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by

Alexei Orlov, and Rajiv Sharma

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Which Witch is Which? Deconstructing the FX Markets Activity*

Alexei G. Orlov[†]

U.S. Commodity Futures Trading
Commission

Rajiv Sharma

U.S. Commodity Futures Trading
Commission

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Abstract

Using regulatory data on transactions and positions, we provide a comprehensive overview of the activity in the foreign exchange (FX) derivatives markets, including futures, swaps, and options, covering both exchange-traded and over-the-counter (OTC) products. The heretofore publicly unavailable statistics trace the behavior of dealers, hedge funds, asset managers, pension funds, insurance companies, and sovereign and supranational institutions before, during, and in the aftermath of the market stress of March 2020. We show that when the COVID market shock sharply increased the demand for the U.S. dollar (USD), certain client sectors (e.g., hedge funds and sovereigns), along with dealers, provided USD liquidity by significantly increasing their long-USD swap positions. We find that client sectors are heterogeneous with respect to their liquidity needs and that their aggregate positions are small compared to dealer inventories. In addition to the inter-sector heterogeneity, we highlight the heterogeneity of firms within a client sector by focusing on hedge funds' USD/Euro swap positions—the most active client sector and currency pair in our data. The FX dealers, on the other hand, follow largely similar strategies, are competitive, and engage in multilateral netting arrangements to significantly reduce their risk exposure. Finally, using a sample of hedge funds that simultaneously participated in swaps and futures markets, we present evidence on trading volumes and frequencies that suggests that the OTC market is the preferred space for FX risk transfer, whereas the exchange-traded derivatives market serves the price discovery and immediacy functions for smaller trades.

Keywords: Foreign exchange markets, FX swaps, FX forwards, FX futures, FX options, FX spot markets, COVID market stress.

JEL classification: F31, G23, G10, G13, G15, G01.

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[†] Corresponding author. U.S. Commodity Futures Trading Commission, 1155 21st Street NW, Washington, DC 20581; aorlov@cftc.gov.

1 Introduction

Foreign exchange (FX) markets are subject to relatively light public reporting requirements—as compared, for example, with interest rate or credit derivatives—and this is the case across all major jurisdictions. In the U.S., for example, physically delivered FX swaps, forwards, and spots account for nearly ninety percent of the FX OTC market, yet they are exempt from the “swap” definition by the U.S. Department of the Treasury and are not subject to public reporting.¹ There is also a gap in the extant academic literature, as well as in the official sector reporting, with respect to detailed FX market statistics based on regulatory data. The dearth of publicly available data and regulatory data summaries makes it difficult for market participants, researchers, and policymakers to understand market trends and make well-informed policy and risk management decisions.

This paper aims at alleviating these deficiencies by studying regulatory data on transactions and positions in FX derivatives. The paper provides heretofore publicly unavailable statistics based on the Commodity Futures Trading Commission (CFTC) regulatory data that include nearly all FX derivatives traded by U.S. reporting entities, including U.S. entities and foreign dealers registered with the CFTC. The CFTC regulatory data account for a significant share of the global FX derivatives markets. For example, for FX swaps/forwards, which is the most important FX derivative category—as measured by both notional amount outstanding and traded volume—we estimate that approximately 60% of the global FX positions are reported to CFTC (see Table 3 in Section 3 below). Additionally, since the U.S. Department of the Treasury has jurisdiction over the FX spot markets, and since spot transactions do not get reported to the CFTC or the public, we acquired FX spot data from the CLS Bank to ensure completeness of our analysis across all FX market segments.

The paper provides a comprehensive overview of the activity in the FX derivatives markets, including futures, swaps, and options, covering both exchange-traded and over-the-counter (OTC) products. Our main sample period is December 2018 through September 2020 and spans the pre-pandemic period, the severe market stress of March 2020, and the subsequent recovery. Although the aggregate notionals remained quite stable during this period, there were interesting shifts in the behaviors of dealers, hedge funds, asset managers, pension funds, insurance companies, and sovereign and supranational institutions, which we explore in this study. We report on the preferred FX instruments of these various market participant groups as

¹ *Determination of Foreign Exchange Swaps and Foreign Exchange Forwards under the Commodity Exchange Act*, November 20, 2012, available at <https://www.federalregister.gov/documents/2012/11/20/2012-28319/determination-of-foreign-exchange-swaps-and-foreign-exchange-forwards-under-the-commodity-exchange>.

well as on how their trading and holdings evolved over time and, in particular, during the COVID-induced market stress. A special emphasis is on the behavior of the hedge funds and other institutional investors in U.S. Dollar/Euro (USD/EUR) derivatives, which is the most active currency pair within the CFTC's jurisdiction and which experienced high volatility during the pandemic.

