Covered Interest Parity: The Long Run Evidence*

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Abstract

This paper provides long run empirical evidence on the covered interest parity (CIP) condition based on a century of data. We construct a comprehensive daily dataset of bid and ask quotes for spot and FX swap rates, as well as money market interest rates, covering 19 advanced-economy currencies from 1921 to 2025. We show that substantial deviations from CIP have been much more common than traditionally assumed before the Global Financial Crisis (GFC), representing the norm rather than the exception. These deviations persist even after accounting for capital controls and transaction costs. We also show that long run patterns in CIP deviations are linked to changes in financial intermediaries' constraints, particularly those associated with banking regulation. Our findings indicate that the failure of CIP since the GFC is not historically exceptional, and that frictions linked to intermediary constraints have been a prevalent feature of financial markets over the past century.

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 remarkable developments 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 eliminated, the forward premium of a foreign currency relative to the domestic currency should equal 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 data from historical sources. We also systematically clean and correct exchange rate data from online databases for the 1983–2000 period by cross-checking multiple sources to address inconsistencies. Notably, exchange rate data for the post-1983 period are generally unsuitable for daily-frequency analysis—except for G10 currencies after 2000—due to frequent misreporting. By overcoming these limitations, we enhance the accuracy and reliability of long-term CIP analysis.

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 time when CIP deviations were economically insignificant was during the 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.

While CIP arbitrage trades entail no currency risk, deviations from CIP may still arise due to capital controls (i.e., government-imposed restrictions on the movement of capital across borders) or credit risk. In particular, capital controls were widespread during the period from 1945 to 1979; to account for such restrictions, we follow the standard practice of assessing CIP using interest rates on offshore (eurocurrency) deposits.[1] While we cannot completely rule out the presence of credit risk in the eurocurrency market, such risk is unlikely to account for a significant share of the observed deviations from CIP, as eurocurrency deposits in various currencies were issued by the same multinational banks operating branches in London, minimizing the scope for credit risk differences across currencies. For the 1921–1939

[1]The use of eurocurrency deposit interest rates to test CIP has been standard in the literature since the 1970s (Aliber, 1973; Frenkel and Levich, 1975, 1977; Akram et al., 2008). The literature on post-GFC CIP deviations also generally relies on offshore interbank interest rates (LIBOR) (Du et al., 2018; Cerutti et al., 2021).

years however, offshore interest rates are unfortunately unavailable, and we therefore assess CIP deviations in this period based on the (onshore) short-term interest rates on standard money market instruments traded in each country. Since these instruments were not fully comparable across countries, it is likely that part of the CIP deviations observed for this period reflected credit risk of capital controls. However, money market instruments with similar credit risk existed in both the United Kingdom and the United States at the time. These instruments, known as bankers' acceptances, were generally regarded by contemporaries as risk-free, as they were payable by first-class financial institutions and could be re-discounted at the respective central bank (Accominotti, 2019). Moreover, during this period, neither the UK nor the US government imposed capital controls that could have prevented investors from engaging in CIP arbitrage. Therefore, while our evidence for the 1921-1939 period is generally less robust than for the post-1963 period (when offshore interest rates become available), we are nevertheless able to assess CIP deviations with greater confidence for the GBP/USD market during this earlier period. We also report indicative measures of the USD basis for other currencies during the 1921–1939 period to evaluate the broader economic significance of CIP deviations.

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 samples, often limited to a small set of currencies, typically covering horizons ranging from several weeks to several years (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 the 1990s, 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 transparent 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 remains even after accounting for transaction costs. Variations in transaction costs alone cannot explain the observed differences in CIP deviations over time.

Our analysis demonstrates that the diverging conclusions reached by previous scholars regarding the economic significance of CIP deviations in the pre-GFC period stem from differences in how they account for transaction costs. Specifically, an investor arbitraging CIP deviations incurs lower transaction costs when using FX swap contracts rather than a combination of spot and outright forward exchange contracts (Clinton, 1988). In a pioneering study, Frenkel and Levich (1977) introduce a method to estimate transaction costs and derive a no-arbitrage band for CIP deviations based on outright forward rates. Using this approach, they find no significant CIP deviations in the GBP/USD market from 1962 to 1975 after accounting for transaction costs. However, when we derive a similar no-arbitrage band based on FX swap rates rather than outright forward rates, and use a direct measure of transaction costs (based on actual bid and ask quotes) rather than an estimated one, we find that CIP deviations were, in fact, economically significant during the same period. Conversely, when we derive a no-arbitrage band based on outright forward rates and employ Frenkel and Levich (1977)'s method for estimating transaction costs, CIP deviations appear virtually nonexistent throughout the entire post-1960 period—including the post-GFC era that has been the focus of recent empirical studies on CIP deviations.

We also investigate the determinants of CIP deviations over the last century. The 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, authorities' approach to banking regulation evolved as the Market Risk Amendment to the Basel I Accord first allowed banks to determine their capital requirements based on their own internal models. At the same time, the rise of the shadow banking system in the late 1990s and 2000s led to an increase in banks' off-balance sheet assets. Since these assets were not adequately accounted for under existing regulatory rules, their growth effectively contributed to relaxing balance sheet constraints on financial intermediaries.

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.

This paper contributes to several strands of the literature. First, our finding that CIP deviations have been the norm rather than the exception over the past century provides strong support for the growing literature that places financial frictions at the center of asset pricing and international finance. The persistence of CIP deviations is inconsistent with models assuming perfect financial markets and instead underscores the need to incorporate binding constraints on financial intermediaries—an approach increasingly reflected in recent theoretical frameworks (Gabaix and Maggiori, 2015; Greenwood et al., 2023).

Second, we contribute to the recent literature on CIP deviations. An initial wave of research documented the sharp increase in deviations during the GFC and the European debt crisis (e.g., Baba and Packer (2009); Ivashina et al. (2015)). More recent work has focused on the persistence of these deviations in the post-crisis period. Du et al. (2018) show that observed deviations cannot be explained by credit risk or transaction costs, while Avdjiev et al. (2019) document co-movement between CIP deviations and the broad dollar index. Rime et al. (2022) argue that arbitrage opportunities are effectively limited to a small set of high-rated banks. A common feature of this literature is the presumption that CIP largely held prior to the GFC. Our contribution is to show that this perception is likely over-extrapolative: except for the years immediately preceding the GFC, CIP deviations have been a persistent feature of international financial markets over the last century. In terms of underlying mechanisms, our evidence of quarter- and year-end spikes in CIP deviations supports the view that intermediary constraints limit the supply of arbitrage capital (Du et al., 2018; Borio et al., 2016; Cerutti et al., 2021).

Finally, our study contributes to the long-run empirical literature in asset pricing, which has examined patterns such as the equity risk premium (Jorion and Goetzmann, 1999; Dimson et al., 2002), the value premium (Davis et al., 2000), IPO underpricing (Chambers and Dimson, 2009), and the returns to currency carry trades (Doskov and Swinkels, 2015; Accominotti et al., 2019). In this tradition, we provide a century-long perspective on deviations from one of the most fundamental no-arbitrage conditions in international finance.

The remainder of the paper is organized as follows. Section 2 describes the data sources and construction. Section 3 defines the U.S. dollar basis and presents descriptive statistics based on our long-span data. Section 4 develops an unified framework to assess the economic significance of CIP deviations. Section 5 examines quarter-end effects on CIP deviations, motivated by a long-run perspective on intermediary constraints. Section 6 concludes.

2 A long run dataset of CIP deviations

To examine whether the CIP deviations observed over the past fifteen years are exceptional from a long run perspective, we extend the methodology developed in the post-GFC literature back in time. This literature has documented the emergence of substantial CIP deviations by computing the benchmark USD basis of G10 currencies using daily data on spot and FX swap rates as well as offshore interbank interest rates (LIBOR) (Borio et al., 2016; Du et al., 2018; Cerutti et al., 2021). In line with this approach, we construct a dataset that enables us to compute a long-run series of the benchmark USD basis for advanced-economy currencies based on comparable data. This allows us to investigate the economic significance of CIP deviations over one century of data.

Our dataset comprises forward exchange rates (FX swap points), spot exchange rates and three-month money market interest rates for 19 advanced countries' currencies at daily frequency over the period 1921-2025. 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.

In line with the recent literature, we compute the USD basis using offshore, unsecured interbank interest rates where possible. The offshore interbank market provides an ideal setting for testing the covered interest parity (CIP) condition, as it is not subject to capital or interest rate controls. This is particularly important for the 1945–1979 period, when such controls were common among advanced economies. Interbank deposits in various currencies on the London offshore market are issued under the same legal jurisdiction, and the credit risk associated with these rates is generally considered minimal (Aliber, 1973).[2] As a result, offshore interbank deposit rates offer a more reliable benchmark than alternative onshore money market instruments for measuring the USD basis.

While recent studies have generally computed the USD basis using benchmark LIBOR rates, these rates were only introduced in 1986 and were discontinued in 2023. To ensure consistency across our sample, we instead rely on eurocurrency deposit rates, which are available over a longer time period.[3]. Both LIBOR rates and eurocurrency deposit rates represent offshore interest rates. However, while LIBOR was computed on a daily basis as the average offered interest rate on short-term interbank loans as reported by a defined panel of banks, eurocurrency deposit rates reflect dealer quotes for interest rates on short-term deposits in various currencies on the London offshore market. However, ever since its origins in the late 1950s, the eurocurrency market has also predominantly been an interbank market (Einzig, 1965; Sarver, 1990; Schenk, 1998).[4]

Eurocurrency deposit interest rates are sourced from FT/Refinitiv and a previously untapped database maintained by the Bank for International Settlements (BIS), which reports representative daily rates recorded at around 11:00 a.m. London time. An additional advantage of using these eurocurrency rates is that, unlike LIBOR - which is an ask rate only - they include both bid and ask quotes. We use these bid and ask quotes to account for changing transaction costs when assessing the economic significance of CIP deviations over our long sample. 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).

As illustrated in Figure A4, the USD basis was consistently and substantially larger when measured using onshore rates (bank bills or Treasury bills) rather than offshore rates (eurocurrency deposits) during the period from the 1960s to the 1980s when capital controls preventing the flow of funds between onshore markets were prevalent. This confirms the importance of relying on offshore interest rates for examining the CIP condition during this period.

Offshore money markets first emerged during the post–World War II era of capital controls, and daily quotations of eurocurrency deposit interest rates are only available starting in 1963—and not for all currencies in our sample (Table A1). For the earlier period (1921–1939), we therefore cannot rely on such data and instead use the best available alternative: three-month onshore interest rates on first-class money market instruments. The reference money market rate during this period was the interest rate on prime short-term paper issued by first-class financial institutions. We collect interest rates on such instruments for several countries during the 1921–1939 period from central bank statistical reports, financial newspapers, and central bank archives. [5]

One implication of using onshore interest rates is that we cannot account for the risk of capital controls during the earlier part of our sample. In addition, prime money market instruments were presumably not fully comparable across countries in terms of credit risk. As a result, we cannot entirely rule out the possibility that such risks partly explain observed CIP deviations in this early period (i.e., 1921–1939). However, both the United Kingdom and the United States

[2]By focusing on offshore rates, we can thus 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.

[3]The use of eurocurrency deposit rates to examine the CIP condition was standard practice in the pre-GFC literature (Aliber, 1973; Frenkel and Levich, 1975, 1977; Clinton, 1988; Akram et al., 2008)

[4]Einzig (1965, p.14) notes that "the Euro-dollar market is confined to interbank dealings". Mc Kinnon (1977, p.11) also describes how "Almost all Eurocurrency transactions are interbank, and most outstanding deposits are interbank claims." Sarver (1990, p.5) reports that 78% of Eurocurrency deposits were held by commercial banks in March 1988.

[5]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 1921-1939 sample.

had large and liquid markets for bankers' acceptances at the time. Bankers' acceptances were private short-term debt instruments issued by first-class UK or US banks. They served as the primary instrument through which the Bank of England and the Federal Reserve provided liquidity to the domestic financial system and were eligible for re-discount at the respective central bank, implying that they could be converted into cash at any time (see Einzig (1937); Kindleberger (1939)). As such, contemporaries generally regarded these instruments as risk-free.[6] At the same time, neither the US nor the UK government imposed direct controls on transactions that could have impaired covered interest arbitrage during the 1920s and 1930s. This allows us to measure the GBP's USD basis with greater reliability during this period. Since similar comparability in the credit risk of money market instruments and the absence of capital controls cannot be established for other countries, we take these limitations of the available data into account when interpreting CIP deviations for those currencies in 1921-1939. Nevertheless, the reported USD basis for these currencies provides valuable benchmark information to assess the economic significance of deviations during this period.

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 $F_i = S_i + FP_i = S_i e^{\phi_i \tau}$. These variables are measured using the mid-market quotations in the data.[7]

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 rate risk through an FX swap contract:

$$e^{y_\$ \tau} = e^{y_i \tau} F_i/S_i, \quad \text{or} \quad y_\$ = y_i + \phi_i \,. \tag{1}$$

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):

$$x_i = -\frac{1}{\tau} \ln\left(\frac{F_i}{S_i} e^{y_i \tau} / e^{y_\$ \tau}\right) = y_\$ - (y_i + \phi_i) \,. \tag{2}$$

The USD basis measures deviations from the CIP condition. Indeed, in frictionless FX and money markets, a

[6]USD and GBP bankers' acceptances were also known as bank bills. Both the Bank of England's and the Federal Reserve's main benchmark interest rates were the discount rates on bankers' acceptances. For a detailed description of these instruments, see Accominotti and Ugolini (2020). Peel and Taylor (2002) also use weekly interest rates on US bankers' acceptances in their study of CIP deviations during the 1920s, although they use interest rates on Treasury bills for the UK. In contrast, we use interest rates on bankers' acceptances for both the UK and the US, allowing us to compute CIP deviations on the GBP/USD market using comparable money market instruments. In addition, our data are at the daily frequency.

[7]For simplicity, subscripts indicating time t and maturity τ are omitted from relevant variables where appropriate.

