



The Currency Book

September 29, 2026

Introduction

With trillions of dollars, euros and yen changing hands every day, foreign exchange is indisputably the largest and most liquid financial market in the world. Yet despite its size, the currency market is also one of the least understood. Unlike bonds or equities, there is no widely accepted framework for explaining currency moves, which reflect a complex interplay of macroeconomics, capital flows, market structure, investor behaviour and (geo)politics.

Over the past two decades, advances in technology and market infrastructure have transformed how currencies are traded, placing FX at the forefront of broader changes in global finance. Yet because currencies sit at the intersection of national economies, the FX market is also fundamentally connected to international trade and cross-border capital flows. It is therefore increasingly exposed to the forces reshaping the global economic landscape—from geopolitical fragmentation and changing trade relationships to shifts in regulation, payments infrastructure and the architecture of the international monetary system.

This Deutsche Bank Currency Book brings together academic, industry and Deutsche Bank expertise to explain how FX markets function, how exchange rates are determined, how investors seek to generate returns from currencies, and how FX risk can be managed by investors and corporates alike. Our aim throughout the *Book* is to set out the enduring principles driving markets alongside the developments defining FX today. Ultimately, the structure of the FX market is not simply a question of how currencies trade, but of who controls the financial infrastructure through which money moves across borders. The evolution of FX is increasingly intertwined with questions of monetary sovereignty, financial resilience and geopolitical power.

Chapter 1 reviews the structure of the FX market, examining its participants, ecosystem and evolution over time. Chapter 2 discusses exchange rate determination, moving from traditional academic theories to modern macro-financial approaches and practical decision frameworks. Chapter 3 reviews FX as an asset class and the evidence on currency investing, while Chapter 4 considers currency hedging for both investors and corporates. Finally, Chapter 5 discusses the future of FX, including the impact of technology, payment systems and digital assets.

Authors

George Saravelos

Global Head of FX Research

Charlie Hyams

Strategist

Rohini Grover

Strategist

Mallika Sachdeva

Strategist

Shreyas Gopal

Strategist

Oliver Harvey

Macro Strategist



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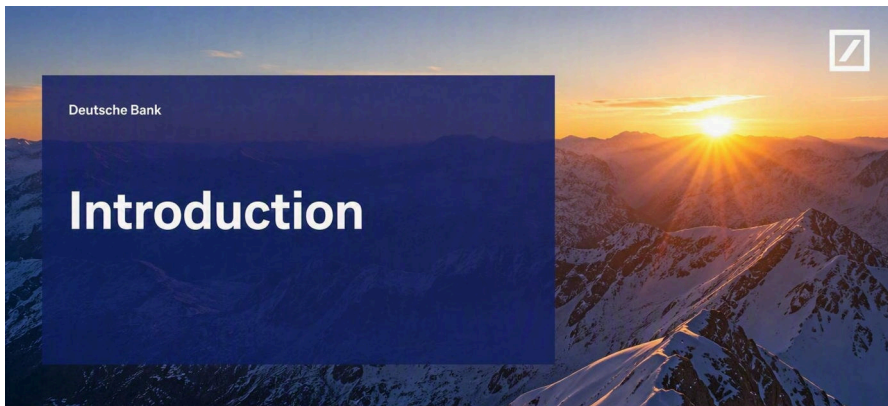
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Introduction

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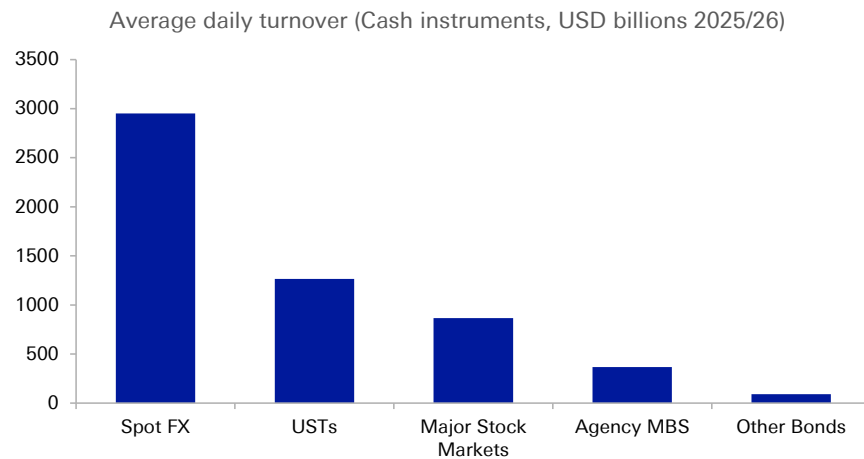
Over the past two decades, advances in technology and market infrastructure have transformed how currencies are traded, placing FX at the forefront of broader changes in global finance. Yet because currencies sit at the intersection of national economies, the FX market is also fundamentally connected to international trade and cross-border capital flows. It is therefore increasingly exposed to the forces reshaping the global economic landscape—from geopolitical fragmentation and changing trade relationships to shifts in regulation, payments infrastructure and the architecture of the international monetary system.

This **Deutsche Bank Currency Book** brings together academic, industry and Deutsche Bank expertise to explain how FX markets function, how exchange rates are determined, how investors seek to generate returns from currencies, and how FX risk can be managed by investors and corporates alike. Our aim throughout the *Book* is to set out the enduring principles driving markets alongside the developments defining FX today. Ultimately, the structure of the FX market is not simply a question of how currencies trade, but of who controls the financial infrastructure through which money moves across borders. The evolution of FX is increasingly intertwined with questions of monetary sovereignty, financial resilience and geopolitical power.



[Chapter 1](#) reviews the structure of the FX market, examining its participants, ecosystem and evolution over time. [Chapter 2](#) discusses exchange rate determination, moving from traditional academic theories to modern macro-financial approaches and practical decision frameworks. [Chapter 3](#) reviews FX as an asset class and the evidence on currency investing, while [Chapter 4](#) considers currency hedging for both investors and corporates. Finally, [Chapter 5](#) discusses the future of FX, including the impact of technology, payment systems and digital assets.

Figure 1: Turnover in spot FX dwarfs other asset classes



Source : Federal Reserve Bank of New York, Bank of England, BIS.
Note: Major Stock Markets covers all US stock Markets, LSE and Nikkei



Introduction

The foreign exchange market is the world's largest and most liquid financial market, but it differs fundamentally from a centralised exchange. Trading takes place across a fragmented, largely over-the-counter network of banks, non-bank liquidity providers, electronic venues and end-users, using instruments ranging from spot and forwards to swaps, futures and options. How do transactions move through this network? Who provides liquidity, who consumes it and what risks arise between execution and settlement? This chapter maps the FX ecosystem from instruments and trading infrastructure to the participants ultimately responsible for currency demand.

1.1 Instruments

The FX market is not one single product. Instead, it is made up of a group of instruments that allow market participants to exchange currencies today, lock in an exchange rate for the future and/or hedge against adverse exchange-rate moves. Below, we outline the main instruments in FX markets and their users.

Spot: This is the simplest and most widely known FX instrument. When market participants refer to "the exchange-rate" or the "spot exchange-rate," they generally mean the price agreed today for exchanging one currency for another on the standard spot settlement date. For most major currency pairs spot settlement is two business days later (T+2).¹ For example, a spot purchase of EUR 1 million against the USD at a EUR/USD exchange-rate of 1.20 means that the buyer receives EUR 1 million in his or her bank account on the settlement date and the seller receives USD 1.2 million from the buyer on the same date.

¹ There are exceptions, for example USD/CAD settles T+1.



By convention, the first currency in an exchange-rate quotation is known as the base currency, while the second is the quote currency. The exchange-rate therefore represents the number of units of the quote currency required to purchase one unit of the base currency. In USD/JPY, for example, the USD is the base currency and the exchange-rate indicates the number of Japanese yen required to purchase one US dollar. A USD/JPY exchange-rate of 160 means 1 USD can be exchanged for 160 JPY.

Spot transactions are the most commonly used foreign exchange payments for cross-border payments for goods and services, the purchase of foreign financial assets, as well as portfolio rebalancing and proprietary trading. In 2025, the Bank for International Settlements (BIS) estimates spot turnover at \$3trn per day, accounting for [31%](#) of global over-the-counter (OTC) FX turnover.

Forwards and futures: An (outright) forward is similar to a spot transaction, but is instead an agreement to exchange two currencies at a rate (price) agreed today, but with settlement taking place at a date more than T+2 days in the future. They are also traded OTC. Forwards are most commonly used by those who have a known future cash flow and want to remove uncertainty around the future exchange rate. In 2025, the BIS estimates that they account for [19%](#) of global turnover, or \$1.8trn per day.

Futures are economically similar to forwards but are standardised contracts traded on exchanges and centrally cleared. This provides transparent pricing and reduces bilateral counterparty risk, but offers less flexibility over contract size, maturity and settlement terms than an OTC forward. Exchange-traded FX futures remain considerably smaller than the OTC FX market.

Non-deliverable forwards (NDFs): An NDF is a cash-settled forward commonly used for currencies where convertibility or offshore deliverability is restricted. Two parties agree today on an exchange rate for a future date, but unlike a standard forward, the underlying currencies are not exchanged. At maturity, the agreed NDF rate is compared with a pre-specified fixing or reference rate. The difference is usually settled in USD. NDFs are commonly used by corporates, banks and investors to hedge or take exposure to currencies subject to capital controls.

Swaps: An FX swap combines two transactions: an exchange of currencies on an initial date and a reverse exchange at a later date, with both exchange rates agreed when the swap is initiated. They are used by institutions that hold cash in one currency (e.g. EUR) but need funding in another (e.g. USD) for investment, hedging or other needs. They are by far the largest FX instrument by turnover, with the BIS estimating turnover of \$4trn per day in April 2025, [42%](#) of global FX turnover. A swap is, in effect, a form of collateralised borrowing, with the collateral being cash in a different currency to that of the currency borrowed.

Cross-currency (XCCY) swaps: A cross-currency swap is similar to an FX swap in that principal amounts denominated in two different currencies are typically exchanged at inception and reversed at maturity. The key difference is that a cross-currency swap also involves periodic exchanges of interest payments denominated in the two currencies over the life of the contract. These payments may be fixed or floating. Cross-currency swaps therefore allow market participants to transform both the currency denomination and, where relevant, the interest-rate characteristics of an asset or liability.



For example:

- Suppose a European corporate issues a USD-denominated bond to US-based investors. It receives the bond proceeds in USD, but must periodically pay interest in USD and repay the USD principal when the bond matures. However, because the corporate primarily earns revenue in EUR, it needs to convert these USD liabilities into EUR liabilities to avoid currency and potentially interest-rate risk.
- The corporate removes FX and interest-rate risk by entering into a xccy swap, where, in essence, it converts this USD-liability into a EUR-liability.²
- They are commonly used by banks, corporates and investors that need to raise money in one currency but need funds in another. The basis is the extra spread added to one side of the swap to balance unequal demand for funding in the two currencies. See [Section 2.11](#) for more on cross-currency basis and [here](#).

Options: An option gives the holder the right, but not the obligation, to buy or sell one currency against another at a specified exchange rate during a specified period. Options are used to hedge currency risk or speculate on currency movements and are particularly useful when the end-user wants an asymmetric payoff profile. Unlike a forward, an option can limit losses from an adverse currency movement while allowing the holder to retain some or all of the benefit from a favourable movement. In 2025, they represented around 7% of global FX turnover. Options are widely used by corporates and investors for hedging, and by investors and dealers to express directional or volatility views.

The simplest and most widely used instruments are *vanilla options*, which give the holder the right to buy (a call) or sell (a put) a currency at a predetermined strike price. A European-style option can be exercised only at expiry, while an American-style option can be exercised at any point up to expiry. More structured products include barrier options, whose payoff is activated or extinguished if the exchange rate reaches a specified level—for example, knock-in and knock-out options. One-touch and no-touch options pay a fixed amount depending on whether the exchange-rate does, or does not, reach a predetermined level during the life of the option. These instruments are commonly used to express views not just on the direction of a currency pair, but also on the probability, timing and magnitude of exchange-rate moves.

1.2 FX spot trading life cycle and risks

Having discussed the main FX instruments, the next step is to examine how these transactions are executed and settled in practice. The complete trade life cycle, meaning the sequence of events and processes involved in executing a trade, is crucial to understanding how FX transactions work. We therefore describe below the broad steps involved in trading FX, focusing on spot transactions. They are:

1. **Pre-trade:** This stage encompasses all the necessary preparations before a trade is executed, including client onboarding, platform selection, credit checks, and regulatory compliance.

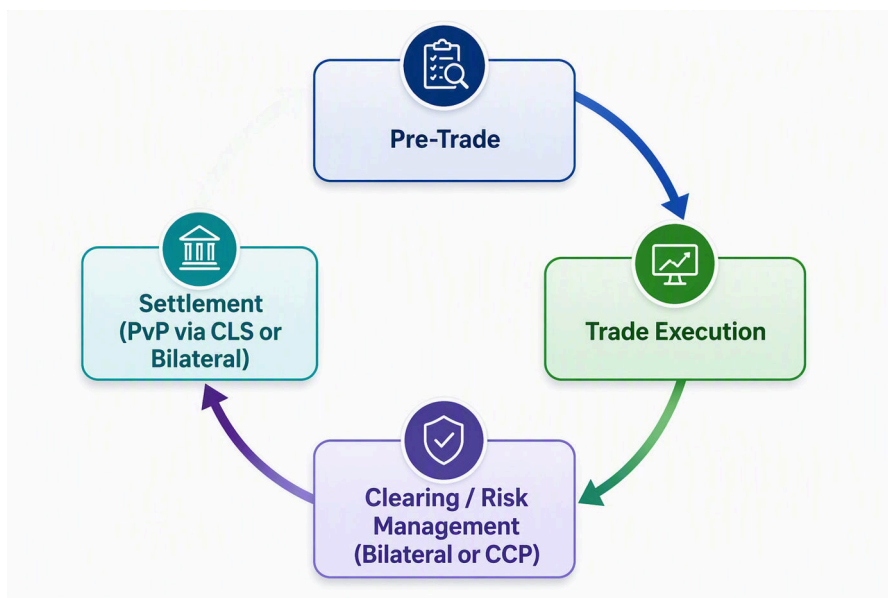
2 Specifically, it exchanges the USD bond proceeds for EUR at inception, receives USD interest payments (from the swap counterparty to pay U.S. bond investors) and pays EUR interest (to the swap counterparty) over the life of the swap, and receives USD principal (from the swap counterparty to pay U.S. investors) in exchange for EUR principal at maturity. The USD receipts from the swap are used to meet the bond's USD interest and principal payments, effectively converting the USD-denominated bond into a EUR-denominated liability.



2. **Trade execution:** This is the point where the trade is agreed upon and executed at a specific exchange rate, creating a legally binding contract.
3. **Trade clearing:** This stage involves validating trade details and managing counterparty credit risk before settlement, either bilaterally or through a central clearing counterparty (CCP). In centrally cleared FX markets, the CCP becomes the buyer to every seller and the seller to every buyer, reducing direct counterparty exposures between market participants. Specialist FX CCPs, such as LCH's [ForexClear](#), clear both non-deliverable and deliverable FX products. While FX spot transactions can be cleared, they are not subject to mandatory clearing requirements. ForexClear supports 25 non-deliverable forward (NDF) currency pairs, 9 non-deliverable option (NDO) currency pairs, and 8 deliverable (Spot, Forwards and Options) currency pairs, at the time of writing.
4. **Trade settlement:** This final stage represents the completion of the transaction, with the actual exchange of currencies taking place. Settlement for spot trades typically occurs two business days (T+2) after the trade date, although exceptions exist. For example, USD/CAD settles on a T+1 basis.

A Central Clearing Counterparty (CCP), also known as a Central Counterparty, stands between buyers and sellers in financial markets, becoming the buyer to every seller and the seller to every buyer. This mitigates counterparty risk.

Figure 2: FX Spot Trade Life Cycle



Source : Deutsche Bank

Risks surrounding FX spot trading

The over-the-counter (OTC) nature of the FX market, while offering flexibility and adaptability to participant needs, does present certain risks that are often more pronounced compared to exchange-traded markets. Below we discuss some of the key risks in FX.

Credit risk: Credit risk in FX trading, stemming from a counterparty's potential inability to fulfill its obligations, is present throughout the trade lifecycle:

- **Pre-trade:** Counterparty creditworthiness is a critical consideration in the



pre-trade stage of FX transactions. A thorough assessment should involve evaluating the potential counterparty's financial strength, credit rating, and reputation. Choosing a creditworthy counterparty significantly reduces the risk of default throughout the trade lifecycle.

- **Post-trade** (Clearing and Settlement): While credit risk exists in both the clearing (post-execution/pre-settlement) and settlement stages of a spot FX trade, it primarily materializes during settlement. This stage, involving the actual exchange of currencies, carries the highest risk due to the potential for settlement failure. This risk, often referred to as settlement risk, arises when one party delivers their currency while the counterparty defaults. Cross-border trades are particularly vulnerable due to time zone differences, which can create a window where one party has performed but the other has not. Additionally, mark-to-market risk from FX rate fluctuations between trade and settlement dates can exacerbate settlement risk by increasing potential losses from a default. This is particularly pronounced with forward contracts, where the longer pre-settlement period leads to greater mark-to-market risk and, consequently, higher settlement risk.

Market Risk: This risk in FX trading arises from potential losses due to adverse exchange-rate movements. This is influenced by factors like economic data, geopolitical events, and interest rates. For customers, asymmetric information, where one party has more or better information than another, can lead to inefficient pricing and increased volatility, thereby exacerbating market risk.

- For dealers, a key component of market risk is inventory management risk – the potential for losses from unfavourable price movements in the currencies they hold to facilitate client trading. Effective inventory management, including position limits and hedging, mitigates this risk.

Liquidity Risk: This refers to the overall market's ability to facilitate the buying and selling of a currency pair quickly and efficiently at a desired price. It's influenced by factors such as market depth, trading volume, volatility, and fragmentation.

Operational Risk: This encompasses risks associated with trade processing, settlement, and technology. Errors in trade execution, system failures, and fraud can all lead to significant losses.

Regulatory Risk: This refers to the risk arising from changes in regulations or their interpretation. The evolving regulatory landscape in FX, particularly concerning non-bank dealers and systemic risk, can impact market participants and create uncertainty.

1.3 Market participants

The FX market comprises a variety of participants with different objectives. FX market participants fall into two broad categories: financial and non-financial. Financial participants can act as both liquidity providers and consumers, while non-financial participants act largely as liquidity consumers.

Financial participants: In the FX market, financial participants are primarily banks acting as dealers.

- **Dealers:** These are mainly large commercial banks, investment banks and securities houses that participate in the inter-dealer market for proprietary



trading.³ and/or for meeting customer demand through market-making.⁴

- **Institutional investors:** These are mutual funds, pension funds, insurance companies and endowment funds, collectively referred to as “real-money investors”, which need to buy currencies to satisfy end-user demand for an underlying asset. For instance, a UK pension fund needs to buy USD to purchase US equities. These investors also engage in hedging, proprietary trading and risk management activities.
- **Hedge Funds & Principal Trading Firms (PTFs):** Hedge funds are investment funds that follow a broad range of investment strategies and are generally not subject to the same borrowing and leverage restrictions as traditional investment funds. They are users of FX and derivatives for speculative purposes. PTFs are principal trading firms, such as XTX Markets and Citadel Securities, that hedge or speculate for their own account and also participate in market-making. This category may include high-frequency trading firms that employ high-speed algorithmic trading strategies.

Non financial institutions: Non-financial participants, such as corporations involved in international trade, retail and the official sector, also primarily consume liquidity.

- **Corporates** are active in currency markets primarily to manage FX exposures⁵ arising from international trade, foreign-currency financing, overseas operations and cross-border mergers and acquisitions (M&A).⁶
- **Official sector:** This category includes central banks, sovereign wealth funds, international financial institutions, such as the IMF and BIS, development banks and government agencies. Monetary-policy, financial-stability and mercantilist considerations have all, at various times, motivated central-bank intervention in FX.⁷
- **Other:** This category includes all other market participants, including retail participants. Retail participants engage in FX both to speculate and to meet transactional demand arising from travel, trade or investment.

1.4 Profit versus non-profit seekers

In 2025, daily FX turnover reached \$9.5 trillion according to the BIS triennial survey (BIS, 2025) making currency trading the world's largest financial market. Yet, size and liquidity do not necessarily imply efficiency. Unlike most equity or bond transactions, a large share of FX activity serves an underlying transactional purpose. For instance, corporates must convert revenues and meet foreign-currency invoices; institutional investors hedge overseas assets; and dealers intermediate these flows. For these participants, expected FX returns may be secondary, or even irrelevant, to the decision to trade. In this section, we investigate

Institutional investors are subject to a variety of (1) regulatory, (2) mandate and (3) process constraints.

(1) Regulatory constraints have had an increasingly [important](#) influence on cross-border investment since 2008.

(2) Mandate constraints relate to limits placed on investment allocations by a fund's internal rules. These constraints may arise from, among other things, fund design (i.e., fund characteristics, regions, target benchmarks, target returns), founding charters or guidelines (i.e. many endowments have externally [imposed](#) constraints on investment allocations and government policy (i.e. Norway's pension fund mandate is determined by the [government](#)). These restrictions can materially limit a fund's ability to take currency risk. The simplest mandate distinction is between passive and active funds, with the former following an index and therefore being explicitly required to track its returns.

(3) Process constraints relate to limits placed on the decision-making process. Most investment funds abide by internal risk rules designed to limit exposure to losses during periods of market volatility. These rules can generate value-at-risk (VaR) shocks.

³ Proprietary trading is a profit-seeking activity that dealers once engaged in more extensively, but which has been severely constrained by regulatory change. Most notably, the Volcker Rule, implemented in 2014-15 under the Dodd-Frank regulations, bans banks from engaging in proprietary trading activities, including many foreign exchange instruments.

⁴ Market making: This is an activity that seeks to capture returns by matching buyers and sellers and charging a price for the service through the bid-offer spread. This spread represents the price that liquidity seekers must pay to access the market and is a “frictional” cost of executing transactions. As such, market-making is a liquidity-provision service rather than a source of the ‘excess returns’ associated with activities such as proprietary trading

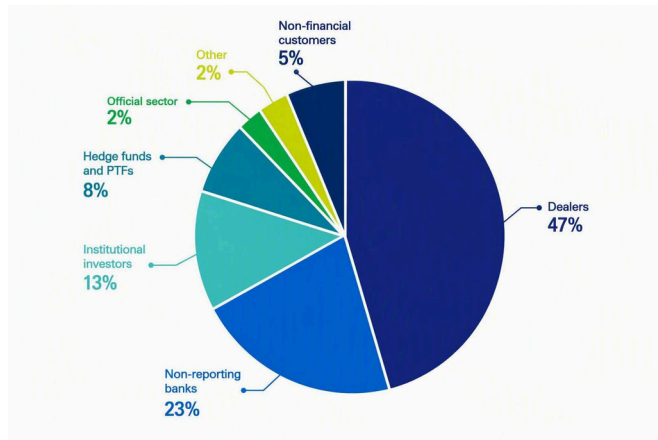
⁵ For more see [here](#)

⁶ Corporates using foreign exchange to hedge future exposures may also seek hedge accounting to



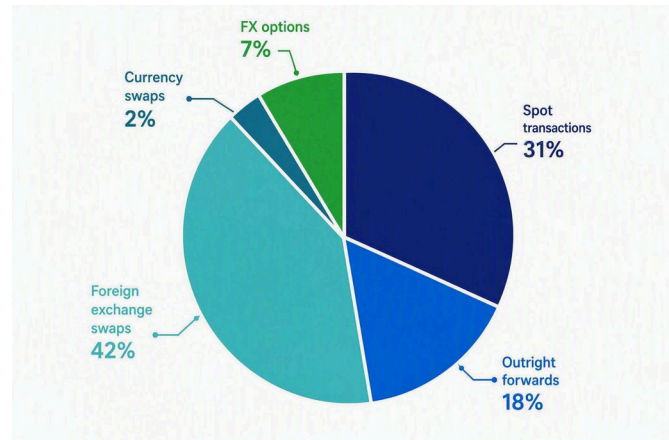
the division of the market between profit-seeking and non-profit-seeking participants. This is the first step in understanding exchange-rate determination.

Figure 3: Daily FX turnover by counterparty



Source : BIS, Deutsche bank

Figure 4: Daily FX turnover by instrument



Source : BIS, Deutsche Bank

Approach 1: The Triennial BIS Survey of FX market volumes

We use the 2025 BIS Triennial Survey to update Deutsche Bank's previous work ([Saravolos et al, 2018](#)) and estimate the share of FX turnover initiated with a profit-seeking currency objective. We construct a "realistic scenario", which applies what we deem to be "realistic" assumptions about participants' ability and mandate to take FX risk.⁸ We find that profit-seeking activity accounts for approximately 40% of turnover under the realistic scenario.⁹

Financial participants

- **Dealers:** Dealer-to-dealer activity accounts for approximately 47% of total daily FX turnover (\$4.44trn) and we classify 10% of dealer flow as profit-seeking (\$444bn/day). Given that much of the daily FX turnover reflects market-making, we assume that inter-dealer transactions conducted by voice are not profit-seeking and that only electronic transactions conducted through order-matching systems such as EBS are profit-seeking.
- **Hedge Funds and PTFs:** Hedge Funds and PTFs account for approximately \$760bn (8%) of headline daily FX turnover and we classify 90% of this as profit-seeking (\$684bn/day). The \$684bn/day figure represents the profit-seeking nature of hedge-funds where the remaining 10% reflects the

ensure that the mark-to-market value of their hedge does not introduce unwanted volatility in the income statement. IFRS 9 provided an updated set of standards for hedge accounting, designed to increase flexibility and better link financial reporting to firms' risk management practices. However, hedge accounting still places limitations on the types of instruments and kinds of hedges that can be implemented. For example, to qualify for hedge accounting, corporates must adhere to hedge effectiveness and demonstrate that an economic relationship between the underlying cash flow or asset and the hedge exists, as well as quantitative limits to hedge ratios.

7 Exchange rates are explicitly targeted by some central banks as part of their overall monetary policy framework (for instance the Monetary Authority of Singapore or the Hong Kong Monetary Authority); other central banks have intervened to defend their inflation target or financial stability reasons (most recently, the Swiss National Bank); and others to prevent competitiveness losses in global trade.



expansion of PTFs to act not only as profit-seekers but also as liquidity providers.

Figure 5: Profit-seekers make up 40% of the FX market

 Counterparty	 Profit-seeking assumptions
 Dealers	Mainly market-makers, small profit-seeking 10%
 Hedge Funds and PTFs	All profit-seeking, except PTF liquidity provision 90%
 Non-Reporting Banks	Mainly market-makers, small profit-seeking incentive 10%
 Institutional Investors	Some fixed-income and equity managers take FX risk 30%
 Official Sector	Reserve managers profit seeking 50%
 Corporates	All corporate activity liquidity-seeking 0%
 Other	Retail participation 50%
 Undistributed	Unknown 0%
Overall	40% of daily FX turnover is profit-seeking

Source : BIS, TIC, Federal Reserve Bank of New York, Deutsche Bank

- **Non-Reporting Banks:** Non-reporting banks account for approximately \$2.19trn, or 23% of headline daily turnover and we classify 10% of this as profit-seeking (\$220bn/day). These largely intermediate for institutional and non-financial customers and apply the same profit-seeking assumptions as we do for dealers.
- **Institutional investors:** Institutional investors account for \$2.56tn of daily BIS turnover ¹⁰ and we classify 30% of this as profit-seeking. We assume 80% of active fixed-income managers have discretion to take FX risk and 50% of active equity managers have discretion to take FX risk, implying a profit-seeking share of approximately 30%.
- **Official Sector:** The official sector accounts for approximately 1-2% of headline FX turnover and we classify 50% of the turnover as profit-seeking. The motivations within this category vary. Central-bank intervention may pursue monetary-policy, financial-stability or exchange-rate objectives, while reserve managers may also seek to preserve capital and earn returns.

