 2007 (January 1, 2015) to March 10, 2025. Columns (1)–(5) present results for different model specifications. All regressions include currency fixed effects. Standard errors are computed using the Newey-West method with 90-day lags and are reported in parentheses. Statistical significance is indicated by $***$, $**$, and $*$, corresponding to the 1%, 5%, and 10% confidence levels, respectively. The sample spans from January 1, 1986, to March 10, 2025. Spot and settlement dates for one-month FX swap contracts are sourced from Bloomberg.

5.8 Year-end effects on the level of CIP deviations

We now examine whether CIP deviations are larger for contracts crossing a year-end date compared to an average quarter-end date. There are numerous reasons to expect that banks face more comprehensive and more intensive

reporting requirements at year-end, compared to other quarter-ends. For instance, year-end financial reporting is subject to greater regulatory scrutiny, as banks must prepare audited annual financial statements, which are reviewed by both regulators and independent auditors. In contrast, quarterly reports are typically unaudited, making year-end disclosures more critical in assessing capital adequacy and risk exposure. [9] Given this background, we conjecture that incremental year-end effects on CIP deviations.

To formally test this hypothesis, we estimate the following panel regression:

$$\begin{aligned}|x_{i,t;1M}| = \alpha_i &+ \beta_0^Q\, QEnd1M_{i,t} + \beta_0^Y\, YEnd1M_{i,t} \\ &+ \beta_1^Q\, QEnd1M_{i,t} \times \mathbb{I}_t[88,95] + \beta_1^Y\, YEnd1M_{i,t} \times \mathbb{I}_t[88,95] \\ &+ \beta_{07}^Q\, QEnd1M_{i,t} \times Post07_t + \beta_{07}^Y\, YEnd1M_{i,t} \times Post07_t \\ &+ \beta_{15}^Q\, QEnd1M_{i,t} \times Post15_t + \beta_{15}^Y\, YEnd1M_{i,t} \times Post15_t \\ &+ \gamma_{07} Post07_t + \gamma_{15} Post15_t + \varepsilon_{i,t}\,, \end{aligned} \tag{11}$$

where $x_{i,t;1M}$ represents the one-month USD basis for currency i at t, and α_i denotes a currency fixed effect. The variable $YEnd1M_{i,t}$ is a dummy that equals one if the one-month contract traded at t for currency i crosses a year-end, and zero otherwise. Similarly, the variable $QEnd1M_{i,t}$ is a dummy that equals one if the contract crosses a quarter-end. The indicator variable $\mathbb{I}_t[88,95]$ is set to one if the trading date t falls within the period between January 1, 1988 and December 31, 1995. The other indicator variable, $Post07_t$ ($Post15_t$) is a dummy that equals one for trading date t that falls within the period from January 1, 2007 (January 1, 2015) to March 10, 2025. Data on precise spot dates and forward settlement dates are sourced from Bloomberg, and the regression is estimated using a daily sample spanning January 1, 1986, to March 10, 2025, covering 19 advanced economy (AE) currencies.

Compared to Equation (10), Equation (11) introduces the year-end effect and its interaction with indicators for periods characterized by tighter banking regulations. This extended specification allows us to test for the incremental effect of one-month contracts crossing a year-end, $\beta_{(\cdot)}^Y$, in addition to the average quarter-end effect of one-month contracts crossing a quarter-end, $\beta_{(\cdot)}^Q$, with the total effect of 31 December on CIP deviations is thus given by $\beta_{(\cdot)}^Q + \beta_{(\cdot)}^Y$.

Table 6 presents the regression results. Column (1) reports the unconditional year-end and quarter-end effects. On average, CIP deviations increase by 2 basis points (bps) at quarter-end compared to non-quarter-end periods. When a quarter-end coincides with a year-end, the deviation rises further to 13 bps. The year-end effect is more pronounced under tighter regulatory conditions, as shown in Columns (4) and (5). Specifically, during the 1988–1995 period (post-2007 period), year-end CIP deviations increase by an additional 12 bps (7 bps), on top of a 4 bps (7 bps) rise at other quarter-ends.

Second, the incremental year-end effect is not more pronounced in the post-2015 period compared to the broader post-2007 period. This finding suggests that while regulatory reforms after the Global Financial Crisis (GFC) imposed stricter balance sheet constraints, the shift toward average-based regulatory measures—such as Basel III's leverage and liquidity requirements—has mitigated the disproportionate impact of year-end regulatory pressures.