A list of questions that our study seeks to answer includes—but is not limited to—the following. How large is each sector (or market participant group) in each major currency market? To what extent are various sectors characterized by netting within counterparty relationships? Which sectors are net long and which are net short for a given currency? How does this breakdown change over time? How much does currency positioning vary across individual entities within a particular sector?

We report many novel stylized facts about the FX derivative markets, and our key findings are as follows. First, during our sample period, the number of unique clients in the FX swaps markets declined steadily for almost all client categories, including asset managers, hedge funds, pension funds, and insurance companies. Second, leveraging our ability to net exposures bilaterally (thanks to our rich regulatory data that include counterparty information), we find that a typical intermediary enters into multiple offsetting contracts with clients, thereby reducing its effective risk exposure to nearly a quarter of the gross notional, on average. We posit that bilaterally netted notional is a better proxy for the true currency risk exposure vis-à-vis the commonly used gross notional.

Third, nearly all FX swap transactions have a swap dealer as one of the counterparties, and the number of swap dealers has remained steady during the sample period. The FX swaps market can be considered competitive, based on our Herfindahl-Hirschman Index (HHI) calculations, and is characterized by a diverse set of dealers. The dealer competition had gradually increased since the start of our sample through the first quarter of 2020, and this (possibly short-lived) trend has reversed in the wake of the pandemic.

Fourth, the aggregate FX swap notional amounts have remained relatively stable during the sample period. However, we observe considerable volatility during the peak of COVID-related market turmoil, with the hedge funds being the most active market participants group. Hedge funds significantly increased their long-USD (or receive-USD) positions during the pandemic. Fifth, during the height of the pandemic-related market stress, the transaction volumes spiked for almost all products, including swaps, forwards, futures, and spots, but these volumes reverted to normal levels soon thereafter. The average trade size and tenor were slightly lower and more volatile during the pandemic vis-à-vis tranquil periods.

Sixth, analyzing the intra-sector variation for the USD/EUR swaps notionals (the currency pair with the highest notional amount), we explore empirical distributions of intermediaries' and clients' positions. Nearly all swap dealers adopt similar strategies of simultaneously having both long and short positions with different counterparties. Conversely, clients are primarily directional and follow heterogeneous strategies. We find that for the hedge funds client category, the size and directionality of a small number of hedge funds drive the overall sector statistics.

Finally, we also present a case study using economically similar Euro futures and USD/EUR swaps held and traded by a sample of hedge funds that used both swaps and futures. The case study highlights the hedge funds' usage of futures vis-à-vis swaps, with futures trading being much more active, non-directional, and smaller by two orders of magnitude as compared with swaps trading.

Our study facilitates a better understanding of the FX derivatives markets in their complexity. Stylized facts presented in the paper should help policymakers, researchers, and market participants to identify areas that may require regulatory attention, formulate fruitful research questions, and fine-tune trading and hedging strategies. Our framework may be helpful in studying other events associated with exchange rate changes. For example, our approach can be relevant for analyzing other shocks in the FX markets, including conventional and unconventional monetary policies and geopolitical events such as Brexit or the Russian invasion of Ukraine.

The rest of the paper is organized as follows. The next section provides pertinent institutional background and a broad overview of the segments that comprise the global FX market. Section 3 describes regulatory and nonregulatory data used in this study. Section 4 summarizes our methodology with respect to the OTC markets, including bilateral netting of positions. Sections 5 and 6 present the FX swaps market analysis, which studies swaps positions by firm type and currency, across- and within-sector distributions of net notionals, dealer concentration, and trading volumes. FX futures open interest, FX futures trading volumes, and FX spot market activity are examined in Section 7. Section 8 presents a case study on hedge funds' simultaneous use of FX swaps and futures. Main conclusions are drawn in Section 9.

2 Product and regulatory background

2.1 Products overview

Similar to other asset classes, the FX market has a spot, or cash market, wherein trades are settled within two days. If a currency contract involves settlement in more than two days, it is considered to be an FX derivative. FX derivatives can be traded either on a regulated futures exchange or bilaterally in the OTC market. The most commonly used FX derivative products are forwards,

swaps, exchange-traded futures, and options. This subsection briefly describes each of these products to facilitate the subsequent discussion of the dynamics of the various FX market segments.