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 Descriptive evidence

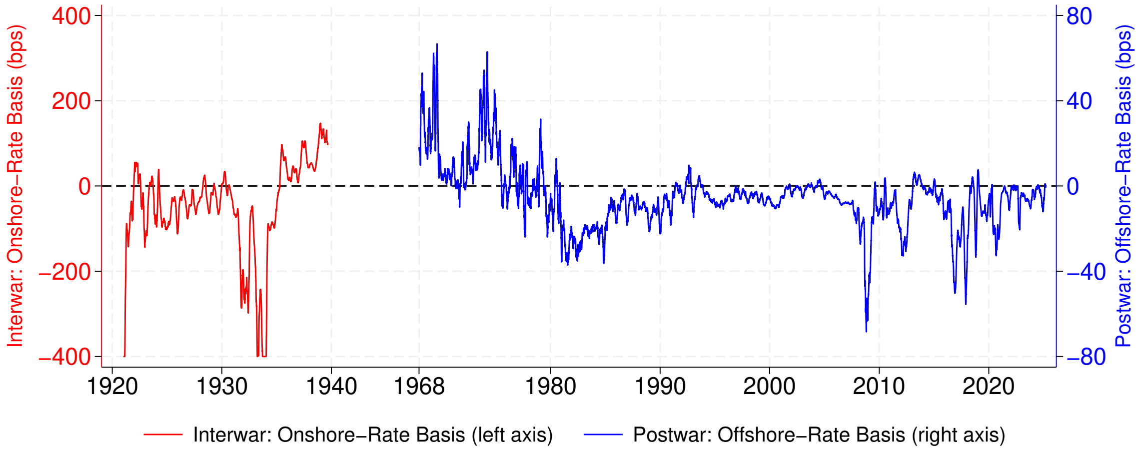
Figure 1 plots the USD basis for the British pound (GBP), Swiss franc (CHF), and French franc (FRF) until 1999, and for the euro (EUR) thereafter, over our long sample. While the precise sample dates vary depending on exchange rate and interest rate data availability, these series cover the period from the 1920s to the 1930s and from the 1960s to 2025. 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 1921–1939 period while they were of comparable magnitude in 1963–1998 and in the post-2007 period. The only time when CIP deviations are minimal is during the pre-GFC years from the late-1990s to 2006.

To complement the time-series patterns in Figure 1, Table 1 reports summary statistics on the USD basis for each currency across six subsample periods: the interwar period (1921–1939), Bretton Woods period (1963–1972), post-Bretton Woods period (1973–1998), pre-GFC period (1999–2006), global financial crisis (2007–2009), and post-GFC period (2010–2025). For each period, we report the number of currency-day observations, the fraction with a negative USD basis, the mean basis, and the mean absolute basis.

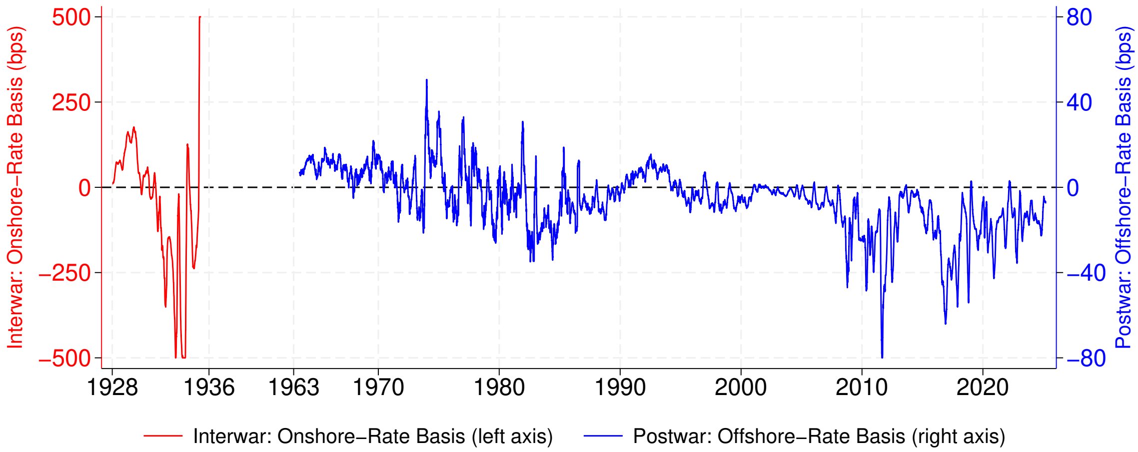
Our purpose in labeling the pre-GFC period is to identify a prolonged interval during which CIP held most closely. As demonstrated in Section 4.2, once transaction costs are accounted for, CIP deviations are virtually nonexistent during this period. Although the formal framework for evaluating the role of transaction costs is introduced in Section 4, the present section examines the statistical properties of the USD basis as a measure of CIP deviations, abstracting from transaction costs.

As shown in Table 1, the level and sign of the USD basis vary substantially across both time periods and currencies. The mean basis and the mean absolute basis are of similar magnitude in the post-Bretton Woods period (1963–1998) and in the GFC and post-GFC periods (2007–2025), though the basis tends to be positive in the former and negative in the latter. The pre-GFC period (1999–2006) stands out as a time of negligible deviations: both the mean and absolute basis are close to zero. During the interwar period, GBP exhibits lower absolute deviations relative to other currencies, consistent with the fact that it was not subject to capital or exchange controls, unlike many other currencies during the 1930s. For the 1963–2025 period, our basis estimates rely on offshore (Eurocurrency) interest rates and are therefore not influenced by domestic capital or exchange controls.

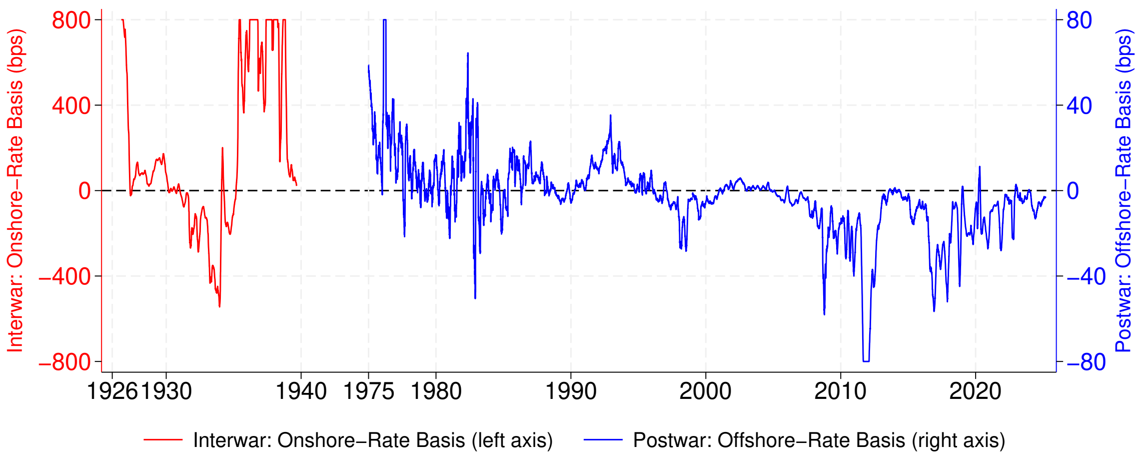
Figure 1: The time series of CIP deviations



(a) GBP



(b) CHF



(c) FRF and EUR

Notes: This figure plots the time series of covered interest parity (CIP) deviations, measured as the 30-day moving average of the USD basis (in basis points) at a three-month maturity. Panel (a) reports results for the British pound (GBP), panel (b) for the Swiss franc (CHF), and panel (c) for the French franc (FRF) and the euro (EUR). In each panel, the left-hand column displays the interwar period (plotted against the left axis in red), while the right-hand column displays the post–World War II period (plotted against the right axis in blue). For visual clarity, all series are trimmed, and the gaps between the interwar and postwar segments are compressed.

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, excluding the USD. The statistics include the number of observations, the fraction of negative USD basis, the means 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 three-month maturity. The descriptive statistics are presented for five subsample periods: 1921–1939, 1963–1998, 1999–2006, 2007–2009, and 2010–2025. 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 in the previous section suggests that deviations from CIP were common over the past century, including several decades before the GFC. 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 evaluate whether observed CIP deviations remain economically meaningful once realistic trading costs are incorporated. Our objective is not to measure the real-time profitability of high-frequency arbitrage strategies that require precise timing and synchronization (e.g., Taylor, 1987, 1989; Akram et al., 2008). Instead, we propose a simple, transparent framework for evaluating the economic significance of CIP deviations over the long-run. This framework enables consistent comparison across time and supports the interpretation of historical patterns.

Since its emergence in the 1920s, the challenge of accounting for transaction costs has been central to the covered interest parity (CIP) literature. Researchers have proposed various approaches specifically for the purpose of applying them in the context of measuring precise arbitrage profits or testing for market efficiency (for a comprehensive survey, see Sarno and Taylor (2003, Chapter 2) and Levich (2017)). We develop a simple analytical framework that enables transparent and consistent comparisons across these methods and facilitates analysis of their implications for assessing the economic significance of CIP deviations over time. This framework allows us to (i) directly compare the results derived from our dataset with those of prior studies based on smaller samples, and (ii) offer a comprehensive approach to evaluating the frequency and magnitude of CIP deviations in the context of evolving transaction costs.

To simplify notation, we suppress the time index t and maturity τ where appropriate. Let y_i^{Bid} and y_i^{Ask} denote the bid and ask annualized interest rates quoted on currency i deposits in the interbank market; S_i^{Bid} and S_i^{Ask} the corresponding interbank quotations for spot exchange rates (expressed in USD per unit of currency i); and FP_i^{Bid} and FP_i^{Ask} the interbank quotations for FX swap points, expressed in U.S. dollars. By market convention, the bid and ask outright forward rates are given by $F_i^{\text{Bid}} = S_i^{\text{Bid}} + FP_i^{\text{Bid}}$ and $F_i^{\text{Ask}} = S_i^{\text{Ask}} + FP_i^{\text{Ask}}$.[8]

Using these quotations, we define proportional bid-ask spreads:

$$d_i^y = y_i^{\text{Ask}} - y_i^{\text{Bid}}, \tag{3}$$

$$d_i^s = \ln S_i^{\text{Ask}} - \ln S_i^{\text{Bid}}, \tag{4}$$

$$d_i^w = \phi_i^{\text{Ask}} - \phi_i^{\text{Bid}}, \tag{5}$$

$$d_i^f = \ln F_i^{\text{Ask}} - \ln F_i^{\text{Bid}} \simeq d_i^s + d_i^w \tau, \tag{6}$$

where the subscripts y, s, w, and f index deposit rates, spot exchange rates, FX swaps, and outright forward contracts, respectively. Annualized bid and ask forward premiums are defined as $\phi_i^{\text{Bid, Ask}} = \tau^{-1} \ln(1 + FP_i^{\text{Bid, Ask}}/S_i)$. Next, we model the effective transaction cost c_i^z in market $z \in \{y, s, w, f\}$ as a linear function of the corresponding proportional

[8] A trader entering a long position in the outright forward contract pays F_i^{Ask} dollars for one unit of currency i at maturity. This entails a transaction cost of $F_i^{\text{Ask}} - F_i = (S_i^{\text{Ask}} - S_i) + (FP_i^{\text{Ask}} - FP_i)$ dollars. Alternatively, the same exposure can be replicated by purchasing spot at S_i^{Ask} and entering an FX swap. The spot transaction incurs a cost of $S_i^{\text{Ask}} - S_i$, while the FX swap entails selling currency i at S_i^{Bid} (cost: $S_i - S_i^{\text{Bid}}$), and later buying it back at $S_i^{\text{Bid}} + FP_i^{\text{Ask}}$ (rebate: $-(S_i - S_i^{\text{Bid}})$ and cost: $FP_i^{\text{Ask}} - FP_i$). The round-trip swap cost is therefore $FP_i^{\text{Ask}} - FP_i$, and the total cost of the synthetic outright forward is again $F_i^{\text{Ask}} - F_i$. Thus, traders do not gain a cost advantage by replicating an outright forward contract through spot and swap transactions.

bid-ask spread, $c_i^z = \frac{1}{2}\kappa^z d_i^z$, where $\kappa^z \in [0, 1]$ reflects the investor's location within the quoted spread. Our baseline assumes $\kappa^z \equiv 1$, yielding conservative estimates of transaction costs and maximizing the likelihood that observed CIP deviations are attributable to transaction costs. Alternative values have been used in the literature on the profitability of currency trading strategies—for instance, Menkhoff, Sarno, Schmeling and Schrimpf (2012) use $\kappa^{s,f} = 0.50$, and Chernov, Dalhquist and Lochstoer (2024) use $\kappa^{s,f} = 0.25$.

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

To hedge FX risk in CIP arbitrage, the investor can either engage in an FX swap or use a combination of spot and outright forward contracts. Each of these two options involves distinct transaction costs.[9] 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 transaction by repurchasing currency i at a pre-agreed forward rate $\widehat{S}_i e^{\phi_i\tau + c_i^w\tau}$ at maturity. 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. Importantly, however, the total transaction cost associated with the FX swap is independent of the choice of $\widehat{S}_i$ and is always equal to $c_i^w\tau$; the spot transaction cost c_i^s does not affect the overall cost of the swap.

By contrast, if the arbitrageur hedges FX risk by employing a combination of spot and outright forward contracts, 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 through the outright forward contract 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 through the outright forward contract 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.

This comparison makes clear that FX swaps are the economically relevant instrument for implementing CIP arbitrage. Using a combination of spot and outright forward contracts instead is strictly less efficient in the context of CIP arbitrage, except when access to FX swaps is restricted.

A rational investor engages in CIP arbitrage only if the expected profit exceeds the associated transaction costs. Accordingly, the no-arbitrage condition implies that the USD basis for currency i should fluctuate within a band $[-\delta_i, \delta_i]$, where δ_i reflects the effective cost of implementing the arbitrage. In the remainder of this section, we introduce a range of threshold values for δ_i, each derived from specific no-arbitrage or market equilibrium conditions. These

[9] FX swaps have been a widely used tool for managing foreign exchange risk and trading since the 1920s, making them a long-established, not recent, financial instrument (see Einzig (1937, pp. 93, 103) and Einzig (1961, pp. 18, 35)). On the other hand, 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.

time-varying and currency-specific bands serve a dual purpose: they establish benchmarks for evaluating the economic significance of observed CIP deviations, and they help extract informative signals from CIP deviations to identify the sources of market dislocations. Crucially, each band is derived by explicitly modeling the implementation of concrete CIP arbitrage strategies over a three-month horizon, properly accounting for transaction costs incurred in FX and cash markets. This construction ensures that our annualized measures of CIP deviations are correctly scaled, thereby avoiding the downward bias in estimated transaction costs or the upward bias in implied arbitrage profits that may arise from naïve annualization (Frenkel and Levich, 1975).