Non-Financial Sector:

- **Corporates and governments:** Corporates and governments account for 10% of daily FX turnover and we classify 0% of this flow as profit-seeking.¹¹

8 An upper-bound scenario, which relaxes those "realistic" assumptions and produces a higher estimate of profit-seeking activity by classifying ambiguous transactions as profit-seeking is outlined in Appendix .

9 See Appendix for full methodology

10 After reallocation flow from intermediated by non-reporting banks, see Appendix for full methodology.

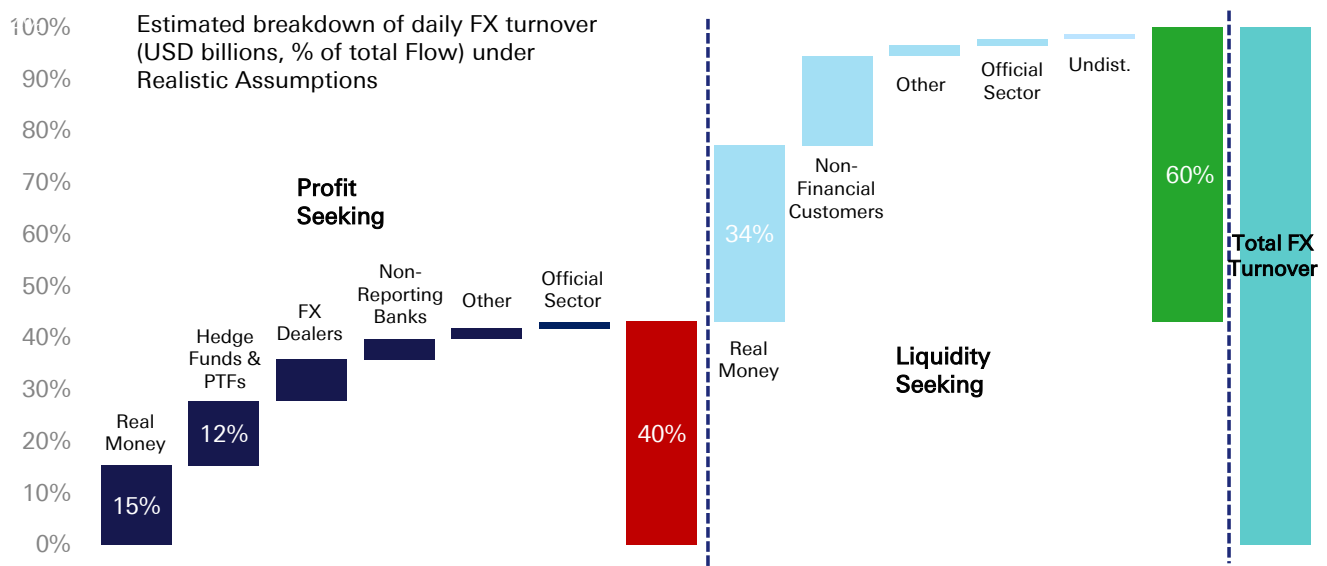


- **Other and Undistributed:** The BIS residual “other” category accounts for approximately 2% of headline turnover. We classify 50% as profit-seeking.

¹² The undistributed category accounts for less than 1% of headline daily turnover and we classify this as 0% profit-seeking.

Bringing it all together: Taken together, we estimate that approximately 40% of adjusted FX turnover is profit-seeking, while approximately 60% is liquidity-seeking or transactional.

Figure 6: There are more liquidity seekers than profit seekers in our baseline estimates of FX market size



Source : BIS, TIC, Federal Reserve Bank of New York, Deutsche Bank

Approach 2: Commitment of Traders CFTC data

While the BIS data provide the most comprehensive view of the global FX market, the survey is only updated every three years. For a higher-frequency perspective, we therefore complement it with the US Commodity Futures Trading Commission's Commitments of Traders (CoT) report, which is published weekly and provides a breakdown of positions in exchange-traded currency futures and options, principally those traded on the Chicago Mercantile Exchange (CME). The report shows the number of outstanding long and short contracts held by different categories of market participant, based on positions as of each Tuesday. Although the futures market represents only a small subset of total global FX activity—most of which takes place over the counter—the CoT data provide a timely and consistent measure of how speculative and hedging positions are evolving.

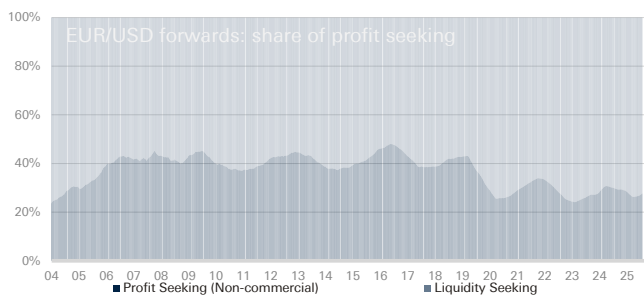
11 Corporates use FX to settle foreign-currency revenues and expenses, finance cross-border activity, hedge forecast cash flows and manage earnings volatility. Governments similarly transact to meet an underlying funding or expenditure requirement.

12 Some investors trade currencies to earn returns, while other transactions relate to travel, remittances or purchases of foreign assets



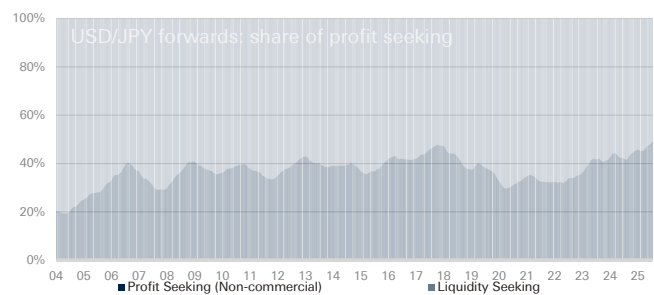
In the traditional or “legacy” CoT report, reportable positions are divided into commercial and non-commercial traders, alongside a residual category of smaller, non-reportable positions. Commercial traders are generally entities that use futures primarily in connection with an underlying business activity and are therefore commonly interpreted as hedgers—for example, corporates or financial institutions managing currency exposures. We classify these positions as liquidity seeking. Non-commercial traders, by contrast, are participants whose futures activity is not classified as commercial hedging and typically includes hedge funds, commodity trading advisers and other leveraged investors. We therefore treat non-commercial positions as profit-seeking. [Figure 7](#) and [Figure 8](#) show how the relative size of the profit-seeking FX market has developed over time. Using one-year rolling averages to reduce the noise of the data, we see that roughly 30-40% of the futures market (*EUR/USD*, *GBP/USD*, *USD/JPY*) is profit-seeking.

Figure 7: Profit-seeking activity in EUR futures



Source : CFTC, Bloomberg Finance LP

Figure 8: Profit-seeking activity in JPY futures



Source : CFTC, Bloomberg Finance LP

Approach 3: Options market DTCC data

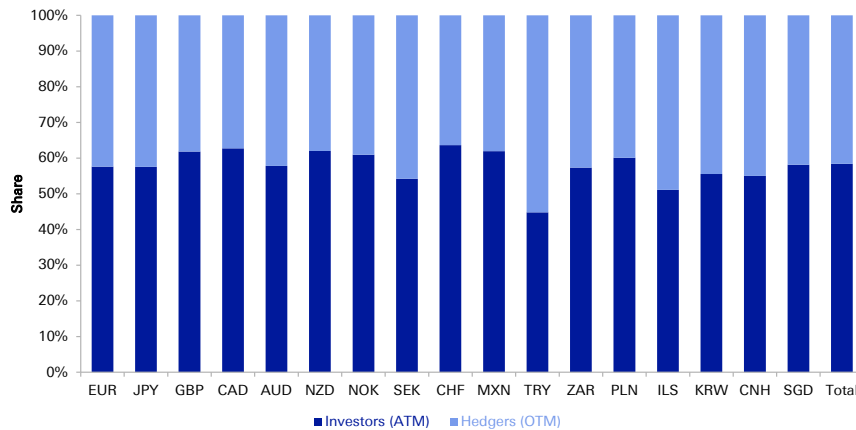
Following the implementation of the Dodd-Frank Act, OTC FX options falling within the US regulatory perimeter are required to be reported to a CFTC-registered swap data repository (SDR). This includes transactions involving US market participants, among others. DTCC operates one of the largest data repositories and therefore captures a substantial share of global institutional FX option activity. We estimate that the DTCC data capture more than 20% of global FX derivative volumes, providing another way of estimating the relative importance of profit- and non-profit-seeking activity in the FX market.

While the data does not provide client granularity, we can back out the likely motivation of the transaction by distinguishing between out-of-the-money and in-the-money option trades. We argue that strikes preferred by the different client groups will likely differ, with hedgers favouring out of the money options (0-25 delta). While speculators focus on directional leverage, the latter often translates to options with strikes nearer to the money (25-75 delta).

[Figure 9](#) shows the split in options volumes for 2025/26 across the two investor categories. We find that option volumes are roughly split equally between investors and hedgers. FX options are instruments that are favoured by hedge funds over corporates and institutional investors, so the results here likely materially overstate the relative importance of profit-maximizing participants in other markets. Again, this shows the FX market is split roughly 50/50 by those who are profit-seeking and those who are not.



Figure 9: Size of profit-seekers in the FX options market



Source : Deutsche Bank , Bloomberg Finance LP, DTCC

*Note: Option volumes captured only for currencies against USD.

1.5 The FX ecosystem

Following [Grover and Saravelos \(2025\)](#), this section examines the significant changes in FX market structure in recent decades, with a particular focus on the FX spot market, and highlights the key challenges that have emerged as a result of this transformation. To understand how these challenges emerged, it is useful to begin by examining the evolution of the FX spot market.

1.5.1 The Evolution of FX Trading: From Voice to Electronic

We analyse the evolution of the FX spot market, focusing on the shift from a pre-electronification era of voice-based trading and bank-centric risk management to the phased electronification of interdealer and dealer-client segments. This transformation has led to the emergence of diverse execution styles and trading venues, which will be explored to provide a comprehensive overview of the changing FX landscape and its implications for risk mitigation. The discussion begins with an examination of the pre-electronification era.

1. Voice trading: The age of the telephone

Early foreign exchange (FX) trading was a two-tiered system conducted over the phone ([Figure 10](#)). Clients contacted dealers (outer tier) directly to inquire about bid and ask prices. Dealers profited from the difference between these prices (the bid-ask spread). Dealers further traded amongst themselves (the "inter-dealer market" - inner tier) to manage inventory imbalances arising from trading with clients. They did this either directly or anonymously through voice brokers.

In this two-tier system, *banks* acted as the sole liquidity providers and risk bearers in the FX market. Inter-dealer trading, used for hedging and inventory management, formed a significant portion of overall trading volume.



Figure 10: The age of the telephone



Source : Deutsche Bank

2. Rise of the machines

The first wave of electronic trading in FX markets primarily affected the inter-dealer market, replacing phone-based trading with computer systems while leaving the dealer-client relationship unchanged. Here, we first discuss the main innovations in the inter-dealer market and then move on to the dealer-client segment.

(a) Electronification of inter-dealer market

Two major innovations in the trading process facilitated by technological advances led to major transformations in the inter-dealer market. They are:

- The **introduction of electronic brokers**, Reuters/Refinitiv (now LSEG) and EBS, in the early 1990s brought a centralized, anonymous limit order book to FX trading, similar to equity market exchanges. This increased the efficiency of price discovery and inventory risk management. These two platforms are still considered primary trading venues.
- Large banks increasingly **internalized trades** (settling within their own books) in the early to mid-2000s. This reduced their need to manage inventory risk through inter-dealer platforms. [Figure 11](#) demonstrates this shift in FX market dynamics, showing a decline in dealer-reported spot trading from roughly 70% in the 1990s to 40% recently. For the largest dealers, internalization now accounts for an estimated 80% or more of major currency pair trades (Moore et al., 2016; Schrimpf and Sushko, 2019).

The two innovations (electronic brokers and trade internalisation) primarily impacted the inter-dealer market, improving efficiency and narrowing bid-ask spreads (King et. al, 2012). Thus, resulting in a more efficient inventory risk management ([Figure 12](#)).

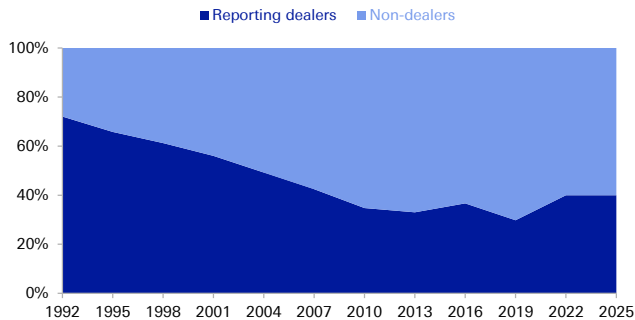
The benefits of electronification were not limited to the trading process. It also helped FX markets address **settlement risk** in the late 1990s. **Settlement risk (a form of credit risk)**, also known as "Herstatt risk," arose due to cross-border currency transfers being limited by central bank operating hours. This created a window where one party to a transaction could default after the other had already settled.

Settlement risk posed a significant challenge. The potential for a default after one leg of an FX transaction had settled created a substantial credit exposure for banks. This exposure could be particularly large for major dealers, where transactions with



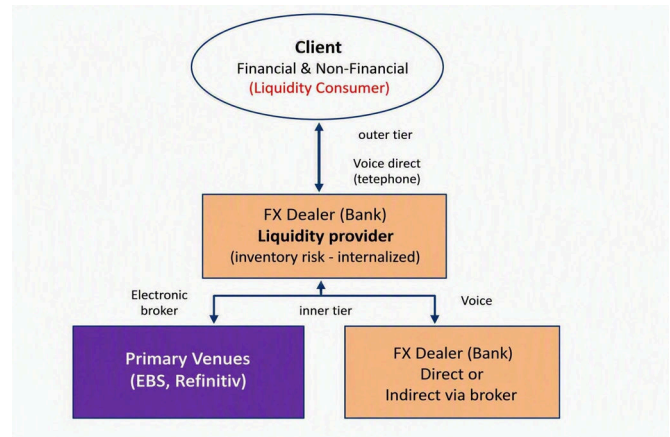
even a single counterparty could exceed the bank's capital.

Figure 11: Drop in dealer share of spot trading as a result of internalization



Source : Deutsche Bank, BIS Triennial Survey

Figure 12: Rise of the machines Part I – electrification of the inter-dealer



Source : Deutsche Bank

To address this, a group of banks developed a new electronic settlement system – the **Continuous Linked Settlement (CLS) Bank**, which began operating in 2002. CLS mitigates settlement risk by simultaneously settling both sides of a trade and by netting payments between member banks.

This netting process drastically reduces the actual funds transferred for settlement to just 4% of the total traded value. *More than \$14 trillion in gross financial obligations were settled on an average day in April 2025, with just over one-third (36%) settled through PvP systems, predominantly CLS, eliminating FX settlement risk for those transactions.*

(b) Electrification of the dealer-client segment

Electronic trading in the inter-dealer market increased efficiency and narrowed bid-ask spreads within that market. However, the dealer-client segment remained largely unchanged, and did not experience the same efficiency gains and reduced bid-ask spreads as the inter-dealer market. This resulted in a surge of new electronic trading platforms specifically designed for clients.

With the electrification of the FX market, new liquidity providers emerged, aiming to reduce market-related liquidity risk and reshape the trading landscape. These new players, enabled by technological advancements, include:

1. Multi-dealer platforms (MDP), emerging in the early 2000s, allowed clients to request for quotes (RFQs) from multiple dealers at once. This streamlined the price discovery process, enabling clients to compare pricing from various dealers through a single platform rather than individual phone calls. The increased competition and transparency benefited clients. Example of MDPs include but are



not limited to FXconnect, FXall, 360T.

2. Single dealer platforms (SDP): Many banks developed their own single-dealer platforms (SDPs) to facilitate direct electronic trading with clients. These SDPs largely replaced older communication methods such as telephone and telex for bilateral trading. Examples include J.P. Morgan eXecute, UBS Neo, and Citi Velocity.

Financial and non-financial consumers of FX (liquidity consumers) can access both multi-dealer platforms (MDPs) and single-dealer platforms (SDPs) for liquidity. Both platform types operate using a request for quote (RFQ) execution protocol and full pre-trade identity disclosure.

A key distinction, however, is that MDPs primarily facilitate connections between liquidity consumers (e.g., asset managers, hedge funds, corporations) and liquidity providers (mainly banks). They do not bear the risk of inventory imbalances stemming from client trades. Conversely, SDPs are integrated within individual bank infrastructures and, consequently, are part of the bank's broader risk management function.

3. Prime-brokerage: The emergence of prime brokerage (PB) arrangements in the late 1990s marked a significant shift in FX market structure, allowing clients such as hedge funds to access the inter-dealer market directly or through electronic brokers. Under a prime-brokerage arrangement, a large bank effectively lends its credit standing and trading relationships to a client—typically a hedge fund, asset manager or other active non-bank institution. Rather than having to establish separate bilateral credit lines and trading documentation with every dealer it wishes to face, the client establishes a primary credit relationship with a single prime broker. The prime broker sets trading limits, monitors the client's exposures, requires collateral or margin where appropriate and charges a fee, typically linked to trading volume and the amount of credit consumed.

Request for Quote (RFQ): It's a request from a liquidity consumer to a liquidity provider (like a bank) asking for the price at which they are willing to buy or sell a specific currency pair. The RFQ will typically specify the currency pair, the amount to be exchanged, and potentially the desired settlement date. The FX provider then responds with a quote, which includes the exchange rate they are offering.

This structure allows hedge funds to access liquidity that was historically available mainly to banks in the interdealer market. A hedge fund can execute an FX trade with one of many approved dealing banks, or through an electronic venue linking multiple dealers, using the credit of its prime broker. The executing dealer therefore does not need to extend a separate bilateral credit line to the hedge fund itself: subject to pre-agreed limits, it accepts the prime broker as the ultimate credit counterparty. Once the client executes the trade, it is "given up" to the prime broker. In legal and settlement terms, the transaction is generally transformed into two matching trades: one between the executing dealer and the prime broker, and another between the prime broker and the hedge fund client. The prime broker consequently stands between the client and the wider dealer network from a credit perspective, even though it need not be involved in choosing the price or executing the original trade.

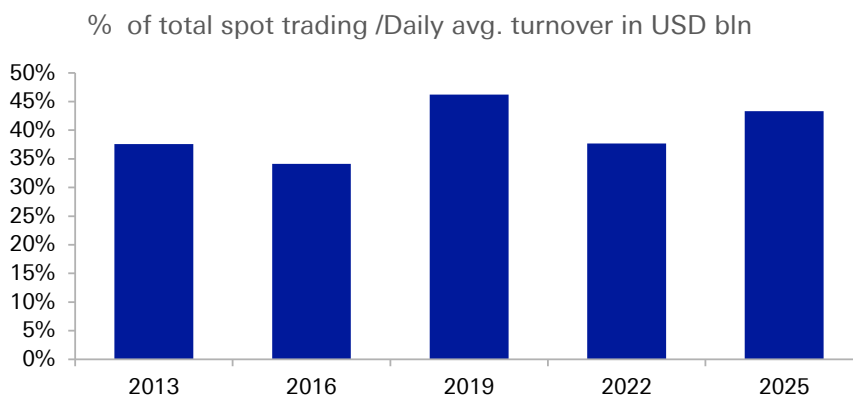
Prime brokerage therefore separates execution from credit provision. A hedge fund can seek the best price across many banks and electronic liquidity pools while concentrating its credit, collateral and settlement relationship with one or a small number of prime brokers. Before PB became widespread, a hedge fund's ability to trade with a dealer depended much more directly on whether that dealer was willing to establish a bilateral credit relationship with it, limiting the number of counterparties it could access and often preventing it from trading on the same electronic venues or at the same prices as large banks. PB substantially lowered this



barrier and helped non-bank institutions become much more active participants in what had previously been a predominantly bank-to-bank market.

Prime brokerage also generates important operational and balance-sheet efficiencies. Because trades with multiple executing dealers are ultimately consolidated at the prime broker, clients can net exposures across counterparties, reducing the amount of collateral and settlement infrastructure required. PB arrangements also facilitate access to a wider range of liquidity providers—including smaller and specialist banks—and support automated trade matching, confirmation and straight-through processing. At the same time, the prime broker assumes significant counterparty and operational risk: it is responsible to executing dealers for trades conducted under its name and must therefore impose credit limits and monitor the client's positions, leverage and trading activity in real time. Prime brokerage thus does not eliminate credit risk; rather, it centralises it at the prime broker while allowing execution to be dispersed across the wider market. Today, a substantial share of spot FX trading is conducted through prime brokerage arrangements ([Figure 13](#)).

Figure 13: Around 40% of total spot trading is done via prime brokerage



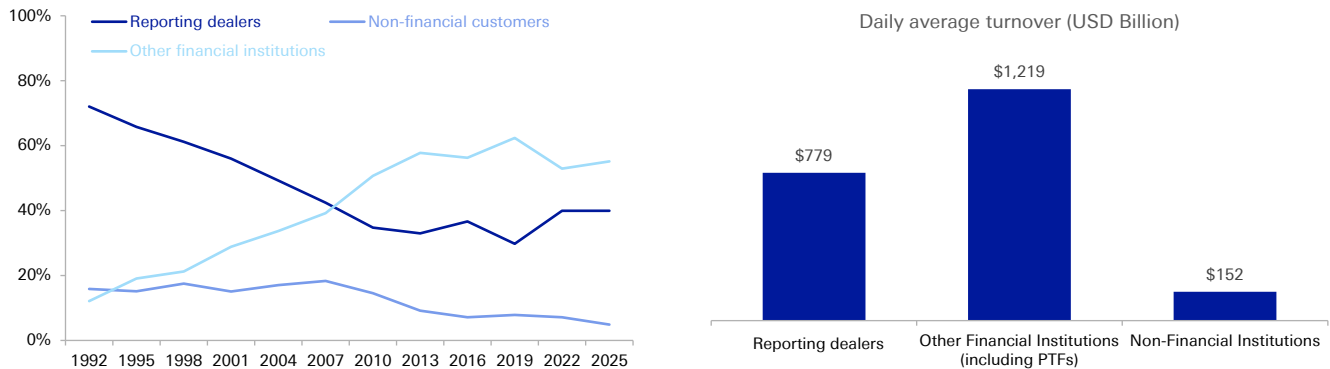
Source : Deutsche Bank, BIS Triennial Survey

4. Principal trading firms (non-bank dealers): Traditionally, banks acted as the primary dealers, or liquidity providers, in the decentralised OTC FX market. However, prime brokerage facilitated client access to primary FX trading venues (EBS/Reuters). This allowed principal trading firms (PTFs), such as XTX Markets and Citadel Securities, to leverage their technological capabilities for electronic market-making, becoming key liquidity providers and serving a wide range of clients, from regional banks to institutional investors.

While Principal Trading Firms (PTFs) are key FX market liquidity providers, they also engage in proprietary trading (investing, hedging, speculating) including high-frequency trading (HFT). HFT firms utilise sophisticated algorithms to execute a large number of rapid trades, often holding positions for extremely short durations. In this capacity, some PTF firms also act as liquidity consumers. This dual role has contributed to the growth of algorithmic traders in FX, impacting inter-dealer trading and the rise of other financial institutions' trading, as noted by BIS Triennial Surveys ([Figure 14](#)).



Figure 14: Increase in financial institution spot trading due to the emergence of principal trading firms (algorithmic firms)



Source : Deutsche Bank, BIS Triennial Survey

5. Electronic communication networks (ECNs): While prime brokerage has facilitated client access to primary FX trading venues (EBS/Reuters), numerous secondary venues, such as Currenex and LMAX, have also emerged as a result of competition driven by technological advances. This has enabled clients (non-banks) to both provide and consume liquidity through limit orders or RFS/RFO model.

Beyond these venues, futures exchanges and dark pools are other alternative liquidity sources. Exchanges utilise centralized limit order books with standardised products, while dark pools operate with hidden order books, matching buy and sell interest at a venue-calculated midpoint. BGC MidFX and FXSpotStream(FSS) MidMatch are prominent examples of FX dark pools.

The rise of secondary and alternative trading venues has also changed how banks manage inventory risk. Banks also utilise multiple venues for hedging client trades. Crucially, the inter-dealer market is no longer exclusive to banks; some clients now also provide liquidity through primary, secondary, and alternative venues.

1.5.2 Execution styles: voices versus electronic trading

This section explores the various FX execution styles, adhering to the Bank for International Settlements (BIS) definitions for the dealer-client segment and the inter-dealer segment.

Outer tier: Dealer-client segment

The two main styles of execution in the dealer-client (outer tier) segment are: Voice and Electronic (BIS Triennial Survey). Each of these can further be classified as direct or indirect. As per BIS, they are defined as follows:

1. Voice-direct (telephone): Trades originated in person, by phone, by telefax or through general messaging systems (eg Outlook, Gmail or Yahoo mail) regardless of how trades are subsequently matched, and not intermediated by a third party.

A Request for Stream (RFS) allows a liquidity consumer to receive a continuous flow of quotes for a specified size and duration, such as a trading day. This functions as a continuous Request for Quote (RFQ), providing real-time price updates for the desired transaction.



2. Voice-indirect (prime-broker): Trade agreed by a voice method and intermediated by a third party (eg a voice broker).
3. Electronic-direct (SDP): Trades executed via an electronic trading system, not intermediated by a third party. These include transactions originated through specific messaging systems that are part of trading platforms. This covers single dealer platforms. It also includes direct API streams: Bloomberg Chat.
4. Electronic-indirect (MDP/ECN): Trades executed via an electronic medium, a third party electronic platform (eg via a matching system). Here, we have multiple platforms that stream prices (RFS/RFO), run a central limit order book, or matching buy and sell interest at a venue-calculated midpoint. [Figure 15](#) highlights the different platforms available where multi dealer platforms are primary RFS/RFO focussed while ECNs do both live streaming and matching.

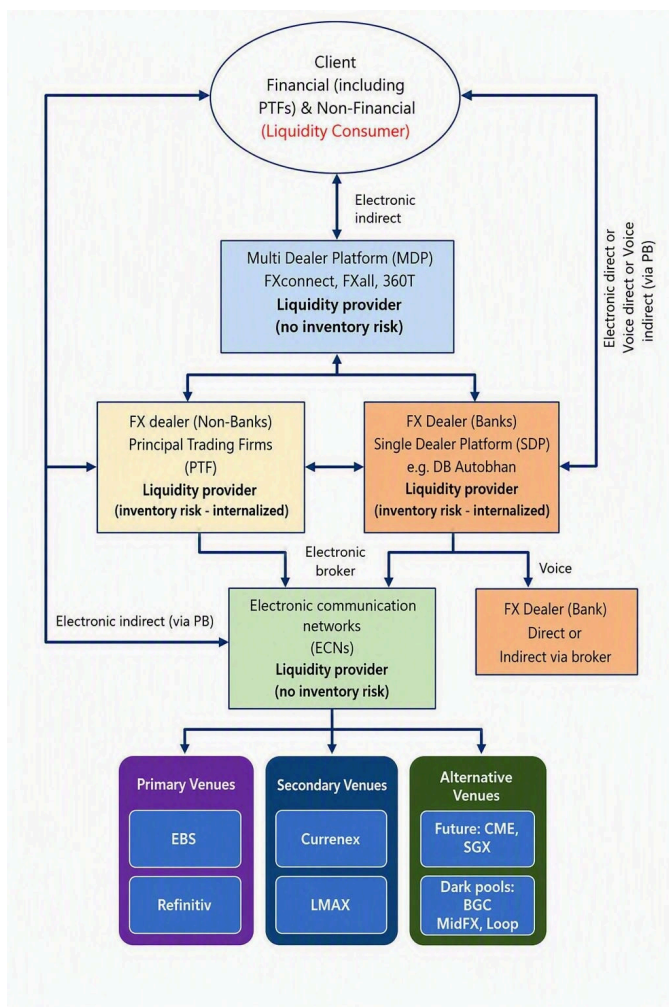
A Request for Stream (RFS) allows a liquidity consumer to receive a continuous flow of quotes for a specified size and duration, such as a trading day. This functions as a continuous Request for Quote (RFQ), providing real-time price updates for the desired transaction.