In the context of FX products, the term *spot market* is used more frequently than *cash market* as each side to a trade is exchanging cash in one currency for cash in another currency, and the term *spot market* avoids any potential confusion. The CFTC has regulatory jurisdiction over derivatives (in addition to anti-fraud and anti-manipulation jurisdiction over the underlying assets). FX spot market is the underlying cash market for FX derivatives; the spot market is under the purview of the U.S. Department of the Treasury.² Spot trading is fragmented across *primary venues*, i.e., Electronic Broking Services (EBS) and Refinitiv (formerly Reuters) Matching, and a number of *secondary venues* consisting of proprietary spot trading platforms offered by large currency dealers.

An *FX futures* contract is a standardized forward contract traded on organized exchanges rather than negotiated and traded on an OTC basis (e.g., King, Osler and Rime, 2012). These futures exchanges offer futures and options on futures on various currencies. Futures markets serve essential functions of immediacy, price transparency, price discovery, and access to many participants (e.g., Rosenberg and Traub, 2009, and references therein). Recently, futures exchanges have encouraged participation by retail investors by offering products such as mini and micro contracts that require relatively small margins.

Unlike futures contracts, OTC contracts are not standardized, although there might be a lot of commonality across a number of products. Instead, the terms and conditions of each contract are negotiated bilaterally with a financial intermediary, which is generally a dealer firm within a large international bank. The OTC category includes a broad set of derivative products, including outright deliverable currency forwards, non-deliverable forwards, plain vanilla FX currency swaps, cross-currency swaps, OTC options, and any other customized derivative contract (e.g., King, Osler and Rime, 2012).

An *FX forward* is a transaction that involves exchanging two currencies on a specific future date at a fixed rate agreed upon at the contract's inception. In an outright USD/EUR FX forward contract, the counterparties agree to deliver a specified amount of EUR in exchange for USD at a future date. A counterparty that is long USD is short EUR, and vice versa. An *FX swap* is the most common FX derivative product, whereby two parties exchange currencies for a specific time and agree to reverse the transaction at the contract's maturity. The near leg of the FX swap closely resembles a spot transaction, while the far leg looks similar to an outright FX forward. An *FX OTC*

² The SEC can indirectly touch this regulatory space by virtue of regulating various trading platforms (e.g., through Reg ATS or Reg SCI).

option provides the option holder the right to buy (in the case of a call option) or sell (for a put option) a predetermined amount of a currency at a predetermined exchange rate. In recent years, Swap Execution Facilities (SEFs) have emerged as electronic trading platforms for OTC products. Tullett Prebon, BGC, Tradition, and GFI SEFs are the top-ranked SEFs for FX OTC trading based on the 2020 average daily volumes.³

2.2 Global foreign exchange market

Every quarter the Bank for International Settlements (BIS) publishes information about exchange-traded FX derivatives. The FX OTC positions are published semi-annually, and the FX transaction volume is presented on a triennial basis. Table 1 scopes the size of the global FX market as of December 2020 (approximately consistent with the end of our clean data sample in September 2020) and provides the average trade volume as of April 2019. BIS reports that as of April 2019, the global daily turnover of FX swaps and outright forwards totaled \$3.2 trillion and \$1 trillion, respectively, while that of FX spot market stood at \$1.9 trillion.⁴ The total notional outstanding of the global FX derivatives was \$97.9 trillion as of December 2020. FX swaps have the largest notional amount in positions outstanding as well as in trading volume.

[Table 1 here]

The size of the OTC FX swaps, forwards, currency swaps, and options has grown considerably over the past few years. Globally, nearly 88% of FX trades have USD as one leg. Euro, Japanese Yen, and British Pound are the next largest currencies with a combined volume of 62% against USD. FX swaps and spots are the largest products in terms of trade volume.⁵ BIS recently released results from the 2022 survey, which shows a 14% growth in the average FX OTC trade volume since the April 2019 survey results.⁶ Overall, the latest survey results are similar to the previous, 2019 survey results used in our analysis. The U.S. dollar was on one side of 88% of all trades (unchanged from 2019). The share of spot trades fell slightly from 2019, whereas the percentage of FX swaps in the overall FX trade volumes has increased in recent years.

Unlike rate swaps, where the notional is a theoretical value based on which interest rate differential payments are calculated, most FX swaps and forwards involve actual delivery of the notional amount in respective currencies (except non-deliverable forwards, which account for less than 10% of the market). Most FX derivatives have short tenors and are rolled over at

³ SEF summary data are provided by FIA and are available at <https://www.fia.org/monthly-volume>.

⁴ *Triennial Central Bank Survey of Foreign Exchange and Over-the-counter (OTC) Derivatives Markets in 2019*, Bank for International Settlements, available at <https://www.bis.org/statistics/rpfx19.htm?m=2617>.

⁵ *Ibid.*

⁶ The most recent, 2022 survey is available at https://www.bis.org/statistics/rpfx22_fx.htm.

maturity. Rollover needs for physical delivery can potentially create settlement risk and liquidity crunch (e.g., Borio, McCauley and McGuire, 2022).