Our results on year-end effects remain robust for CIP deviations based on three-month contracts (Table 7).

[9] see Code of Federal Regulations, 363.2

Table 6: (Incremental) Year-End Effects on the Level of One-Month CIP Deviations

	(1)	(2)	(3)	(4)	(5)
$QEnd1M_{i,t}$	1.88***	-7.12***	-7.12***	-2.17**	-2.17**
	(0.59)	(0.97)	(0.97)	(1.00)	(0.99)
$YEnd1M_{i,t}$	12.57***	10.88***	10.88***	5.95***	5.95***
	(1.17)	(1.60)	(1.60)	(2.07)	(2.07)
$QEnd1M_{i,t} \times \mathbb{I}_t[1988, 1995]$		16.19***	16.19***	4.20***	4.20***
		(1.45)	(1.45)	(1.55)	(1.54)
$YEnd1M_{i,t} \times \mathbb{I}_t[1988, 1995]$				12.12***	12.12***
				(3.23)	(3.23)
$QEnd1M_{i,t} \times Post07_t$		12.31***	6.62***	7.36***	1.67
		(1.34)	(1.66)	(1.35)	(1.67)
$YEnd1M_{i,t} \times Post07_t$		2.51	4.51	7.44***	9.44***
		(2.32)	(3.23)	(2.67)	(3.48)
$QEnd1M_{i,t} \times Post15_t$			10.62***		10.62***
			(1.84)		(1.83)
$YEnd1M_{i,t} \times Post15_t$			-4.76		-4.75
			(3.52)		(3.50)
$\mathbb{I}_t[1988, 1995]$				9.49***	9.49***
				(1.28)	(1.28)
$Post07_t$		-2.24**	-0.86	1.15	2.53*
		(1.02)	(1.30)	(1.11)	(1.36)
$Post15_t$			-2.59*		-2.59*
			(1.47)		(1.46)
Constant	13.12***	14.21***	14.21***	10.73***	10.73***
	(1.55)	(1.62)	(1.62)	(1.67)	(1.67)
Observations	111,638	111,638	111,638	111,638	111,638
R-squared	0.02	0.03	0.03	0.03	0.03

Notes: This table reports regression results on the incremental year-end effects, in addition to the quarter-end effects, for the daily one-month USD bases across 19 advanced economy (AE) currencies in our sample. The dependent variable is the absolute value of one-month USD basis. The variable $YEnd1M_{i,t}$ is a dummy that equals one if the one-month contract traded at t for currency i crosses a year-end, and zero otherwise. Similarly, the variable $QEnd1M_{i,t}$ is a dummy that equals one if the contract crosses a quarter-end. The indicator variable $\mathbb{I}_t[88, 95]$ is set to one if the trading date t falls within the period between January 1, 1988 and December 31, 1995. The other indicator variable, $Post07_t$ ($Post15_t$) is a dummy that equals one for trading date t that falls within the period from January 1, 2007 (January 1, 2015) to March 10, 2025. Columns (1)–(5) present results for different model specifications. All regressions include currency fixed effects. Standard errors are computed using the Newey-West method with 90-day lags and are reported in parentheses. Statistical significance is indicated by $***$, $**$, and $*$, corresponding to the 1%, 5%, and 10% confidence levels, respectively. The sample spans from January 1, 1986, to March 10, 2025. Spot and settlement dates for one-month FX swap contracts are sourced from Bloomberg.

Table 7: Year-End Effects on the Level of Three-Month CIP Deviations

	(1)	(2)	(3)	(4)	(5)
$YEnd3M_{i,t}$	4.09***	1.68***	1.68***	0.64	0.64
	(0.43)	(0.57)	(0.57)	(0.74)	(0.74)
$YEnd3M_{i,t} \times \mathbb{I}_t[1988, 1995]$				2.52**	2.52**
				(1.15)	(1.15)
$YEnd3M_{i,t} \times Post07_t$		5.12***	5.46***	6.15***	6.49***
		(0.86)	(1.16)	(0.97)	(1.23)
$YEnd3M_{i,t} \times Post15_t$			-0.27		-0.26
			(1.31)		(1.29)
$\mathbb{I}_t[1988, 1995]$				5.36***	5.36***
				(0.70)	(0.70)
$Post07_t$		3.46***	4.97***	5.17***	6.68***
		(0.56)	(0.72)	(0.60)	(0.74)
$Post15_t$			-2.80***		-2.80***
			(0.81)		(0.79)
Constant	9.90***	8.03***	8.03***	6.24***	6.24***
	(0.85)	(0.87)	(0.87)	(0.89)	(0.89)
Observations	111,635	111,635	111,635	111,635	111,635
R-squared	0.03	0.04	0.05	0.06	0.06