Single dealer platform (SDP): Bank developed single-dealer platforms (SDPs) to facilitate direct electronic trading with clients.

Multi-dealer platform (MDP): Allows clients to request quotes (RFQs) from multiple dealers at once. Example of MDPs include but not limited to FXconnect, FXall, 360T.

Electronic Communication Network (ECN): Primary, secondary and alternative trading venues are collectively referred to as ECN.

Figure 15: Rise of the machines Part II – electronification of dealer-client segment – current market structure



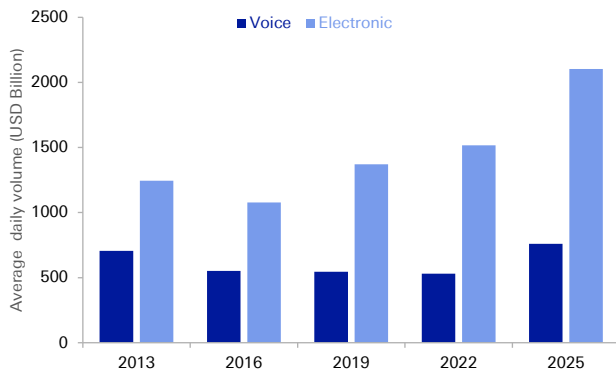
Source : Deutsche Bank

[Figure 16](#) highlights the impact of electronification on FX markets, revealing a



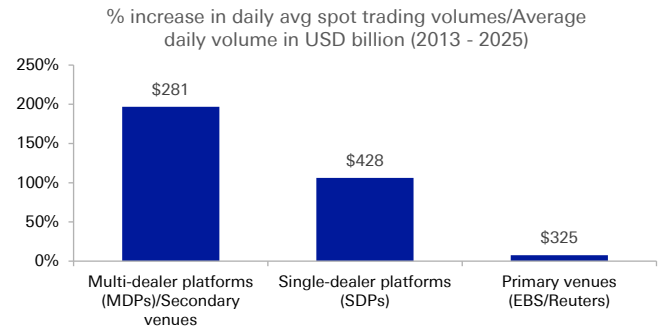
substantial increase in electronic trading in recent years. Notably, the growth of third-party venues has significantly outpaced that of single-bank dealer platforms (Figure 17). These third-party venues provide price streaming aggregation technology and typically charge a pre-trade brokerage fee to liquidity providers.

Figure 16: Share of FX spot trading using electronic methods has been on the rise



Source :Deutsche Bank, BIS Triennial Survey

Figure 17: More than 100% growth in e-spot trading via third party intermediaries (MDPs/Secondary Venues)



Source :Deutsche Bank, BIS Triennial Survey

Inner tier: Inter-dealer segment

For trades that are not internalized (settled across own books), dealers can choose between voice or electronic trading to manage remaining inventory. While traditionally relying on primary venues like EBS/Reuters, they now also have the option of hedging through secondary or alternative venues. This expanded choice, along with increased internalisation, contributes to the observed decline in inter-dealer platform activity (Figure 17).

1.5.3 Trading Venues: Anonymity and Liquidity

Different trading venues can be distinguished based on their offerings in terms of two key characteristics: pre-trade anonymity and liquidity firmness (Chaboud et al., 2023). Pre-trade anonymity refers to the degree to which counterparties remain unknown to each other before a trade is executed. Liquidity firmness, on the other hand, describes the certainty of execution at a quoted price.

Pre-trade anonymity: The level of anonymity can range from fully disclosed to fully anonymous. Multi-dealer platforms (MDPs), acting as aggregators of dealer liquidity, typically operate on a fully disclosed basis. Clients, both financial institutions and corporations, submit requests for quote (RFQs) via the platform to multiple dealers, revealing their identity before trade execution. Similarly, bank-owned single-dealer platforms also function with full disclosure, as the bank dealer knows the identity of the client submitting the RFQ.

At the other end, primary venues running a centralized limit order book (such as EBS/Reuters) generally operate on a fully anonymous basis. The displayed orders do not show a source and all participants can be matched based on the typical price and time priority rules of a CLOB. However, it is important to note that unlike exchanges, this still preserves bilateral relationship of an OTC market structure



since only those that have established bilateral credit relationships, either directly or via their PBs can participate on such venues. Exchange venues, on the other hand, provide the highest possible level of pre-trade (and post-trade) anonymity, basically by definition, as the exchange is the counterparty to each trade.

This anonymity stems from the exchange acting as the central counterparty to every trade, effectively shielding the identities of the ultimate buyers and sellers. This characteristic distinguishes exchange-based trading from other FX venues and contributes to a distinct trading environment.

Secondary FX trading venues occupy a middle ground between the full disclosure of MDPs/SDPs and the complete anonymity of primary venues/exchanges. They offer partial pre-trade disclosure, often employing "tags" to identify counterparties based on specific characteristics or trading styles. This allows participants to select counterparties based on factors like execution quality, creating a tiered system of interaction.

Liquidity firmness: The firmness of liquidity in FX trading, meaning the certainty of execution at a quoted price, is significantly influenced by the practice of "last look." This practice allows liquidity providers (LPs) a brief window, typically milliseconds, to review a trade request before accepting or rejecting it (Oomen, 2016; Cartea, Jaimungal, and Walton, 2019).

Last look was initially developed to address challenges posed by network latencies, platform multiplicity, and varying technological sophistication among market participants. Its acceptable use includes near-instantaneous checks for credit availability and price validity. However, more controversial applications involve imposing additional hold times before trade confirmation.

Liquidity on primary venues is generally considered firm, as last look is prohibited. Conversely, last look is widely employed on secondary venues and universally available on MDPs and SDPs, where LPs retain the option to use it. Consequently, liquidity on these platforms is viewed as less firm, introducing uncertainty regarding trade execution upon hitting a quoted price.

1.5.4 Current market structure challenges

The adoption of electronic trading has generally enhanced FX market quality. Benefits include increased pre-trade transparency, improved operational efficiency through electronic clearing and settlement, and tighter bid-ask spreads and lower intraday volatility in the spot market.

[Figure 18](#) and [Figure 19](#), which track G10 FX high-frequency realized volatility and top-of-the-book spreads respectively, both calculated using one-minute mid-price changes, indicate a downward trend in these metrics. This suggests an improvement in FX market quality over time. The sustained decrease in spreads over time reflects intensified competition for client business in the FX market. The proliferation of trading venues has fostered a competitive environment among liquidity providers, driving them towards consistently narrower, approaching zero, spreads.

A Request for Stream (RFS) allows a liquidity consumer to receive a continuous flow of quotes for a specified size and duration, such as a trading day. This functions as a continuous Request for Quote (RFQ), providing real-time price updates for the desired transaction.

Single dealer platform (SDP): Bank developed single-dealer platforms (SDPs) to facilitate direct electronic trading with clients.

Multi-dealer platform (MDP): Allows clients to request quotes (RFQs) from multiple dealers at once. Example of MDPs include but not limited to FXconnect, FXall, 360T.

Centralised limit order book (CLOB): It is a centralised electronic trading platform used to match buy and sell orders.

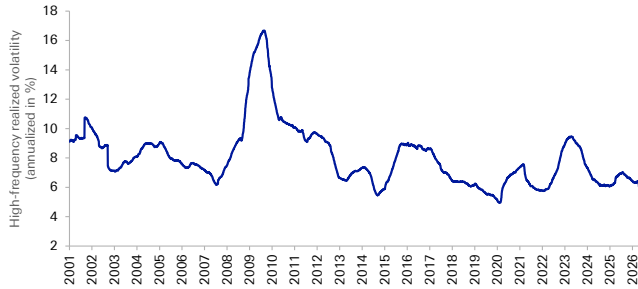
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Last look: This practice allows liquidity providers (LPs) a brief window, typically milliseconds, to review a trade request before accepting or rejecting it.

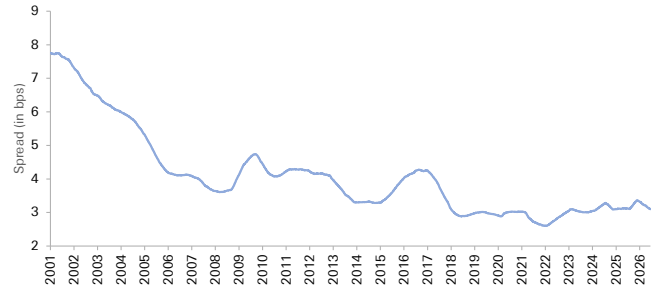


Figure 18: High-frequency G10 FX vol has fallen over time



Source : Deutsche Bank, Reuters. Daily HF realised vol= square root of sum of squared intraday price changes. Annual vol= Daily vol * sqrt(252)

Figure 19: Top of the book spread has also fallen over time



Source : Deutsche Bank, Reuters
Spread=(Ask-Bid)/(Ask+Mid)/2

However, the current structure is not without its flaws. We highlight a few key areas of research for our future publications.

The FX Liquidity Mirage: Myth or Reality?

The fragmentation of the FX market, driven by the decline of inter-dealer electronic brokerage and the rise of diverse trading venues, particularly in the dealer-to-customer segment, presents significant challenges for liquidity assessment. The proliferation of platforms can create a deceptive appearance of increased liquidity, a "liquidity mirage," as the same liquidity might be reflected across multiple interconnected venues. Executing a trade on one platform can trigger a simultaneous reduction in liquidity on others, leading to an overestimation of available liquidity when simply aggregating displayed market depth.

Further, accessing liquidity across this fragmented landscape can be technologically challenging and costly due to latency issues and access fees. While aggregated depth might suggest the feasibility of executing a large order, attempting to do so could significantly impact prices as liquidity is tapped across various platforms.

Accurately measuring FX liquidity requires a more sophisticated approach than simply aggregating depth. Metrics like effective spreads (inclusive of slippage and fees) and price impact offer a more realistic representation of transaction costs and market depth. Analysing volume distribution across venues can help identify concentrations of genuine liquidity, but practical constraints such as technological limitations and access fees must also be factored into the assessment.

Electronification of markets and flash crashes

The increasing attention given to flash crashes in recent years has coincided with the electronification of financial markets. Computer algorithms are now used to automatically make trading decisions, submit orders, and manage those orders after submission. Algorithmic trading (AT) now contributes to more than 70% of trading volumes in equity and FX markets (Hendershott, 2012 and BIS, 2018). Recent flash crashes have triggered an important policy debate over the merits of algorithmic trading in financial markets. As argued in Deutsche Bank research (Glover et al., 2019), establishing a direct link between flash crashes and electronification is far from straightforward. First, there is no universal agreement

Algorithmic trading: Automated transactions where a computer algorithm decides the order-submission strategy.



on what constitutes a flash crash event, though recently Christensen et al. (2017) have made some important contributions on this topic. Second, limited high-frequency data makes it difficult to identify flash crash events going back in time, in turn making it difficult to compare the frequency of such events with changes in market structure. Third, there is a risk of confounding the presence of flash crashes and market electrification. Market automation allows trading to take place during highly illiquid hours with limited human presence, raising the question of whether flash crashes as a phenomenon are in any case only possible due to the electrified nature of the market - the alternative in previous eras being a complete market breakdown where no trades took place.

New intermediaries and Bank dealers: Disruption or Evolution?

Changes in the composition of market intermediaries in the FX spot market also raise interesting research questions.

1. Third party multi-dealer platforms: Multi-dealer platforms (MDPs) offer price aggregation technology and charge liquidity providers a pre-trade brokerage fee, enabling clients to access liquidity from multiple dealers. However, MDPs do not assume inventory risk. Increased competition among dealers, driven in part by MDPs, has compressed spreads, reducing bank dealer profit margins. This presents a challenge for banks, who face declining profits while still incurring MDP brokerage fees and bearing inventory risk from client trades executed through these platforms. Thus, potentially reducing the bank's risk-taking capacity.

2. Non-bank firms: Bank dealers now face competition from principal trading firms (PTFs) in providing FX liquidity. These lightly capitalised, non-bank PTFs leverage speed and cross-asset correlations to manage their risk. The rise of multiple trading venues, in contrast to the pre-electrification era where banks primarily relied on platforms like EBS/Reuters for inventory management, adds another layer of complexity. This fragmentation makes it challenging for banks to discern true liquidity from the "liquidity mirage" of aggregated, but potentially inaccessible, depth across various platforms.

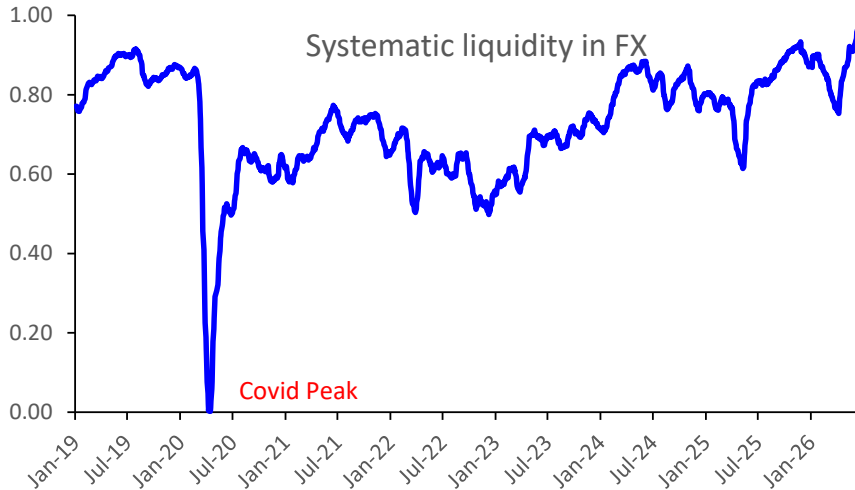
Has the risk-bearing capacity of FX market intermediaries, in total, changed as a result of (1) and (2)? Has this affected market volatility or the frequency of flash events?

Multi-dealer platform (MDP): Allows clients to request quotes (RFQs) from multiple dealers at once. Example of MDPs include but not limited to FXconnect, FXall, 360T.

For example, during the initial stages of the Covid crisis in March 2020 ([Figure 20](#)), top of the book bid-ask spreads in the FX market widened significantly. For instance, the spread for USD/JPY doubled from 1 basis point (bp) to 2 bps, while the spread for GBP/USD increased from 1.5 bps to 3 bps over a 10-day period see [Grover, \(2020\)](#).



Figure 20: FX liquidity dropped significantly during Covid Peak (March 2020)



Source : Deutsche Bank

Systematic FX Liquidity is computed as scaled first principal component of Z-scores across measures and currencies. Here, liquidity measures include but not limited to top of book spreads, order book depth, price impact etc. A higher score implies higher liquidity. For more details, please see [FX Liquidity Snapshot: Introducing the DB FX liquidity monitor](#)

New intermediaries: Is FX Price Discovery Broken?

FX market fragmentation raises key questions about price discovery. Have primary CLOBs, despite lower trading volumes, retained their central role? Or has it shifted, potentially to futures markets, given the smaller CLOB size and the increased influence of PTFs using futures-based spot pricing? Analysing latency, order flow, market impact, and correlations across venues is crucial to understanding price discovery in this evolving landscape.

Clearing in FX: Balancing Benefits and Risks in the Modern Market

Regulations like the Standardised Approach for Counterparty Credit Risk (SA-CCR) and the Uncleared Margin Rules (UMR) are increasing capital and margin requirements for non-cleared FX derivatives, making bilateral trading more costly and complex. This is driving some market participants to consider clearing a portion of their FX exposure through CCPs.

Besides exchange-based clearing for standardised FX products using CLOBs, initiatives are emerging to facilitate clearing for bilateral trades like block trades and Exchange For Physical (EFPs). Block trades allow private negotiation of FX futures/options with later clearing house reporting, subject to size/time thresholds. EFPs enable migration of OTC FX exposures to cleared positions, enhancing risk management, operational efficiency, and access to diverse liquidity pools. These initiatives broaden the scope of FX clearing. For more details, please see [Grover \(2025\)](#).

The potential advantages of increased FX clearing include enhanced operational efficiency, potential margin benefits compared to some bilateral arrangements under SA-CCR, expanded counterparty access, and regulatory support. However, drawbacks remain, including increased clearing fees, reduced flexibility in trade

Multi-dealer platform (MDP): Allows clients to request quotes (RFQs) from multiple dealers at once. Example of MDPs include, but not limited to FXconnect, FXall, 360T.

Centralized limit order book (CLOB): It is a centralised electronic trading platform used to match buy and sell orders.

Central Counterparty (CCP): It is a financial market infrastructure that reduces bilateral counterparty risk by acting as the intermediary to both sides of a trade and managing the resulting credit exposure through collateral and default-management mechanisms.

CLS is an independent multi-currency settlement system for FX transactions.



execution and settlement, potential market fragmentation from diverse clearing venues, and the operational challenges of adapting to new technologies and processes. The future of FX clearing depends on the evolving balance between these advantages and disadvantages.

Is FX Settlement Still a Concern?

Settlement risk (Herstatt risk) is the risk of paying out a currency in an FX transaction without receiving the purchased currency. This arises from separate payments in different currencies, often settling across time zones. PvP (Payment versus Payment) mitigates this risk by ensuring simultaneous currency exchange, eliminating the possibility of one party paying while the other defaults. PvP is crucial for FX transactions, especially those settling across time zones, where settlement failures are more likely. CLS operates a PvP settlement service for eligible FX transactions. However, not all FX trades settle through CLS. CLS settlement is not universal due to currency eligibility (not all currencies are included), cost (membership and transaction fees), operational requirements, the availability of alternative methods (like bilateral netting), and internal settlement of intra-group transactions.



Introduction

Exchange rates are famously difficult to forecast. Why can currencies move sharply when macroeconomic fundamentals appear unchanged? Why do apparently compelling exchange-rate models so often fail out of sample? This chapter provides an overview of FX drivers over the short, medium, and long-run horizon. We rely on academic evidence, Deutsche Bank research and practitioner experience to show that while there is no single, universally reliable model of exchange-rate determination, there is a compelling set of frameworks and drivers that can help explain and forecast exchange rate movements over time.

2.1 Why the efficient market hypothesis breaks down in FX

As the world's largest and most liquid financial market, foreign exchange is often regarded as a particularly strong candidate for satisfying the efficient market hypothesis. This states that the current exchange rate fully reflects all publicly available information and it should not be possible to use that information systematically to earn abnormal risk-adjusted profits. In his seminal paper Fama (1970) identified three conditions that would be sufficient to ensure market efficiency:

(a) there are no transaction costs;

(b) all available information is freely available to all market participants; and

(c) all participants agree on the implications of that information for current prices and the underlying model of the economy.

Omitted from these conditions is, however, a fourth and critically important one that is only left implicit in Fama's paper:



(d) a sufficient number of market participants are profit-seeking and are able to move the market rapidly to equilibrium valuations.

FX market structure itself provides perhaps the most compelling reason why the mechanism supporting market efficiency in FX may be significantly weaker than is commonly assumed. Earlier in this book we presented evidence from several sources suggesting that FX turnover is divided roughly evenly between transactions motivated by profit and transactions undertaken for commercial, hedging, institutional or policy purposes. Moreover, with the expansion of passive investment and the increasing importance of regulatory, mandate and balance sheet constraints, the relative importance of unconstrained, return-seeking risk capital may be declining.

A high share of non-profit-motivated or price-insensitive demand has important implications. If transactional flows are large relative to the capital available to arbitrageurs, prices may then reflect not only expectations of future fundamentals, but also hedging demand, corporate cash flows, reserve-management decisions, benchmark rebalancing, regulation and the balance sheet capacity of intermediaries. These forces will generate persistent deviations from conventional measures of fundamental value and predictable returns as compensation for providing liquidity and bearing inventory or balance sheet risk.

Note that the market inefficiency argument does not require non-speculative participants to be irrational or poorly informed. It rests on the simpler observation that, unlike equities and bonds, currencies are required to complete a broad range of underlying economic transactions unrelated to FX profit-seeking. Other participants may seek to maximise returns but be constrained by leverage limits, risk budgets, benchmarks, regulation or investment mandates. The presence of such participants weakens the practical arbitrage mechanism through which information is presumed to be incorporated into prices. Where non-profit-motivated flows are large and the capital of informed speculators is limited, exchange-rate determination is likely to depend on a broader and more distinctive set of forces than in traditional asset markets.

2.2 Underlying principles of exchange rate determination

First, like all asset prices, the exchange rate is forward-looking: today's level embeds expectations about the entire future path of fundamentals and of risk premia. Engel and West (2005) formalised this, showing that in a rational-expectations present-value model when fundamentals are shifting over time the exchange rate will behave almost exactly like a random walk under certain conditions. This is not because fundamentals are irrelevant, but because the exchange rate optimally aggregates expected future fundamentals. This reconciles the empirical failure of fundamentals to *forecast* currencies with the belief that currencies are ultimately driven by fundamentals.

Second, exchange rates are not purely driven by macroeconomic but also financial drivers. In the traditional academic paradigm, the exchange rate equilibrated goods and money markets. In the modern paradigm, it is set at the margin by financial intermediaries and investors operating in imperfect, segmented capital markets subject to balance sheet constraints and time-varying risk-bearing capacity. This shift, associated with Gabaix and Maggiori (2015), Itskhoki and Mukhin (2021), Jiang, Krishnamurthy and Lustig (2021) and the broader intermediary-asset-pricing literature explains not only long-standing "puzzles" of exchange-rate determination but also begins to explain phenomena like the cross-currency basis.



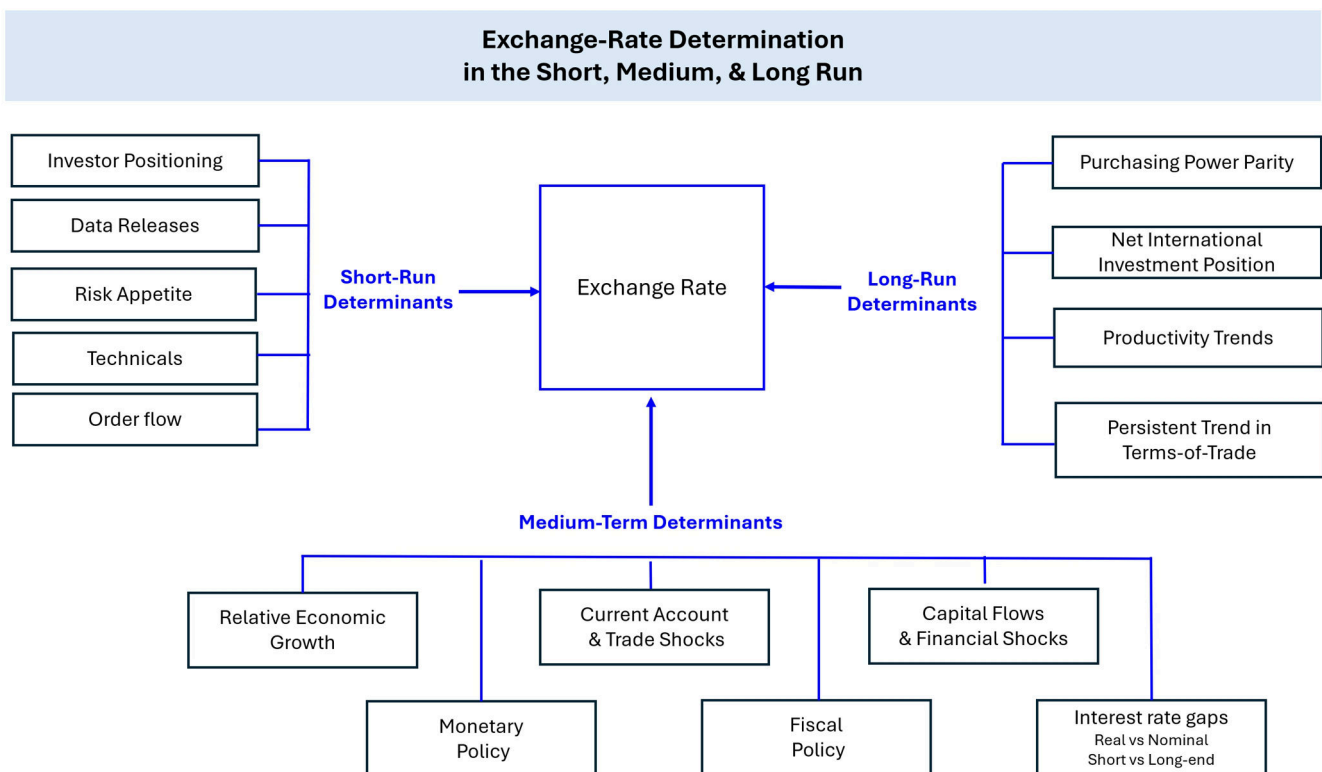
2.3 Time horizons of exchange rate determination

Predicting exchange rates is famously difficult. A helpful organising principle, and the one that structures the remainder of this chapter, is to think about exchange rate determination across three horizons:

- In the **short run** (intraday to a few weeks), exchange rates are dominated by order flow, positioning, sentiment, risk appetite, data releases and technical/trend-following behaviour.
- In the **medium run** (months to a couple of years), cyclical macro forces — interest rate differentials, the monetary policy cycle, relative growth, the current account and capital flows pull currencies around their long-run anchors.
- In the **long run** (several years and beyond), fundamentals reassert themselves: relative prices (PPP), productivity (Balassa-Samuelson), terms of trade, and net international investment positions shape the equilibrium real exchange rate.

In the next few sections we will proceed by horizon and by mechanism. We begin with the long-run anchors (PPP, productivity, terms of trade, external balances and equilibrium-exchange-rate concepts), then turn to the medium-run parity conditions and macro models, then to the short-run microstructure of the market (order flow, positioning, options and technical analysis). We then review forecasting performance tests, before moving on to modern financial theories of the exchange rate, central bank intervention, currency regimes and crises, and finally a set of frontier topics — machine learning and digital currencies.

Figure 21: Overview of Exchange Rate Determination



Source : Deutsche Bank



2.4 Purchasing Power Parity and the long-run real exchange rate

The concept

Purchasing power parity is the oldest and most intuitive theory of the exchange rate.

- *Absolute* PPP says that once converted into a common currency, a representative basket of goods should cost the same everywhere; the nominal exchange rate should equal the ratio of national price levels. This absolute PPP form has little empirical support for reasons discussed later.
- *Relative* PPP says that the change in the exchange rate should offset the difference in inflation rates, so that the real exchange rate (the nominal rate adjusted for relative prices) is stationary and mean-reverting around a constant.

The real exchange rate can be written simply as:

$$q = s + p^* - p$$

Where s is the nominal exchange rate (domestic price of foreign currency, in logs), p is the domestic price level and p^* the foreign price level. PPP holds in the long run if q reverts to a constant mean.

The PPP puzzle and the half-life debate

The central empirical problem, crystallised by Rogoff (1996) as the "PPP puzzle", is FX deviations from PPP are highly persistent and volatile. In Rogoff's (1996, p. 648) own words, "consensus estimates for the rate at which PPP deviations damp... suggest a half-life of three to five years, seemingly far too long to be explained by nominal rigidities." Such slow reversion is very hard to reconcile with nominal price stickiness that lasts one to two years; something other than sticky goods prices must be driving the persistence.

The survey by Taylor and Taylor (2004, Journal of Economic Perspectives) documents how the profession's view on PPP has evolved, concluding that by the early 2000s "the idea of long-run PPP now enjoys perhaps its strongest support in more than thirty years." Two methodological advances drove this:

1. Panel and long-horizon data greatly increased the power to reject the random-walk hypothesis and detect mean reversion.
2. More importantly, nonlinear mean reversion modelling is used: because arbitrage in goods markets is subject to transaction costs, trade barriers and large non-traded sectors, the real exchange rate reverts faster the further it is from equilibrium, and can wander almost freely within a "band of inaction". Once nonlinearity is modelled, estimated half-lives fall and PPP reversion looks far more consistent with economic theory. The more recent survey by Vo and Vo (2023, Journal of Economic Surveys) confirms the long-run validity of PPP and a 3-5 year half-life.