Table 2 presents exchange-traded FX futures and options open interest by location of the exchange, as reported by the BIS in their quarterly statistics on exchange-traded derivatives. As of December 2020, the global FX futures and options market was about \$450 billion in open interest, of which North America accounts for approximately 60%.

[Table 2 here]

FX derivatives reporting is fragmented and limited, which creates a need for more information on aggregate FX trading activity and the sizes of positions held. The most comprehensive information to date about the global FX markets comes from the dealer surveys conducted by the BIS. Appendix A describes various other sources of information on FX derivatives.

3 Regulatory and proprietary data overview

This section describes the data—both regulatory (for derivatives) and proprietary (for the spot market)—used in our study, and compares the CFTC regulatory data with global estimates from BIS. We highlight several methodological differences to facilitate the comparison of our numbers with those reported by the BIS. The FX OTC Part 45 data are extensive and complex. Before analyzing these data, we clean them by removing duplicate records (e.g., due to two-sided reporting), inter-affiliate records, and data reporting errors. The data are then standardized for product descriptions and categorized to calculate gross and bilaterally netted notionals. We source FX futures data from CFTC’s Integrated Surveillance System (ISS), which uses data collected under Part 17 of the CFTC regulations.⁷

3.1 FX OTC positions data

The global statistics on FX OTC positions are obtained from the BIS semi-annual survey of about 70 dealers in 12 countries.⁸ Dealers report positions to the reporting authority of the country where the parent company of the dealer is headquartered. Reporting is done on a consolidated basis so that inter-affiliate positions are excluded. BIS consolidates reports from the 12 countries and removes duplicate reporting of the dealer-to-dealer positions. In the U.S., the reporting authority is the Board of Governors of the Federal Reserve System.

We follow a similar approach to that of the BIS to calculate the gross notional of OTC FX positions reported to CFTC in Part 45 data. Table 3 provides the coverage of the FX position reported CFTC vis-a-vis BIS’ global numbers. Panel A summarizes the size of the global FX derivatives by product

⁷ 17 CFR Part 17, available at <https://www.ecfr.gov/current/title-17/chapter-I/part-17>.

⁸ “BIS OTC derivatives statistics: Explanatory notes,” available at <https://www.bis.org/statistics/derstats.htm?m=2071>

and currency, as reported by the BIS. USD is the dominant currency for all product categories, and swaps/forwards have the largest notional of \$55.6 trillion for all currencies as of June 2020. Panel B of Table 3 tabulates a similar summary of the FX market under CFTC jurisdiction, and panel C compares CFTC numbers with those provided by the BIS. For example, as shown in Panel C, our coverage is 58%, 40%, and 48% of the global market for swaps/forwards, cross-currency swaps, and options, respectively.

[Table 3 here]

3.2 FX OTC transactions data

BIS trade volume data are sourced from a different survey that is conducted once every three years. BIS triennial surveys of the FX trades started in 1986 and are considered to be the most comprehensive source of information on the size and structure of the global FX OTC derivatives market. Nearly 1,300 banks and dealers located in 53 countries participated in the 2019 survey. Unlike the positions survey, which is on a consolidated basis, the BIS trade volume survey is based on the location of the trading desk or the sales desk. Each participating central bank surveys the dealers located in its country. BIS then consolidates survey results from the central banks to compile global totals.

The global average trading volume for FX swap and forwards was \$5.5 trillion as of April 2019 according to the BIS triennial survey (Table 4). UK has traditionally been the hub of FX trading and accounts for approximately 40% of the global trading volume, followed by the U.S. with roughly 15% of the global trading volume. Hong Kong, Singapore, and Japan are the next three big trading hubs for FX derivatives.

[Table 4 here]

3.3 Methodological differences for OTC transactions data: CFTC vs. BIS

Regulatory data received by the CFTC for the same period is ostensibly about a quarter of the global volume (Table 4). This lower coverage of transactions volume contrasts with the coverage for positions where CFTC data accounts for more than half of the global amount outstanding. Significant differences in collecting and compiling CFTC transaction data vis-à-vis the BIS triennial survey might help explain the purportedly low CFTC coverage. Methodology differences for processing of inter-affiliate, allocation (or back-to-back), and compression trades are some of the examples that may cause differences in trading volumes between BIS and CFTC. Dealers participate in multilateral compression services, such as those provided by triReduce, that replace offsetting positions with a single new trade representing the net position that leaves the economic exposure materially unchanged. The resulting compression trade can have a large

notional amount since it applies to the entire portfolio of outstanding derivatives positions. Each compression cycle can create new compression trades, which artificially inflate trade volumes.