Notes: This table reports regression results on the year-end effects for the daily three-month USD bases across 19 advanced economy (AE) currencies in our sample. The dependent variable is the absolute value of three-month USD basis.The variable $YEnd3M_{i,t}$ is a dummy that equals one if the one-month contract traded at t for currency i crosses a year-end, and zero otherwise. The variable $QEnd1M_{i,t}$ is a dummy that equals one if the one-month contract traded at t for currency i crosses a quarter-end (i.e., the quarter-end date falls between the spot date and the forward maturity date), and zero otherwise. The indicator variable $\mathbb{I}_t[88, 95]$ is set to one if the trading date t falls within the period between January 1, 1988 and December 31, 1995. The other indicator variable, $Post07_t$ ($Post15_t$) is a dummy that equals one for trading date t that falls within the period from January 1, 2007 (January 1, 2015) to March 10, 2025. Columns (1)–(5) present results for different model specifications. All regressions include currency fixed effects. Standard errors are computed using the Newey-West method with 90-day lags and are reported in parentheses. Statistical significance is indicated by $***$, $**$, and $*$, corresponding to the 1%, 5%, and 10% confidence levels, respectively. The sample spans from January 1, 1986, to March 10, 2025. Spot and settlement dates for three-month FX swap contracts are sourced from Bloomberg.

6 Conclusion

This paper presents the first comprehensive daily dataset that enables the analysis of Covered Interest Parity (CIP) deviations for 19 advanced market currencies from 1921 to 2021. Our data contribution extends beyond collecting historical data. Specifically, we systematically clean and validate modern data samples through cross-checks across multiple historical and modern sources, addressing errors and inconsistencies in the raw data. Notably, modern electronic databases on exchange rates are not immediately suited for daily-frequency analysis except for G10 currencies after 2000. By overcoming these limitations, our dataset ensures greater accuracy and reliability for long-term analysis of CIP deviations. Our eurocurrency interest rate data allows us to rule out the possibility that our measured CIP deviations are largely driven by capital control.

Utilising this long-run dataset, we evaluate the economic significance of CIP deviations by determined the impact of transaction costs on CIP deviations. Our first main finding is that, over the last century, economically significant deviations from CIP have been more prevalent for advanced currencies than commonly assumed, representing the norm rather than the exception. This finding implies the prevalence of limits to arbitrage in the foreign exchange market as CIP as a no-arbitrage condition should hold in the absence of any frictions. The only period during which CIP deviations were economically insignificant was pre-GFC years from the mid-1990s to 2006., when CIP held closely for G10 currencies amid a peak in global banking deregulation.

We also highlight the critical role of methodological and data choices in evaluating the economic significance of CIP deviations. In particular, we show that the arbitrage strategy used, whether based on FX swaps or outright forward and spot transactions, impact the assessment of CIP deviations. Traders implementing arbitrage through FX swaps are more likely to identify economically significant profit opportunities, whereas those relying solely on outright forwards and spot rates are less likely to do so. Empirically, we find stronger evidence of economically significant CIP deviations in the same sample as Frenkel and Levich (1977) when using no-arbitrage bands derived from FX swaps (Table 3). In contrast, deviations appear less economically significant in the Du et al. (2018) sample, where no-arbitrage bands are based on outright forwards (Table 4). This contrast becomes even more striking when no-arbitrage bands are estimated using the transaction cost measures from Frenkel and Levich (1977). Under such an approach, economically significant CIP deviations would have appeared virtually nonexistent since the 1960s, including during and after the Global Financial Crisis.

Finally, our findings reveal that quarter-end effects on CIP deviations are not unique to the post-GFC period, as similar patterns were also present in the 1980s and 1990s. This suggests that intermediary constraints arising from the banking regulatory environment may have imposed limits to arbitrage in earlier periods as well, restricting CIP arbitrage activity back in the 1980s and 1990s.