4.1.1 No-arbitrage bands using FX swaps

Consider first the case of an investor arbitraging CIP deviations using FX swap contracts. Such a strategy yields positive excess returns only if the absolute value of currency i's USD basis exceeds the threshold δ_i^{NASW}:

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

When $x_i \in [-\delta_i^{\text{NASW}}, 0)$, the arbitrage profit net of transaction costs, denoted π_i^{NASW}, is nonpositive:

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

That is, arbitraging a negative USD basis—borrowing in USD, investing in currency i, and hedging via FX swaps—is unprofitable unless $x_i < -\delta_i^{\text{NASW}}$. In that case, the net profit is approximately $\pi_i^{\text{NASW}} \simeq (|x_i| - \delta_i^{\text{NASW}})\tau > 0$.

Likewise, when $x_i \in (0, \delta_i^{\text{NASW}}]$, arbitraging a positive basis by borrowing in currency i and investing in USD is also unprofitable:

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

Profits only emerge when $x_i > \delta_i^{\text{NASW}}$, with net profit approximated by $\pi_i^{\text{NASW}} \simeq (|x_i| - \delta_i^{\text{NASW}})\tau > 0$.

The corresponding no-arbitrage band $[-\delta_i^{\text{NASW}}, \delta_i^{\text{NASW}}]$ aligns with the methodology used in the recent literature on CIP deviations (Clinton, 1988; Du et al., 2018) that accounts for the effects 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.

4.1.2 No-arbitrage bands using outright forwards

Let us now turn to the case of an investor using a combination of spot and outright forward contracts to hedge exchange rate risks. In this case, arbitrage is profitable only if the USD basis lies outside the band $[-\delta_i^{\text{NAFW}}, \delta_i^{\text{NAFW}}]$, with

$$\delta_i^{\text{NAFW}} = c_\$^y + c_i^y + \frac{1}{\tau}(c_i^s + c_i^f) = c_\$^y + c_i^y + c_i^w + \frac{2}{\tau} c_i^s \,, \tag{10}$$

where the second equality follows from the observation that the transaction cost associated with an outright forward contract incorporates the costs of both a spot transaction and an FX swap, i.e., $c_i^f = c_i^s + c_i^w \tau$.

Specifically, if $x_i < -\delta_i^{\text{NAFW}}$, arbitraging the negative basis generates:

$$\pi_i^{\text{NAFW}} = \underbrace{\frac{F_i e^{-c_i^f}}{S_i e^{c_i^s}} e^{(y_i - c_i^y)\tau} - e^{(y_\$ + c_\$^y)\tau}}_{\simeq (|x_i| - \delta_i^{\text{NAFW}})\,\tau} > 0\,, \tag{11}$$

while for $x_i > \delta_i^{\text{NAFW}}$, arbitraging the positive basis yields:

$$\pi_i^{\text{NAFW}} = \underbrace{e^{(y_\$ - c_\$^y)\tau} - \frac{F_i e^{c_i^f}}{S_i e^{-c_i^s}} e^{(y_i + c_i^y)\tau}}_{\simeq (|x_i| - \delta_i^{\text{NAFW}})\,\tau} > 0\,. \tag{12}$$

This band corresponds to the classical no-arbitrage range first formalized by Frenkel and Levich (1975), who emphasized the role of transaction costs in limiting arbitrage. Unlike Frenkel and Levich, who estimated these costs indirectly, we compute them directly from observed bid-ask spreads for spot and forward quotes, thereby providing more precise bounds for empirical analysis.

4.1.3 Market equilibrium bands

The no-arbitrage bands defined above are commonly used to identify profitable covered interest parity (CIP) arbitrage opportunities net of transaction costs. However, even when the USD basis lies within these bands, implying that no arbitrage profits are available, markets may still be in disequilibrium if it is more costly to take a position directly than to replicate it synthetically in another market. Such situations give rise to so-called "one-way arbitrage" and can lead to a breakdown of trading activity in the affected markets (Deardorff, 1979; Callier, 1981; Clinton, 1988).

In assessing the economic significance of CIP deviations, it is therefore essential to delineate the thresholds, referred to in the literature as market equilibrium bands, beyond which one-way arbitrage arises, disrupting equilibrium in either the FX swap or cash markets. These bands impose tighter restrictions on the range of deviations that can be sustained in equilibrium, highlighting the limitations of transaction costs in fully explaining observed violations of CIP.

USD cash market equilibrium band Consider first the USD cash market. Disequilibrium in this market will occur when the absolute value of currency i's USD basis exceeds the threshold value $\delta_i^{\$\text{Cash}}$:

$$\delta_i^{\$\text{Cash}} = c_i^w + c_i^y - c_\$^y\,. \tag{13}$$

If $x_i > \delta_i^{\$\text{Cash}}$, it is cheaper to borrow USD synthetically—by swapping $\widehat{S}_i^{-1}$ units of currency i into USD today and repurchasing at the forward ask price—than through the cash market:

$$e^{(y_\$ + c_\$^y)\tau} > \frac{\widehat{S}_i e^{(\phi_i + c_i^w)\tau}}{\widehat{S}_i} e^{(y_i + c_i^y)\tau}\,. \tag{14}$$

In this case, USD borrowers shift to the synthetic route, while lenders remain concentrated in the cash market, resulting in excess supply and disequilibrium in the USD cash market.

Conversely, if $x_i < -\delta_i^{\$\text{Cash}}$, lending USD through the cash market yields less than its synthetic alternative, which entails converting USD into currency i today and reselling it forward at the bid price:

$$e^{(y_\$ - c_\$^y)\tau} < \frac{\widehat{S}_i e^{(\phi_i - c_i^w)\tau}}{\widehat{S}_i} e^{(y_i - c_i^y)\tau} . \tag{15}$$

Here, USD lenders shift to the synthetic strategy, while borrowers remain in the cash market, again generating excess demand and imbalance in the USD cash market.

Hence, for the USD cash market to remain in equilibrium, the USD basis must lie within $[-\delta_i^{\$\text{Cash}},\ \delta_i^{\$\text{Cash}}]$.

Currency i cash market equilibrium band A similar condition applies to the cash market in currency i. In this market, disequilibrium arises when the USD basis falls outside the band $[-\delta_i^{\text{Cash}},\ \delta_i^{\text{Cash}}]$, where

$$\delta_i^{\text{Cash}} = c_i^w - (c_i^y - c_\$^y) . \tag{16}$$

FX swap market equilibrium band Turning to the FX swap market, disequilibrium emerges when the USD basis exceeds the threshold δ_i^{Swap}:

$$\delta_i^{\text{Swap}} = c_i^y + c_\$^y - c_i^w . \tag{17}$$

If $x_i < -\delta_i^{\text{Swap}}$, the cost of repurchasing currency i via an FX swap is higher than that of borrowing in the USD combined with investing in the currency i cash market:

$$\widehat{S}_i e^{(\phi_i + c_i^w)\tau} > \widehat{S}_i e^{-(y_i - c_i^y)\tau} e^{(y_\$ + c_\$^y)\tau} . \tag{18}$$

As a result, forward demand for currency i concentrates in the cash market, while forward supply shifts to the swap market, leading to imbalance.

If instead $x_i > \delta_i^{\text{Swap}}$, the FX swap yield from selling currency i forward is inferior to that from investing in the USD cash market combined with a borrowing in currency i:

$$\widehat{S}_i e^{(\phi_i - c_i^w)\tau} < \widehat{S}_i e^{-(y_i + c_i^y)\tau} e^{(y_\$ - c_\$^y)\tau} . \tag{19}$$

In this case, forward supply shifts to the cash market and demand to the swap market, again resulting in disequilibrium.

Thus, an FX swap market equilibrium requires the USD basis to remain within $[-\delta_i^{\text{Swap}},\ \delta_i^{\text{Swap}}]$.

Unified market equilibrium band Finally, for overall equilibrium to hold across the FX swap and both cash markets, the USD basis for currency i must lie within the intersection of all three individual no-disequilibrium regions. That is, equilibrium requires $x_i \in [-\delta_i^{\text{UMEQ}},\ \delta_i^{\text{UMEQ}}]$, where the effective threshold is given by

$$\delta_i^{\text{UMEQ}} = \min \left\{ \delta_i^{\$\text{Cash}},\ \delta_i^{\text{Cash}},\ \delta_i^{\text{Swap}} \right\} . \tag{20}$$

This band, introduced by Clinton (1988), ensures that no one-way arbitrage opportunity arises in any of the three markets, thereby guaranteeing the existence of a general market equilibrium. [10]

4.2 Empirical assessment of the economic significance of CIP deviations

This section empirically evaluates the economic significance of CIP deviations among advanced economy currencies using our long daily sample spanning 1921 to 2025. The analysis compares observed USD basis values to the no-arbitrage and market equilibrium bands introduced in the preceding subsections.

For each currency i on day t, the USD basis $x_{i,t}$ is classified as economically significant relative to a given threshold $\delta_{i,t}$ if it lies outside the corresponding band; that is, if $|x_{i,t}| > \delta_{i,t}$. To summarize the incidence and magnitude of such deviations over a given sample or subsample, we compute two statistics.

First, we measure the *frequency* of economically significant CIP deviations:

$$\mathrm{FRQ} = \frac{1}{P} \sum_{i,t} \mathbf{I}_{\{|x_{i,t}| > \delta_{i,t}\}} \,, \tag{21}$$

where $\mathbf{I}_{\{.\}}$ denotes the indicator function, which equals one if the condition in braces is satisfied and zero otherwise, and P is the total number of currency-day observations in the sample. This measure plays a role analogous to the p-value in hypothesis testing: under the null of CIP holding, economically significant deviations from CIP should be rare, for instance, with a frequency below 5%.

Second, we compute the *average net magnitude* of economically significant deviations:

$$\mathrm{ANM} = \frac{1}{P} \sum_{i,t} \max\left\{ 0 \,, \; |x_{i,t}| - \delta_{i,t} \right\} \,, \tag{22}$$

which can be interpreted as the annualized average arbitrage profit, net of transaction costs, from a strategy that engages in CIP arbitrage only when deviations exceed the economic threshold. [11]

Together, these two statistics quantify both the prevalence and materiality of CIP deviations, enabling consistent comparisons across currencies, time periods, and arbitrage bounds.

We estimate these statistics across the same subsample periods as analyzed in Section 3.2: the interwar period (1921–1939), the Bretton Woods period (1963–1972), the post-Bretton Woods period (1973–1998), the pre-GFC period (1999–2006), the global financial crisis (GFC) period (2007–2009), and the post-GFC period (2010–2025). For the interwar period, we distinguish between GBP and other currencies, as GBP was largely free from capital controls, whereas many other currencies experienced intermittent capital or exchange restrictions during the 1930s. For all other periods, we pool observations across all advanced economy currencies. Importantly, our use of offshore (Eurocurrency deposit) rates ensures that the results are not distorted by capital or exchange restrictions, particularly in the pre-liberalization decades prior to the 1980s.

[10] Although one could also derive an equilibrium band from spot market conditions, the resulting threshold coincides with the no-arbitrage band based on FX swaps, given by $\delta_i^{\text{Spot}} = \delta_i^{\text{NASW}} = c_{\$}^y + c_i^y + c_i^w$. This band is typically wider than those derived from the cash and FX swap market equilibrium conditions, and hence is implicitly nested within the unified market equilibrium band. Formally, the unified threshold can be expressed as $\delta_i^{\text{UMEQ}} = \min\{\delta_i^{\$\text{Cash}},\, \delta_i^{\text{Cash}},\, \delta_i^{\text{Swap}}\} = \min\{\delta_i^{\$\text{Cash}},\, \delta_i^{\text{Cash}},\, \delta_i^{\text{Swap}},\, \delta_i^{\text{Spot}}\}$. As such, the spot market condition does not further restrict the range for equilibrium.

[11] The per-period average arbitrage profit, net of transaction costs, is therefore ANM $\times\, \tau$ for a given maturity of τ years.

For each subsample, we evaluate the economic significance of CIP deviations relative to the two no-arbitrage bands and the four market equilibrium bands developed in the previous section. Additionally, we introduce two further benchmarks for historical and comparative purposes.

First, we consider a constant no-arbitrage band of $[-50\,\text{bps},\ 50\,\text{bps}]$, motivated by the Keynes–Einzig conjecture (see Keynes (1922, 1923); Einzig (1937, 1961, 1962); Peel and Taylor (2002)). Given that the constant *Keynes-Einzig* band was originally formulated as a rule-of-thumb threshold for actionable arbitrage during the interwar period, we apply it only to the 1921-1939 period.

Second, we construct a time-varying, currency-specific proxy for the no-arbitrage band originally proposed by Frenkel and Levich (1977). In their original work, Frenkel and Levich imposed constant bands of $[-166\,\text{bps},\ 166\,\text{bps}]$ for the period January 1968 to June 1969, and $[-474\,\text{bps},\ 474\,\text{bps}]$ for July 1973 to May 1975, based on indirectly estimated transaction costs.[12] These band estimates have been subject to criticism for overstating actual transaction costs (e.g., McCormick, 1979; Clinton, 1988). Moreover, their static nature makes them inappropriate for a sample spanning multiple decades with evolving market structures.

To preserve the spirit of their methodology while addressing these limitations, we define a *Frenkel–Levich Proxy* band as three times the corresponding no-arbitrage band based on outright forwards, where the latter is estimated using directly observed bid-ask spreads for each currency i and day t where available. This adjustment reflects the empirical observation that Frenkel–Levich's original bands are at least three times wider than those derived from quoted bid-ask data in the same sample period, and ensures comparability across different historical contexts.