According to the BIS, a rise in non-market-facing trades, such as compression and back-to-back trades, helped boost turnover in OTC markets, and compression trades may account for a large portion of the increased turnover in BIS transaction data (Ehlers and Hardy, 2019). However, in our calculations we are able to avoid these issues thanks to the granularity and richness of the CFTC regulatory data.

For the CFTC totals discussed above, diligent attempts were made to exclude these non-market-facing trades, which lowers CFTC's numbers relative to BIS's. Indeed, our approach, which properly accounts for compressions and excludes inter-affiliate trades, allows for more precise calculations of risk exposures and risk transfers.

3.4 FX spot market data

The daily trading volume of FX spot market is significant, accounting for nearly a third of the total FX derivative trading volume (Table 1). As spots get settled within a day or two, the outstanding positions on any given day are close to zero. Spot settlement data for this study was acquired from CLS Bank, which is considered to be one of the best sources of FX spot market data. For example, Hasbrouck and Levich (2017) use CLS Bank's settlement data to examine liquidity in the FX spot market and describe in detail the structure and mechanics of the CLS Bank. CLS began its operation in 2002 as a Continuous Linked Settlement (CLS) system by a consortium of 74 banks. It is a specialized multilateral payment-versus-payment settlement system that simultaneously settles both legs of every trade to reduce foreign exchange settlement risk.⁹ Settlement risk is a crucial operational risk in the FX market, and failure to settle a large FX trade could trigger a string of defaults.

Table 5 compares the CLS settlement data with the global volumes reported in the BIS triennial survey. CLS spot settlement data used in our study represents approximately 20% of the global FX spot trading volume for USD. This is consistent with the BIS estimates that nearly 80% of FX spot trades are internalized by dealers, i.e., the dealers settle approximately 80% of the FX spot trades within their customer accounts and send the remaining 20% of FX trades to a third-party settlement system such as the CLS bank.¹⁰

[Table 5 here]

⁹ See the CLS Bank's webpage for further details: <https://www.cls-group.com/about/>.

¹⁰ Internalization ratio for G4 currencies for the UK and the US was about 80% in 2019 (Drehmann and Sushko, 2022, Graph 6).

4 Methodology for calculating FX OTC net positions

4.1 Bilateral netting

Notional amounts reported earlier are arguably an inflated measure of the size of the OTC markets, as described in the Entity-Netted Notionals (ENNs) reports (CFTC, 2022b). When the counterparties offset an existing OTC contract, they often enter into a new contract taking opposite sides vis-à-vis the original contract. As a result, the reported gross notional amount gets doubled rather than reduced to zero. Double-counting an effectively closed position is a known problem with using gross notional as the size of the swaps and forwards. CFTC introduced Entity-Netted Notionals (ENNs) as a more accurate metric for expressing notional amounts. Our regulatory data allow us to calculate potential bilateral netting within counterparty and currency pairs.

We leverage the ENNs methodology for FX swaps to calculate bilaterally netted notional for each firm in our sample by netting long and short positions for each currency between the same pair of legal counterparties. If a firm has long and short positions in a currency against different counterparties, we do not net those positions. In contrast, all FX futures contracts on an exchange face a single clearing house, which results in perfect netting. Under this arrangement, the open interest for a contract is a good measure of FX risk transfer. The ENN calculation, which nets positions bilaterally, does not refer to the more traditional interpretation of net position as long minus short. Net long and net short positions for each market participant group represent the long ENN and short ENN positions, respectively. Unless noted otherwise, in this paper net long and net short positions are studied separately. Lest there is any confusion, when we subtract shorts from longs, we refer to this difference as “long minus short” instead of “net” in order to distinguish this difference from the concept of bilateral netting.

4.2 Net notional calculation

We remove inter-affiliate trades, allocation trades, and duplicate trades to calculate the entity netted notionals (ENNs) for the FX swaps data. We then net the gross notional within each legal entity and each currency pair. The FX options are expressed in delta equivalents when calculating the entity-netted notional amounts. Products included in the entity net notional calculations include swaps, forwards, non-deliverable forwards, cross-currency swaps, and options. Each legal entity is classified into various sectors based on S&P’s Cross-Reference Services and manual classification by the CFTC staff.

We group participants into several sectors: dealers, hedge funds, asset managers, banks, pension funds, insurance companies, and sovereign and supranational institutions. As highlighted previously, a sample of questions that our analysis attempts to answer includes the following. How large is each market participant group in each major currency market? To what extent are

various sectors characterized by netting within counterparty relationships? Which sectors are net long and which are net short for a given currency? How does this breakdown change over time? How much does currency positioning vary across individual entities within a particular sector?