Practical implications and DB house research

For investors, the operational lesson is that PPP is a poor timing tool but a powerful valuation anchor. Deviations can persist for years, an overvalued currency can become more overvalued, but they do eventually correct, and the correction is exploitable if the holding period is long enough. This is precisely what Deutsche

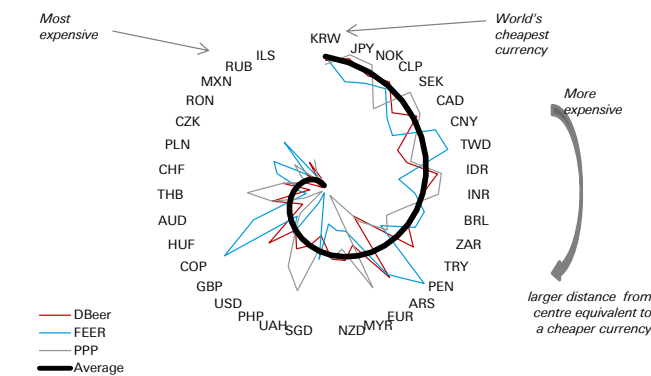


Bank's own back-testing confirms.

[Grover \(2025\)](#), in a study of long-term FX value investing, finds that PPP-based valuation signals generate economically significant mean-reversion signals whose performance improves as the holding period lengthens, peaking at around 24 months - consistent with a PPP misalignment half-life in excess of two years, echoing Lothian and Taylor (2000), Ricci et al. (2013) and [Winkler \(2017\)](#).

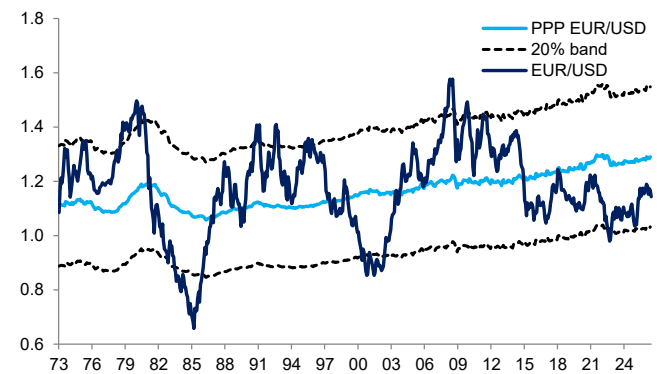
A cross-sectional portfolio that goes long the most undervalued and short the most overvalued currencies on a 12-month hold delivers a Sharpe ratio of 0.60 on the PPP signal after costs, with PPP working best in G10. Volatility-adjusted valuation signals outperform simple sign-based signals, particularly in G10. Notably, [Grover \(2025\)](#) also finds that valuation models underperformed over the two years to early 2025, especially in G10, plausibly because cyclical drivers and extreme macro divergence (aggressive and desynchronised hiking cycles) dominated valuation over that window, a reminder that valuation is a long-horizon strategy that can suffer extended drawdowns.

Figure 22: Valuations ranked



Source : Haver Analytics, Deutsche Bank

Figure 23: EURUSD versus PPP



Source : Refinitiv Workspace Datastream, Deutsche Bank Research

Relative PPP does not imply that real exchange rates must remain constant over all horizons. Even when nominal exchange rates broadly adjust to differences in national inflation rates, equilibrium real exchange rates can drift as the relative price of domestic and foreign consumption baskets changes. Such movements may reflect persistent differences in productivity growth between tradable and non-tradable sectors, shifts in the terms of trade, changes in trade barriers and consumption preferences, pricing-to-market, or movements in international capital flows and risk premia.

Real exchange rate appreciation or depreciation should therefore not automatically be interpreted as a deviation from equilibrium or evidence against PPP; it may instead represent an adjustment in the equilibrium real exchange rate itself. The best-known explanation for such structural movements is the Balassa–Samuelson effect, to which we turn in the following section, before considering other forces that can generate persistent cross-country differences in prices and real exchange rates.



2.5 Productivity, the Balassa-Samuelson effect and terms of trade

Balassa-Samuelson

Absolute PPP based on broad consumer-price baskets fails partly because those baskets include large non-traded components (services, housing). These components cannot be arbitrated over borders. The Balassa-Samuelson (BS) hypothesis provides the classic explanation for systematic trend deviations from absolute PPP.

The logic is that countries that experience faster productivity growth in their traded-goods sector can pay higher wages there; wage equalisation across sectors pushes up wages, and hence prices, in the non-traded sector; this raises the country's overall price level and appreciates its real exchange rate. Rich, high productivity countries therefore have higher price levels and currencies that look "overvalued" on a naive PPP metric but are in fact in equilibrium. Productivity convergence should thus produce trend real appreciation in catching-up economies, or even in developed economies with different productivity rates.

The empirical record on Balassa-Samuelson (BS) is mixed. Egert, Halpern and MacDonald (2006) and the survey by Tica and Druzic (2006) document that the hypothesis has been tested dozens of times across scores of countries. They find that the evidence is strongest for the intermediate links in the mechanism: richer or more productive economies have higher relative prices, and faster tradable-sector productivity growth is often associated with rising non-tradable prices. Cross-sectional tests are overwhelmingly supportive, while panel and time-series results are more heterogeneous and sensitive to the countries, periods and econometric specifications used.

Evidence for the full proposition, that productivity differentials reliably explain aggregate real exchange-rate appreciation, is considerably weaker, in part because purchasing-power parity often fails even within the tradable sector. Productivity catch-up tends to raise relative service prices and can generate real appreciation, but its magnitude is highly uncertain and it is rarely sufficient on its own to explain observed exchange-rate movements.

Terms of trade and commodity currencies

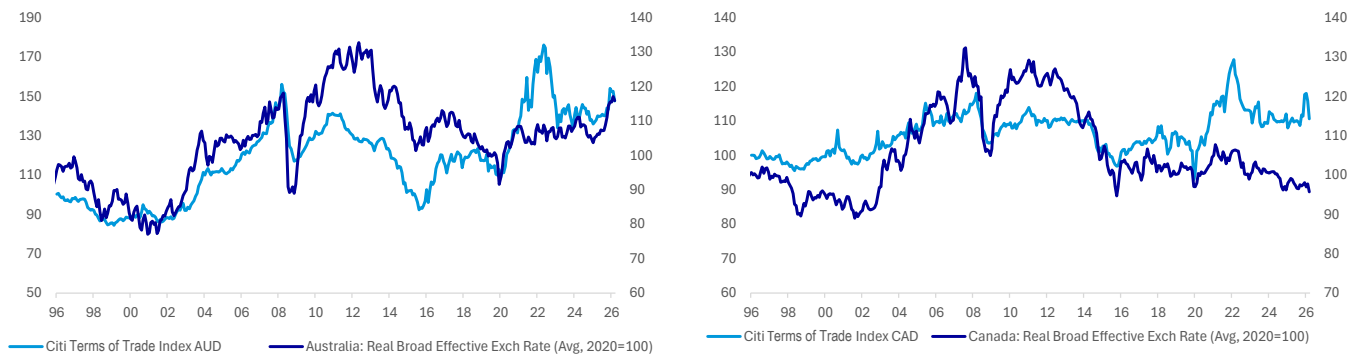
For commodity-exporting economies, the terms of trade, the price of exports relative to imports, can be a more important driver of the real exchange rate than productivity. A rise in the world price of a country's main export commodity increases the purchasing power of its exports and raises national income and wealth. Higher income increases domestic demand, including for non-tradable goods and services whose prices are determined locally. Because the prices of internationally traded goods are more tightly anchored by world markets, the resulting rise in the relative price of non-tradables produces a real exchange-rate appreciation.

This mechanism is sometimes associated with what is known as "Dutch disease". In the classic framework, a commodity boom generates a spending effect, as higher national income raises demand and prices in the non-traded sector, and potentially a resource-movement effect, as labour and capital shift toward the booming commodity sector and away from other tradable industries. Both



channels tend to raise the relative price of non-tradables and appreciate the real exchange rate. The resulting currency appreciation can in turn reduce the competitiveness of other non-commodity exporters in the country.

Figure 24: Commodity terms of trade vs. commodity-currency real exchange rates for AUD and CAD



Source : Deutsche Bank

Terms of trade commodity shocks should be distinguished from the Balassa–Samuelson effect. Balassa–Samuelson attributes real appreciation to relatively rapid productivity growth in the tradable sector: higher tradable-sector productivity raises wages, which spill over into the non-tradable sector, increasing non-tradable prices and appreciating the real exchange-rate. A commodity terms-of-trade shock can produce a similar observable outcome but originates from an improvement in export prices and national income rather than faster productivity.

Chen and Rogoff (2003) formalised the empirical importance of this mechanism for “commodity currencies,” showing that the real exchange-rates of major commodity exporters such as Australia, New Zealand and Canada have strong long-run relationships with world commodity prices.

A striking and much-cited result is the forecasting reversal in Chen, Rogoff and Rossi (2010, Quarterly Journal of Economics): because exchange rates are forward-looking asset prices that embed expectations about future fundamentals, commodity-exporter exchange rates actually help predict world commodity prices, more reliably than the reverse. The follow-up by Ferraro, Rogoff and Rossi (2015, Journal of International Money and Finance) sharpens the caveat for practitioners: the relationship between oil prices and the Canadian dollar is robust and strong at the daily (contemporaneous) frequency but is fragile and largely disappears at the monthly and quarterly horizons and out of sample. Commodity terms of trade are a real-time co-movement story more than a forecasting tool. Terms of trade and the BS effect are incorporated into our [DBeer](#) model, below.



2.6 External balances, net foreign assets and equilibrium exchange rate concepts

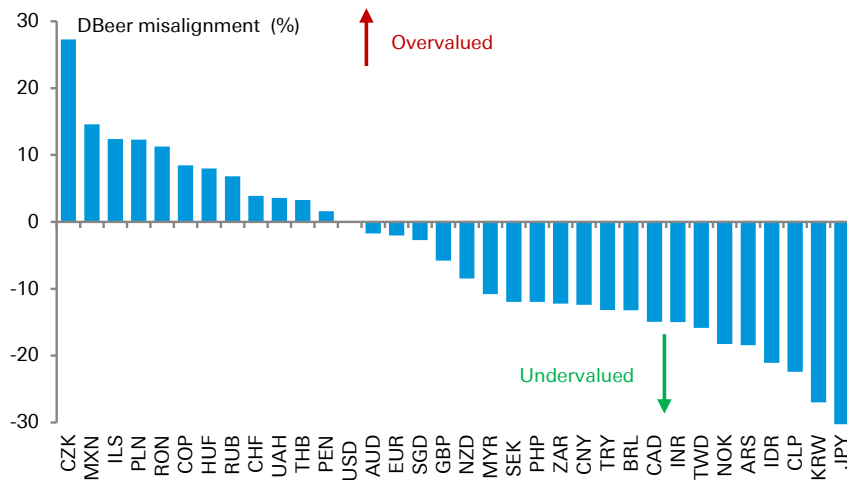
The flow and stock approaches

Two related traditions link the exchange rate to a country's external position. The flow (current account) approach holds that a currency must adjust to bring the current account toward a sustainable level: persistent deficits require a weaker real exchange rate to restore competitiveness. The stock (portfolio/net-foreign-asset) approach emphasises that a country running deficits accumulates external liabilities, and the real exchange rate must eventually be weak enough to generate the trade surpluses that service them or strong enough, for creditor nations, to permit the running down of surpluses. The policy and sell-side community operationalises these ideas through equilibrium exchange-rate models, of which there are three main families:

- The **FEER (Fundamental Equilibrium Exchange Rate)**, (Williamson 1994) and the closely related **DEER (Desired EER)** are normative, macroeconomic-balance concepts: they identify the real effective exchange rate consistent with the economy achieving internal balance (full employment, target inflation) and external balance (a "sustainable" current account) over the medium term. FEER requires an assumption about a current account equilibrium and trade elasticities but is largely model-free about the adjustment path. Such an approach is used as part of our [FX Valuation Snapshot](#).
- The **BEER (Behavioural Equilibrium Exchange Rate)**, Clark and MacDonald 1998) is essentially an econometric model. It regresses the observed real exchange rate on a set of fundamentals, net foreign assets, productivity/relative prices (Balassa-Samuelson), the terms of trade, and real interest-rate differentials, and defines the equilibrium as the fitted value, with the residual measuring misalignment. One of our proprietary valuation frameworks use a BEER model, called [DBeer](#). It uses terms of trade, a productivity ratio and trade openness. [Grover \(2025\)](#) shows it produces mean-reversion signals and that, in contrast to PPP, DBeer performs better in emerging markets, where idiosyncratic and terms-of-trade dynamics dominate, while PPP dominates in G10.
- The **IMF's External Balance Assessment (EBA)**, introduced in 2012, is not a separate exchange rate theory so much as a framework that combines three approaches. First, its principal current account model estimates an underlying current account balance and compares it with a "norm" consistent with economic fundamentals and policies set at their desired levels. The resulting current account gap is then converted, using estimated trade elasticities, into the real-exchange-rate adjustment that would be required to close it. In this respect, the operational procedure is similar to a FEER calculation, although the current-account norm is itself estimated econometrically rather than imposed entirely outside the model. Second, EBA also contains direct REER panel regressions that are closer in spirit to the BEER approach, estimating the exchange rate implied by fundamentals and desired policy settings. A third, external-sustainability approach calculates the current-account balance needed to stabilise or move the net foreign asset position towards an appropriate benchmark. IMF staff use the three approaches as cross-checks and combine them with country-specific evidence and judgement to arrive at an overall assessment of the current-account and REER gaps.



Figure 25: Dbeer estimated over/undervaluation (%) versus USD across G10 and major EM currencies



Source : Haver Analytics, Deutsche Bank

2.7 Medium-run macro models

The monetary model of exchange rates

The monetary approach treats the exchange rate as the relative price of two monies, determined by money supplies, output (money demand) and interest rates. In Dornbusch's (1976) sticky-price version this is how exchange rate overshooting is generated. Because goods prices are sticky, a monetary expansion causes the exchange rate to depreciate more than proportionately on impact before reverting, explaining why exchange rates are more volatile than the underlying fundamentals.

The original monetary model dominated academic thinking in the 1970s but was challenged by the forecasting failure documented by Meese and Rogoff (1983). It nonetheless remains a useful framework for thinking about the exchange rate consequences of relative monetary policy and the interest rate differential is a key input used by FX market practitioners to this day.

Covered and uncovered interest parity, carry trades in FX

The relationship between interest rate differentials and exchange rates is one of the most widely studied in academic research and has given birth to what are known as the two "parity conditions".

- Covered interest parity (CIP) is an arbitrage relationship linking spot and forward exchange rates to interest rates across currencies. It states that an investor should earn the same return from investing in domestic cash as from converting funds into a foreign currency, investing at the foreign interest rate, and simultaneously using a forward contract to lock in the exchange rate at which the proceeds will be converted back. If the two hedged returns differed, investors could borrow in the lower-returning market and invest in the higher-returning one, using the forward market to eliminate exchange-rate risk, until the arbitrage opportunity disappeared.



CIP held almost exactly in the data until 2008 (see later section).

- Uncovered interest parity (UIP) is a looser condition: it says the expected change in the exchange rate should equal the interest rate differential, so that a high-interest-rate currency should be expected to depreciate by exactly enough to offset its yield advantage. UIP is tested through the Fama (1984) regression of realised exchange-rate changes on the interest differential (or forward premium):

$$\Delta s = \alpha + \beta(i - i^*) + \varepsilon$$

Where Δs is the change in the base currency and i is the base-currency interest rate.

UIP predicts $\beta = 1$. The overwhelming empirical finding for decades was that the estimated β was not only below one but frequently negative. This is what is known as the forward premium puzzle in academia or as the "carry trade" in daily market practice: high-yield currencies tend, on average, to appreciate rather than depreciate, which is exactly what makes the carry trade profitable. This is one of the most robust anomalies in international finance.

Figure 26: Illustration of FX carry trade



Source :Deutsche Bank

The literature offers several competing explanations for the existence of carry trades. One interpretation is that carry returns represent compensation for bearing state-dependence or crash risk rather than a free arbitrage. Brunnermeier, Nagel and Pedersen (2009) show that carry returns are negatively skewed: high-yielding currencies can fall sharply and funding currencies appreciate when risk appetite and market liquidity deteriorate. Such episodes can trigger simultaneous unwinding of leveraged positions, amplifying exchange-rate movements. Menkhoff, Sarno, Schmeling and Schrimpf (2012) similarly find that high interest rate currencies tend to perform poorly following unexpected increases in global FX volatility, while low interest rate funding currencies provide insurance in precisely those adverse states.



The broad conclusion is therefore more nuanced than a simple rejection of UIP. Carry trades have historically earned positive average returns, but those returns are negatively skewed, perform poorly during volatility and liquidity shocks, and appear partly related to global risk exposure. At the same time, conventional models have struggled to explain fully the magnitude and time variation of the returns.

Taylor-rule fundamentals and interest rate differentials

In its most recent form, monetary modelling of exchange rates replaces money supplies with the monetary policy reaction function and interest rates. If central banks set interest rates according to a Taylor rule (responding to inflation and the output gap), then the interest differential and hence, via UIP, the expected exchange rate change can be expressed in terms of relative inflation and output gaps. Engel and West (2005), Molodtsova and Papell (2009) and Rossi (2013) showed that Taylor-rule fundamentals can help model exchange rates. With Rossi finding that Taylor-rule and net-foreign-asset fundamentals as the most promising predictors. The strong academic support of monetary exchange-rate modelling is reflected in the strong emphasis on interest rate differentials in market practitioner analysis.

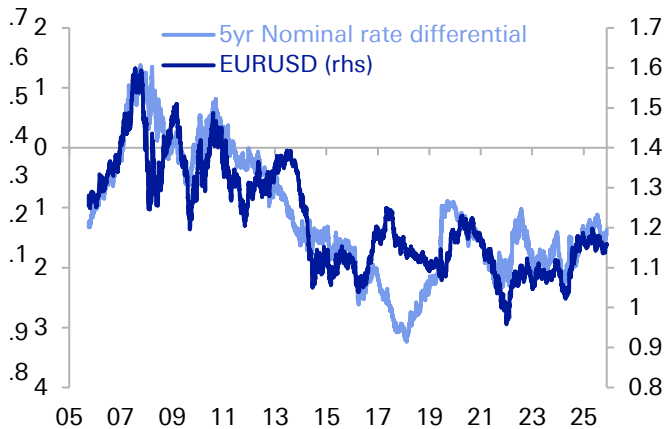
Relative interest rates remain among the most closely watched drivers of exchange rates among market participants, but the distinction between nominal and real differentials is critical:

- Nominal interest-rate differentials determine the carry earned on an unhedged currency position and therefore matter directly for short-run portfolio allocation; in practice, currencies often respond most strongly to revisions in the expected path of policy rates rather than to the current policy rate itself.
- For medium-run valuation, however, the more relevant concept is the expected ex ante real interest-rate differential, the nominal rate adjusted for expected inflation, because it measures the relative return on purchasing power. A high nominal yield generated by tighter monetary policy and a higher real rate should, other things equal, support a currency, whereas the same nominal yield caused by high expected inflation may provide little support and can instead be associated with depreciation.

This distinction is central to Frankel's (1979) real-interest-differential model, although the empirical relationship is not stable. Meese and Rogoff (1988) find little robust connection between real exchange rates and real-rate differentials, while Baxter (1994) found a stronger relationship at business-cycle and lower frequencies. The practical conclusion is that nominal differentials matter most for carry and near-term policy pricing, while expected real rate differentials are the more meaningful, though still imperfect, guide to medium-run exchange-rate valuation.

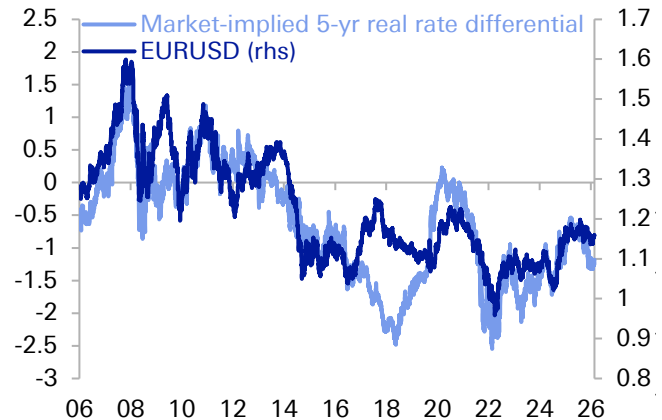


Figure 27: EUR/USD and the nominal interest rate differential



Source : Deutsche Bank, Bloomberg Finance LP

Figure 28: EUR/USD and the real interest rate differential



Source : Deutsche Bank, Bloomberg Finance LP

Current accounts, capital flows and the basic balance

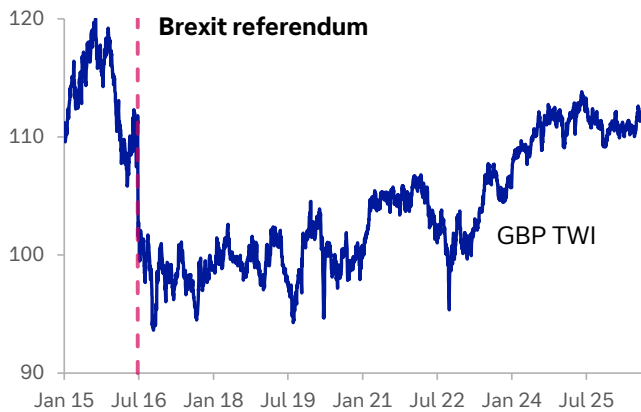
Current accounts provide one of the clearest medium-run anchors for exchange rates because they summarise the gap between national saving and domestic investment. Persistent current-account deficits imply that domestic consumption exceeds output and must be financed by net capital inflows, while persistent surpluses imply the opposite. In the medium run, those external positions cannot drift without consequence: a weaker net foreign asset position must eventually be stabilised through stronger future net exports, favourable valuation effects on the external portfolio, or both, and the exchange rate is one of the key relative prices through which that adjustment is delivered (Chinn and Prasad, 2003; Gourinchas and Rey, 2007).

The composition of capital flows matters as much as the headline balance. Portfolio equity and bond flows are typically more sensitive to relative returns, hedging demand and global risk appetite, so marginal reallocations in these categories can produce sizeable currency moves. FDI is usually the stickier component of external financing, reflecting the partial illiquidity of direct ownership. For FX, a deficit financed by long-horizon FDI is therefore very different from one financed by return-seeking portfolio debt or equity inflows that can reverse quickly when relative yields or risk sentiment change (Hau and Rey, 2006; Albuquerque, 2003; Gabaix and Maggiori, 2015; Greenwood et al., 2023).

Large changes in the trading regime can also shift the expected path of the external balance abruptly. Events such as Brexit, the imposition of tariffs or a major trade agreement can alter expected export demand, import costs, investment and the location of production, with potentially significant consequences for the equilibrium exchange rate. Importantly, currencies are forward-looking asset prices: they need not wait for a trade shock to appear in realised current account data. Once markets assign a sufficiently high probability to a future change in trade arrangements, the exchange rate can adjust immediately in anticipation of its expected effects on future trade flows, investment and national income. The sizeable adjustment in sterling around the 2016 Brexit referendum is a prominent example of the exchange rate moving well before the full effects of the new trading relationship became visible in the balance of payments data.



Figure 29: GBP moved well before the full effects of Brexit took place



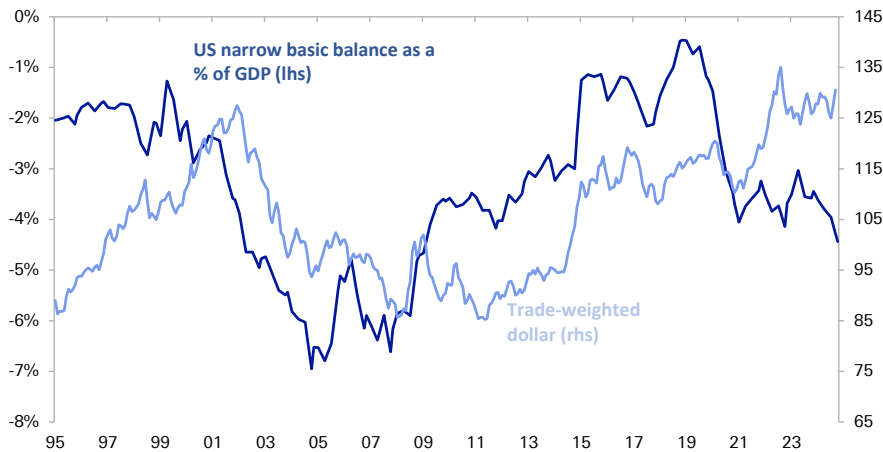
Source : BIS, Bloomberg Finance LP, Deutsche Bank

For medium-run FX analysis, the key issue is whether saving-investment trends and the composition of external financing are moving in a currency supportive or negative direction. Economies with chronically low saving relative to investment are more likely, over time, to require a weaker real exchange rate to generate the external adjustment needed to service a larger stock of foreign liabilities, whereas economies with excess saving and stronger external balance sheets can sustain firmer currencies for longer (Chinn and Prasad, 2003; Gourinchas and Rey, 2007; Lane and Milesi-Ferretti, 2004).

Practitioners often construct measures of the basic balance to assess shifts in external financing and the underlying demand for a currency. A narrow measure typically combines the current account balance with net foreign direct investment, on the grounds that these are among the slowest-moving components of the balance of payments. Broader measures may also include longer-term portfolio flows, particularly bond and equity investment. These indicators are useful but incomplete, because other financial flows can at times dominate exchange rate dynamics. This is especially true for currencies used extensively as funding currencies: during the 2000s, for example, large-scale borrowing in the low-yielding yen generated substantial capital outflows, while the unwinding of those positions periodically produced sharp yen appreciation.



Figure 30: Basic balance metrics are loosely correlated to currencies



Source : Deutsche Bank, Bloomberg Finance LP

The importance of hedge ratios as a medium-run FX driver

Alongside the current account and portfolio flow channels discussed above, the hedging decision on existing foreign asset stocks may become a first-order driver of exchange rates. The mechanism is a stock adjustment one: when a non-US pension fund or insurer holds unhedged US securities, a decision to raise its hedge ratio does not require selling the underlying bond or equity, but it does generate a flow of dollar sales to enact the forward hedge that is then rolled in perpetuity. Because the pool of cross-border foreign ownership of assets is very large, even modest shifts in the desired aggregate hedge ratios of foreign investors can dominate other flows in the balance of payments. The medium-run character of the channel comes from its persistence: hedge ratios are sticky, adjusted slowly and in cycles rather than day-to-day.

The incentive to hedge is governed largely by the cost of hedging, which for a rolling short-dated hedge would tend to be in the 3m to 1-year tenor and approximated by the front-end interest rate differential plus the cross-currency basis. A wide positive rate differential between the US and the rest of the world makes selling the dollar forward expensive, it subtracts directly from the hedged return and, when the hedged yield on a US bond turns negative, removes the entire rationale for holding the asset in hedged form. This is precisely why hedge ratios fell across the developed world as US front-end rates rose after 2022, leaving investors structurally under-hedged and dollar exposure near historical highs ([Gopal, Baker and Dynan, 2025](#)).

The relationship is not mechanical, however and after the US administration's trade actions in 2025 investors raised dollar hedges sharply in response to surprise shifts in US economic and foreign policy (Shin, Wooldridge and Xia, 2025 and [Saravolos, 2025](#)). The practical conclusion is that hedge ratio dynamics are best read as a joint function of the short-end rate differential (the cost) and broader shifts in underlying currency views ([Grover and Harvey, 2024](#)).