Table 2 reports the results. We find that economically significant CIP deviations have been a persistent feature of international financial markets—not only during the GFC and post-GFC periods, as widely documented in the recent literature, but also throughout much of the past century. While the frequency and average net magnitude of such deviations vary across subsamples, the evidence indicates that they have been present in every historical period, with one notable exception. The pre-GFC period (1999–2006) stands out as a rare episode during which CIP held with remarkable precision: not only is the frequency of economically significant deviations consistently 1% or lower when assessed using no-arbitrage bands based on outright forwards or wider thresholds, but the average net magnitude is also virtually zero—5 bps or lower—under all band definitions. This period contrasts sharply with the rest of the historical record and underscores that tight adherence to CIP is the exception rather than the norm.

Consistent with the recent literature, we find that both the frequency and average net magnitude of economically significant CIP deviations remain elevated in the post-GFC period. Interestingly, these values are comparable to those observed during the post-Bretton Woods period (1973–1998). Specifically, the post-GFC period shows a frequency of 0.23 and an average net magnitude of 4 bps, while the post-Bretton Woods period records a frequency of 0.17 and a magnitude of 6 bps. This similarity supports the view that economically significant CIP deviations are not unique to the post-GFC era, but rather reflect broader structural features of international financial markets in the absence of full arbitrage efficiency.

In the interwar period (1921–1939), the frequency of CIP deviations is similarly high for both GBP and other advanced economy currencies. However, the average net magnitude of deviations is notably smaller for GBP. This

[12] For the 1968–1969 sample, Frenkel and Levich (1977) assume transaction costs in the spot and forward markets of $c_i^s = 10$ bps and $c_i^f = 16$ bps, respectively. For the three-month cash market, they set per-period (quarterly) interest rate spreads at 0.0381% for the USD and 0.1172% for currency i (GBP), implying $c_\$^y = 15$ bps and $c_i^y = 47$ bps when annualized using $\tau = 0.25$. The implied no-arbitrage threshold is $c_\$^y + c_i^y + (c_i^s + c_i^f)/\tau = 166$ bps. For the 1973–1975 sample, they specify $c_i^s = 52$ bps, $c_i^f = 51$ bps, $c_\$^y = 15$ bps, and $c_i^y = 47$ bps, yielding a threshold of 474 bps.

discrepancy is consistent with the fact that GBP was largely exempt from capital or exchange controls during this period, whereas other currencies were subject to such restrictions in the 1930s.

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. Frequency of Economically Significant CIP Deviations:							
No-Arbitrage Bands							
FX swap	0.86	0.83	0.10	0.17	0.13	0.37	0.23
Outright Forward	0.75	0.63	0.02	0.03	0.01	0.09	0.09
Frenkel-Levich Proxy	0.24	0.25	0.00	0.00	0.00	0.00	0.00
Keynes-Einzig (50 bps)	0.54	0.69	n.a.	n.a.	n.a.	n.a.	n.a.
Equilibrium Bands							
USD Cash Market	0.95	0.90	0.30	0.49	0.62	0.85	0.73
Foreign Cash Market	0.95	0.90	0.30	0.53	0.86	0.75	0.90
FX Swap Market	0.95	0.98	0.99	0.72	0.29	0.62	0.30
Unified	0.98	0.98	0.99	0.93	0.94	0.93	0.97
Panel B. Average Net Magitude of Economically Significant CIP Deviations (bps)							
No-Arbitrage Bands							
FX swap	68	182	2	6	1	4	4
Outright Forward	52	145	1	3	0	2	2
Frenkel-Levich Proxy	15	77	0	1	0	0	0
Keynes-Einzig (50 bps)	46	177	n.a.	n.a.	n.a.	n.a.	n.a.
Equilibrium Bands							
USD Cash Market	78	191	5	11	3	12	11
Foreign Cash Market	78	191	5	12	5	11	14
FX Swap Market	81	217	17	22	1	8	5
Unified	83	217	17	25	5	14	15

Notes: This table presents two statistics measuring the economic significance of CIP deviations for a sample of 19 advanced market (AE) currencies, excluding the USD, from from January 8, 1921 to March 10, 2025. Panel A reports the frequency of currency-day observations with an economically significant USD basis, computed as $\frac{1}{P}\sum_{i,t}\mathbb{I}\{|x_{i,t}| > \delta_{i,t}\}$ for each of the six subsample periods: 1921-1939, 1963-1972, 1973-1998, 1999-2006, 2007-2009, and 2010-2025, where P is the total number of currency-day observations for a given sample. Panel B reports the average net magnitude of economically significant USD basis defined as $\frac{1}{P}\sum_{i,t}\max\{0, |x_{i,t}| - \delta_{i,t}\}$. 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 four market equilibrium bands to determine its economic significance.

Crucially, the interpretation of how widespread and economically material CIP deviations are depends on the criterion used for assessment. No-arbitrage bands based on outright forwards indicate that CIP deviations are relatively limited in both frequency and magnitude, implying that profitable arbitrage opportunities using outright forwards are rare. In particular, the Frenkel-Levich Proxy band, which is also constructed using outright forward rates (but with overstated transaction costs), suggests that economically significant CIP deviations have been virtually non-existent across the entire post-1963 sample, including the GFC and post-GFC periods. By contrast, no-arbitrage bands based on FX swaps yield higher frequencies and larger average net magnitudes of economically significant deviations, suggesting that arbitrage opportunities are more readily identified when using FX swaps as the instrument.

Moreover, market equilibrium bands indicate an even broader prevalence of CIP deviations. In particular, under the unified market equilibrium band, more than 90% of currency-day observations exceed the threshold in every subsample, suggesting that deviations from market-clearing conditions are near-ubiquitous. This evidence implies that transaction costs alone can account for only a small fraction of the observed CIP deviations in our long sample, and that broader structural forces (such as intermediary constraints analyzed in Section 5) may play a more central role. Additionally, the 1999–2006 pre-GFC period remains exceptional in that the average net magnitude of deviations remains below 5 bps, even under the market equilibrium bands, which are narrower than the no-arbitrage bands.

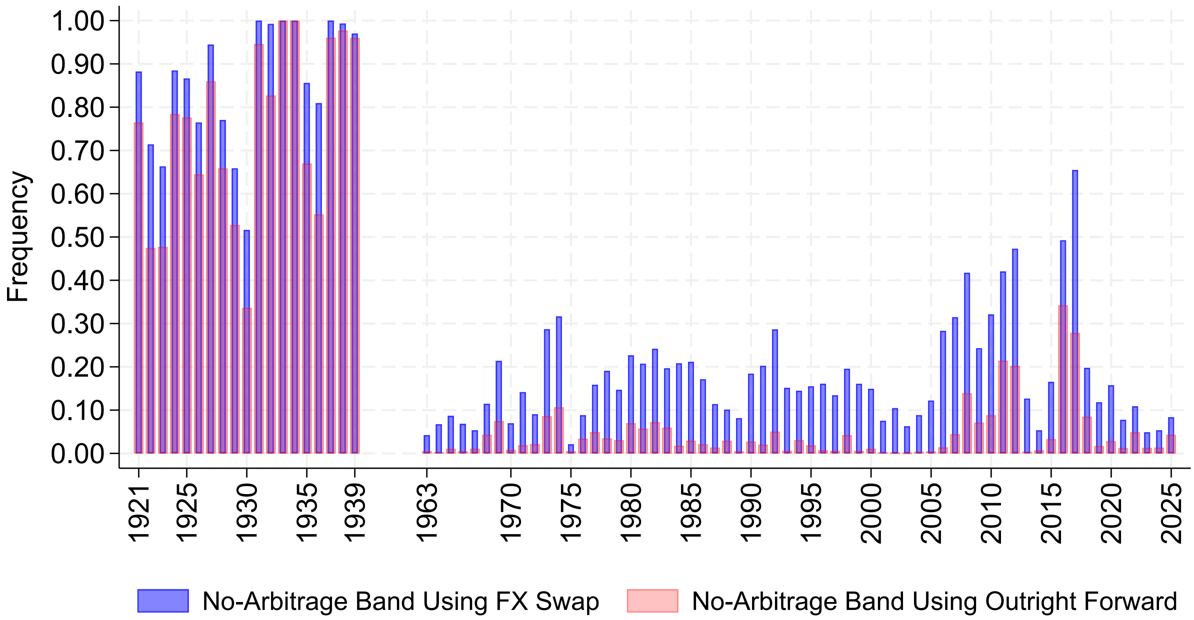
To complement the period-based analysis in Table 2, Figure 2 presents the year-by-year evolution of the economic significance of CIP deviations. Specifically, we compute the frequency and average net magnitude of economically significant CIP deviations using all currency-day observations within each calendar year. For 1921–1939, we restrict the sample to GBP, which was largely free from capital and exchange controls; for all other years, we include all advanced economy currencies with available data.

This figure provides a finer-grained view of how the prevalence and materiality of CIP deviations evolved over the past century. Based on no-arbitrage bands using FX swaps, the frequency of economically significant deviations exceeds 5% in nearly every year of the sample. Moreover, the average net magnitude, is remarkably stable from the 1960s through the 1990s and again during the GFC and post-GFC periods. These findings reinforce the view that CIP deviations are not unique to the post-crisis era.

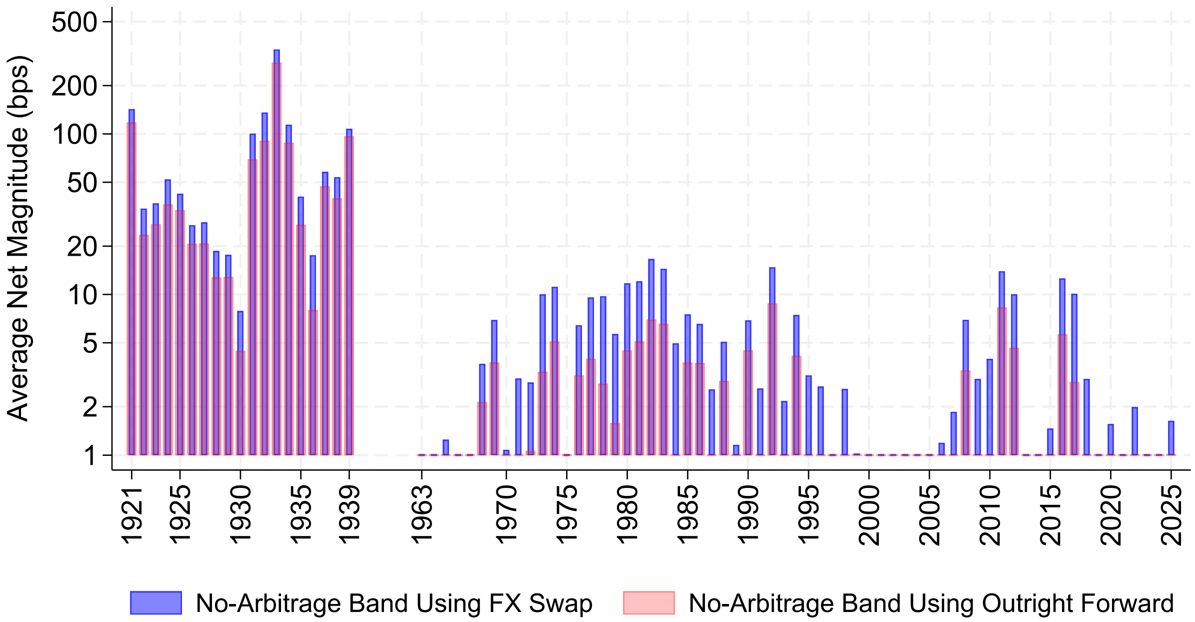
In contrast, applying no-arbitrage bands constructed from outright forwards substantially reduces both the frequency and the average net magnitude of economically significant deviations across the sample, including the post-GFC period. As discussed in Section 4.1, outright forward-based bands reflect tighter arbitrage conditions due to overstated transaction costs embedded in spot and forward bid-ask spreads separately. This difference highlights the sensitivity of empirical conclusions to the choice of arbitrage instrument and underscores the importance of clearly specifying the arbitrage strategy when assessing the economic significance of CIP deviations.

Interpreting CIP deviations requires jointly considering both frequency and magnitude. For example, while the frequency of significant deviations remains modestly above 5% in 2006 under the FX swap-based bands, the average net magnitude is close to zero—about 1 basis point. Relying on frequency alone would result in overstating the economic significance of CIP deviations in this year. By combining these two complementary statistics, the figure provides a more accurate and nuanced assessment of how economically material CIP deviations have been over time.

Figure 2: Time-Varying Economic Significance of CIP Deviations



(a) Frequency of Economically Significant CIP Deviations in Each Year



(b) Average Net Magnitude of Economically Significant CIP Deviations in Each year

Notes: This figure illustrates the time-varying economic significance of CIP deviations for a sample of 19 advanced market (AE) currencies, excluding the USD, from January 8, 1921 to March 10, 2025. Panel (a) reports the frequency of currency-day observations with an economically significant USD basis, computed as $\frac{1}{P}\sum_{i,t}\mathbb{I}\{|x_{i,t}| > \delta_{i,t}\}$ for each year, where P is the total number of currency-day observations in a given calendar year. Panel (b) reports the average net magnitude of economically significant USD basis defined as $\frac{1}{P}\sum_{i,t}\max\{0, |x_{i,t}| - \delta_{i,t}\}$ 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.

4.3 Reconciling our findings with prior studies on CIP

Our findings from the long-sample analysis suggest that economically significant deviations from CIP have been the norm rather than the exception over the past century. The most notable exception to this pattern is the pre-GFC period (1999–2006), during which CIP deviations can be accounted for by transaction costs. This conclusion stands in sharp contrast to the widely held belief—shaped by interpretations of the literature—that CIP held remarkably well throughout the history of international financial markets prior to the global financial crisis. While the original studies do not explicitly claim this broader historical regularity, their findings have often been interpreted or generalized as evidence that CIP adherence was the norm before the GFC. This conventional belief is reinforced by numerous standard international finance textbooks. [13]

Given this divergence, it is natural to ask whether there exists a fundamental discrepancy between our findings and those of earlier studies; if so, what accounts for these differences? More importantly, how should we interpret our findings in light of prior work, and what can we realistically infer about the historical validity of CIP as a benchmark for international financial integration?