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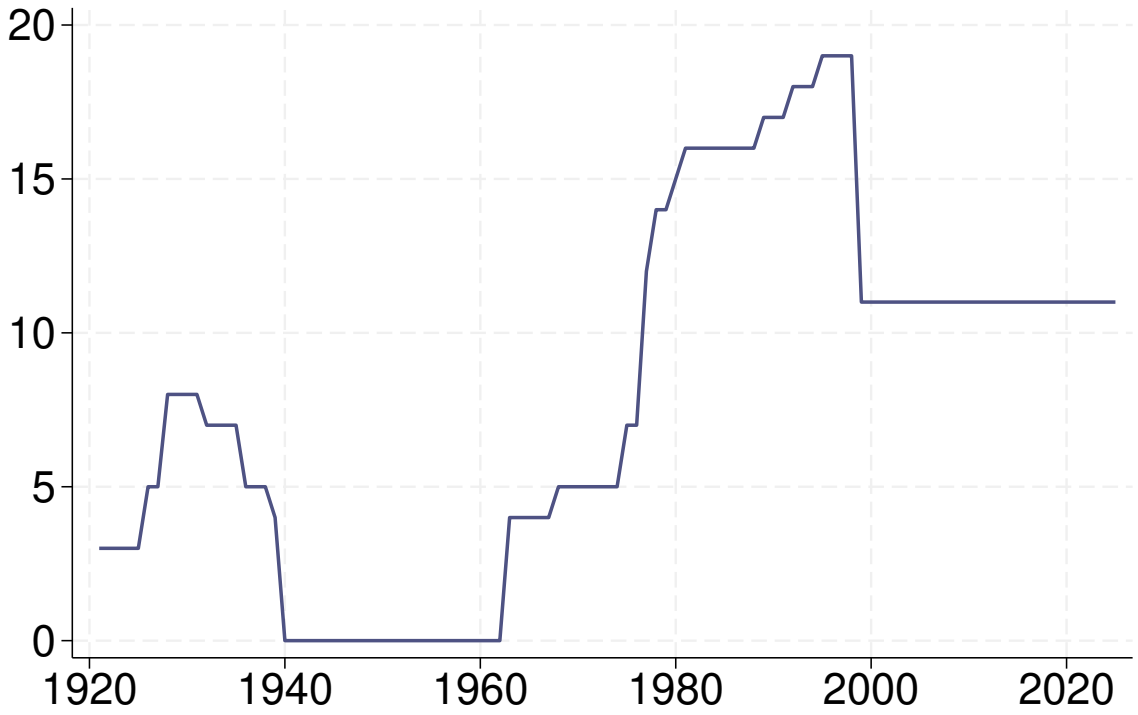
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Appendix A Sample coverage and data sources

A1 Sample coverage

Figure A1: Evolution of the Number of Currencies with Measurable USD Basis



Notes: This figure presents the time series of the number of currencies in our sample for which the USD basis is measurable.

A2 Interest rates

Table A1: Interest rate data

Panel A: Interwar period

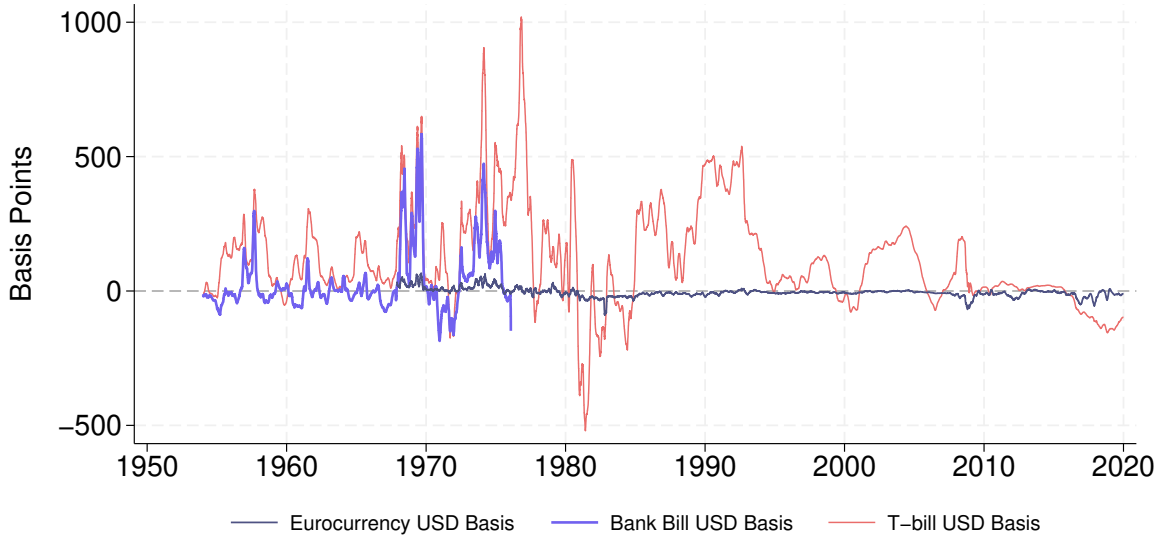
Currency	Coverage	Source	Instrument
BEF	1926-1938	Bulletin hebdomadaire d'information et de documentation (1926-1927), Bank of France archives (1928-1938)	Private discount rate on commercial paper.
CHF	1928-1934	Bank of France archives	Private discount rate on prime bank bills and commercial paper.
DEM	1928-1939	Bank of France archives	Private discount rate.
FRF	1926-1939	Bank of France archives	Commercial bills from 1926 to 1931 (see Bazot et al. (2016, p96-97)). From January 1932 onwards, rate on acceptances.
GBP	1920-1939	Bank of France archives	Private discount rate on bankers' bills.
ITL	1928-1937	Bank of France archives	Private discount rate.
NLG	1920-1939	Nederlandsche Bank Annual Reports (1920-1927), Bank of France archives (1928-1939)	Private discount rate.
USD	1920-1939	New York Times (1920-1929), Bank of France archives (1930-1939)	Private discount rate on bankers' bills.