The yield curve and FX

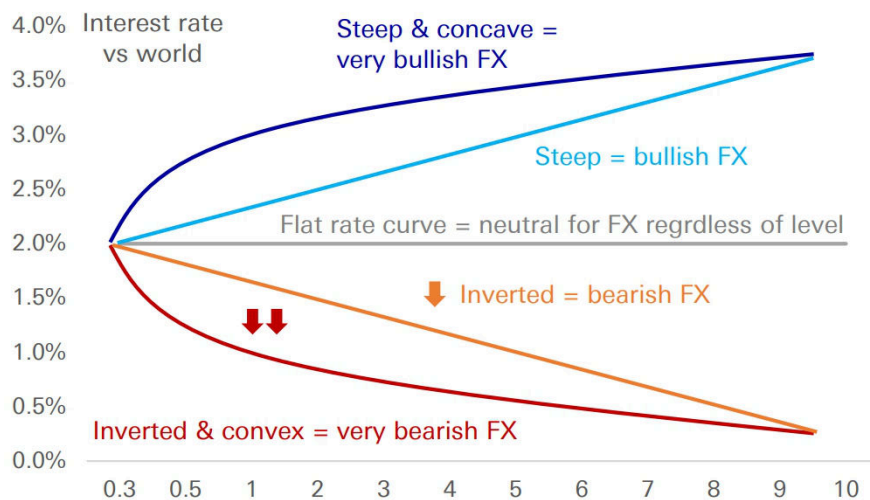
The shape of the yield curve carries independent information for the medium-run exchange rate, and does so through two complementary channels. The first is



predictive. Because the term structure embeds the market's expectations of future short rates, growth, inflation and policy risk (term premium), cross-country differences in the slope of the curve can help forecast currency returns at longer horizons. Ang and Chen (2010) show that term spreads and changes in interest rates significantly predict excess FX returns for up to twelve months, and that portfolios built on these signals carry low skewness and little correlation with the carry trade.

[Winkler \(2022\)](#) breaks down term structures into three curve factors: level, slope and curvature. He shows that the dollar depends more on the slope and curvature of the US rate curve than its level. A steep and hump-shaped rate curve relative to the rest of the world, implying a young business cycle and rising real rates, predicts a stronger dollar, and vice versa. The practical reading is that a relatively steep domestic curve is a signal of expected future easing or of a term premium demanded for macro risk, both of which are currency-negative over the medium run.

Figure 31: FX implications of the shape of the rate curve relative to the world



Source : Deutsche Bank

The second channel via which the yield curve affects FX is a flow mechanism that connects directly to the hedging discussion above. Nenova, Schrimpf and Shin (2025) show that the relative slope of yield curves governs where hedged bond capital is allocated: a steeper curve draws foreign bond inflows and, with them, a rise in FX swap hedging volumes because hedging is cheap. Flatter curves reduce the attractiveness of FX hedging encouraging more un-hedged inflow.



2.8 Short-run determination I: Order flow and market microstructure

Order flow and market microstructure

Because macro fundamentals are near-useless at high frequency, the short-run behaviour of exchange rates is the domain of market microstructure, the study of how the trading process itself conveys information and moves prices. The initial insight, due to Evans and Lyons (2002), is that order flow (signed transaction volume — the net of buyer-initiated and seller-initiated trades) is the proximate driver of exchange rates and the channel through which dispersed information about fundamentals, risk appetite and hedging demand is aggregated into price. Order flow explains a large share of daily and intraday exchange-rate variation, more than macro news alone.

The most important modern contribution is Menkhoff, Sarno, Schmeling and Schrimpf (2016), where using a large dealer's disaggregated customer order flow, they show that order flow is highly informative about future exchange rates. Crucially, different customer segments (asset managers, hedge funds, corporates, private clients) differ markedly in their trading styles, information content and risk exposures. Financial and non-financial customers tend to trade in opposite directions, so the dealers intermediate risk sharing between them, and the information in financial-customer flow has a persistent, longer-term impact on returns consistent with it carrying fundamental information.

DB house research: CORAX and the anatomy of FX flows

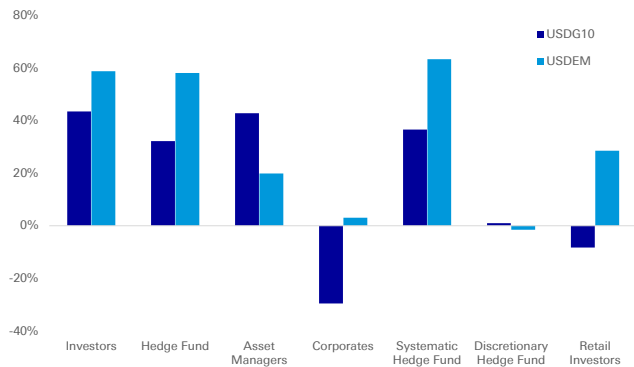
Deutsche Bank's [CORAX](#) indicators (Categorised ORderflow from Autobahn FX), derived from the bank's globally aggregated electronic spot flow, allow this literature to be applied directly. [Grover \(2021\)](#), building explicitly on Menkhoff et al. (2016), studies discretionary versus systematic hedge-fund flows across G10 and liquid EM from January 2016. The findings largely mirror the results of the academic literature:

- Both discretionary and systematic hedge-fund flows are positively correlated with contemporaneous spot, the relationship being stronger for systematic funds.
- Looking forward, discretionary investor flows in G10 positively predict spot for up to about ten days, turning negative at longer horizons — while systematic flows provide more of a mean reversion signal. In EM, discretionary flows show strong mean reversion.
- Across the broader client taxonomy, real-money flows are positively correlated with contemporaneous and one-day-ahead spot; corporate flows are negatively correlated contemporaneously but positively related to future spot in the near-to-medium term in G10; and retail flows are negatively correlated (contrarian in the near term, becoming trend-following at the medium term).

Flows are powerful contemporaneous and short-horizon indicators, and the sign of their predictive content depends on which client segment is trading and over what horizon.

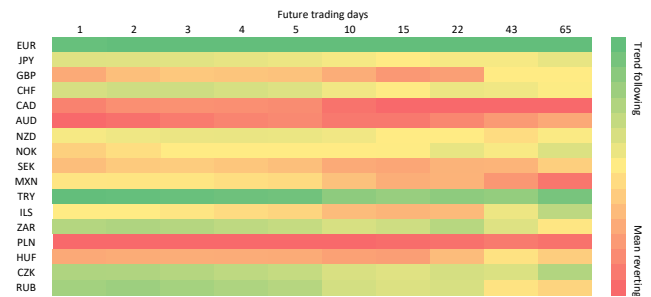


Figure 32: Systematic HF flows show a higher degree of contemporaneous correlation than other client categories



Source : Deutsche Bank

Figure 33: Correlation between CORAX systematic HF flows and future spot move



Source : Deutsche Bank

2.9 Short-run determination II: Positioning, options flow, sentiment, data releases and technical analysis

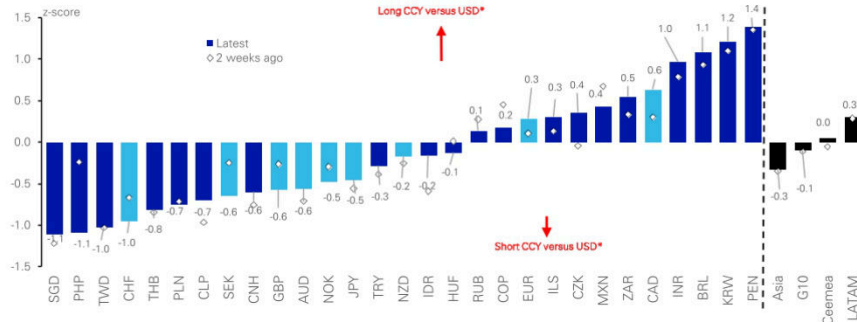
Positioning

Because currencies can overshoot and trend, measures of market positioning are valuable, particularly as contrarian signals at extremes. Positioning refers to the stock of existing long and short currency exposures held by investors: a market is described as “long” a currency when investors have, in aggregate, built positions that benefit from its appreciation, and “short” when they are positioned for depreciation. This differs from flows, which measure new buying and selling over a period; positioning instead captures the cumulative result of past flows and therefore indicates how much directional risk is already embedded in investor portfolios.

Positioning matters because the impact of new information depends partly on how investors are already positioned. When a currency has been rising for some time, investors may progressively add to long positions, reinforcing the trend. But once positioning becomes crowded, fewer investors remain to initiate additional longs, while a negative surprise can force existing holders to unwind positions simultaneously. Stop-losses, margin constraints and systematic trading strategies can amplify this process, turning an initially modest reversal into a sharp move. Conversely, an extremely short currency can rally strongly even on modestly positive news as investors rush to cover their positions. Positioning is therefore most useful not as a mechanical timing indicator, but as a measure of market vulnerability and asymmetry: stretched positioning raises the probability that an adverse surprise generates a disproportionately large price response.



Figure 34: DB EPIC+ positioning (as of 01-Sep-2026)



Source : Deutsche Bank, Bloomberg Finance LP, DTCC, EBS, Reuters, IMM, CORAX Note: 1) * Long (or short) versus EUR for CZK, HUF, PLN, CHF, NOK and SEK. 2) The black bars on the right-hand side are average positioning levels for G10, Asia, CEEMEA and LatAm. 3) The y-axis shows readings of positioning index in a z-score format, which is an average of rolling one year z-scores for individual sub-indicators. Thus, the long or short of each currency is relative to its one year's average instead of absolute level.

The classic public gauges are the CFTC/IMM speculative futures positions, which provide weekly data on long and short positions held by different investor categories, and dealer or investor sentiment surveys. These measures capture only parts of the global FX market, however, and practitioners therefore supplement them with other metrics.

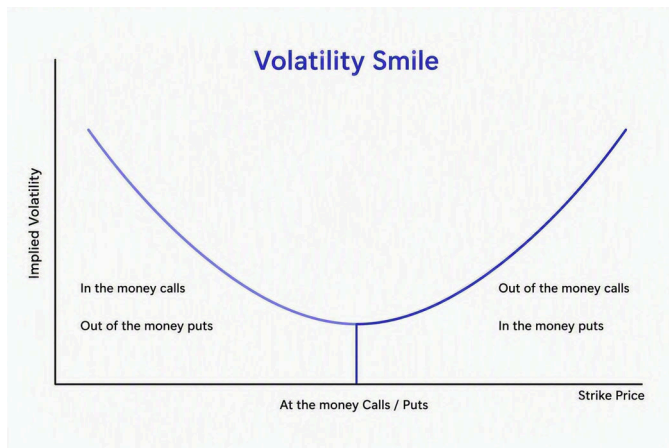
Deutsche Bank's [EPIC+ framework](#) aggregates positioning across both direct measures (CFTC/IMM) and indirect ones (CORAX & spot flows, inter-dealer order-book data, risk reversals, and the DTCC-derived Skew Volume/COFFEE options indicators). [Grover, Nandy, Charles and Xu \(2024\)](#) evaluate the live, out-of-sample performance of position-fading (contrarian) strategies since the EPIC+ launch in January 2021 and find them still profitable for most pairs over the medium term: an equal-weighted position-fading portfolio delivered a Sharpe ratio of 0.54 after costs (0.75 excluding EUR, CNH and THB, which are better traded as position-following), while a cross-sectional long-short portfolio that fades excessive positioning delivered a Sharpe ratio of 1.2 after costs (against 1.7 in backtest). Importantly, performance dips when FX volatility is high and the dollar is trending strongly — contrarian signals work best in less-trending markets. Risk reversals, CORAX and IMM are the most effective inputs for spotting fading opportunities in DM; the COFFEE options-skew indicator and spot imbalance work better in EM.

Options market information

Given the size and depth of the currency option market, option prices can contain information about market expectations and risk sentiment that is not fully visible in spot or forward rates. Implied volatility measures the market price of protection against exchange rate movements, while the volatility smile provides information about the perceived balance of tail risks.



Figure 35: Simplistic depiction of a volatility smile



Source : Investopedia, Deutsche Bank

The most widely followed measure of this asymmetry is the risk reversal, usually calculated as the implied volatility of an out-of-the-money currency call minus that of an equivalent-delta currency put. A positive risk reversal means that calls on the base currency are more expensive than comparable puts, indicating greater demand for protection against, or exposure to, base-currency appreciation. Risk reversals should not, however, be interpreted as pure forecasts: they reflect the market's risk-neutral distribution and therefore combine expected outcomes with risk premia, hedging demand and position imbalances. More generally, option prices can be used to recover information about the market-implied distribution of future exchange rates, including its volatility, skewness and tail probabilities (Campa, Chang and Reider, 1998).

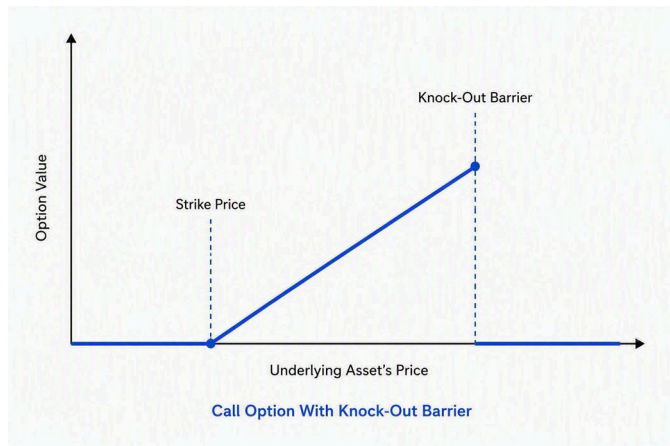
Options can also affect the exchange rate mechanically through the hedging activity they generate. Dealers typically manage the delta of their option books (the change to the value of their positions driven by spot exchange-rate movements) by buying or selling the underlying currency as spot moves. The direction of these flows depends importantly on the market's aggregate gamma, which measures how rapidly an option portfolio's delta changes with the exchange rate. Dealers who are long gamma generally sell the currency after it rises and buy it after it falls, creating countercyclical flows that can dampen volatility and sometimes pull spot towards large strikes around expiry. Dealers who are short gamma must instead buy as the currency rises and sell as it falls, producing procyclical flows that can amplify an existing move. Empirical evidence using trade-repository data confirms that negative market-maker gamma can increase spot-market volatility, while positive gamma has the opposite effect (Anderegg, Ulmann and Sornette, 2022).

These effects can become especially pronounced around barrier options, which are activated or extinguished when the exchange rate reaches a predetermined level. As spot approaches a barrier, the option's delta and gamma may change sharply, requiring increasingly large hedge adjustments. Investors with an interest in preventing the barrier from being triggered may also trade defensively around the level. If the barrier is ultimately breached, the associated option exposure and hedges can disappear or change abruptly, generating a sudden reversal of previous hedging flows or accelerating the move through the level. The precise direction depends on whether the option is a knock-in or knock-out, whether it is a call or put,



and which side of the transaction dealers hold. Consequently, large strikes, expiries and barriers do not provide deterministic support or resistance, but they can materially alter the short-run elasticity of market flows and help explain why exchange-rates occasionally become unusually stable near particular levels.

Figure 36: Simplistic depiction of a knock-out call



Source : Financialtrading.com Deutsche Bank

Weng and Grover (2017) introduce Deutsche Bank's [Skew Volume Indicators](#), built from DTCC data (the DTCC registers almost all US currency-option trades, over a fifth of global derivative volumes). The key innovation is separating option transactions into investors (at-the-money options, 25-75 delta, the SVA indicator), versus hedgers (out-of-the-money options, 0-25 delta, the SVO indicator). The findings are tradeable: investor flows positively lead currency moves (it pays to follow investors), whereas hedging flows negatively lead returns (it pays to fade hedgers). A momentum strategy on SVA earned a Sharpe ratio of 0.83, a contrarian strategy on SVO a Sharpe of 0.67, and a blended strategy 0.96 in their sample.

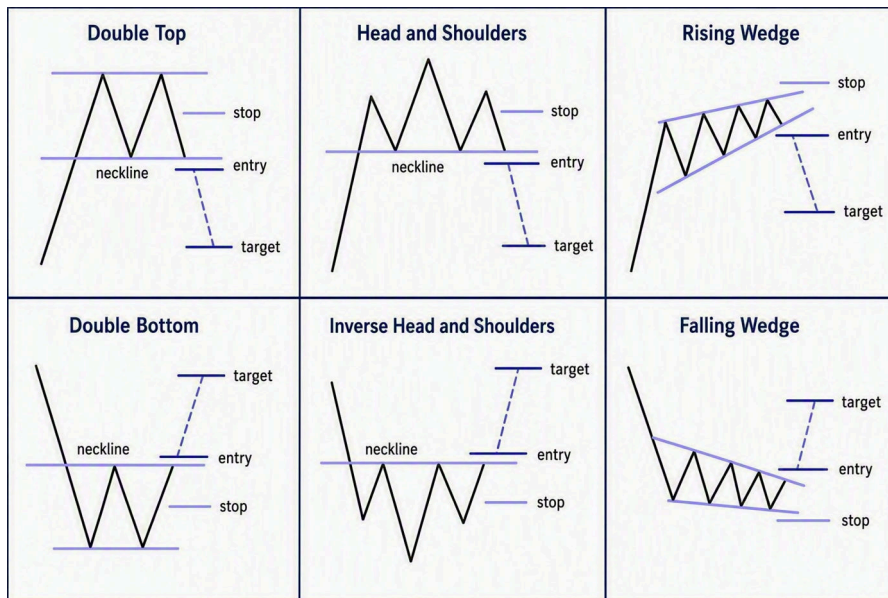
Technical analysis and trend-following

Technical analysis refers to forecasting future price movements from patterns in past market data rather than from an explicit model of economic fundamentals. In FX, this typically means analysing the history of exchange rates and sometimes volume, volatility or positioning to identify trends, momentum, turning points and important price levels.

Common techniques include moving averages, which generate signals when a short-term price trend crosses a longer-term one; momentum and oscillator indicators, which attempt to identify overbought or oversold conditions; and support and resistance levels, where previous highs, lows or other widely watched prices are expected to influence future trading behaviour. More sophisticated systematic versions of technical analysis translate these ideas into mechanical trend-following or breakout rules.



Figure 37: Examples of technical analysis



Source : Aimarrow.com, Deutsche Bank

The underlying premise is not necessarily that past prices contain fundamental information, but that investor behaviour, herding, stop-loss activity and institutional trading practices can generate persistence or recurring patterns in prices. Technical analysis is pervasive in FX markets, with surveys finding widespread use among FX dealers and professional fund managers, associated with the belief that psychological and non-fundamental factors can influence prices (Gehrig and Menkhoff, 2006; Menkhoff, 2010).

There is also a substantial literature showing that simple technical trading rules have historically generated statistically and economically significant returns in FX. Levich and Thomas (1993), using bootstrap tests on currency futures, find that moving-average and filter rules produced profits that were difficult to reconcile with simple random exchange-rate processes. Neely, Weller and Dittmar (1997) similarly find significant out-of-sample excess returns across several major exchange rates using rules selected by genetic-programming techniques. Menkhoff and Taylor (2007) survey this literature and evaluate four broad explanations for the use of technical analysis: irrational behaviour, exploitation of central bank intervention, efficient processing of dispersed information, and the ability of technical signals to capture non-fundamental influences on exchange rates. They regard the final explanation as the most persuasive. In this interpretation, technical analysis is useful because FX prices can be driven for extended periods by order flow, positioning, herding and other market dynamics that are not immediately captured by standard macroeconomic models.

News, Announcements and High-Frequency Dynamics

A distinct microstructure literature studies how exchange rates react to scheduled macroeconomic news at high frequency. The work of Andersen, Bollerslev, Diebold and Vega (2003) showed, using real-time data, that exchange rates respond within seconds to the surprise component of macro announcements (relative to survey



expectations) and that announcement surprises explain a meaningful share of high-frequency volatility. This body of work reconciles the "fundamentals don't matter" result with intuition: fundamentals do move exchange rates, but they do so in sharp, news-driven jumps around data releases and central-bank communications, which are hard to see in monthly data. It also underpins the modern reality that the largest intraday FX moves cluster around US payrolls, CPI and FOMC decisions.

Risk sentiment and impact on FX

Risk sentiment is an important cross-cutting driver of exchange rates because it changes investors' willingness and capacity to hold leveraged or risky currency positions. During periods of strong risk appetite and low volatility, investors tend to borrow in low-yielding funding currencies and invest in higher-yielding currencies, supporting carry-trade returns. When volatility rises or market liquidity deteriorates, however, losses, tighter funding constraints and margin calls can trigger a simultaneous unwinding of these positions: high-yielding and relatively illiquid currencies are sold, while funding currencies are repurchased, amplifying the initial exchange-rate move.

Brunnermeier, Nagel and Pedersen (2009) document the resulting negative skewness and crash risk of carry trades, while Menkhoff, Sarno, Schmeling and Schrimpf (2012) show that high-yield currencies perform poorly following increases in global FX volatility. Risk appetite is generally perceived to be negatively correlated with the broad US dollar: the dollar often strengthens when global risk sentiment deteriorates, reflecting its central role in international funding, liquidity and safe-asset demand. The relationship between the dollar and risk appetite is however not stable over time, with shocks that disproportionately impact the US such as the bursting of the 2000 dot-com bubble often associated with a weaker dollar.

2.10 Forecasting performance and the Meese-Rogoff Puzzle

Meese and Rogoff (1983), showed that the structural exchange-rate models of the day, monetary, portfolio-balance, could not out-forecast a naive random walk out of sample, even when fed the realised (future) values of the fundamentals. Four decades on, the Meese-Rogoff puzzle remains the benchmark against which every forecasting claim is measured, and the random walk without drift has proven extraordinarily hard to beat at horizons under a year.

One of the most useful modern surveys on exchange-rate forecasting is Rossi (2013, *Journal of Economic Literature*). Her review of the post-1983 literature reaches a mixed verdict: predictability does exist, but it is fragile and conditional. Parameter instability is one of the biggest challenges to systematic exchange-rate modelling: it is not only that fundamentals change over time, but the relationship between these and exchange rates changes too.



2.11 Modern theories of the exchange rate

Exchange rates dominated by financial markets

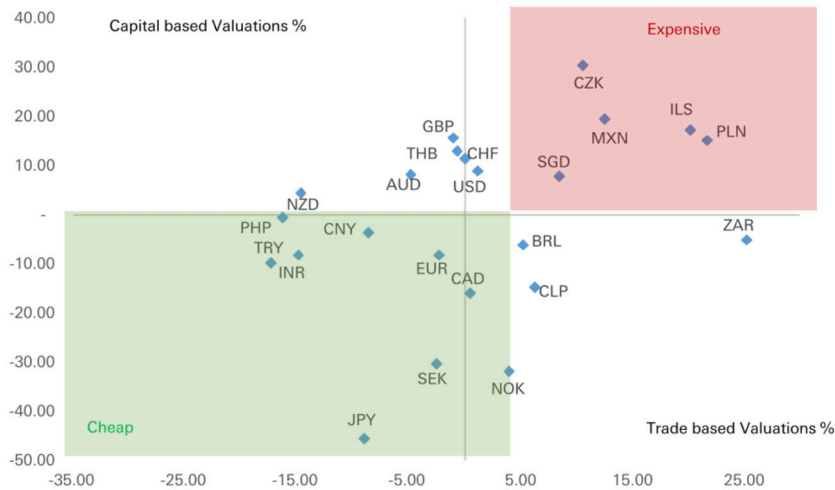
With financial markets outpacing the real economy in size and growth, Gabaix and Maggiori (2015) provide a theory in which exchange rates are determined by capital flows intermediated through imperfect financial markets. Gabaix and Maggiori introduce financial intermediaries (primarily banks) with limited risk-bearing capacity into their model. When, for example, investors in one country increase their demand for foreign assets, intermediaries must take the opposite currency exposure to clear the market. As their balance sheets become more exposed, they require greater compensation for bearing that risk, and the exchange rate moves sufficiently to induce them to absorb the imbalance. The larger the required flow relative to intermediaries' risk-bearing capacity, the larger the resulting exchange-rate adjustment. This provides an important explanation for why exchange rates can move substantially even when trade flows or conventional macroeconomic fundamentals change little. Shifts in international portfolio preferences, financial regulation, intermediary balance sheet capacity or global risk appetite can all generate exchange-rate movements by changing the willingness of financial institutions to intermediate the resulting flows.

The framework is therefore particularly useful for understanding episodes such as the 2008 global financial crisis, when large exchange-rate movements were associated with deleveraging, balance-sheet constraints cross-border portfolio adjustment rather than simply changes in goods trade. A closely related perspective is provided by Rey (2015), who argues that the US dollar sits at the core of the global financial cycle. The large pool of dollars sitting outside the US banking system means easier US financial conditions are associated with expanding cross-border leverage and capital flows and, typically, a weaker dollar. Conversely, tighter financial conditions and rising global risk aversion trigger deleveraging, repatriation and demand for dollar liquidity, tending to strengthen the dollar. The dollar therefore acts not simply as the relative price of US and foreign goods, but as a key price through which changes in global financial conditions and risk-bearing capacity are transmitted internationally.

Conventional PPP and real effective exchange rate measures weight currencies according to bilateral trade, implicitly reflecting the importance of different countries in goods and services markets. This financial-market perspective is the motivation behind the Deutsche Bank's [Capital-weighted PPP model](#). A capital-weighted approach instead gives greater weight to currencies against which a country has large cross-border financial exposures, recognising that the relevant counterparties for exchange rate determination may increasingly be determined by the geography of portfolios rather than trade. Our capital-based valuation measures therefore construct a real effective financial exchange rate using capital weights and compare its level with a historical equilibrium in much the same way that conventional PPP compares a trade-weighted real exchange rate with its long-run norm. For countries with very large external asset and liability positions, this can yield materially different measures of currency valuation from traditional trade-weighted PPP and provides a useful complement in a world where gross capital flows substantially exceed the flows associated with international trade.



Figure 38: Scatter plot of current capital and trade-based valuations



Source : Haver Analytics, Deutsche Bank

Convenience yields and safe-asset demand for dollars

A complementary financial mechanism, specific to the dollar, is the convenience yield on safe dollar assets. Jiang, Krishnamurthy and Lustig (2021) develop a theory in which the dollar's value reflects the convenience (safety and liquidity) services that global investors derive from holding US Treasuries. This convenience yield is measurable via the Treasury basis (the yield gap between US government bonds and currency-hedged foreign government bonds); when it widens, the dollar appreciates immediately and then depreciates subsequently. In their words, "the variation in the Treasury basis accounts for 25 percent of the quarterly variation in the dollar between 1988 and 2017," and "on average, foreign investors earn an extra convenience yield of 2% on Treasury holdings," 90% of which is directly attributable to the dollar denomination.

Covered Interest Parity Deviations and the Cross-Currency Basis

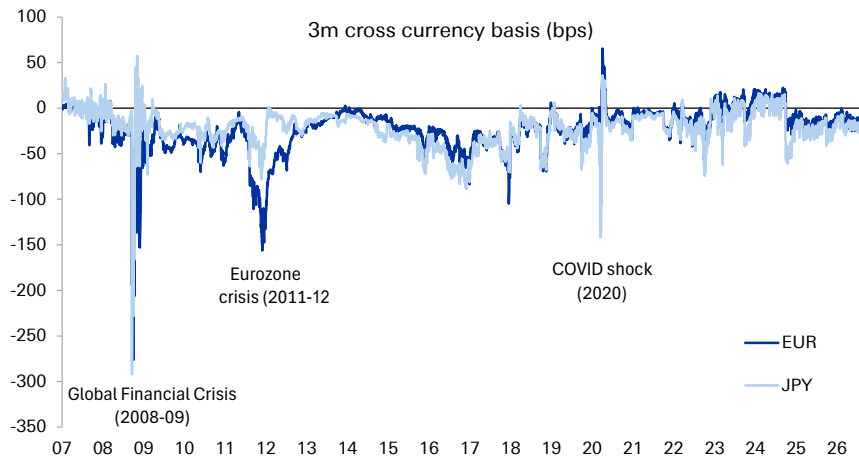
Among the most consequential post-crisis developments is the breakdown of covered interest parity. CIP is a pure no-arbitrage identity and held almost perfectly before 2008. Since the crisis, persistent, systematic deviations have opened up, measured by the cross-currency basis: the extra cost, over and above the interest differential, of borrowing dollars synthetically through the FX swap market. Du, Tepper and Verdelhan (2018) document that these deviations are large, persistent and systematic, and are not explained by credit risk or transaction costs alone. They are strongest for contracts that sit on bank balance sheets at quarter-ends, pointing to post-crisis banking regulation (leverage ratios, risk-weighted capital) as the cause: the balance-sheet cost of arbitrage means dealers no longer close the gap. The basis is typically negative for currencies whose investors demand dollar hedges (JPY, EUR), reflecting a structural shortage of dollar funding. See more [here](#).