A central point to emphasize is that the empirical foundation of prior studies is extremely limited in scope. Specifically, the currency-day observations analyzed in earlier studies on CIP deviations before the GFC account for less than 1% of those covered in our long-sample analysis. As such, previous studies are not positioned to draw general conclusions about whether CIP adherence or deviation has been the historical norm. It is not necessarily the case that these earlier studies were methodologically flawed; rather, there is a concern that their findings may have been misinterpreted or extrapolated beyond their empirical scope by readers.

To illustrate this point, we replicate the core empirical analysis of Frenkel and Levich (1977), one of the most influential early studies on CIP. We analyze the exact two sample periods used in their study: January 1, 1968 to December 31, 1969 and July 1, 1973 to May 31, 1975. For each period, we compute the frequency of economically significant CIP deviations for the GBP using the original constant transaction cost thresholds adopted by Frenkel and Levich—166 bps for the first period and 474 bps for the second. In addition, we compute the frequency using two alternative, time-varying no-arbitrage bands based on outright forwards and FX swaps, respectively. Since we are analyzing the same historical periods, there is no need to apply the Frenkel–Levich Proxy bands used in our full-sample analysis.

Frenkel and Levich (1977) used weekly data, but did not specify the weekday used for sampling. Accordingly, we replicate their frequency analysis using five alternative weekly samples—one for each weekday—as well as a weekly average sample, and also report results using our daily data.

[13] For instance, Hallwood and MacDonald (2000) conclude that the evidence "*suggests that CIP does appear to be strongly supported by the data, especially if Eurodeposit interest rates are considered*" citing the direct tests in Frenkel and Levich (1975, 1977) and the regression-based tests in Marston (1976); Cosandier and Lang (1981); Fratianni and Wakeman (1982). Copeland (2014) remarks: "*The evidence to which Levich (1979) refers relates to the years 1962–1975, a period of broadly fixed exchange rates, and certainly very different from the environment of the 1980s and 1990s. If anything, the progressive liberalisation of international financial markets in recent years is likely to have tied interest rates even more closely together. Indeed, in cases where interest rates have deviated from CIRP (i.e., CIP) during the 1960s and 1970s, there seems every reason to suppose the cause to have been exchange controls, actual or threatened*." Melvin and Norrbin (2013) similarly note that "*...careful studies of the data indicate that small deviations from interest rate parity do occur... The most obvious reason is the transaction cost between markets... Studies indicate that for comparable financial assets that differ only in terms of currency of denomination (for example, dollar- and pound-denominated Eurodeposits in a German bank), 100 percent of the deviations from interest rate parity can be accounted for by transaction costs*." Sercu and Uppal (1995) further state: "*Tests (of CIP based on no-arbitrage bands) show that (CIP) hold perfectly if one uses euro-interest rate data, that is, rates in offshore financial markets*."

Table 3: Frequency 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 Frenkel-Levich: 166 bps	0.03	0.04	0.04	0.04	0.02	0.00	0.04
No-Arbitrage Bound, Forward	0.20	0.17	0.30	0.18	0.18	0.19	0.21
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 Frenkel-Levich: 474 bps	0.00	0.00	0.01	0.00	0.00	0.00	0.00
No-Arbitrage Bound, Forward	0.34	0.30	0.47	0.34	0.30	0.29	0.35
No-Arbitrage Bound, FX Swap	0.66	0.51	0.77	0.68	0.64	0.64	0.65

Notes: This table reports the frequency of economically significant CIP deviations, computed as $\frac{1}{P}\sum_{i,t}\mathbb{I}\{|x_{i,t}| > \delta_{i,t}\}$, 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. P denotes the total number of currency-day observations in the sample. 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 original 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 virtually the same results when comparing the absolute value of USD basis measured by our data with the original Frenkel-Levich constant bands.

Table 3 presents three key findings. First, using the original Frenkel–Levich constant bands, the frequency of economically significant CIP deviations is around 3% for the 1968–1969 period and essentially zero for the 1973–1975 period, regardless of the sampling method. These results align precisely with the original findings and confirm that discrepancies do not arise from differences in data sources or sampling frequency.

Second, when we instead apply time-varying no-arbitrage bands based on outright forwards—calibrated from quoted bid-ask spreads—the frequency of economically significant CIP deviations increases substantially, rising to 17% to 35%. This result suggests that the original thresholds used by Frenkel and Levich overstated transaction costs, thus understating the economic significance of observed CIP deviations. This issue has been noted previously in the literature, including by McCormick (1979) and Clinton (1988), who raised concerns about the indirect estimation methods used to infer transaction cost bounds.

Third, using no-arbitrage bands based on FX swaps further increases the frequency of deviations by an additional 14 to 35 percentage points, depending on the sampling method. These results highlight the critical role played by the arbitrage instrument and, by extension, the arbitrage implementation strategy in shaping empirical conclusions about CIP deviations.

To further illustrate how the choice of benchmark and methodology for measuring transaction costs can significantly shape our interpretation of CIP deviations, we revisit the sample analyzed in Du et al. (2018), which focuses on G10 currencies from January 1, 2007 to September 15, 2016. This period spans both the global financial crisis and the post-crisis era, and has been central to the recent literature on persistent CIP deviations.

Table 4 reports the frequency of economically significant CIP deviations across two subsample periods—2007–2011 and 2012–2016—and under four different band definitions: FX swap-based no-arbitrage bands, outright forward-based no-arbitrage bands, the Frenkel–Levich proxy bands, and the original Frenkel–Levich constant bands. The results demonstrate that our conclusions regarding the pervasiveness of CIP deviations depend critically on the criterion used for assessment.

Consistent with recent studies documenting large and persistent deviations from CIP since the GFC, we find that under FX swap-based no-arbitrage bands, the frequency of economically significant deviations is above 10% for all G10 currencies in both subsample periods, ranging from 11% to 55%. When outright forward-based no-arbitrage bands are used instead, the frequency declines by 8 to 39 percentage points. Economically significant deviations remain, but they appear generally weaker and less prevalent, with five currencies in the first subsample and three in the second showing frequencies below 5%.

In sharp contrast, the use of the Frenkel–Levich proxy bands results in a dramatic reduction in violation frequencies: only EUR in the 2012–2016 subsample exhibits a frequency above 5%. Finally, under the original Frenkel–Levich constant bands, economically significant deviations disappear entirely across all currencies and both subsamples.

Taken together, the results from Table 3 and Table 4 highlight the central importance of applying consistent benchmarks and methodologies when evaluating the economic significance of CIP deviations. In particular, when assessing significance using no-arbitrage bands based on FX swaps, CIP deviations appear similarly frequent in both the historical sample analyzed by Frenkel and Levich (1977) and the GFC and post-GFC sample studied by Du et al. (2018). By contrast, when using no-arbitrage bands based on outright forwards—especially those incorporating overstated transaction cost estimates—economically significant CIP deviations are exceedingly rare in both samples. These findings demonstrate that differences in the construction of transaction cost bounds and the choice of arbitrage instruments can substantially alter our understanding of the prevalence and materiality of CIP deviations. Without consistency in these criteria, there is a heightened risk of misinterpreting empirical findings or overgeneralizing from narrow samples, leading to potentially misleading conclusions about the historical robustness of CIP.

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

	FX Swap	Forward	FL: Proxy	FL: 166 bps	FL: 474 bps
Panel A. January 1, 2007 – December 31, 2009					
AUD	0.17	0.02	0.00	0.00	0.00
CAD	0.19	0.01	0.00	0.00	0.00
CHF	0.34	0.04	0.00	0.00	0.00
DKK	0.33	0.15	0.00	0.00	0.00
EUR	0.45	0.23	0.01	0.00	0.00
GBP	0.55	0.20	0.00	0.00	0.00
JPY	0.50	0.11	0.00	0.00	0.00
NOK	0.16	0.02	0.00	0.00	0.00
NZD	0.23	0.00	0.00	0.00	0.00
SEK	0.34	0.06	0.00	0.00	0.00
Panel B. January 1, 2010 – September 15, 2016					
AUD	0.15	0.03	0.00	0.00	0.00
CAD	0.11	0.03	0.00	0.00	0.00
CHF	0.36	0.09	0.00	0.00	0.00
DKK	0.38	0.22	0.01	0.00	0.00
EUR	0.40	0.26	0.05	0.00	0.00
GBP	0.20	0.09	0.00	0.00	0.00
JPY	0.35	0.12	0.01	0.00	0.00
NOK	0.23	0.08	0.00	0.00	0.00
NZD	0.15	0.01	0.00	0.00	0.00
SEK	0.31	0.07	0.00	0.00	0.00

Notes: This table reports the frequency of economically significant CIP deviations, computed as $\frac{1}{P}\sum_{i,t}\mathbb{I}\{|x_{i,t}| > \delta_{i,t}\}$, 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. P denotes the total number of currency-day observations in a given sample. 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 (FL) no-arbitrage bands (defined by a constant of 166 bps and 474 bps, respectively) as well as two alternative no-arbitrage bands, based outright forwards and FX swaps, 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 FL Proxy band measured as three times the outright 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.

5.1.1 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.

5.1.2 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.

5.1.3 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.[14] 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 percent for banks with assets under 1 billion USD and 5 percent for banks with assets exceeding 1 billion USD. 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 percent capital requirement was extended to them by June 1983. By June 1985, a unified capital ratio of 5.5 percent 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.[15] These national regulations anticipated the international Basel Accord of 1988, which introduced an international minimum ratio of capital to risk-weighted assets of 8 percent.

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 percent 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.

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

[15] 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".

5.1.4 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.[16] 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.

5.1.5 2008–2025: post-GFC banking regulation

After the Great Financial Crisis, banking regulations tightened significantly (see Du et al. (2018); Boyarchenko et al. (2020)). 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.

5.2 Empirical tests

5.2.1 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

[16] 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:

$$|x_{i,t;1M}| = \alpha_i + \beta_0\, QEnd1M_{i,t} + \beta_1\, QEnd1M_{i,t} \times \mathbb{I}_t[88,95] + \beta_{07}\, QEnd1M_{i,t} \times Post07_t \\ + \beta_{15}\, QEnd1M_{i,t} \times Post15_t + \gamma_{8895}\mathbb{I}_t[88,95] + \gamma_{07}Post07_t + \gamma_{15}Post15_t + \varepsilon_{i,t}\,, \qquad (23)$$

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, 1988, 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 (23). 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 (5) 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 generally 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 period prior to the GFC (1988–1995) emerges during which the quarter-end effects on CIP deviations appear more pronounced than the reference period (1996–2006). 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 1996–2006 period (columns (4)–(5)). This finding suggests that similar regulatory constraints on banks restricted CIP arbitrage activities long before the onset of the GFC.

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)
$QEnd1M_{i,t}$	6.05***	3.08***	2.82***	-0.20	-0.20
	(0.52)	(0.73)	(0.70)	(0.95)	(0.95)
$QEnd1M_{i,t} \times \mathbb{I}_t[88,\ 95]$				6.56***	6.56***
				(1.41)	(1.40)
$QEnd1M_{i,t} \times Post07_t$		6.39***	0.59	10.01***	3.60**
		(1.14)	(1.36)	(1.23)	(1.50)
$QEnd1M_{i,t} \times Post15_t$			11.06***		11.07***
			(1.58)		(1.57)
$\mathbb{I}_t[88,\ 95]$				12.93***	12.93***
				(1.36)	(1.36)
$Post07_t$			0.72	3.72***	5.10***
			(1.34)	(1.15)	(1.40)
$Post15_t$			-2.59*		-2.59*
			(1.50)		(1.46)
Constant	13.02***	12.86***	13.18***	8.82***	8.82***
	(1.57)	(1.57)	(1.66)	(1.68)	(1.69)
Observations	105,537	105,537	105,537	105,537	105,537
R-squared	0.01	0.01	0.02	0.03	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, 1988, to March 10, 2025. Spot and settlement dates for one-month FX swap contracts are sourced from Bloomberg.

5.2.2 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. [17] Given this background, we conjecture that incremental year-end effects on CIP deviations.

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

$$\begin{aligned}
|x_{i,t;1M}| = \alpha_i &+ \beta_0^Q\, QEnd1M_{i,t} + \beta_0^Y\, YEnd1M_{i,t} \\
&+ \beta_1^Q\, QEnd1M_{i,t} \times \mathbb{I}_t[88,95] + \beta_1^Y\, YEnd1M_{i,t} \times \mathbb{I}_t[88,95] \\
&+ \beta_{07}^Q\, QEnd1M_{i,t} \times Post07_t + \beta_{07}^Y\, YEnd1M_{i,t} \times Post07_t \\
&+ \beta_{15}^Q\, QEnd1M_{i,t} \times Post15_t + \beta_{15}^Y\, YEnd1M_{i,t} \times Post15_t \\
&+ \gamma_{8895}\mathbb{I}_t[88,95] + \gamma_{07} Post07_t + \gamma_{15} Post15_t + \varepsilon_{i,t}\,,
\end{aligned} \tag{24}$$

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, 1988, to March 10, 2025, covering 19 advanced economy (AE) currencies.

Compared to Equation (23), Equation (24) 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 (2)–(5). Specifically, as Column (5) shows, during the 1988–1995 period (post-2007 period), year-end CIP deviations increase by an additional 13 bps (10 bps), on top of a 4 bps (1 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).