We begin by calculating FX OTC net notional for each sector. Table 6 presents the number of firms in dealer and client categories (column 2) followed by their corresponding total gross notional for all FX OTC products with USD as one leg (column 3). Our data show a \$52 trillion gross notional for 2020Q3 (the sum of the dealer and client gross notionals divided by two), as compared with the BIS report's gross notional of \$80 trillion for 2022Q2 (Borio, McCauley and McGuire, 2022). In the BIS report, payment obligation figures are based on gross positions and do not factor in bilateral netting. In contrast, CFTC regulatory data allows us to calculate net positions after bilateral netting, leveraging the entity-netted-notional (ENN) methodology.

[Table 6 here]

Accordingly, in Columns 4 and 5 of Table 6, we estimate the net positions after bilateral netting. These estimates of bilateral netting net down the dealer notional to \$8.8 trillion long USD (11% of gross notional) and \$9.2 trillion short USD (12% of gross notional). The short USD position is an obligation to pay USD and receive the currency of the other leg of the trade and vice versa.

Among the client categories, asset managers, pension funds, and insurance companies have predominantly short-USD positions, i.e., they have more positions where they pay USD against receipts in multiple currencies rather than receive USD against payments in multiple currencies. These clients generally have obligations in domestic currency, but they hold a globally diversified portfolio with a substantial portion of assets denominated in the U.S. dollar. These market participants use FX swaps to finance asset purchases and to hedge the currency mismatch between their asset and liabilities.

On the other hand, hedge funds, corporates, and sovereign and supranational institutions have positions resembling the supply side for the U.S. dollar. The sovereign/supranational category consists of central banks, sovereign funds, and supranational lending agencies. The "other" category consists of firms with relatively small notional amounts that cannot be classified due to missing information. A vast majority of these firms are non-U.S. firms.

In aggregate, the gross notional of clients nets down to \$5 trillion long-USD, i.e., receive-USD (which represents 20% of gross client notional) and \$4.6 trillion short-USD (18% of gross client notional). Similarly, for dealers the notional nets down to 23% (11% long plus 12% short) when bilateral netting is applied. Most dealers also participate in multilateral netting arrangements that further reduce net positions. Industry estimates from CLS Settlement claim that multilateral

netting of FX OTC nets down the notional amounts to about 4% of the gross notional.¹¹ Thus, our net notional calculations are upper-bound estimates of a dealer’s currency exposure because it does not take into account multi-party netting arrangements. The clients are less likely to be part of multilateral netting arrangements, and our ENNs estimates of bilateral netting could be close to their actual net positions.

5 Within- and across-sector distributions of FX OTC net notional

In this section we explore the variation of the OTC net notional across sectors as well as across entities within each sector. One important question that our analysis is concerned with is this: if a sector as a whole is net long or net short a particular currency, are nearly all of the entities in the sector positioned the same way, or is there more heterogeneity within some sectors so that many entities are net long and many others are net short?

5.1 Distribution of OTC net notionals across sectors

We begin by studying variation across sectors. Table 7 presents the number of firms and net notionals in billions of USD for various sectors, followed by the distribution of their net notional into three categories: exclusively long-USD, exclusively short-USD, and both long- and short-USD. A firm is defined as exclusively long (or short) USD if more than 90% of its positions, measured in terms of USD net notional, are long (or short) USD against its various counterparties. Our results show that almost all swap dealers exhibit similar net FX swap holding patterns. The distribution of the swap dealers sector resembles that of a typical intermediary, having both long- and short-USD positions simultaneously. Long-USD positions of a swap dealer with some end-user clients match exactly with short-USD positions with their other end-user clients.

[Table 7 here]

This pattern for dealers contrasts with client sectors that exhibit bimodal or trimodal distributions. An overwhelming majority of entities are typical clients in the sense of being exclusively net long-USD or net short-USD. For example, 59% of hedge funds’ notional and 74% of the sovereign and supranational sector’s notional is exclusively net long-USD, whereas 47% of asset managers’ notional, 70% of pension funds’ notional, and 52% of insurance companies’ notional are exclusively net short-USD.

The histograms in Figure 1 show a similar variation of notional across entities within a sector. In contrast with Table 7, these histograms focus more narrowly on the USD/EUR swaps held by each entity and plot their entity-netted notional (ENN) amounts based on directionality. Bars close to

¹¹ According to the CLS Bank, their “centralized platform and approach to multilateral netting mitigates settlement risk, reduces costs – and shrinks funding requirements by over 96%” (<https://www.cls-group.com/products/settlement/clssettlement/>).

zero percent on the x-axis represent the aggregate ENN of exclusively short-EUR positions, and those close to 100% on the x-axis represent exclusively long-EUR positions. Each bar represents the proportion of the sector's aggregate entity-netted notional (ENN). As is shown in Panel A of Figure 1, the dealers are balanced in their positions, whereas the various client sectors shown in Panels B through E are predominantly in either long- or short-EUR categories.