The macro-financial significance was crystallised by Avdjiev, Du, Koch and Shin (2019), who document a "triangular" relationship: a stronger broad dollar goes hand-in-hand with a higher cost of dollar funding and a contraction in cross-border dollar bank lending. This links the cross-currency basis (a microstructure/funding



variable) directly to the broad-dollar cycle and global credit conditions.

Figure 39: Cross currency basis for EUR and JPY



Source : Deutsche Bank calculations, Bloomberg Finance LP

The Dominant Currency Paradigm and Invoicing

The Dominant Currency Paradigm (DCP) of Gopinath, Boz, Casas, Díez, Gourinchas and Plagborg-Møller (2020) and alters the textbook framework in which prices are set either in the producer's currency or the destination's. Using a dataset of more than 2,500 country pairs covering 91% of world trade, they show that the vast majority of world trade is invoiced in a small number of dominant currencies, overwhelmingly the US dollar, and that those invoice prices are sticky in dollars ([Sachdeva, 2026](#)).

This has important implications: exchange rate movements against the dollar, rather than bilateral rates, drive trade prices and quantities and expenditure switching operates weakly and asymmetrically. The dollar therefore exerts a systemic influence on global trade and inflation that no other currency matches, reinforcing the demand for dollar invoicing, dollar funding and dollar reserves in a self-sustaining equilibrium. Combined with the safe-asset/convenience-yield channel and the funding/basis channel, this literature completes the picture of dollar dominance as a structural feature of the international monetary system.

2.12 Central bank intervention

Official intervention in the FX market, the purchase or sale of foreign currency by the central bank, is a long-standing but contested policy tool. The theoretical channels are the portfolio-balance channel (intervention changes the relative supply of assets), the signalling channel (intervention reveals information about future policy) and, more recently, an order-flow/microstructure channel (intervention



affects price like any large order). Sterilised intervention¹⁴ by advanced economies was long viewed sceptically. The best modern evidence is more encouraging. Fratzscher, Gloede, Menkhoff, Sarno and Stöhr (2019) using a novel daily dataset covering 33 countries from 1995–2011, find that "intervention is widely used and an effective policy tool, with a success rate in excess of 80 percent under some criteria." It works best at smoothing the exchange-rate path and defending narrow bands; moving the level of a floating currency requires that interventions be large, public and supported by communication.

Menkhoff (2013) surveys the specific and generally more favourable evidence for emerging markets, where intervention and reserve management are pervasive. Recent episodes illustrate the spectrum: the Swiss National Bank's EUR/CHF floor (2011–15) and its abrupt abandonment in January 2015; large-scale Japanese intervention to slow yen depreciation in 2022 and 2024; and routine EM intervention. Intervention is most effective when it works with fundamentals and market positioning rather than against them.

2.13 Currency regimes and emerging market crises

The distinction between fixed and floating exchange rates is in practice a continuum. The IMF's de facto classification distinguishes ten regimes according to the strength of the authorities' commitment to an exchange-rate level or path, the observed behaviour of the currency and the extent of official intervention. At one extreme, dollarisation and currency boards largely eliminate monetary autonomy; at the other, freely floating currencies are almost entirely market determined. Between them sit a range of pegs, bands, crawling regimes and managed arrangements that trade greater exchange-rate stability for progressively less monetary-policy independence.

¹⁴ Intervention by a central bank to buy or sell a currency changes the currency's money supply. A sterilization involves an offsetting transaction by the central bank in the domestic money market to remove or add back the liquidity.



Figure 40: Exchange rate regimes according to the IMF

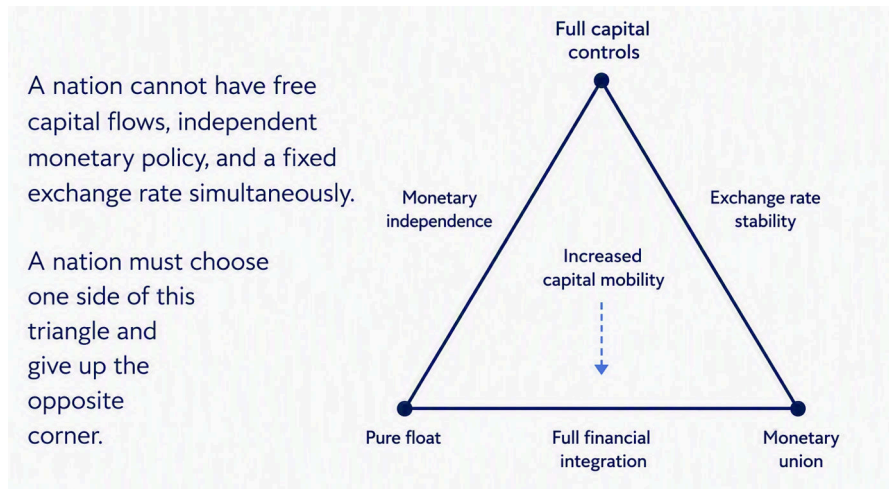
Broad FX regime	IMF category	What it means	Main IMF classification criteria
Hard peg	No separate legal tender	The country uses another country's currency as its legal tender—for example, through formal dollarisation—so there is no independent domestic exchange rate.	Authorities' de jure arrangement is confirmed; another country's currency is the sole legal tender. This effectively eliminates independent national monetary policy.
Hard peg	Currency board	Domestic currency exists, but its value is rigidly fixed to an anchor currency and its issuance is constrained by the availability of foreign reserves.	There is an explicit legal commitment to exchange domestic currency for a specified foreign currency at a fixed rate. Domestic currency is normally backed by foreign assets and the issuing authority faces tight restrictions on discretionary monetary policy.
Soft peg	Conventional pegged arrangement	The currency is formally pegged to another currency or a basket, but unlike a currency board the peg can ultimately be changed and the central bank retains more policy flexibility.	Authorities formally announce or notify the IMF of the peg and stand ready to defend it through direct or indirect intervention. The rate must generally stay within $\pm 1\%$ of a central parity, or within a total 2% range, for at least six months.
Soft peg	Stabilized arrangement	A de facto peg: the authorities may not formally announce a peg, but the exchange rate behaves as though one exists.	The spot rate remains within a 2% margin for six months or more relative to an identifiable currency or basket, and the stability is judged to result from official action or structural market rigidities. Unlike a conventional peg, there need not be an announced commitment.
Soft / intermediate	Crawling peg	Instead of fixing the currency permanently at one level, the authorities periodically adjust the central rate in small steps.	A formally announced rule determines the crawl—for example a fixed depreciation rate or adjustments based on inflation differentials or other indicators. The rule and its parameters are public or notified to the IMF.
Soft / intermediate	Crawl-like arrangement	A de facto crawling peg: the currency follows a relatively smooth trend even though the authorities have not formally committed to a crawling rule.	The rate remains within a 2% margin around a statistically identified trend for at least six months and cannot qualify as floating. Generally the trend must be sufficiently persistent; an annualised movement of at least 1% can qualify if appreciation or depreciation is sufficiently monotonic and continuous.
Soft / intermediate	Pegged within horizontal bands	The authorities commit to keeping the exchange rate inside a band around a central parity rather than at one precise level. The band gives monetary policy somewhat more room than a conventional peg.	The central rate and band are formally announced or notified to the IMF. The permitted fluctuation is at least $\pm 1\%$ around the central rate, or the distance between the maximum and minimum permitted exchange rates exceeds 2%.
Floating	Floating	The exchange rate is primarily determined by market supply and demand. The central bank can still intervene to dampen volatility, but does not defend a particular exchange-rate level.	The rate is largely market determined and has no ascertainable or predictable path. Intervention may moderate excessive movements, but targeting a particular exchange-rate level is inconsistent with the classification.
Floating	Free floating	The strongest form of floating: the market determines the exchange rate and official intervention is very rare.	Must first meet the criteria for floating. Intervention should occur only exceptionally to address disorderly markets; under the IMF methodology it is limited to no more than three episodes in the previous six months, each lasting no more than three business days.
Residual / managed	Other managed arrangement	The authorities materially influence the exchange rate, but its behaviour does not fit any of the IMF's peg, crawl or floating definitions. This can include regimes where the intervention strategy or exchange-rate objective changes over time.	Residual category used when none of the other definitions is satisfied; regimes characterised by frequent changes in exchange-rate policy can fall here.

Source : Deutsche Bank, IMF



The exchange-rate regime shapes how shocks are absorbed and how vulnerable a currency is to crisis. The "Impossible Trinity" (fixed rate, free capital mobility, monetary autonomy: choose two) remains the organising principle.

Figure 41: The Impossible Trinity



Source : Feridun, M. (2014), Deutsche Bank

The literature on early warning systems for emerging-market currency crises identifies recurrent symptoms: real overvaluation, weak growth, adverse terms-of-trade shocks, deteriorating current accounts, excessive domestic credit expansion, banking-system fragility, large fiscal deficits, high ratios of short-term external liabilities (and of M2) to reserves, and reserve losses (Frankel and Saravelos, 2012). Successive generations of crisis models – first-generation (fiscal/monetary fundamentals), second-generation (self-fulfilling expectations and multiple equilibria), and third-generation (balance-sheet and banking/currency-mismatch channels, motivated by the 1997–98 Asian crisis) — map onto these symptoms.

2.14 Frontier topics: machine learning and digital currencies

The application of machine learning (ML), random forests, gradient boosting, neural networks, and now large language models for news processing, to exchange-rate forecasting has grown significantly in recent years. Several studies report ML models beating the random walk in directional (sign) forecasting and when many predictors and time effects are combined, but the improvements are typically small and concentrated in specific regimes.

Rigorous recent work continues to find that ML models frequently fail to beat a random walk on error-magnitude (RMSE) criteria under strict out-of-sample, expanding-window evaluation — the Meese-Rogoff result proves robust even to modern methods (Pfahler, 2022 and Jackson & Magkonis (2024). ML is most promising for (i) directional and volatility forecasting, (ii) exploiting high-frequency and alternative data (order flow, news, positioning), and (iii) nonlinear combination of the fundamentals and factors described in this section rather than as a magic



solution to level forecasting.

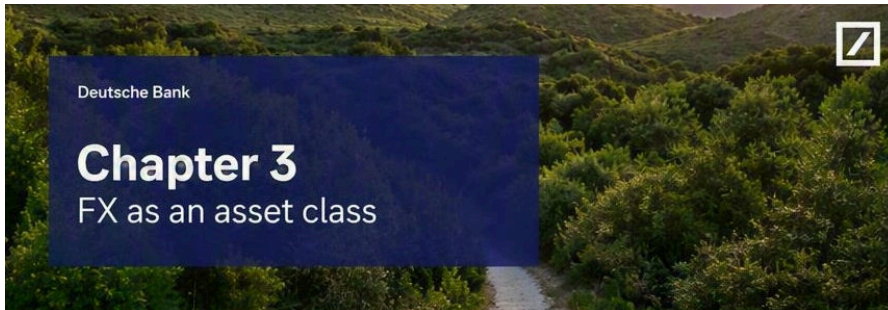
2.15 Cryptocurrencies, stablecoins and CBDCs

Digital assets are increasingly relevant to FX. Dollar-pegged stablecoins are emerging as a potentially meaningful conduit for dollar demand, particularly in emerging markets with weak currencies or capital controls, effectively extending dollar dominance. A recent Deutsche Bank [study](#) has expanded into this topic in more detail (Sachdeva and Saravelos, 2025). Central-bank digital currencies (CBDCs) and cross-border CBDC projects could, over time, alter FX-market plumbing, settlement and the mechanics of intervention, though their macro impact on exchange-rate determination remains speculative as of 2026. Cryptocurrencies themselves remain too volatile and too small to function as genuine exchange rate anchors, but the infrastructure they have spawned — 24/7 settlement, tokenised deposits — is beginning to matter for market microstructure.

2.16 Bringing it all together

No single model of exchange rate determination is right all the time; the challenge lies in matching the tool to the horizon and the regime. The evidence assembled here supports a staged approach to exchange rate determination.

- First, *anchor exchange rates with valuation (strategic, 3 years+)*. Use PPP, BEER and FEER to establish a fair-value range and the direction of long-run misalignment. Prefer PPP for G10 and DBBeer for EM.
- Second, *align FX forecasting with the economic cycle (cyclical, 1–2 years)*. Use interest rate differentials, both level (carry) and change, the monetary policy cycle and Taylor rule fundamentals for medium-run direction. Take account of shifts in the balance of payments, both on the current account and the capital flow side of the ledger.
- Third, *flow and positioning matter (tactical overlay)*. Use order flow, options flow and positioning as high-frequency short-horizon mean-reversion signals.
- Finally, be aware of regime changes. This can take the form of a change in exchange rate regime from a peg to a float, an underlying abrupt shift in macroeconomic fundamentals (Brexit) or a large financial shock that shifts the market to a new equilibrium (2008 Financial Crisis or Eurozone crisis).



Introduction

Currency investing starts from a different premise to equities or bonds: a currency has no stand-alone expected return and every exposure is inherently relative, involving a long position in one currency and a short position in another, typically implemented through spot, forwards or options. Do investors make money from trading FX? Can FX be treated as an investable asset class? Our first chapter demonstrated the importance of non-profit-seeking participants in the FX market. This weakens the application of the efficient-market hypothesis and creates scope for excess returns. Our second chapter introduced the exchange-rate frameworks that can inform an investment approach to currencies. This chapter turns from theory to real-world evidence. We examine whether systematic currency factors such as carry, momentum and value have generated persistent returns, whether quantitative investors can capture them after costs and whether discretionary currency managers generate alpha beyond these systematic exposures.

3.1 FX "beta" and factor investing

The poor out-of-sample performance of models designed to forecast exchange rate levels, together with the persistent empirical rejection of uncovered interest parity (UIP) has generated a large investor ecosystem focused on harvesting currency risk premia via systematic strategies and indices across baskets of currencies rather than individual exchange rates. Three investment-style factors have become canonical:

- *Carry* involves buying high-interest-rate currencies and funding the position by selling low-interest-rate currencies. Its profitability is the investment counterpart of the forward-premium puzzle: high-yielding currencies have not, on average, depreciated sufficiently to eliminate their interest-rate advantage. Carry returns are often interpreted as compensation for exposure to global risk, since high-yielding currencies



tend to underperform during episodes of rising volatility, deteriorating liquidity and widespread deleveraging (Lustig, Roussanov and Verdelhan, 2011; Menkhoff et al., 2012a).

- *Momentum* involves buying currencies with strong recent excess returns—the “winners”—and selling recent “losers.” Menkhoff, Sarno, Schmeling and Schrimpf (2012b) document substantial cross-sectional momentum in currencies. Proposed explanations include the gradual incorporation of information into exchange rates, investor underreaction and overreaction, and limits to arbitrage, although transaction costs reduce the returns available to implementable strategies.
- *Value*, sometimes described as a valuation or mean-reversion strategy, involves buying currencies judged to be undervalued and selling those judged to be overvalued relative to an equilibrium benchmark such as purchasing-power parity or a behavioural equilibrium exchange rate model. Value signals generally operate over longer horizons than carry or momentum, reflecting the slow tendency of real exchange rates to revert towards equilibrium. Evidence for currency value strategies forms part of the broader finding that value and momentum premia appear across several asset classes (Asness, Moskowitz and Pedersen, 2013). Practitioner implementations include Deutsche Bank’s PPP and DBeer frameworks ([Grover, 2025](#)).

One of the earliest practical attempts to package these systematic returns into a currency “beta” equivalent to the S&P 500 for equities was the Deutsche Bank Currency Returns (DBCR) Index, introduced in 2007. The index equally weights transparent, rules-based carry, momentum and valuation strategies across liquid developed-market currencies and was designed to be investable after transaction costs. In its original backtest over 1980–2006, DBCR generated an annualised excess return of approximately 4 per cent, volatility of 5.2 per cent and a Sharpe ratio of 0.77, with a maximum drawdown of 11 per cent. Its relatively low correlations with global bonds and equities illustrated the potential diversification benefits of combining systematic currency exposure with traditional asset classes (Hafeez, 2007).

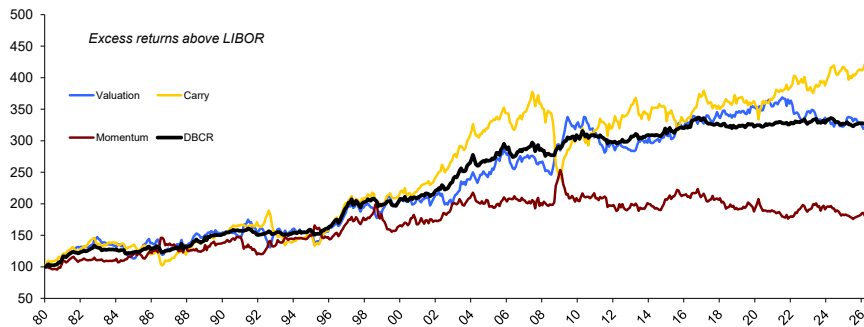
A subsequent reassessment by [Saravolos et al. \(2018\)](#) found that the risk-adjusted returns of the combined carry, momentum and value approach had remained resilient after the global financial crisis. Over the longer sample beginning in the 1980s, systematic currency returns were found to be comparable on a risk-adjusted basis with those of global bond and equity portfolios, while adding FX exposure to a conventional portfolio reduced historical volatility and drawdowns.

These benefits arise partly because the component factors perform well in different environments: momentum can offset some of the losses suffered by carry and value during sharp regime changes, while valuation may benefit from the eventual reversal of prolonged trends.

Factor returns nevertheless remain cyclical and can be exposed to crash risk, crowding, changing monetary regimes and implementation costs; they should therefore be understood as compensation for bearing a collection of risks rather than as mechanical arbitrage profits.



Figure 42: DBCR returns vs risk-free-rate



Source : Deutsche Bank

3.2 Systematic and quant-based investors

Systematic currency and macro managers construct portfolios using predefined, rules-based models that are more advanced than the drivers highlighted above. These may combine price-based signals, such as trend, momentum and volatility, with macroeconomic and valuation variables, including interest-rate differentials, purchasing power parity, external balances and policy expectations. Traditional factor strategies, econometric models and more recent machine-learning approaches all fall within this category. Their defining feature is the consistent translation of observable data into positions through a repeatable portfolio-construction and risk-management process. Commodity Trading Advisors, or CTAs, are an important subset of systematic macro managers. Despite their name, CTAs are not confined to commodities: they typically trade diversified portfolios of equity-index, government-bond, interest-rate, commodity and currency markets. Their currency positions are therefore usually part of a broader cross-asset portfolio rather than a dedicated FX mandate.

CTAs commonly implement currency exposure through exchange-traded futures. Futures are standardised, centrally cleared and highly liquid in the major currency contracts, while allowing investors to take long or short positions with relatively little initial capital through margining.

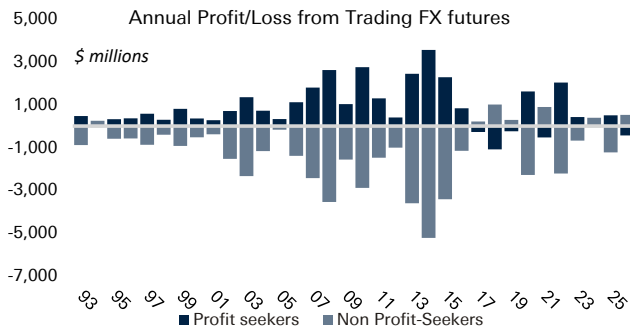
We thus return to the CFTC weekly commitment of traders report to produce an estimate of returns from profit-seeking activity from quant-based models using the methodology of Kearns and Manners (2004). As noted above, the IMM report gives the FX futures position of commercial and non-commercial every Tuesday. Given this information, it is a relatively straightforward exercise to calculate the profit or loss made every week by the respective parties.

We find that profit seekers make billions of dollars trading FX futures at the expense of hedgers almost every year since 1993.¹⁶ The breakdown for the individual currency pairs is also as expected, with annualised losses for non-profit seekers highest in EUR and JPY.

¹⁶ (We use dollar rates for CAD, CHF, EUR (since 1999), GBP, AUD (since 2000) and JPY)

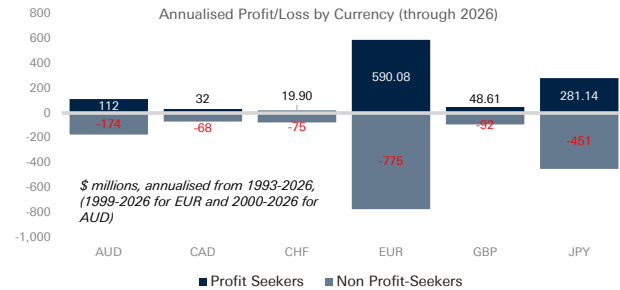


Figure 43: CFTC data shows that speculators consistently make money



Source : CFTC, Bloomberg Finance LP, Deutsche Bank

Figure 44: Profit-seekers consistently make money across all currencies



Source : CFTC, Bloomberg Finance LP, Deutsche Bank

3.3 Discretionary currency manager "alpha"

FX has been one of the asset classes of choice for macro investors since the 1980s so in contrast to other asset classes, we have a long history of "active" manager returns too. Discretionary macro investors take currency positions as part of a broader assessment of the global economic and policy environment. Their decisions may reflect views on monetary-policy divergence, fiscal policy, political risk, capital flows, commodity prices or shifts in the international monetary system.

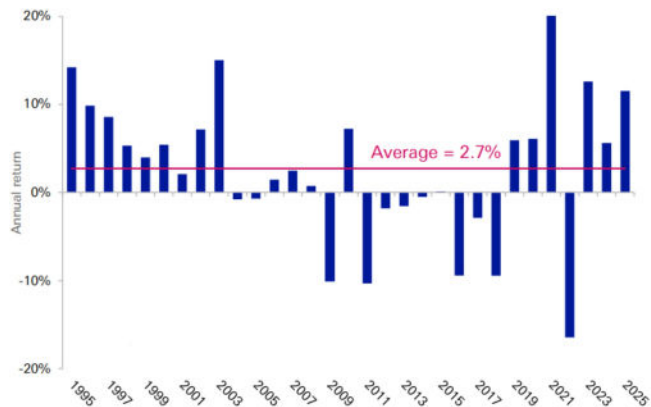
Unlike purely systematic strategies, discretionary investors can place greater weight on events that are difficult to incorporate into historical models, including elections, policy regime changes and geopolitical shocks. This flexibility can be valuable around turning points, but performance depends heavily on the quality of the investor's judgement, timing and risk management.

How have these returns behaved? We take the average of the Barclays, Parker, Hedge Fund Research and Bloomberg macro indices - where returns are available - to come up with an estimate of active manager returns. We show that since 1995, the annual return has been 2.7% on average.

Finally, the Deutsche Bank research team has been producing a tri-annual publication of top trade "[FX Blueprint](#)" recommendations since 2008, intended to replicate the trade recommendations that would appeal to a "traditional" macro hedge fund. The returns of this discretionary macro portfolio are shown below and have also been positive over time.

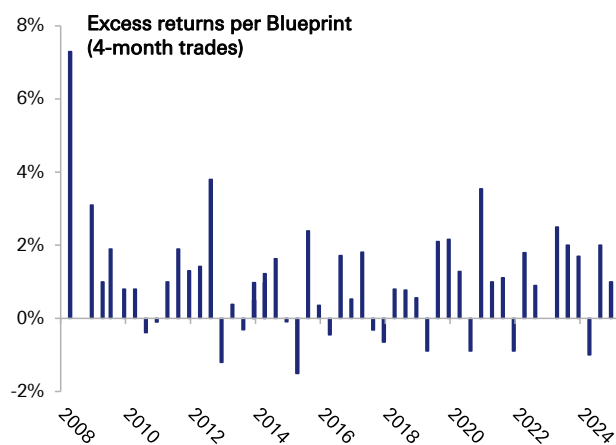


Figure 45: Active FX manager currency returns

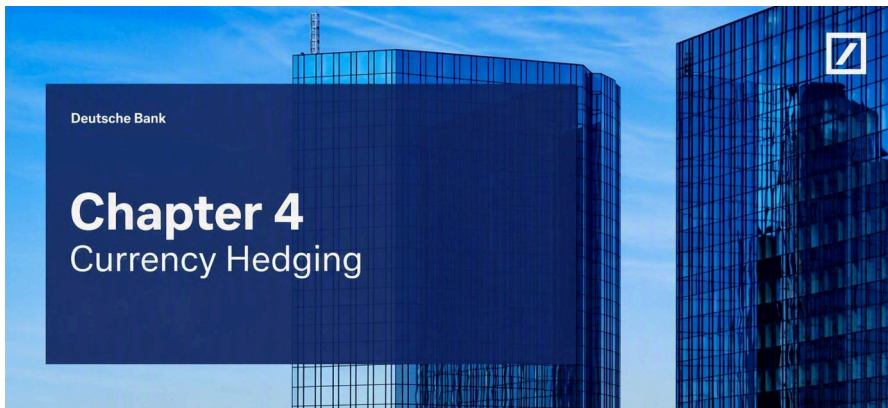


Source : Deutsche Bank, Bloomberg Finance LP [Average returns of Barclays, Parker, HFR and Bloomberg Finance LP FX macro indices]

Figure 46: DBFX Research trade recommendations



Source : Deutsche Bank, Bloomberg Finance LP



Introduction

Currency exposure is unavoidable whenever assets, liabilities or cash flows are denominated in a foreign currency. Yet the decision to hedge is not as simple as choosing between being hedged and unhedged. What is the objective of the hedge? How much risk should be removed, over what horizon, with what instrument and at what cost? Every hedge involves a trade-off. It can reduce uncertainty around portfolio returns, revenues or costs, but it also incurs direct costs through forward points, option premia and transaction expenses, as well as an opportunity cost if the currency subsequently moves in the hedger's favour. This chapter develops a framework for making those decisions. Rather than treating FX hedging as a standalone transaction, it considers currency risk within the investor's total portfolio or the corporate's full set of exposures. It examines passive and dynamic hedge ratios, currency overlay programmes, cash-flow and balance-sheet hedging, and the additional complications created by restricted emerging market currencies. The central argument is that there is no universally optimal hedge ratio: the appropriate strategy depends on the hedger's objective, constraints, underlying exposures and tolerance for cost and risk.

4.1 The problem of defining the hedging "objective"

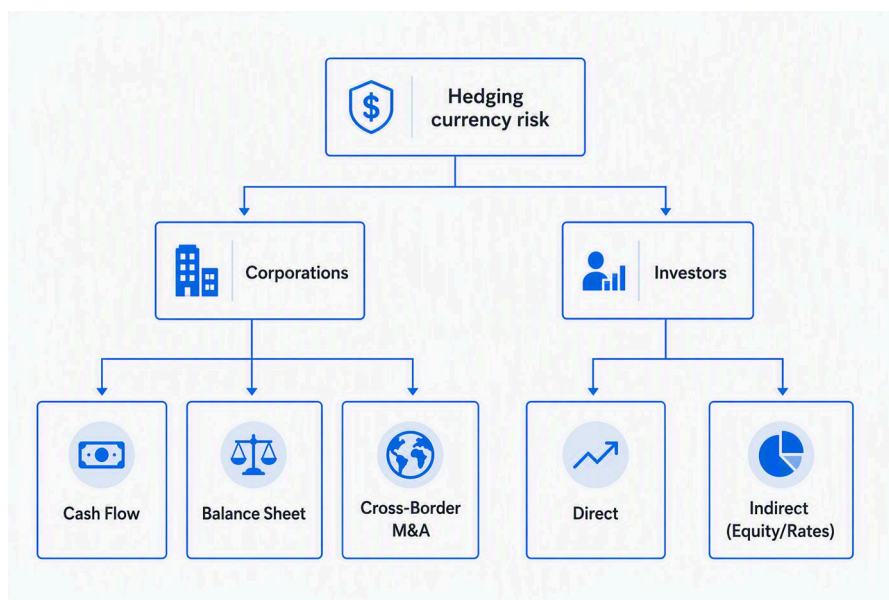
So far we have looked at currency returns from the perspective of an active investor. The objective here is clear: maximise returns. But what about market participants where FX risk is an unwanted by-product of underlying economic exposure. While in theory simple to understand, a hedging objective is far more complicated to implement in practice. The first challenge is that a hedging objective is not well-defined. An investor aims to maximise returns; a "hedger" aims to offset underlying



currency exposure, but to what end? The most frequent objective of hedging is to minimise earnings volatility for a corporate or returns volatility for a passive investor versus a benchmark. In practice, this objective faces multiple difficulties.