[17] 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)
$QEnd1M_{i,t}$	2.33***	-8.39***	-8.39***	-1.53	-1.53
	(0.61)	(1.06)	(1.06)	(1.09)	(1.09)
$YEnd1M_{i,t}$	12.77***	11.08***	11.08***	5.35**	5.35**
	(1.21)	(1.68)	(1.68)	(2.26)	(2.26)
$QEnd1M_{i,t} \times \mathbb{I}_t[88,\ 95]$		18.61***	18.61***	3.56**	3.56**
		(1.51)	(1.51)	(1.61)	(1.60)
$YEnd1M_{i,t} \times \mathbb{I}_t[88,\ 95]$				12.69***	12.69***
				(3.35)	(3.35)
$QEnd1M_{i,t} \times Post07_t$		13.57***	7.88***	6.71***	1.03
		(1.41)	(1.72)	(1.42)	(1.73)
$YEnd1M_{i,t} \times Post07_t$		2.31	4.31	8.03***	10.03***
		(2.38)	(3.27)	(2.81)	(3.58)
$QEnd1M_{i,t} \times Post15_t$			10.62***		10.62***
			(1.84)		(1.83)
$YEnd1M_{i,t} \times Post15_t$			-4.76		-4.75
			(3.52)		(3.49)
$\mathbb{I}_t[88,\ 95]$				12.92***	12.92***
				(1.35)	(1.35)
$Post07_t$		-1.30	0.08	3.72***	5.10***
		(1.04)	(1.31)	(1.15)	(1.39)
$Post15_t$			-2.59*		-2.59*
			(1.47)		(1.45)
Constant	12.94***	13.78***	13.78***	8.77***	8.77***
	(1.56)	(1.62)	(1.62)	(1.68)	(1.68)
Observations	105,537	105,537	105,537	105,537	105,537
R-squared	0.02	0.03	0.03	0.04	0.04

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, 1988, 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)
$YEnd3M_{i,t}$	4.24***	1.67***	1.67***	0.43	0.43
	(0.45)	(0.60)	(0.60)	(0.80)	(0.80)
$YEnd3M_{i,t} \times \mathbb{I}_t[88,\ 95]$				2.73**	2.73**
				(1.19)	(1.18)
$YEnd3M_{i,t} \times Post07_t$		5.12***	5.46***	6.36***	6.71***
		(0.89)	(1.18)	(1.02)	(1.27)
$YEnd3M_{i,t} \times Post15_t$			-0.27		-0.26
			(1.32)		(1.28)
$\mathbb{I}_t[88,\ 95]$				7.23***	7.23***
				(0.74)	(0.73)
$Post07_t$		4.06***	5.57***	6.57***	8.08***
		(0.58)	(0.73)	(0.63)	(0.76)
$Post15_t$			-2.80***		-2.80***
			(0.81)		(0.79)
Constant	9.86***	7.72***	7.72***	5.22***	5.22***
	(0.86)	(0.88)	(0.88)	(0.90)	(0.90)
Observations	105,534	105,534	105,534	105,534	105,534
R-squared	0.03	0.05	0.05	0.07	0.07

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, 1988, 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 2025. 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 examining 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. In contrast, deviations appear less economically significant in the Du et al. (2018) sample, where no-arbitrage bands are based on outright forwards. 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.

References

Accominotti, Olivier, "International Banking and Transmission of the 1931 Financial Crisis," *The Economic History Review*, 2019, *72* (1), 260–285.

— **and Stefano Ugolini**, "International trade finance from the origins to the present: market structures, regulation and governance," *arXiv preprint arXiv:2009.08668*, 2020.

— **, Jason Cen, David Chambers, and Ian W. Marsh**, "Currency regimes and the carry trade," *Journal of Financial and Quantitative Analysis*, 2019, *54* (5), 2233–2260.

Akram, Q Farooq, Dagfinn Rime, and Lucio Sarno, "Arbitrage in the foreign exchange market: Turning on the microscope," *Journal of International Economics*, 2008, *76* (2), 237–253.

Aliber, Robert Z, "The interest rate parity theorem: A reinterpretation," *Journal of Political Economy*, 1973, *81* (6), 1451–1459.

Avdjiev, Stefan, Wenxin Du, Catherine Koch, and Hyun Song Shin, "The dollar, bank leverage, and deviations from covered interest parity," *American Economic Review: Insights*, 2019, *1* (2), 193–208.

Baba, Naohiko and Frank Packer, "From turmoil to crisis: dislocations in the FX swap market before and after the failure of Lehman Brothers," *Journal of International Money and Finance*, 2009, *28* (8), 1350–1374.

Bahmani-Oskooee, Mohsen and Satya P Das, "Transaction costs and the interest parity theorem," *Journal of Political Economy*, 1985, *93* (4), 793–799.

Bank of England Bulletin, "Limits on UK banks' foreign exchange positions," 1975.

Bazot, Guillaume, Michael D Bordo, and Eric Monnet, "International shocks and the balance sheet of the Bank of France under the classical gold standard," *Explorations in Economic History*, 2016, *62*, 87–107.

Borio, Claudio EV, Mobeen Iqbal, Robert N McCauley, Patrick McGuire, and Vladyslav Sushko, "The failure of covered interest parity: FX hedging demand and costly balance sheets," *BIS Working Papers*, 2018.

— **, Robert N McCauley, Patrick McGuire, and Vladyslav Sushko**, "Covered interest parity lost: understanding the cross-currency basis," *BIS Quarterly Review September*, 2016.

Boyarchenko, Nina, Thomas M. Eisenbach, Pooja Gupta, Or Shachar, and Peter Van Tassel, "Bank-intermediated arbitrage," 2020. Federal Reserve Bank of New York Staff Reports 858.

Callier, Philippe, "One way arbitrage, foreign exchange and securities markets: a note," *The Journal of Finance*, 1981, *36* (5), 1177–1186.

Cerutti, Eugenio M, Maurice Obstfeld, and Haonan Zhou, "Covered interest parity deviations: Macrofinancial determinants," *Journal of International Economics*, 2021, *130*, 103447.

Chambers, David and Elroy Dimson, "IPO underpricing over the very long run," *The Journal of Finance*, 2009, *64* (3), 1407–1443.

Chernov, Mikhail, Magnus Dalhquist, and Lars Lochstoer, "An anatomy of currency strategies: The role of emerging markets," 2024. NBER Working Paper 32900.

Clinton, Kevin, "Transactions costs and covered interest arbitrage: theory and evidence," *Journal of Political Economy*, 1988, *96* (2), 358–370.

Committee on Banking Regulations and Supervisory Practices, "Supervision of banks' foreign exchange positions," 1996.

Copeland, Laurence, *Exchange Rates and International Finance*, 6 ed., Pearson Education Limited, 2014.

Cosandier, Pierre-Alexis and Bruno R. Lang, "Interest rate parity tests: Switzerland and some major western countries," *Journal of Banking and Finance*, 1981, *5*, 187–200.

Davis, James L, Eugene F Fama, and Kenneth R French, "Characteristics, covariances, and average returns: 1929 to 1997," *The Journal of Finance*, 2000, *55* (1), 389–406.

Deardorff, Alan V, "One-way arbitrage and its implications for the foreign exchange markets," *Journal of Political Economy*, 1979, *87* (2), 351–364.

DeRosa, David F., *Foreign Exchange Operations: Master Trading Agreements, Settlement, and Collateral*, John Wiley & Sons, Inc., Hoboken, NJ, 2014.

Dimson, Elroy, Paul Marsh, and Mike Staunton, *Triumph of the optimists: 101 years of global investment returns*, Princeton University Press, 2002.

Doskov, Nikolai and Laurens Swinkels, "Empirical evidence on the currency carry trade, 1900–2012," *Journal of International Money and Finance*, 2015, *51*, 370–389.

Du, Wenxin, Alexander Tepper, and Adrien Verdelhan, "Deviations from covered interest rate parity," *The Journal of Finance*, 2018, *73* (3), 915–957.

— **and Amy Huber**, "Dollar Asset Holding and Hedging Around the Globe," *Available at SSRN 4478513*, 2023.

— **and Jesse Schreger**, "CIP deviations, the dollar, and frictions in international capital markets," in "Handbook of International Economics," Vol. 6, Elsevier, 2022, pp. 147–197.

Einzig, Paul, *Theory of Forward Exchange*, Macmillan and Company, London, 1937.

— , *A Dynamic Theory of Forward Exchange*, Macmillan, London, 1961.

— , *A History of Foreign Exchange*, Macmillan, London, 1962.

— , *The Euro-Dollar System. Practice and Theory of International Interest Rates*, Macmillan and Company, London, 1965.

Federal Deposit Insurance Corporation, "History of the Eighties: Lessons for the Future," 1997.

Fratianni, Michele and L. MacDonald Wakeman, "The law of one price in the eurocurrency market," *Journal of International Money and Finance*, 1982, *1*, 307–323.

Frenkel, Jacob A and Richard M. Levich, "Covered interest arbitrage: Unexploited profits?," *Journal of Political Economy*, 1975, *83* (2), 325–338.

— **and** — , "Transaction costs and interest arbitrage: Tranquil versus turbulent periods," *Journal of Political Economy*, 1977, *85* (6), 1209–1226.

Gabaix, Xavier and Matteo Maggiori, "International liquidity and exchange rate dynamics," *The Quarterly Journal of Economics*, 2015, *130* (3), 1369–1420.

Greenwood, Robin, Samuel Hanson, Jeremy C Stein, and Adi Sunderam, "A quantity-driven theory of term premia and exchange rates," *The Quarterly Journal of Economics*, 2023, *138* (4), 2327–2389.

Hallwood, C. Paul and Ronald MacDonald, *International Money and Finance*, 3 ed., Blackwell Publishing, Australia, 2000.

Ivashina, Victoria, David S Scharfstein, and Jeremy C Stein, "Dollar funding and the lending behavior of global banks," *The Quarterly Journal of Economics*, 2015, *130* (3), 1241–1281.

Jorion, Philippe and William N Goetzmann, "Global stock markets in the twentieth century," *The Journal of Finance*, 1999, *54* (3), 953–980.

Keely, Michael C., "Bank capital regulation in the 1980s: Effective or ineffective?," *Federal Reserve Bank of San Francisco Economic Review*, 1988.

Keynes, John M., "The forward market in foreign exchange," *The Manchester Guardian (Reconstruction Supplement), April 20*, 1922.

— , *A Tract on Monetary Reform*, Macmillan and Company, London, 1923.

Kindleberger, Charles P, "Speculation and forward exchange," *Journal of Political Economy*, 1939, *47* (2), 163–181.

Kinnon, Ronald I. Mc, "The Eurocurrency Market," *Princeton Essays in International Finance*, 1977, *125*, 1–36.

Levich, Richard M., *The International Money Market: An Assessment of Forecasting Techniques and Market Efficiency*, JAI Press, Greenwich, CT, 1979.

— , "CIP then and now: A brief survey of measuring and exploiting deviations from covered interest parity," *BIS symposium: CIP-RIP*, 2017.

Marston, Richard C., "Interest arbitrage in the eurocurrency markets," *European Economic Review*, 1976, *7*, 1–13.

McCormick, Frank, "Covered interest arbitrage: Unexploited profits? Comment," *Journal of Political Economy*, 1979, *87* (2), 411–417.

Melvin, Michael and Stefan C. Norrbin, *International Money and Finance*, 8 ed., Academic Press/Elsevier Inc., 2013.

Menkhoff, Lukas, Lucio Sarno, Maik Schmeling, and Andreas Schrimpf, "Currency momentum strategies," *Journal of Financial Economics*, 2012, *106*, 660–684.

Peel, David A and Mark P Taylor, "Covered interest rate arbitrage in the interwar period and the Keynes-Einzig conjecture," *Journal of Money, Credit and Banking*, 2002, *34* (1), 51–75.

Rime, Dagfinn, Andreas Schrimpf, and Olav Syrstad, "Covered interest parity arbitrage," *The Review of Financial Studies*, 2022, *35* (11), 5185–5227.

Sarno, Lucio and Mark P Taylor, *The Economics of Exchange Rates*, Cambridge University Press, 2003.

Sarver, Eugene, *The Eurocurrency Market Handbook. Second Edition*, New York institute of Finance, New York, 1990.

Schenk, Catherine R, "The origins of the eurodollar market in London: 1955–1963," *Explorations in Economic History*, 1998, *35* (2), 221–238.

Sercu, Piet and Raman Uppal, *International Financial Markets and the Firm*, South-Western College Publishing, Cincinnati, OH, 1995.

Spong, Kenneth, *Banking Regulation: Its Purposes, Implementation, and Effects*, Division of Supervision and Risk Management, Federal Reserve Bank of Kansas City, 2000.

Taylor, Mark P, "Covered interest parity: a high-frequency, high-quality data study," *Economica*, 1987, pp. 429–438.

— , "Covered interest arbitrage and market turbulence," *The Economic Journal*, 1989, *99* (396), 376–391.

White, Eugene N., "Lessons from the history of bank examination and supervision in the United States, 1863–2008," in "Financial Market Regulation in the Wake of Financial Crises: The Historical Experience Conference, p. 15" 2009.