[Figure 1 here]

5.2 Intra-sector distributions of OTC net notionals

To study the within-sector distribution of individual firms, we focus on the net USD/EUR OTC positions of the hedge funds client category. Some hedge funds have significantly large net swap positions, so we convert net notional amounts into their natural logarithmic values for further analysis. The empirical distributions of $\log(\text{long-EUR})$ and $\log(\text{short-EUR})$ positions of hedge funds look quite similar, as shown in Table 8. The last two columns have the corresponding notional amounts in millions of USD. The distribution plots appear to resemble lognormal distributions (Figure 2), although formal statistical testing rejects the null hypothesis of log-normality in both long- and short-EUR distributions.¹²

[Table 8 and Figure 2 here]

Studying the summary statistics of the entire distributions (Table 9), we observe that the means are similar for long- and short-EUR distributions. Moreover, as is visually apparent from Figure 2, the two distributions are quite similar, suggesting that both long- and short-Euro strategies are well-represented within the hedge fund category. Both distributions have negative skewness and positive kurtosis. Based on negative skewness, we infer that there is a large number of hedge funds on the left side of the distribution, i.e., with relatively small net notional amounts. The positive kurtosis indicates the presence of fat tails—i.e., there are few hedge funds with large net notional amounts in both long- and short-EUR distributions.

[Table 9 here]

These findings suggest that although there are a large number of hedge funds in our sample, few funds with large net notionals dominate the overall sector statistics and obscure the behavior of the many smaller hedge funds. For example, top 20 funds with large net positions contribute nearly half of the total net notional in both long- and short- Euro distributions. The relative size of a few big long-EUR strategy funds vis-à-vis the size of a few big short EUR strategy funds

¹² Tests results are omitted due to space considerations but are available from the authors upon request.

determines the directionality of the sector. We ran these calculations for different periods and currencies for robustness and obtained similar results.

6 FX OTC analysis

In this section we extend our study by adding more explicitly the time-series dimension and analyze the FX OTC positions, bilateral netting based on FX ENN calculations, the directionality of net positions, and how these changed around the COVID period. We first analyze OTC positions at the sector level starting with dealers and moving into all of the aforementioned client categories. We also analyze changes in market concentration and look at the transaction activity before, during, and in the immediate aftermath of the COVID-induced market stress.

Before we go into details, we would like to highlight that at an aggregate level, the FX derivatives market was relatively stable, in terms of aggregate gross notional positions, during our sample period from December 2018 through September 2020. Figure 3 shows the weekly notional positions of OTC and exchange-traded products indexed on the respective notionals as of the beginning of our sample period. In December 2018, the total FX OTC notional was \$52 trillion, whereas the exchange-traded futures notional was \$164 billion. As can be seen in Figure 3, the aggregate notional positions were relatively stable during this sample period for OTC markets (swaps) and exchange-traded markets (futures). Besides COVID (denoted by a grey vertical bar), the other significant event in this market was the implementation of Phase 3 of the Uncleared Margin Rules for OTC swaps in September 2019 (shown as a dotted vertical line), which temporarily increased the futures aggregate notionals before the COVID pandemic. The total notionals towards the end of the sample period were roughly the same as the starting notionals.

[Figure 3 here]

6.1 FX OTC net positions

This section presents the analysis of FX OTC net notionals for each firm type and currency across time. Figures 4 and 6 through 10 have three panels each: Panel A shows the number of entities for each currency, Panel B depicts the gross and net notionals by currency, and Panel C plots the directionality of net notionals in terms of whether each trader category longs (i.e., receives) or shorts (i.e., pays) the currency. The gap between the gross notional and the net notional for a currency in Panel B represents the effect of netting. Nearly 95% of the FX swaps have USD as one leg of the contract, which is why USD appears to be a dominant currency in these panels. In panel C we present whether a sector in aggregate is long or short for a given currency and if the pattern changed over time, particularly during the COVID-related market stress of 2020.

6.1.1 Dealers

FX swap dealers are the intermediaries that fulfill the search-and-match function for their clients and are under no formal obligation to provide liquidity (unlike, for example, primary dealers in the Treasury markets). Almost all trades in our regulatory data have a swap dealer as at least one of the two counterparties. Most swap dealers registered with CFTC are part of large bank holding companies. There are a few non-bank dealers, and they account for much lower notional amounts than bank dealers (non-bank dealers hold approximately 6% of the total dealer notional).