First, particularly for corporates, there is no widely accepted and well-defined "benchmark" against which to measure the success or cost of a hedging decision. Second, the objective of earnings volatility minimisation may not be achievable because of imperfect foresight: cashflows and balance sheet exposure are not infinitely predictable and hedgeable into the future. Third, hedging involves a cost. There is the direct cost that needs to be paid to purchase the underlying hedging instrument, usually in the form of forward points. There is also the indirect cost of the "counter-factual" exchange-rate that would have prevailed had the underlying exposure not been hedged. The simple point is that there is an opportunity cost to hedging; and that the volatility minimisation or other objective needs to be set in the context of this cost.

Figure 47: The broad landscape of hedging currency risk



Source : Deutsche Bank

4.2 Currency hedging for investors

Institutions with global investments face unavoidable currency exposure and therefore currency risk. A EUR-based investor holding US equities, for example, is exposed not only to US equity market risk but also to movements in EUR/USD. Because exchange rates can be volatile, economically meaningful and correlated with the underlying asset exposure, FX can materially affect overall portfolio risk and returns.

From static hedging to portfolio-aware hedging

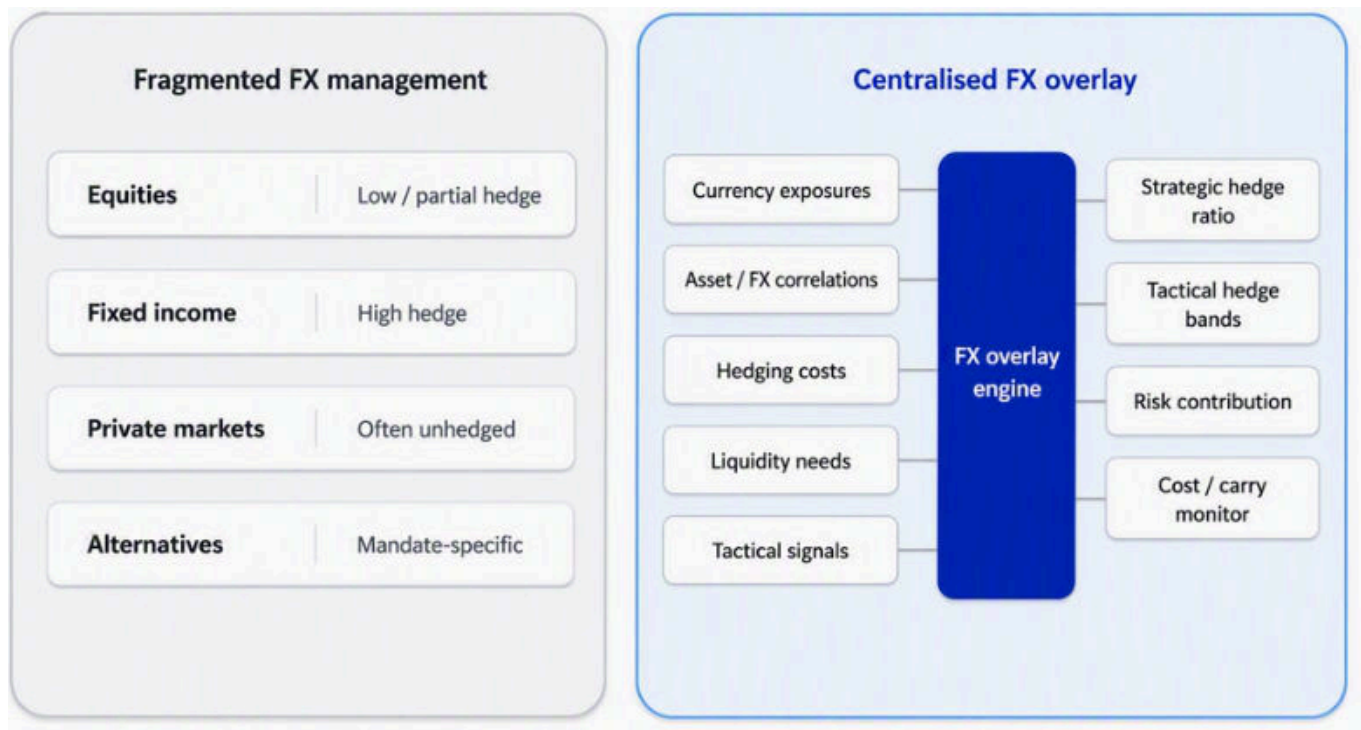
Traditional FX hedging has often been managed in a siloed way: investors may leave exposures unhedged, fully hedge them, or apply a fixed hedge ratio such as 50%



across the portfolio. While simple to implement, this approach can overlook important interactions between currencies, asset classes and portfolio objectives.

A more integrated approach treats currency exposure as part of the total portfolio rather than as a standalone transaction cost. This allows investors to assess whether FX should be hedged to reduce risk, retained as a potential source of return, or managed dynamically through an overlay strategy.

Figure 48: Currency risk – the underrated opportunity under the total portfolio approach



Source : Deutsche Bank, Grover and Anand (2026)

Dynamic FX hedging and total-portfolio risk

Currency risk management is increasingly being viewed through a holistic portfolio lens. [Grover and Anand \(2026\)](#) argue that currency exposure should be assessed within the full portfolio rather than treated as a standalone overlay.

The hedging decision can be viewed through three key considerations:

- How FX contributes to total portfolio risk.
- The cost or benefit of hedging, particularly through forward carry.
- The expected direction of spot, informed by tactical signals such as carry, momentum and valuation.

Cost of carry is only one part of the decision. The realised cost or benefit of hedging ultimately depends on how spot evolves over the hedging period. [Grover and Anand](#)



(2026) find that tactical hedging can help reduce the opportunity cost of hedging by identifying periods when currency returns are more likely to support portfolio performance. The main conclusions of their paper include:

- Dynamic hedging strategies can deliver stronger risk-adjusted outcomes than static hedge ratios.
- Investors generally benefit more from prioritising portfolio volatility reduction than maximising FX carry.
- Incorporating a view on future spot movements through currency signals can improve risk-adjusted returns.
- Tactical signals can help reduce the opportunity cost of hedging by selectively participating in favourable currency moves.

Why currency risk is moving up the agenda

Currency risk has often been overlooked or managed in silos, but investor interest in more active FX management is increasing as institutions adopt a Total Portfolio Approach (TPA) to investing. Choosing not to hedge is itself a risk decision and, if implemented passively, can materially influence portfolio outcomes. While bond portfolios have traditionally been hedged more actively than equity portfolios, many institutional investors are increasingly exploring centralised management of FX exposures across the full portfolio.

Grover and Anand (2026) identify key themes in institutional FX risk management:

1. **Defining the objective:** A fundamental question is whether currency risk should be managed primarily to enhance returns or to improve portfolio risk management. While FX can generate returns in certain market environments, a hedging approach should aim to design programmes that improve portfolio stability while preserving returns where possible.
2. **Benchmark-aware hedging:** An important theme in currency risk management is how to manage currency risk without straying too far from benchmark performance. Many funds are measured against market indices that are unhedged—for example, equity portfolios often track the MSCI World. Another common reference point is peer performance. These practical constraints can be incorporated into a total portfolio approach framework and may still allow for efficiency gains over standard approaches.
3. **Hedging instruments:** While forwards remain the main tool for managing currency risk, options are becoming more widely used. Their embedded cost efficiencies have made them increasingly attractive as a secondary instrument. Funds that must maintain a fully hedged currency exposure are also using options to introduce more flexibility and improve efficiency.
4. **Looking beyond direct currency holdings:** A holistic view of currency risk extends beyond the currencies directly held within a portfolio. For example, if a fund owns a US stock whose business is materially exposed to the Japanese yen, the fund may also have indirect yen exposure. While there is no simple way to measure this, one possible approach is to review company annual and quarterly reports to estimate those exposures.
5. **Private markets and uncertain cash flows:** Currency management is more difficult in private markets because the timing and size of cash flows are uncertain. One emerging approach is to model expected private-asset



distributions under different scenarios, using long-term currency volatilities and correlations, and then design hedging strategies that balance risk reduction against the carry cost of forwards and options.

6. **Cash-flow and liquidity management:** A key practical issue in hedging is managing margin calls, especially when the hedge moves against the hedger. For example, if a currency someone is hedging against starts to strengthen, the hedged position can experience large swings. Solutions are emerging to help clients manage the resulting liquidity needs.

Currency overlay management

Many of these hedging approaches are implemented through currency overlay programmes managed by specialist managers. These firms specialise in managing the foreign exchange exposures that arise from international investment portfolios. Their traditional role has been to implement hedging programmes for institutional investors such as pension funds, insurance companies and asset managers, helping to reduce the impact of currency fluctuations on portfolio returns. These programmes are typically managed separately from the underlying investment portfolio. Systematic currency overlay programmes can range from simple passive hedging to more active approaches. Passive programmes maintain a predefined hedge ratio across foreign currency exposures, while dynamic programmes adjust hedge ratios according to predefined signals such as valuation, momentum or carry. Some overlay managers also run currency alpha mandates, taking active currency positions with the objective of generating returns.

4.3 Currency hedging for corporates

While many of the principles of dynamic FX hedging also apply to corporates, the underlying hedging problem is different. Institutional investors typically hedge currency exposure embedded within assets whose value changes over time. Because the asset value itself fluctuates, a 100% hedge does not necessarily eliminate risk and may even increase volatility if currency and asset returns naturally offset one another. The objective is therefore to manage FX risk as part of the total portfolio.

Corporates, by contrast, are usually hedging known or forecast foreign-currency cash flows, revenues, costs, assets or liabilities. Because the size of the underlying exposure is often known in advance, a corporate can in principle hedge a much larger proportion of its FX risk. The challenge is therefore less about portfolio optimisation and more about balancing risk reduction against hedging costs and opportunity costs. While investors ask how much currency risk should be retained within a portfolio, corporates are typically focused on how much uncertainty around future cash flows should be eliminated and at what cost.

For corporates, the most common source of FX risk arises when purchases, sales, assets or liabilities are denominated in a currency other than the entity's functional currency. The main corporate hedging strategies are cash flow hedging, balance sheet hedging and, less frequently, deal-contingent hedging linked to transactions such as cross-border M&A.

- **Cash flow hedging:** This is one of the most common hedging strategies that require hedging currency risk when the underlying item is not in the entity's functional currency. For example, a sale that has been forecast but has not yet happened does not get recorded on the income statement of the company. These types of transactions that are forecast but not recorded



require a cash flow hedge. In this case, hedge accounting is important as the hedge's mark to market does not affect net income until the underlying transaction is recorded in earnings. It does not create profit/loss volatility during the hedging period. Hedging strategies that are commonly used to hedge future cash flow are the purchase or sale of FX forwards or net purchased options. Let's say a US-based company is contracted to manufacture tyres for a German automaker. This results in a predictable stream of euro cashflows. However, given the company's cost base is in US dollars, it may not be able to protect its revenue margin if euro depreciates considerably against the dollar. The company here then opts for a cash flow hedge to protect its margins.

- **Balance sheet hedging:** In the example above, the company is hedging a transaction which has not yet been recognised as a sale or expense on the income statement. Now say the manufacturer decides to shift its cost base to Europe by building a factory in Europe. Now, the parent company has a EUR asset on its USD balance sheet. Once they start billing out of their EUR subsidiary, for accounting purposes a regular balance sheet hedge may be required as the parent company's functional currency is still USD. In summary, this type of hedging hedges assets and liabilities on corporate balance sheets that are not in the entity's functional currency. A typical balance sheet hedging strategy may be rolling short dated forwards.
- **Deal-contingent and M&A hedging:** Continuing with the example, say the US company instead chooses to merge or acquire a European company. Thus, the cross-border merger and acquisition (M&A) now creates a need for hedging the foreign currency. In certain respects, this type of hedge is conceptually similar to cash flow hedges, as it is based on a potentially unpredictable transaction, but with additional complexities, including whether the underlying transaction is in stock or cash.

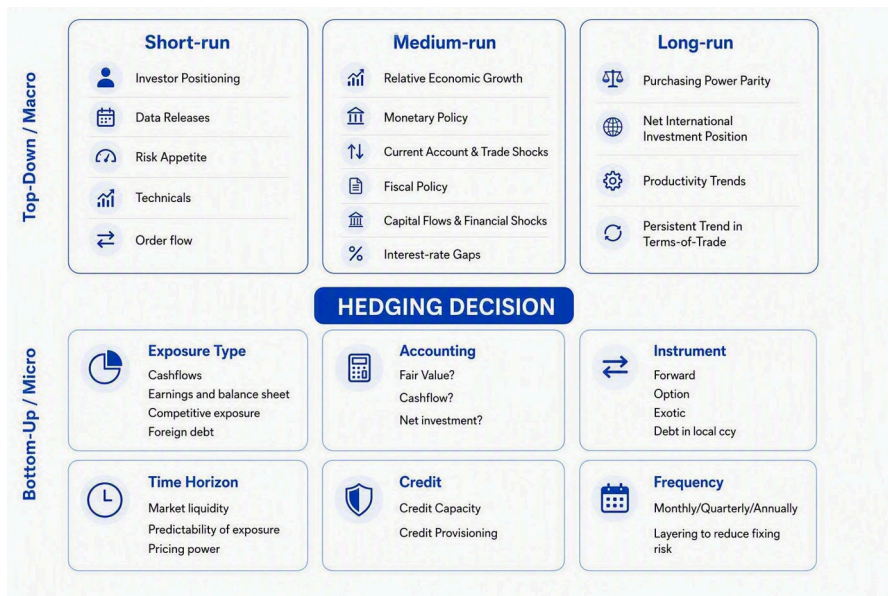
The corporate hedging decision

The "bottom-up" hedging decision involves a large number of parameters the optimal mix of which is unique for each firm. While it is true that many firms share the same basic exposure profile, each firm's strategy can vary dramatically depending on its objectives and constraints. Empirical investigations into the hedging practices of multinational firms show that hedging decisions are influenced by a large number of case-specific factors. These include accounting treatment, competitive price concerns and recent hedging outcomes. Overall empirical studies of corporate risk management suggest that a single, clear and value-maximising policy for risk management is not obvious (Brown, GW 2001). The micro hedging decision will also vary depending on market conditions. In all, the evidence cited above argues against recommending a universally applicable hedging programme for all firms.

The "top-down" elements of the hedging decision relate to the market drivers of FX that we identified in the earlier sections of the report. Unlike the multiple parameters involved in the micro hedging decision, the macro decision boils down to market variables: where does the Treasurer or CFO expect the exchange rate(s) to be over the relevant hedging period and how does this relate to the underlying exposure of the firm? One approach is for the hedger to make a discretionary decision based on his or her underlying assessment of market drivers. Another is to adopt a rules-based approach based on the systematic excess returns we have identified in the FX market. Such an approach would be no different to the dynamic hedging strategy employed by a passive "profit-constrained" investor discussed in the section above.



Figure 49: The Hedging Decision



Source : Deutsche Bank

Dynamic FX hedging for corporates

Dynamic FX hedging differs for corporates and institutional investors. Corporates typically hedge known exposures tied to contracted or forecast cash flows, rather than currency risk embedded in assets whose value can grow over time. In principle, they can remove much of this risk by hedging 100% of the identified exposure. However, a full hedge can carry opportunity costs. For multi-currency exposures, it may overlook diversification benefits when currency moves partly offset one another. It can also lock in hedging costs before the full-period outcome is known, potentially causing corporates, like institutional investors, to forgo gains from favourable currency moves. For corporates, the hedging framework should aim to reduce these opportunity costs without materially increasing risk.

For companies with a single-currency exposure, signal-based hedging frameworks can be useful. Rather than relying solely on forward points, hedge decisions can incorporate carry, momentum and valuation signals to assess whether hedging is likely to be more or less beneficial. [Grover \(2024\)](#) suggests this can reduce the opportunity cost of fully hedging, or of hedging based only on current forward points.

For companies with multiple currency exposures, hedging becomes more portfolio-like. Managing the joint risk of the currency basket through Value-at-Risk or cross-currency correlation analysis can help capture diversification benefits that a full-hedge approach may miss. [Grover and Nandy \(2025\)](#) show that, over recent decades, a holistic FX framework has delivered lower-cost and higher-return hedging outcomes than fully hedging each exposure. This result is particularly clear for euro-based exporters, where carry costs have been higher and correlations between euro crosses have been lower, increasing the value of a portfolio-based approach. Overall, corporate hedging is best approached as a two-step process:



- Manage risk across the full currency exposure, particularly where diversification between currencies exists.
- Use currency signals such as carry, momentum and valuation to reduce the opportunity cost of hedging and retain some participation in favourable currency moves.

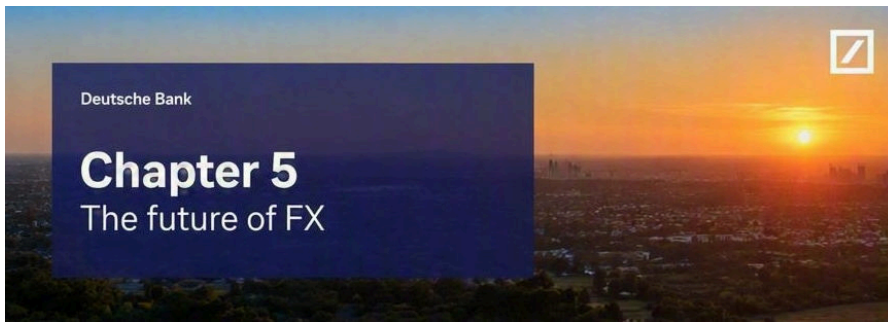
This approach recognises that, while corporates and investors start from different objectives, both can benefit from combining strategic risk management with dynamic currency signals. The difference is that institutional investors seek to optimise FX exposure within a broader investment portfolio, whereas corporates seek to minimise uncertainty around future cash flows while controlling the cost of doing so.

4.4 Hedging emerging market currencies

While the framework above is applicable to both G10 and EM currencies, some EM currencies require additional consideration when hedging. In particular, currencies that are subject to current account restrictions, capital controls, or both operate under different market constraints. We refer to these as restricted markets. Many of these currencies trade offshore through non-deliverable forwards (NDFs), and foreign institutional investors and corporations have historically relied on NDFs to hedge their currency exposures.

However, offshore markets are not always the most cost-effective venue for hedging. On average, onshore forward curves have traded around 40 basis points below offshore curves over the past decade. That creates a potential opportunity for investors. By accessing onshore markets, they may be able to achieve lower hedging costs. For currencies, where operational challenges exist, tactical hedging via cheaper onshore forward markets can further improve hedging efficiency ([Grover, 2026](#) and [Harvey et al., 2025](#)).

Another important consideration when hedging EM currencies is the cross-currency basis, which represents a hidden component of hedging costs for corporate and institutional investors ([Harvey and Friedemann, 2023](#)). Although it has attracted significant attention since the 2008-09 financial crisis, its role in emerging markets is often overlooked despite being larger and more volatile than in many developed markets. The cross-currency basis can create either costs or opportunities for hedgers and issuers. While instruments such as cross-currency basis swaps can be used to manage these exposures, liquidity and market access vary considerably across EM currencies, and usage is typically concentrated at longer tenors. As most shorter-dated EM hedging remains centred on FX forwards and swaps, investors should remain aware of the cross-currency basis when assessing the true cost of hedging.



Introduction

The foreign exchange market has always evolved alongside the technologies, institutions and regulations through which money moves across borders. Payment systems determine which currencies are easiest to use, where liquidity accumulates and who controls the infrastructure supporting cross-border transactions. This final chapter considers how technology, regulation and geopolitics may reshape FX market structure, payments and currency demand.

5.1 Technology and market structure

While electrification aimed to improve the FX market by reducing risk and increasing efficiency, it has inadvertently introduced greater complexity and fragmentation. This has resulted in a more decentralised and dispersed market structure, increasing operational risks such as vulnerability to cyberattacks, even in a traditionally liquid market like FX. Despite these challenges, technological innovation continues to drive change. Distributed ledger technology (DLT), with its decentralised and shared database, offers potential benefits like improved efficiency, transparency, and reduced settlement risk. Furthermore, automation promises cost reductions and efficiency gains in trading processes, while AI and machine learning are being increasingly applied to price prediction, risk management, and fraud detection. The interplay between these technological advancements and the evolving market structure will continue to shape the future of the FX market.

5.2 Stablecoins and payment rails as the new geopolitical battle lines

The dollar is hugely dominant in FX markets today. According to BIS, 88% of FX transactions have a USD leg. The USD acts as a global vehicle currency. It offers the deepest pools of liquidity which makes it cheaper to trade third currencies via their USD crosses. The USD accounts for 50% of messages exchanged on SWIFT for cross-border payment, and its share in trade invoicing far exceeds the US' economic share of global trade. Cross-border USD payments today are mostly



intermediated through the USD correspondent banking system. Global banks are able to transact in USD with each other because they hold accounts with large correspondent banks that settle with each other via the Fed balance sheet in wholesale central bank USD.

But [Sachdeva and Saravelos \(2025\)](#) show that the dollar correspondent banking has been at growing risk of disruption from faster distributed ledger technology, geopolitical competition, alternative payment systems, and underserved corridors in the Global South. Correspondent banking still features slow settlement times, high fees, and fractured access. Many parts of the Global South have declining access to correspondent bank relationships due to growing AML/CFT. Combined with the use of sanctions that cut certain countries from SWIFT, there has been interest in developing alternative payment rails, particularly by BRICS. China has developed CIPS as an equivalent RMB correspondent banking system. China has also been a core member of Project mBridge that explores cross-border CBDC payments on a distributed ledger.

Keeping the dollar dominant in payments and transactions will be of significant importance to the US in a world of heightened geopolitical competition. Remaining the preferred currency of payment is closely linked to being the currency in which external surpluses are built. The world's willingness to save in USD in turn lowers the cost of USD financing which is a big advantage for the US government and corporates. To support the dollar's role in payments in the future, the US appears to be turning to the power of distributed ledger technology and a private form of money: stablecoins.

Stablecoins are new forms of private digital money tokens hosted on blockchains that maintain a peg to a fiat currency. Under GENIUS Act regulation, USD stablecoins will be fully backed by liquid, short-term USD reserves like T-bills to help maintain their 1:1 peg with the USD. 99% of stablecoins outstanding today are linked to the USD. They are issued and traded on distributed ledgers, making them accessible anywhere through the internet. Their on-chain attributes mean stablecoins offer the possibility of near-instant settlement - where all aspects of monetary value transfer from messaging to reconciliation happen together in the form of a ledger update. Stablecoins do however disintermediate the Fed from the settlement process for international payments in USD. Europe and China have taken a very different approach thus far to digital money, concentrating more efforts on central bank digital currencies as their response to the future of cross-border payments.

5.3 Tokenization and programmability

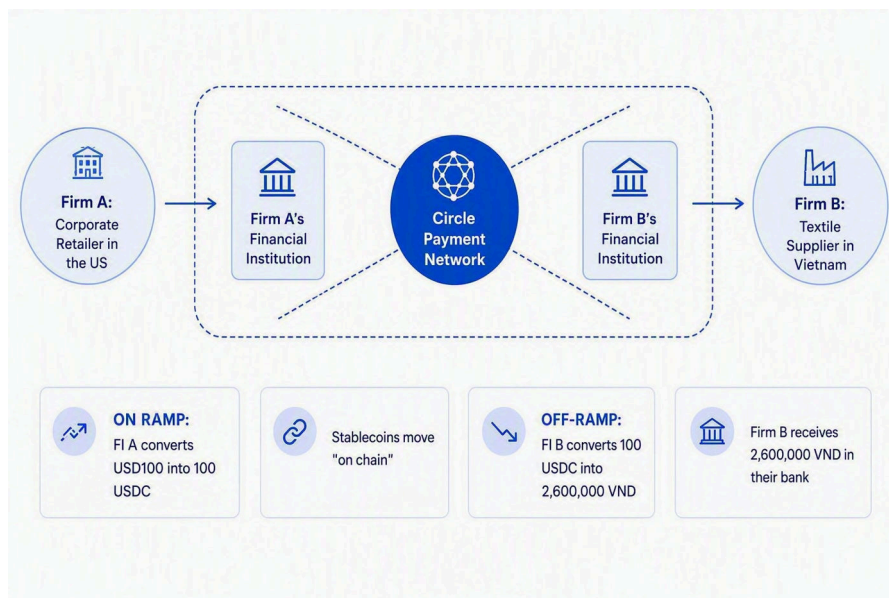
Stablecoins are arguably just a subset of a broader trend towards tokenisation that could open many new possibilities for how FX markets operate in the future. Tokenisation is the process of creating claims on underlying money or assets, that can then be represented as digital tokens and made transferrable on a shared infrastructure. Stablecoins are a new type of tokenized private money, backed by cash, bank deposits or bills. But tokenisation also extends into existing commercial bank deposits, central bank money, and traditional assets like equities, money markets and bonds. In the earlier section we covered how stablecoins might help with cross-border payments, by offering 24/7 infrastructure to move USD that does not rely on traditional banking relationships and hours. But tokenized money can also help with other aspects of the FX settlement process - the exchange of currencies for each other, or for assets. Because FX trading takes place primarily in the over-the-counter market, once a trade is executed and enters the post-trade



process there is settlement risk that is created: payment-versus-payment mechanisms such as CLS or pre-settlement netting reduce the risk to some extent, but tokenized money could offer another feature that addresses it more directly: programmability.

Programmability allows certain automated rules and conditions to be embedded into money processes. This is often implemented through smart contracts that execute transactions when predefined conditions are met, helping improve timing frictions, settlement risk, or the need to pre fund and trap liquidity to meet payment obligations. In a programmable world, a payment can be released only if a corresponding asset is transferred, or an FX transaction can settle only if both currency legs are ready for delivery. This technology can thus support more synchronised settlement processes, linking cash, securities and collateral movements through predefined rules and automated execution. While tokenised money can improve payments and settlement on a standalone basis, its full potential may emerge when combined with increasingly tokenised securities.

Figure 50: How stablecoins might change a cross-border payment



Source : Deutsche Bank, Circle Payment Network White Paper

5.4 Concluding thoughts

The foreign exchange market is one of the most innovative and rapidly evolving financial markets in the world. Over the past two decades, advances in technology, electronic trading, data and market infrastructure have transformed how currencies are traded, priced and managed, placing FX at the forefront of broader changes in global finance. Yet because currencies sit at the intersection of national economies, the FX market remains fundamentally connected to international trade and cross-border investment. It is therefore increasingly exposed to the forces reshaping the global economic landscape—from geopolitical fragmentation and changing trade relationships to shifts in regulation, payments infrastructure and the architecture of the international monetary system. Ultimately, the structure of the FX market is not simply a question of how currencies trade, but of who provides liquidity, intermediates capital and controls the financial infrastructure through



which money moves across borders. In that sense, the evolution of FX is increasingly intertwined with questions of monetary sovereignty, financial resilience and geopolitical power. One thing is therefore clear: understanding what moves and shapes exchange rates, and the market through which they are traded, is more important than ever.



Appendix

Profit vs non-profit seekers in the FX market

We use the 2025 BIS Triennial Survey to update [previous work](#) and estimate the share of FX turnover initiated with a profit-seeking currency objective. We construct two estimates:

- A realistic scenario, applying what we deem realistic assumptions about participants' ability and mandate to take FX risk;
- And an upper-bound scenario, which relaxes those assumptions by classifying ambiguous transactions as profit-seeking.

We find profit-seeking activity accounts for approximately 40% of turnover under the realistic scenario and 60% under the upper-bound scenario.