Appendix A Data Appendix

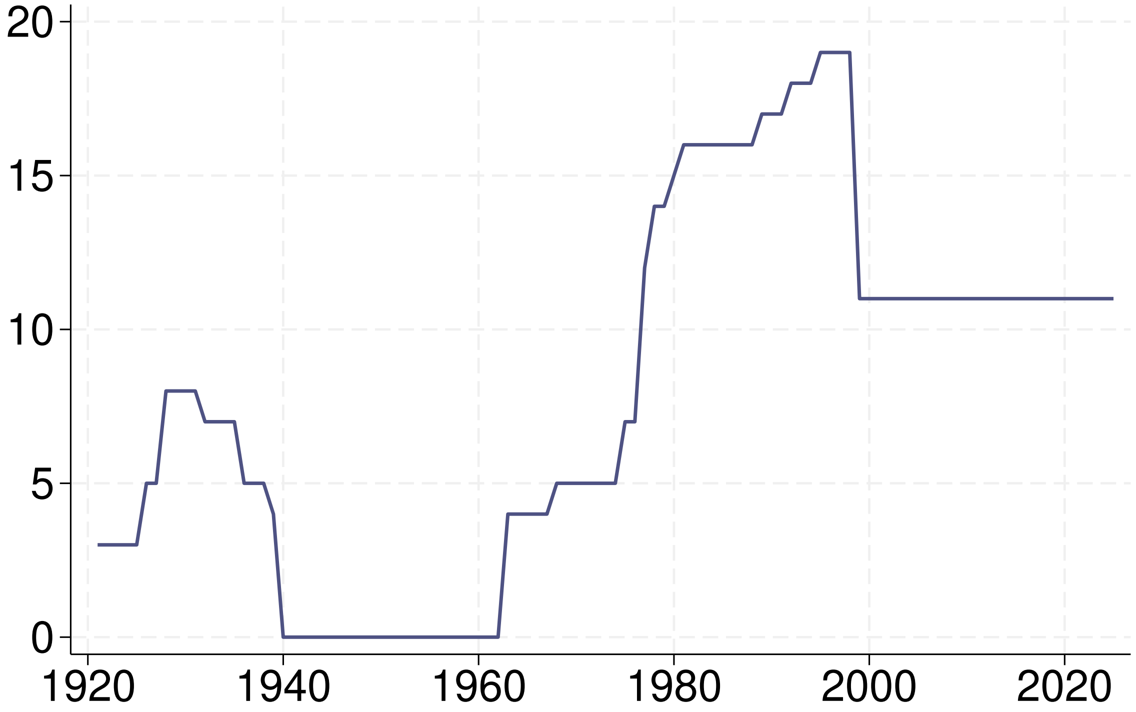
A1 Sample coverage and data sources

Table A1: Currency-specific data coverage for measuring CIP deviations

Currency	CIP deviations	Exchange rates	Offshore interest rates	Onshore interest rates
USD	n.a.	n.a.	1963–2025	1919–1939, 1954–2025
AUD	1988–2025	1984–2025	1988–2025	n.a.
CAD	1975–2025	1935–1939, 1951–2025	1975–2025	n.a.
CHF	1928–1936, 1963–2025	1921–1939, 1952–2025	1963–2025	1928–1935
DKK	1977–2025	1953–2025	1977–2025	n.a.
EUR	1999–2025	1999–2025	1999–2025	n.a.
GBP	1921–1939, 1968–2025	1921–1939, 1951–2025	1968–2025	1918–1939, 1954–1975
JPY	1978–2025	1978–2025	1977–2025	n.a.
NOK	1977–2025	1953–2025	1977–2025	n.a.
NZD	1995–2025	1984–2025	1995–2025	n.a.
SEK	1977–2025	1953–2025	1977–2025	n.a.
ATS	1978–1998	1957–1998	1978–1998	n.a.
BEF	1926–1938, 1977–1998	1921–1939, 1952–1998	1977–1998	1926–1938
DEM	1928–1931, 1963–1998	1924–1931, 1953–1998	1963–1998	1928–1939, 1967–1998
ESP	1980–1998	1926–1936, 1976-1998	1980–1998	n.a.
FRF	1926–1939, 1975–1998	1921–1939, 1951–1998	1975–1998	1926–1939
IEP	1981–1998	1976–1998	1981–1998	n.a.
ITL	1928–1935, 1977–1998	1921–1935, 1955–1998	1977–1998	1928–1937
NLG	1921–1939, 1963–1998	1921–1939, 1952–1998	1963–1998	n.a.
PTE	1992–1998	1959–1998	1992–1998	n.a.

Notes: This table reports the data coverage for each currency in our sample. The column "CIP deviations" reflects the period for which both exchange rate and interest rate data are available to compute CIP deviations. The columns "Exchange rates," "Offshore interest rates," and "Onshore interest rates" report the respective coverage of spot and forward exchange rates, offshore interest rates, and onshore interest rates.

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. For the detail of currencies covered, see column "CIP deviations" in Table A1.

Table A2: Data Coverage and Sources for Spot Exchange Rates and FX Swap Points

<table>
<tr><th>Period</th><th>Primary Source</th><th>Secondary Source</th></tr>
<tr><td>1921–1939</td><td>FT-£</td><td>MG (1922–1924)
Einzig (1921–1936)</td></tr>
<tr><td>1963–1975</td><td>FT-£</td><td>The Times and The Telegraph</td></tr>
<tr><td>1976–1997</td><td colspan="2">LSEG/Refinitiv (1990–2025)
HSBC (1985–1998)
NatWest (1986–1998)
Barclays (1983–1998)
FT-£ (1921–1939, 1963–1985)
WM/Reuters-£ (1976–1997)
Bloomberg (1988–2025)
The Times and The Telegraph</td></tr>
<tr><td>1997–2025</td><td>WM/Reuters-$</td><td>Bloomberg (1988–2025)
LSEG/Refinitiv (1990–2025)</td></tr>
</table>

Notes: This table presents the sources used to construct our series of spot exchange rate quotations and FX swap points. Primary sources are those from which the data are collected, while secondary sources are used to fill occasional gaps and to cross-check and clean the primary data. FT stands for Financial Times and MG stands for Manchester Guardian. Einzig refers to Einzig (1937). Last, the Pound (£) and Dollar ($) sign indicate whether the source reports Pound- or Dollar-based spot rates and FX Swap points.

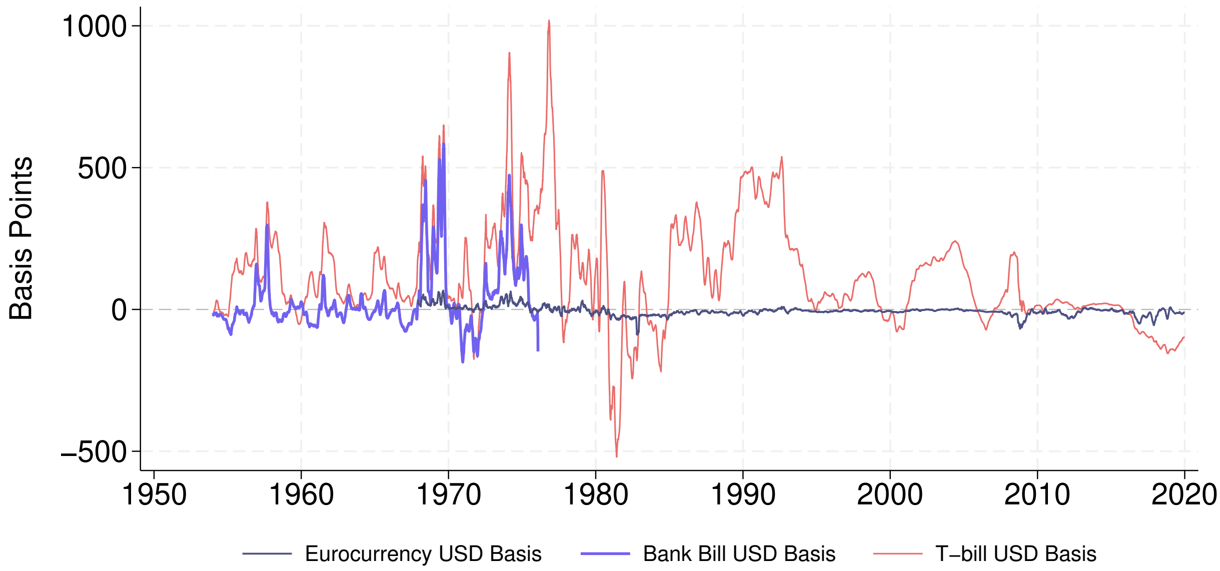
Table A3: Interest rates - Sources and instruments

Currency	Period	Source	Instrument
All currencies	1963–2025	BIS and FT	1- and 3-month Eurocurrency deposit rates in London (offshore)
BEF	1926-1938	Bulletin hebdomadaire d'information et de documentation of the NBB (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	Private discount rate on 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

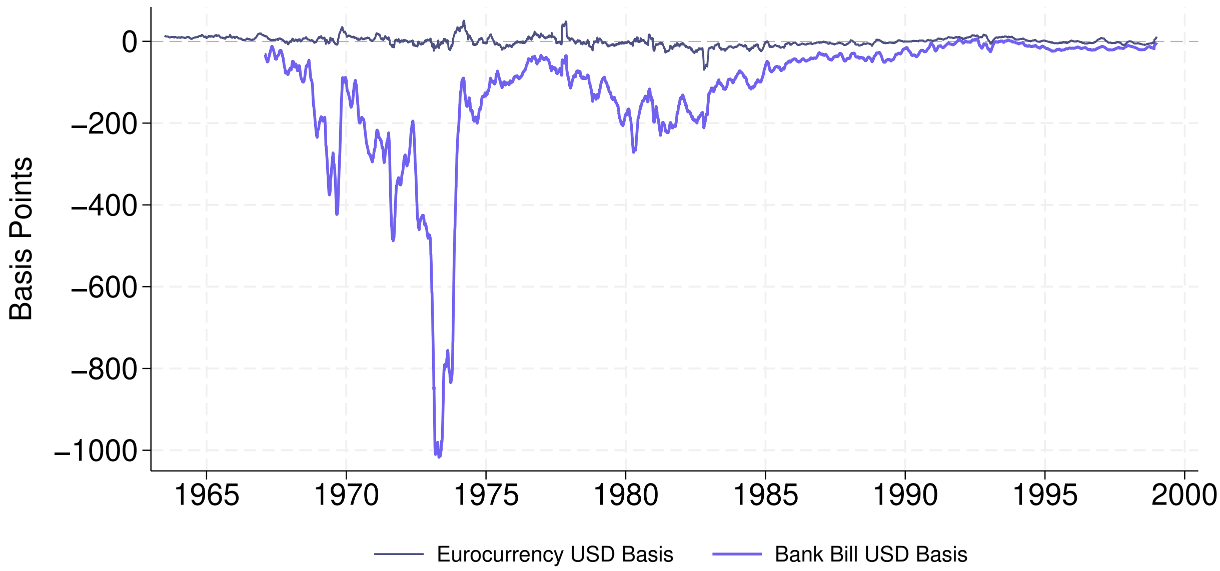
Notes: This table presents the sources and instruments used to construct our interest rate series. For the postwar period, we use a common source and instrument across all currencies. For the interwar period, both the source and instrument vary by currency.

A2 Additional graphs

Figure A2: USD Basis Measured by Alternative Money Market Instruments



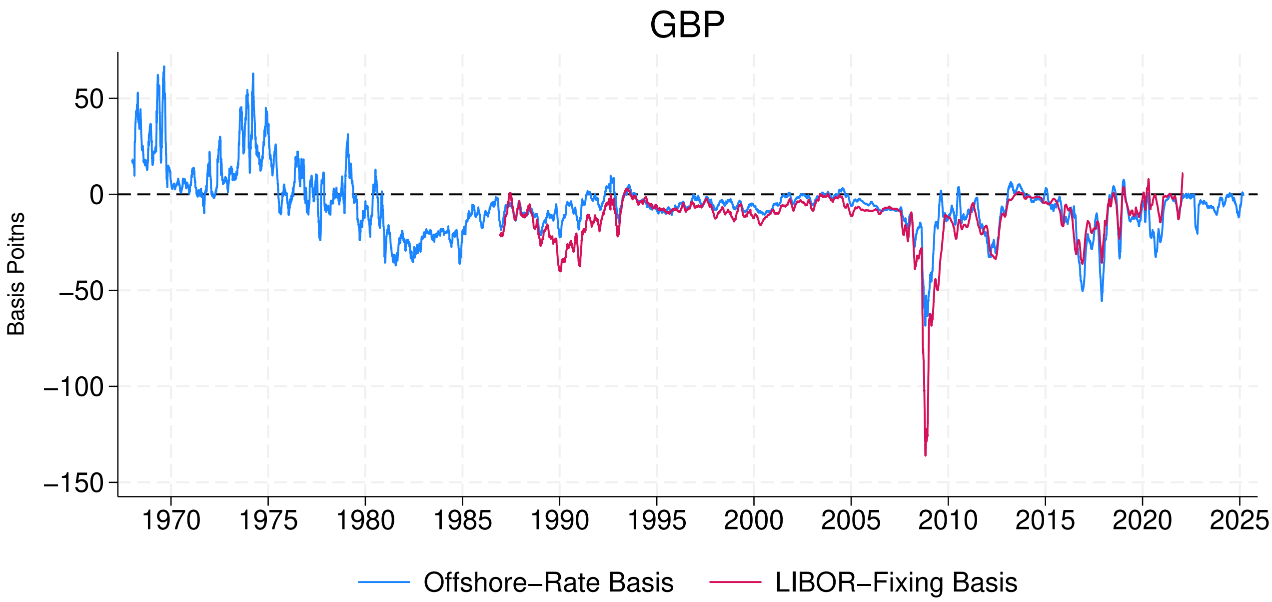
(a) GBP



(b) DEM

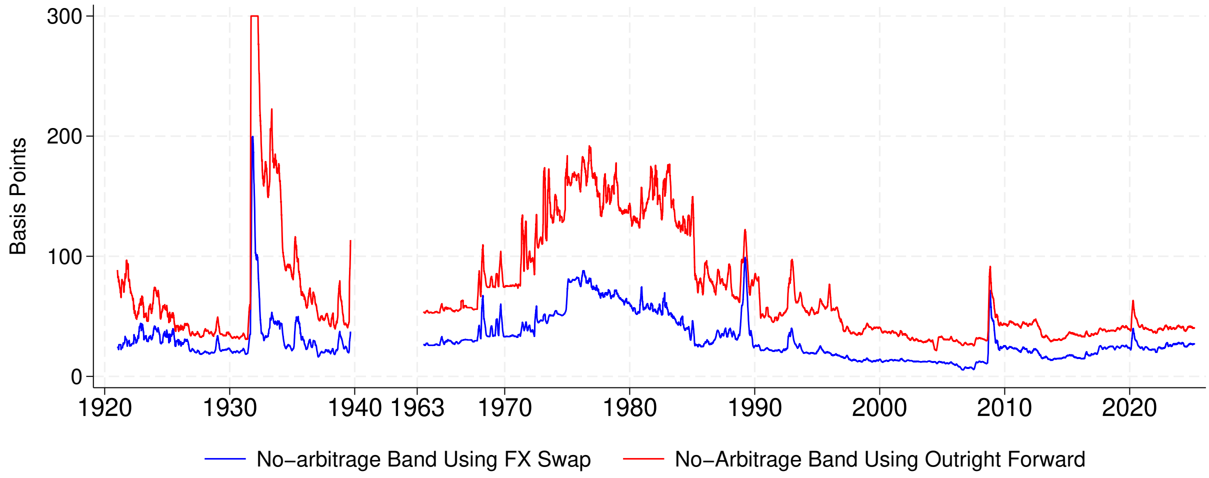
Notes: This figure illustrates the 30-day moving average of USD basis, calculated using daily interest rates from various money market instruments with a three-month maturity. Panel (a) shows USD basis for GBP, calculated using the eurocurrency rates, bank bill rates, and treasury bill rates, respectively. 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.