Panel B: Postwar period

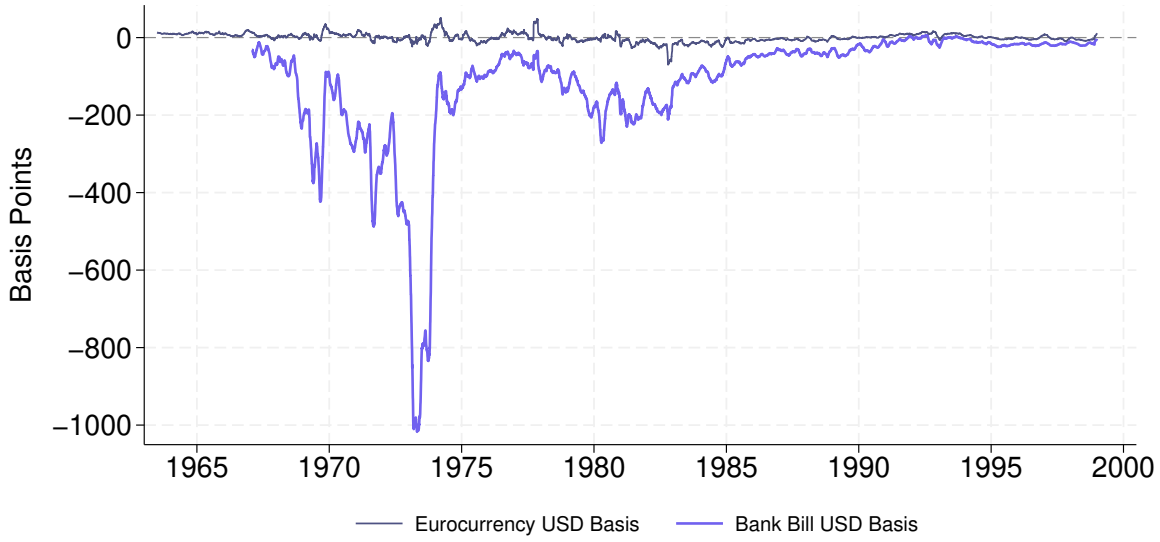
Currency	Coverage	Source and Instrument
Advanced market currencies	1963-2020	Eurocurrency deposit rates from FT/Refinitv Datatream (starting date ranging from 1971 to 1997). We extend the data back to 1963 using eurocurrency rates from the BIS.

A3 Alternative interest rates for measuring USD basis

Figure A2: USD Basis Measured by Alternative Money Market Instruments



(a) GBP



(b) DEM

Notes: This figure illustrates the USD basis, calculated using daily interest rates from various money market instruments with a three-month maturity. Panel (a) shows USD basis for GBP, calculated using the eurocurrency rates, bank bill rates, and treasury bill rates, respectively. Panel (b) shows the USD basis for DEM, based on the eurocurrency rates, and bank bill rates, respectively. The sample period spans January 4, 1954 to December 31, 2019 for GBP and July 2, 1963 to December 31, 1998 for DEM.