Financial participants

Dealers:

Dealer-to-dealer activity accounts for approximately 47% of [total daily FX turnover](#) (~\$4.44tn). However, treating all inter-dealer activity as speculative would materially overstate profit-seeking demand. Much of this turnover reflects market-making: dealers absorb client flow, manage the resulting inventory and redistribute risk across the market. In other words, market-making activity provides liquidity to the FX market and should not be interpreted as reflecting speculative objectives, especially given regulatory change since 2008.¹⁷

In order to find the percentage of dealers who engage in profit-seeking behaviour, we assume that inter-dealer transactions conducted by voice are not profit-seeking and that only electronic transactions conducted through order-matching systems such as EBS are profit-seeking.¹⁸

By doing this we find that:

- 20% of dealer flow, approximately \$889bn per day, goes through electronic broking systems, as such, we class all of this as profit-seeking under our "upper-bound" scenario. Given the impact of Dodd-Frank and the Volcker rule on banks' proprietary activities we believe this to be a relaxed assumption.
- Therefore, under a more realistic set of assumptions we classify half of this

¹⁷ At the same time, post-global-financial-crisis regulation has increased the balance-sheet cost of some forms of dealer intermediation and arbitrage. Basel III introduced tighter risk-based capital requirements alongside new liquidity and leverage constraints, including a leverage ratio that captures both on- and off-balance-sheet exposures and derivative positions. These constraints can affect banks' willingness and capacity to deploy balance sheets to market-making and arbitrage activities. One important manifestation has been the persistent, although time-varying, deviations from covered interest parity (CIP) observed since the global financial crisis, reflected in the cross-currency basis. See Borio et al., "Covered Interest Parity Lost: Understanding the Cross-Currency Basis," BIS Quarterly Review, September 2016

¹⁸ More specifically, we use data from the April 2017 Federal Reserve Bank of New York FX Survey and data from the 2025 FXJSC FX turnover survey. In the FRBNY paper, trade execution method is split



flow, 10% of dealer flow as profit-seeking (\$444bn/day). To account for the decline in bank proprietary trading and the importance of inventory management within inter-dealer activity

Hedge Funds and PTFs

Hedge Funds and PTFs account for approximately \$760bn (8%) of headline daily FX turnover and are reported together in the BIS data. Traditionally, banks acted as the primary dealers, or liquidity providers, in the decentralised OTC FX market. However, the expansion of prime brokerage, which has facilitated client access to primary FX trading venues such as EBS and Reuters, has allowed principal trading firms to act not only as profit-seekers but also as liquidity providers.

We assume that:

- All hedge-fund activity is profit-seeking. Hedge funds generally have a mandate to take FX risk, meaning that even transactions associated with purchases and sales of foreign assets may incorporate an active currency view.
- Because the BIS data does not disaggregate the dual role of PTFs (liquidity providing and profit-seeking) we assume liquidity provision is 10% of the BIS' headline "hedge fund & PTFs" \$760bn figure. PTFs, we assume that 90% of headline activity is profit-seeking and 10% reflects liquidity provision.¹⁹

Therefore, under both the realistic and upper-bound scenario we assume that \$684bn (90% of their daily turnover) of hedge fund and PTF activity is profit-seeking.

Non-Reporting Banks

Non-reporting banks account for approximately \$2.19tn, or 23% of headline daily turnover. However, these institutions frequently intermediate transactions for institutional investors and non-financial customers rather than representing a separate source of final currency demand.

We assume that:

- Under our realistic (upper-bound) scenario, we assume that 90% (80%) of this daily flow represents the fact that non-reporting banks act as an intermediary for institutional and other non-financial customers. Therefore, we distribute the 90%, \$1.97tn of daily turnover proportionately, across institutional investors and other non-financial customers.²⁰
- We therefore assume that under the realistic (upper-bound) scenario 10% (20%) of non-reporting bank flow is profit-seeking, in line with our dealer

across two dimensions - voice/electronic and direct/indirect. We assume all voice transactions are liquidity seeking, as well as direct electronic transactions that are conducted through single-bank electronic trading systems. Transactions executed via voice are highly unlikely to be speculative in nature since they typically involve large-ticket customer flow. Foreign exchange desks at banks would be unlikely to be executing large proprietary transactions of such size which would typically take place on electronic matching systems such as EBS. More recent data from the Bank of England finds that 20% of reporting dealer flow goes through these electronic broking systems. We apply the final 20% figure to the worldwide BIS survey from 2025 (10% under our more realistic set of assumptions) to come to an estimate.

¹⁹ Our first assumption is that liquidity provision by PTFs is largely dominated by the spot market. We therefore focus on Hedge fund and PTF volumes from spot trading. According to [BIS](#) 45% of Hedge



assumptions.²¹

Institutional investors:

Institutional investors account for \$1.26tn of daily BIS turnover and present the most difficult classification challenge. After reallocating the relevant flow intermediated by non-reporting banks, their estimated turnover increases to \$2.56tn under the realistic scenario.

We assume that:

- First, given that BIS data does not divide institutional-investor turnover according to the underlying asset class we instead use US Treasury International Capital (TIC) data on gross cross-border purchases and sales of securities to estimate the relative contribution of fixed-income and equity portfolios.²² This adjustment produces an estimated asset-allocation split of 63% equities and 37% fixed income.
- Second, considering this asset allocation split, we use [Morning Star](#) and [ICI](#) data on the share of passive versus active investment funds. We estimate that approximately 45% of equity assets and 60% of fixed-income assets are actively managed. Passive investors consist of index or benchmark-tracking funds and we assume they are active in FX on a transactional non-profit-seeking basis. Active investors aim to outperform a stated benchmark or offer unconstrained positive returns. In practice, this type of investor would still face limits on the amount of exchange-rate risk that can be taken but for the purposes of this exercise we assume all "active" investor flow is profit-seeking in FX.

Putting this together we find that:

Using the US TIC data, it implies an asset allocation split of 66% equity and 34% fixed income split. As per data from Morningstar and ICI, 45% of those equities will be actively managed, compared with 60% of those fixed income holdings.

- **Under our upper-bound scenario**, we assume that all of these actively managed holdings are with firms that are mandated to take FX risk. This implies that approximately 50% of institutional-investor turnover, or around \$1.28tn per day, is profit-seeking.
- Under the **realistic assumption**, active management of the underlying portfolio does not necessarily imply an active currency mandate. An investor may actively select foreign bonds or equities while remaining required to hedge the associated FX exposure mechanically. So, instead of assuming all actively managed equities and fixed income assets are with funds that are mandated to take FX risk, we assume 80% of active fixed-income managers have discretion to take FX risk and 50% of active equity

Fund and PTF volume comes from spot trading. We assume that this is split 50/50 between Hedge Funds, an upper-bound estimate. Further, we also find that [30% of PTF trading can be attributed to market making](#). Together, these assumptions leave us with an estimate of approximately 10% liquidity provision.

²⁰ We do not allocate a share to hedge funds or the official sector, which are more likely to transact directly with large reporting dealers.

²¹ Recent evidence shows that a proportion of non-reporting bank activity is growing <https://www.greenwich.com/market-structure-technology/behind-market-structure-future-nbfp-landscape>, as is their share of profit-seeking activity. As a result of their growing importance, we apply the same split as we do for dealers.

²² TIC data reports (1) monthly purchases and sales of domestic and foreign securities by security type



managers have discretion to take FX risk. This implies a profit-seeking share of approximately 30% under the realistic scenario. Applied to \$2.56tn of institutional-investor turnover, this would equal approximately \$800bn per day.

Official Sector

The official sector includes central banks, sovereign wealth funds and international financial institutions. Its activity accounts for approximately 1%–2% of headline FX turnover. The motivations within this category vary. Central-bank intervention may pursue monetary-policy, financial-stability or exchange-rate objectives, while reserve managers may also seek to preserve capital and earn returns.

We therefore divide official-sector activity evenly between the two categories under both realistic and upper-bound scenarios.

- We classify 50% of the turnover as profit-seeking. Because official-sector activity represents a small share of aggregate turnover, the final result is relatively insensitive to this assumption.

Non-Financial Sector:

Corporates and governments

After allocating non-reporting-bank turnover, estimated non-financial-customer activity is equivalent to around \$952 bn per day in the realistic scenario and \$896 bn in the upper-bound scenario.

We assume that:

- Corporates use FX to settle foreign-currency revenues and expenses, finance cross-border activity, hedge forecast cash flows and manage earnings volatility. Governments similarly transact to meet an underlying funding or expenditure requirement. We classify all non-financial-customer turnover as liquidity-seeking under both scenarios.

Other

The BIS residual “other” category accounts for approximately 2% of headline turnover. It includes activity for which the underlying participant or motivation cannot be identified precisely, including some retail-driven flow. Retail and other residual transactions can serve both speculative and transactional purposes.

Some investors trade currencies to earn returns, while other transactions relate to travel, remittances or purchases of foreign assets. We assume that:

- We classify 100% as profit-seeking under the upper-bound scenario and 50% as profit-seeking under the realistic scenario.

Undistributed

(Table 4). and; (2) foreign holdings of US securities, split between official and private investors and by asset class (Table B). Because we assume official-sector investors have different profit-seeking incentives from private institutional investors, we exclude their activity from the asset-class split. When doing so we find the proportion of institutional investors transacting in fixed income vs equity markets.



Final residual category accounts for less than 1% of headline turnover. Because there is insufficient information to identify its underlying motivation, we classify this turnover as

- 100% liquidity-seeking rather than assume that it represents directional risk-taking. The treatment has little effect on the aggregate result because the category is very small.

Bringing it all together:

Taken together, **under our realistic assumptions** the current model estimates that approximately 40% of adjusted FX turnover is profit-seeking, while approximately 60% is liquidity-seeking or transactional.

Under the upper-bound assumptions, the split is approximately 60% profit-seeking and 40% liquidity-seeking.



Glossary of terms

A

- Algorithmic trading (AT) — Automated trading in which a computer algorithm decides the order-submission strategy.
- Alpha — Return generated by skill or active judgement in excess of a benchmark or of systematic factor exposure, as pursued by discretionary currency managers.
- American-style option — An option that can be exercised at any point up to expiry.
- At-the-money (ATM) — An option whose strike is at or near the prevailing spot/forward rate.

B

- Balance sheet hedge — A corporate hedge of assets or liabilities on the balance sheet that are denominated in a currency other than the entity's functional currency.
- Balassa–Samuelson effect — Theory that faster productivity growth in the tradable sector raises wages and non-tradable prices, generating real exchange-rate appreciation.
- Barrier option — An option whose payoff is activated (knock-in) or extinguished (knock-out) when spot reaches a specified level.
- Basel III — Post-crisis bank regulation introducing tighter capital, liquidity and leverage requirements that raise the balance-sheet cost of dealer intermediation and arbitrage.
- Basic balance — A measure combining the current account with the slowest-moving financing flows (net FDI, and sometimes long-term portfolio flows) to gauge underlying currency demand.
- Basis point (bp) — One hundredth of a percentage point (0.01%).
- Behavioural Equilibrium exchange-rate (BEER) — An equilibrium model estimating the exchange-rate implied by economic fundamentals through panel regression.
- Beta (FX beta) — The systematic, rules-based return available from generic currency factor exposures such as carry, momentum and value.
- Bid-ask (bid-offer) spread — The difference between the price at which a dealer buys (bid) and sells (offer); a frictional cost of trading and the market maker's compensation.

C

- Call option — The right, but not the obligation, to buy one currency against another at a predetermined strike price.
- Capital controls — Official restrictions on cross-border capital movements, common in restricted and emerging-market currencies.
- Capital-weighted PPP — A valuation approach that weights currencies by cross-border financial exposures rather than by trade, reflecting the



geography of portfolios.

- Carry / carry trade — Borrowing a low-yielding currency to invest in a higher-yielding one to earn the interest differential; historically profitable but with negative skew and crash risk.
- Central Bank Digital Currency (CBDC) — A digital form of central-bank money.
- Central Counterparty / Central Clearing Counterparty (CCP) — Financial market infrastructure that interposes itself between buyer and seller, becoming the buyer to every seller and the seller to every buyer, reducing counterparty risk.
- Commodity currencies — Currencies of major commodity exporters (e.g. AUD, NZD, CAD) whose real exchange-rates have strong long-run relationships with world commodity prices.
- Commodity Futures Trading Commission (CFTC) — The US derivatives regulator; source of the IMM speculative-positioning data used to gauge FX positioning.
- Commodity Trading Advisor (CTA) — A systematic macro manager trading diversified futures across asset classes, including currencies, typically via exchange-traded futures.
- Continuous Linked Settlement (CLS) — An independent multi-currency payment-versus-payment settlement system that mitigates FX settlement risk by settling both legs simultaneously and netting payments.
- Convenience yield — The safety and liquidity premium global investors derive from holding US Treasuries, which supports the dollar; measurable via the Treasury basis.
- CORAX — Categorised ORderflow from Autobahn FX — Deutsche Bank's categorised indicators built from globally aggregated electronic spot order flow.
- Covered Interest Parity (CIP) — The no-arbitrage condition that the forward premium/discount equals the interest-rate differential; held almost exactly until 2008.
- Cross-currency basis — The extra spread, over and above the interest differential, of borrowing dollars synthetically through the FX swap market; reflects structural dollar-funding demand.
- Cross-currency swap (XCCY) — A swap that exchanges principal in two currencies at inception and maturity and also involves periodic interest payments in each currency over the life of the contract.
- Cryptocurrency — A digital asset secured through cryptographic and distributed-ledger technologies, such as Bitcoin.
- Currency board — A hard-peg regime in which domestic currency issuance is rigidly backed by foreign reserves at a fixed rate, tightly constraining monetary policy.
- Currency overlay — A programme, often run by specialist managers, to manage the FX exposures arising from an international investment portfolio, separately from the underlying assets.
- Current account — The balance of a country's trade and income flows; a key medium-run anchor summarising the gap between national saving and investment.



D

- Dark pool — A venue with hidden order books that matches buy and sell interest at a venue-calculated midpoint (e.g. BGC MidFX, FXSpotStream MidMatch).
- Deal-contingent / M&A hedge — A hedge linked to a potentially unpredictable transaction such as a cross-border merger or acquisition.
- Dealer — A large commercial or investment bank (or securities house) that makes markets and trades in the inter-dealer market for proprietary purposes and to meet customer demand.
- Delta — The change in an option's value for a change in spot; also used to describe moneyness (e.g. 0–25 delta is out-of-the-money).
- Depository Trust & Clearing Corporation (DTCC) — Operator of a major swap data repository that captures a substantial share of global institutional FX option activity.
- Deutsche Bank Currency Returns Index (DBCR) — A 2007 index packaging transparent, rules-based carry, momentum and valuation strategies into an investable currency 'beta'.
- Deutsche Bank Equilibrium exchange-rate (DBer) — DB's proprietary behavioural-equilibrium model using the terms of trade, a productivity ratio and trade openness; performs better in emerging markets.
- Discretionary manager — An investor who takes active currency positions based on judgement rather than a purely systematic, rules-based process.
- Dodd-Frank — The US post-crisis regulatory framework; includes the Volcker Rule and OTC-derivative reporting requirements.
- Dollarisation — Use of another country's currency as legal tender, which largely eliminates independent national monetary policy.
- Dornbusch overshooting — Model in which sticky goods prices cause the exchange-rate to overshoot its long-run level on impact before reverting, explaining excess FX volatility.
- Drawdown — The peak-to-trough decline in the value of a strategy or portfolio.
- Dutch disease — A situation in which a commodity boom raises the real exchange-rate and erodes the competitiveness of a country's other tradable sectors.

E

- EBS — A primary inter-dealer electronic broking venue, historically central to banks' inventory management.
- Effective spread — A transaction-cost measure inclusive of slippage and fees, giving a more realistic picture of liquidity than quoted depth alone.
- Efficient Market Hypothesis (EMH) — The theory that asset prices fully reflect available information.
- Electronic Communication Network (ECN) — A third-party electronic venue that both streams prices and matches buy and sell orders.
- Electronification — The shift of FX trading from voice to electronic execution across both the inter-dealer and dealer-client segments.
- Emerging markets (EM) — Developing-economy currencies, often subject



to capital controls, higher basis volatility and offshore NDF trading.

- EPIC+ — Deutsche Bank's positioning framework aggregating direct measures (CFTC/IMM) and indirect measures (CORAX, inter-dealer orderbook, risk reversals, DTCC options).
- Equilibrium exchange-rate — The exchange-rate consistent with economic fundamentals and internal/external balance; estimated via frameworks such as FEER, BEER and DBeer.
- European-style option — An option that can be exercised only at expiry.
- External Balance Assessment (EBA) — The IMF methodology that estimates current-account and REER 'gaps' using several complementary approaches.

F

- Fama regression — A test of UIP that regresses realised exchange-rate changes on the interest differential (or forward premium); typically yields a slope below one — the forward-premium puzzle.
- Flash crash — A sudden, severe and short-lived price dislocation, increasingly studied alongside the electronification of markets.
- Foreign Direct Investment (FDI) — The stickier, long-horizon component of external financing, reflecting the partial illiquidity of direct ownership.
- Forward (FX forward) — A contract to exchange currencies at a future date at an exchange-rate agreed today.
- Forward points — The forward premium or discount added to spot; the direct carry cost or benefit of hedging with a forward.
- Forward premium puzzle — The robust empirical finding that high-yield currencies tend on average to appreciate rather than depreciate, making the carry trade profitable and contradicting UIP.
- Functional currency — The primary currency in which an entity operates and reports; FX risk arises from items denominated in other currencies.
- Fundamental Equilibrium exchange-rate (FEER) — The real exchange-rate consistent with the economy operating at internal and external balance.
- FX swap — A contract combining a spot exchange of currencies with a reverse exchange at a later date; the largest FX instrument by turnover and effectively collateralised borrowing.

G

- G10 — The group of major, most liquid developed-market currencies.
- Gamma — The rate at which an option's delta changes with spot; long-gamma dealers dampen volatility while short-gamma dealers amplify moves through their hedging.
- GENIUS Act — US legislation requiring USD stablecoins to be fully backed by liquid, short-term USD reserves (such as T-bills) to maintain a 1:1 peg with the dollar.
- Give-up — The process by which a trade executed by a client is transferred ('given up') to its prime broker, becoming two matching trades.
- Global financial cycle — Rey's concept in which the US dollar and global risk appetite drive worldwide leverage, capital flows and financial



conditions.

H

- Hedge accounting — Accounting treatment that defers a hedge's mark-to-market so it does not affect net income until the underlying transaction is recorded in earnings.
- Hedge ratio — The proportion of an exposure that is hedged; typically sticky and adjusted in cycles, and an increasingly first-order driver of FX.
- Herstatt risk — See Settlement risk.
- High-frequency trading (HFT) — Very high-speed algorithmic trading, often conducted by principal trading firms.

I

- Implied volatility — The market's expected volatility embedded in option prices; the price of protection against exchange-rate movements.
- In-the-money (ITM) — An option that has intrinsic value because its strike is favourable relative to spot.
- Inter-dealer market — The 'inner tier' in which dealers trade among themselves to manage inventory imbalances; no longer exclusive to banks.
- Intermediary asset pricing — A framework in which exchange-rates are set at the margin by constrained financial intermediaries with limited, time-varying risk-bearing capacity.
- Internalisation — Dealers matching offsetting client flow on their own books rather than hedging externally, which has reduced their share of inter-dealer trading.
- International Monetary Market (IMM) — The CME division whose weekly CFTC futures positioning data are used to proxy speculative positioning in FX.
- Intervention — Central-bank buying or selling of a currency to influence the exchange-rate; most effective when large, public, communicated and aligned with fundamentals.

K

- Knock-in / knock-out option — Barrier options that are activated (knock-in) or cancelled (knock-out) when spot reaches a predetermined level.

L

- Last look — A brief window (typically milliseconds) allowing a liquidity provider to accept or reject a trade request after receiving it; prohibited on primary venues.
- Leverage ratio — A non-risk-weighted Basel III capital constraint capturing both on- and off-balance-sheet exposures and derivative positions.
- Liquidity consumer (seeker) — A participant that takes liquidity to meet an underlying need, such as corporates, real-money investors and retail.
- Liquidity firmness — The certainty of execution at a quoted price; reduced by the use of last look on secondary venues, MDPs and SDPs.



- Liquidity mirage — The appearance of depth created by aggregated but potentially inaccessible liquidity spread across fragmented venues.
- Liquidity provider (LP) — A participant that supplies two-way prices to the market, principally banks and some PTFs.

M

- Market maker / market making — Providing two-way prices and capturing the bid-offer spread; a liquidity-providing service rather than a source of the 'excess returns' from proprietary trading.
- Market microstructure — The study of how the trading process itself conveys information and moves prices.
- Meese-Rogoff puzzle — The 1983 finding that structural exchange-rate models cannot out-forecast a naive random walk out of sample, even given realised fundamentals.
- Momentum — A factor and technical signal based on the tendency of price trends to persist.
- Monetary model — An exchange-rate model based on relative money supplies and interest rates; in modern form it uses the monetary policy reaction function and Taylor-rule fundamentals.
- Multi-dealer platform (MDP) — A venue that lets clients request quotes (RFQs) from multiple dealers at once (e.g. FX Connect, FXall, 360T); it bears no inventory risk.

N

- Net Foreign Assets / Net International Investment Position (NFA / NIIP) — A country's external assets minus its liabilities; a long-run anchor for the real exchange-rate.
- Nominal exchange-rate — The quoted price of one currency in terms of another.
- Non-deliverable forward (NDF) — A cash-settled forward for a restricted currency, settled (usually in USD) against a fixing rather than by physical delivery.
- Non-deliverable option (NDO) — A cash-settled option on a restricted, non-deliverable currency pair.
- Non-reporting banks — Smaller banks that do not report turnover directly to the BIS and largely intermediate for institutional and non-financial customers.

O

- Official sector — Central banks, sovereign wealth funds, international financial institutions (IMF, BIS), development banks and government agencies.
- One-touch / no-touch option — Options that pay a fixed amount depending on whether spot does (one-touch) or does not (no-touch) reach a predetermined level during the option's life.
- Order flow — Signed transaction volume (buyer-initiated minus seller-initiated trades); the proximate driver that aggregates dispersed



information into price.

- Out-of-the-money (OTM) — An option with no intrinsic value (0–25 delta); the band favoured by hedgers.
- Over-the-counter (OTC) — Bilateral trading conducted away from an exchange; the dominant structure of the FX market.

P

- Payment-versus-Payment (PvP) — The simultaneous exchange of both currency legs of a trade, which eliminates settlement risk (e.g. through CLS).
- Positioning — The stock of existing long and short currency exposures held by investors; most useful as a contrarian signal at extremes and a measure of market vulnerability.
- Pre-trade anonymity — The degree to which counterparties remain unknown to each other before execution; highest on exchanges and lowest on fully disclosed MDPs/SDPs.
- Prime brokerage (PB) — An arrangement in which a bank lends its credit standing and trading relationships to a client, separating execution from credit provision.
- Principal Trading Firm (PTF) — A lightly capitalised non-bank firm (e.g. XTX Markets, Citadel Securities) that trades for its own account and also makes markets, often via HFT.
- Programmability — The embedding of automated rules and conditions into money, usually via smart contracts, enabling conditional and synchronised settlement.
- Proprietary trading — Profit-seeking trading with a firm's own capital; heavily constrained for banks by the Volcker Rule.
- Purchasing Power Parity (PPP) — The theory that exchange-rates adjust so that identical baskets of goods cost the same across countries; a powerful long-run anchor but a poor short-run timing tool.
- Put option — The right, but not the obligation, to sell one currency against another at a predetermined strike price.

R

- Random walk — A price process with no predictable drift; the benchmark that FX forecasting models struggle to beat at short horizons.
- Real effective exchange-rate (REER) — A trade-weighted measure of a currency's real value against a basket of trading partners.
- Real exchange-rate — The nominal exchange-rate adjusted for relative price levels; it mean-reverts under PPP in the long run.
- Real interest-rate differential — The nominal interest differential adjusted for expected or realized inflation; the more relevant concept for medium-run valuation (Frankel's real-interest-differential model).
- Real money investors — Mutual funds, pension funds, insurance companies and endowments that buy currencies to satisfy end-user demand for underlying assets.
- Reporting dealers — The major banks that report turnover to the BIS; their



share of spot trading has fallen as internalisation has grown.

- Request for Quote (RFQ) — A request from a liquidity consumer to a liquidity provider for the price to buy or sell a specified currency pair, amount and settlement date.
- Request for Stream (RFS) — A continuous flow of quotes for a specified size and duration (such as a trading day) — in effect a continuous RFQ providing real-time price updates.
- Restricted markets — Currencies subject to capital controls and/or current-account restrictions, often traded offshore through NDFs.
- Risk reversal — The implied-volatility difference between an out-of-the-money currency call and an equivalent-delta put; a gauge of skew and directional demand.

S

- Settlement risk (Herstatt risk) — The risk of paying out one currency in an FX trade without receiving the other, arising from settlement across time zones; mitigated by PvP/CLS.
- Sharpe ratio — A measure of risk-adjusted return, defined as excess return per unit of volatility.
- Single-dealer platform (SDP) — A bank's own electronic platform for direct client trading (e.g. Deutsche Bank Autobahn), integrated within the bank's risk-management function.
- Skew Volume Indicators (SVA/SVO) — Deutsche Bank indicators built from DTCC data that separate investor flows (at-the-money, SVA) from hedger flows (out-of-the-money, SVO).
- Slippage — The difference between the expected price of a trade and the price at which it is actually executed.
- Smart contract — Self-executing code that performs a transaction automatically when predefined conditions are met.
- Spot / FX spot — The purchase or sale of one currency against another for near-immediate delivery, typically settling two business days later (T+2).
- Stablecoin — A digital token that maintains a peg to a fiat currency (about 99% are USD-linked), backed by reserves; a potential conduit for dollar demand.
- Standardised Approach for Counterparty Credit Risk (SA-CCR) — A regulatory approach for measuring counterparty credit risk on derivatives, relevant when comparing cleared and bilateral margining.
- Sterilised intervention — Central-bank intervention offset by a domestic money-market operation so that the money supply is left unchanged.
- Straight-through processing (STP) — The automated, end-to-end matching, confirmation and settlement of trades.
- Strike price — The predetermined exchange-rate at which an option can be exercised.
- Swap Data Repository (SDR) — A CFTC-registered repository to which in-scope OTC FX derivatives must be reported under Dodd-Frank.
- Systematic investor — A manager who translates observable data into positions through a repeatable, rules-based portfolio-construction and risk-management process.



T

- **T+1 / T+2** — Settlement one or two business days after the trade date; spot normally settles T+2, while USD/CAD settles T+1.
- **Taylor rule** — A monetary-policy reaction function relating the interest rate to inflation and the output gap; central to modern monetary models of the exchange-rate.
- **Technical analysis** — Forecasting future price moves from patterns in past market data rather than fundamentals (e.g. moving averages, momentum, support and resistance).
- **Terms of trade** — The price of a country's exports relative to its imports; a key real-exchange-rate driver for commodity-exporting economies.
- **Tokenization** — The process of creating transferable digital tokens that represent claims on underlying money or assets on a shared infrastructure.
- **Top-of-book spread** — The best (tightest) bid-offer spread available on a venue; used to track FX market quality over time.
- **Total Portfolio Approach (TPA)** — Managing currency exposure as an integral part of the whole portfolio rather than as a standalone overlay or transaction cost.
- **Treasury basis** — The yield gap between US government bonds and currency-hedged foreign government bonds; a measure of the dollar's convenience yield.
- **Treasury International Capital data (TIC)** — US data on gross cross-border purchases and sales of securities, used to split investor turnover between fixed income and equities.

U

- **Uncovered Interest Parity (UIP)** — The condition that the expected change in the exchange-rate equals the interest-rate differential; strongly rejected in the data, which underpins the carry trade.

V

- **Value (valuation factor)** — A strategy that goes long undervalued and short overvalued currencies relative to an equilibrium anchor such as PPP or DBBeer.
- **Value-at-Risk (VaR)** — A statistical estimate of the potential loss on a position or portfolio over a horizon at a given confidence level; used in portfolio hedging.
- **Vanilla option** — A standard call or put option with no exotic features.
- **Voice trading** — Trade negotiation by telephone or messaging rather than electronic systems; classified as voice-direct or voice-indirect (via a broker).
- **Volatility smile** — The pattern of implied volatility across option strikes, conveying the market's perceived balance of tail risks.
- **Volcker Rule** — A Dodd-Frank provision (implemented 2014–15) banning banks from most proprietary trading, including many foreign-exchange instruments.



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Other Sources

Artificial Intelligence has been used to generate and/or enhance certain diagrams and parts of the text in this handbook, including the cover image.



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