Figure A3: Offshore-Rate Basis and LIBOR-Fixing Basis

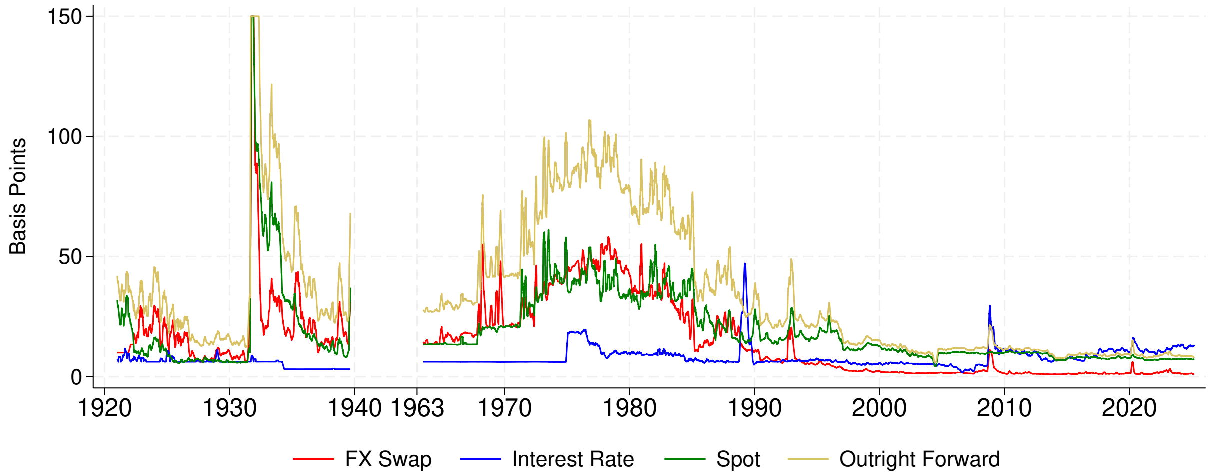


Notes: This figure plots the 30-day moving average of USD basis for GBP, calculated using daily Eurocurrency deposit rates (mid quotes) and using LIBOR fixing rates (offered rates by definition), respectively.

Figure A4: No-Arbitrage Bands and Transaction Costs



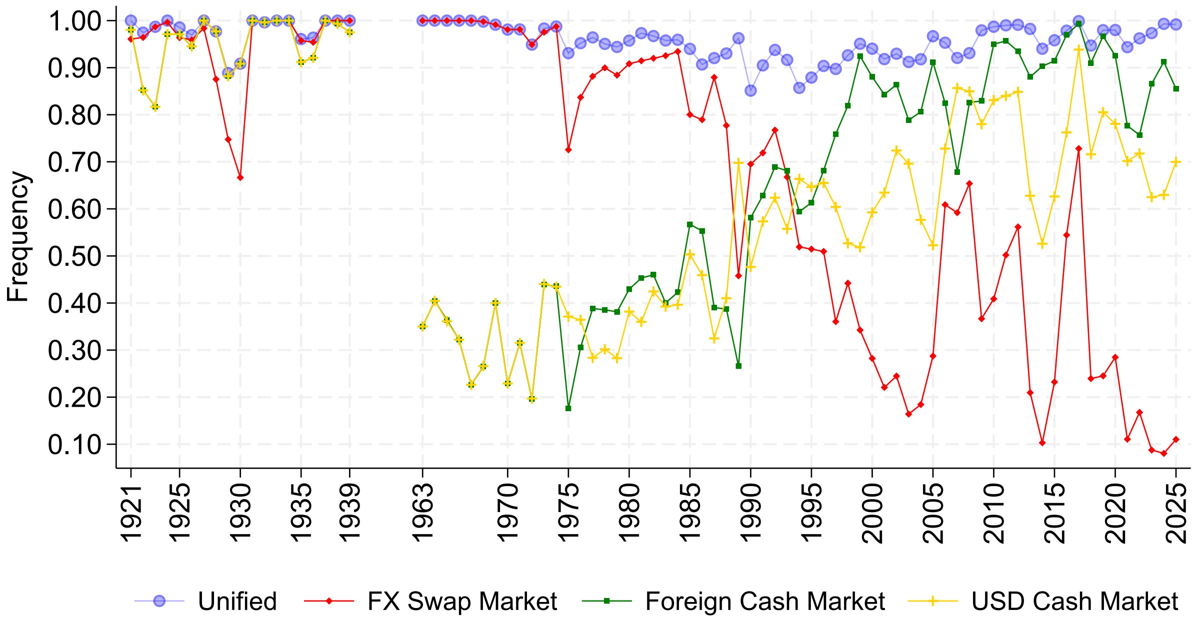
(a) No-Arbitrage Bands



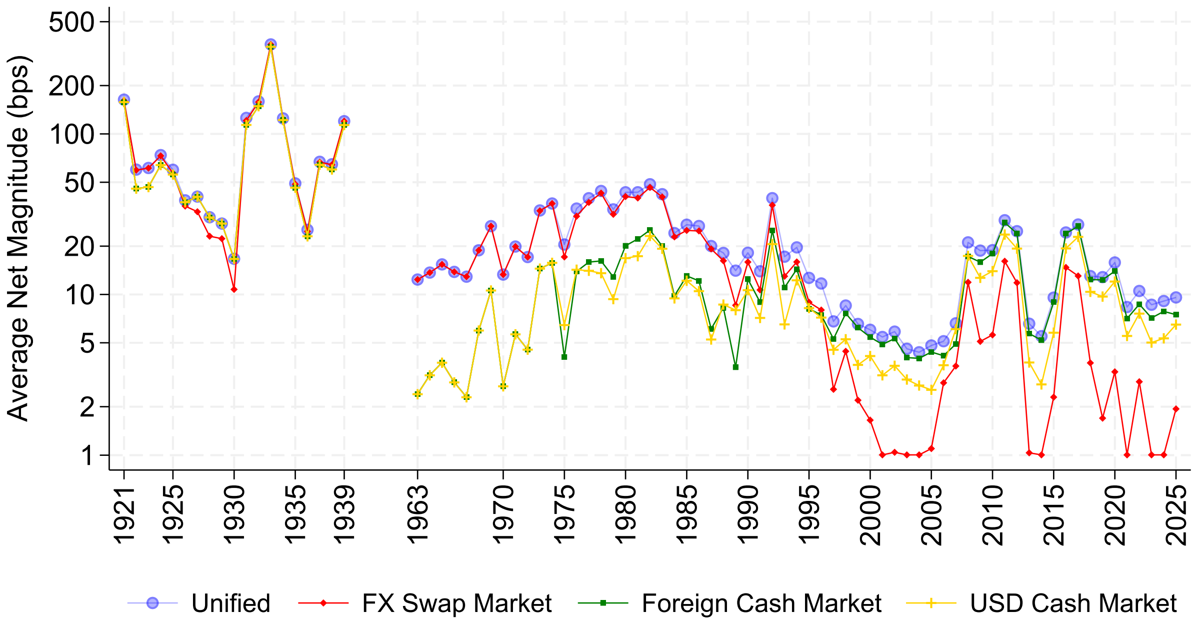
(b) Individual Market Transaction Costs

Notes: This figure presents the 30-day moving average of the cross-sectional median level of no-arbitrage bands (Panel (a)) and transaction costs across markets (Panel (b)). For visual clarity, values are trimmed at 300 basis points in Panel (a) and 150 basis points in Panel (b). For each trading day, we compute the median value of the relevant variable (no-arbitrage band or transaction cost) across all currencies and then apply a 30-day moving average to the resulting daily series. In Panel (a), the no-arbitrage band based on FX swaps is given by $\delta_i^{\text{NASW}} = c_\$^y + c_i^y + c_i^w$, while the no-arbitrage band using outright forwards is defined as $\delta_i^{\text{NAFW}} = c_\$^y + c_i^y + \frac{1}{\tau}(c_i^s + c_i^f) = c_\$^y + c_i^y + c_i^w + \frac{2}{\tau} c_i^s$, where c_i^w, c_i^y, c_i^s, and $c_i^f = c_i^s + c_i^w \tau$ denote the transaction costs associated with currency i's FX swap, money market instrument, spot exchange, and outright forward, respectively. In Panel (b), spot and forward transaction costs are adjusted to reflect a 3-month maturity horizon, consistent with the construction of the no-arbitrage bands. Specifically, we report $\frac{1}{\tau} c_i^s$ and $\frac{1}{\tau} c_i^f = \frac{1}{\tau} c_i^s + c_i^w$.

Figure A5: Time-Varying Economic Significance of CIP Deviations Based on Market Equilibrium Bands



(a) Frequency of Economically Significant CIP Deviations in Each Year



(b) Average Net Magnitude of Economically Significant CIP Deviations in Each year

Notes: This figure illustrates the time-varying economic significance of CIP deviations for a sample of 19 advanced market (AE) currencies, excluding the USD, from January 8, 1921 to March 10, 2025, based on market equilibrium bands for FX swap market, foreign cash market, USD cash market, and the unified market equilibrium bands. Panel (a) reports the frequency of currency-day observations with an economically significant USD basis, computed as $\frac{1}{P}\sum_{i,t}\mathbb{I}\{|x_{i,t}| > \delta_{i,t}\}$ for each year, where P is the total number of currency-day observations in a given calendar year. Panel (b) reports the average net magnitude of economically significant USD basis defined as $\frac{1}{P}\sum_{i,t}\max\{0,\ |x_{i,t}| - \delta_{i,t}\}$ 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.

Appendix B Further replications and comparative analyses

Table B4: Comparing transaction costs - Our data versus Frenkel and Levich (1977) (FL)

	# of	Transaction costs (bps)					No-arbitrage bounds (bps)	
		$-cash	i-cash	Swap	Spot	Forward	Forward	Swap
	Obs.	$c^y_\$$	c^y_i	c^w_i	c^s_i	c^f_i	$\delta^{\text{NAFW}}_\$$	$\delta^{\text{NASW}}_\$$
Panel A. January 1, 1968 – December 31, 1969								
Original FL	n.a.	15	47	n.a.	10	16	166	n.a.
Monday	90	6	6	14	3	6	48	27
Tuesday	98	6	6	14	3	6	48	27
Wednesday	96	6	6	15	3	6	48	27
Thursday	90	6	6	14	3	6	48	27
Friday	92	6	6	14	3	6	48	27
Weekly Average	91	6	6	14	3	6	48	27
Daily	466	6	6	14	3	6	48	27
Panel B. July 1, 1973 – May 31, 1975								
Original FL	n.a.	15	47	n.a.	52	51	474	n.a.
Monday	85	10	11	9	3	5	41	21
Tuesday	91	10	12	9	3	5	43	21
Wednesday	90	10	12	9	3	5	42	21
Thursday	91	10	12	10	4	7	56	22
Friday	92	10	11	9	3	5	41	21
Weekly Average	85	10	11	9	3	5	46	22
Daily	449	10	11	9	3	5	45	21

Notes: This table reports the means of transaction costs and no-arbitrage bands based on our data, alongside the corresponding estimates originally reported in Frenkel and Levich (1977). Panel A corresponds to the sample from January 1, 1968 to December 31, 1969 and Panel B corresponds to the sample from July 1, 1973 to May 31, 1975.

Table B5: Comparing results - Our data versus Clinton (1988)

Panel A. Transaction costs and bands (bps)

	Our Data						Clinton				
	# of obs	c_i^w	c_i^y	$c_\$^y$	δ_i^{UMEQ}	$\delta_i^\star$	c_i^w	c_i^y	$c_\$^y$	δ_i^{UMEQ}	$\delta_i^\star$
CAD	116	6	12	6	1	13	5	6	6	5	n.a.
DEM	117	4	6	6	2	7	3	6	6	3	n.a.
FRF	117	24	16	7	2	38	11	18	n.a.	n.a.	n.a.
GBP	117	6	6	6	3	13	6	6	6	6	n.a.
JPY	118	7	5	6	3	12	4	6	6	4	n.a.

Panel B. Summary statistics for USD basis

	Our Data				Clinton			
	$\lvert x\rvert > \delta^\star$		$\lvert x\rvert$		$\lvert x\rvert > \delta^\star$		$\lvert x\rvert$	
	FRQ	ANM	50th PCT	95th PCT	FRQ	ANM	50th PCT	95th PCT
CAD	0.51	6	12	41	0.37	3	8	22
DEM	0.52	3	7	18	0.34	2	4	16
FRF	0.10	3	14	70	0.34	4	11	49
GBP	0.55	4	13	30	0.15	1	5	15
JPY	0.42	3	11	25	0.36	2	6	18

Notes: This table presents a comparative analysis of Clinton (1988). Panel A reports the means of transaction costs and equilibrium bands based on our data, alongside the corresponding estimates originally reported in Clinton (1988). Panel B presents the frequency (FRQ) and average net magnitude (ANM) of economically significant CIP deviations, defined relative to the band $[-\delta^\star_{i,t}, \delta^\star_{i,t}]$, where $\delta^\star_{i,t} = \min\{2(c^y_{i,t} + c^y_{\$,t}),\ 2c^w_i\}$. In addition, Panel B reports the 50th and 95th percentiles of the absolute value of the USD basis ($|x_{i,t}|$). All statistics in Panel B are computed using both our data and the original results from Clinton (1988). The sample is November 21, 1985 to May 9, 1986.

Table B6: Comparing results - Our data versus McCormick (1979)

	No-arbitrage band using outright forward			No-arbitrage band using FX swaps
	McCormick Original	Our Replication	Our Estimation	Our Estimation
Data for USD Basis	Original	Our data	Our data	Our data
Data for Transaction Costs	Original	Original	Our data	Our data
Time-varying Band	No	No	Yes	Yes
# of Obs.	124	121	121	121
$c_{\$}^{y}$	15	15	20	20
c_{i}^{y}	47	47	25	25
c_{i}^{w}	n.a.	n.a.	12	12
c_{i}^{s}	9	9	3	3
c_{i}^{f}	9	9	6	6
Band δ_i	134	134	82	57
Frequency of $\lvert x_i \rvert > \delta_i$	0.00	0.01	0.10	0.18

Notes: This table reports the means of transaction costs, no-arbitrage bands, and the frequency of economically significant CIP deviations outside the corresponding bands. The sample is April 26, 1976 to October 22, 1976, the same as in McCormick (1979).