Our FX OTC data have about a hundred currencies; the top currencies are plotted in Panel A over a two-year time window from 2018Q4 to 2020Q3, including the COVID pandemic period.¹³ The number of dealers in the FX OTC markets has remained steady during the sample period (Panel A of Figure 4). It should be noted Panel A looks at one currency at a time, so “double-counting” is naturally embedded in the figure—i.e., a USD/JPY dealer would show up under both USD and JPY. Appendix B contains abbreviations for all currencies used in our study.

[Figure 4 here]

In panel B of Figure 4 we observe that dealers’ net notional (the dotted line) is much smaller than their gross notionals (the solid line), especially for USD, which is a predominant currency in most swaps. USD gross notional of nearly \$80 trillion nets down to less than \$20 trillion. This notional reduction due to bilateral netting is in line with the expectation that a typical intermediary enters into multiple offsetting contracts with clients, thereby reducing its net notional. The net notional, therefore, is a better proxy for the true currency risk exposure vis-à-vis gross notional. As was discussed earlier, multilateral netting would further reduce the net notional.

Panel C of Figure 4 shows the directionality of the net positions for the major currencies. For swap dealers, the long and short net notionals are close, suggesting that the dealers are flat for each currency on net, which is a typical pattern for intermediaries. The net long (the solid blue line) and net short positions (the dotted red line) for a currency are shown separately instead of netting them out to zero, as in this case, because the long and short positions are with different entities. There was a noticeable decline in net notionals during COVID for USD and JPY, but these notionals recovered quickly.

To assess the competitive landscape, we calculate the Herfindahl-Hirschman Index (HHI) for the FX dealers in our data. Figure 5 shows that HHI values over the two-year sample period were ranging between 500 and 600, which indicates a competitive market—i.e., there is low market

¹³ Figures 4 through 10 are plotted based on ENNs calculations, which use quarterly snapshot of open positions instead of more frequent snapshots. ENNs calculation is computationally costly, but the benefit of more frequent reporting is not apparent as positions rarely change in any significant way at a higher data frequency.

concentration among dealers.¹⁴ Dealer concentration had decreased over time since the start of our sample in 2018 until 2020Q1, and this (possibly short-lived) trend reversed in the wake of the COVID-induced market stress. Thus, the market became somewhat less competitive after the pandemic.

[Figure 5 here]

6.1.2 Hedge Funds

The hedge fund sector is a broad range of entities with strong expectations about the direction of the FX markets. Their strategies may involve taking outright positions on the exchange rate or taking advantage of arbitrage opportunities within and across currency markets. The number of hedge fund entities in our data has declined over the sample period, as shown in Panel A of Figure 6. We also observe a corresponding decline in the gross notional in Panel B of Figure 6. However, the net notional in Panel B of Figure 6 has remained relatively steady during the pandemic.

[Figure 6 here]

The firms in the hedge fund sector actively change their position on a currency from long to short and vice versa over a short period. When such a reversal in position happens for a currency before the expiration of the existing contracts, we observe net notional amounts that are much smaller relative to the gross notional. As seen in Panel B of Figure 6, the net notional amounts are much smaller relative to gross notional for the hedge funds, especially for the USD.

Although net notionals remained steady, when we bifurcate them into long and short net notionals, we find that hedge funds actively increased their USD long positions (receive USD) and reduced their USD short positions during the pandemic and continued to do so in its aftermath (Panel C of Figure 6). For EUR, hedge funds have more prominent short positions than long ones in our data, and the opposite is true for JPY and GBP. During the sample period, hedge funds actively shorted developing countries' currencies, including the Chinese Yuan and Turkish Lira, using USD/CNY and USD/TRL swaps, which shows up as an increase in USD long positions by the hedge funds in Panel C of Figure 6.

6.1.3 Asset Managers

Asset managers range from small to large institutional investors who manage funds and portfolios for their clients; they use FX derivatives to manage currency risk in their portfolios. It is the largest sector in our data, as judged by the number of firms in each sector. Similar to hedge funds, the number of asset management firms in our data has declined over the sample period,

¹⁴ Generally, markets with HHI less than 1500 are deemed competitive.

as shown in Panel A of Figure 7. However, the notionals in Panel B of Figure 7 do not exhibit a downward trend.

[Figure 7 here]

The asset management sector shows some netting, especially for USD and EUR. As shown in Panel B of Figure 7, the net notional amounts are much smaller than the gross notionals for these currencies. There is not as much netting of gross notional for other currencies. Panel C of Figure 7 reveals that asset managers have predominantly short-USD (pay USD) and long-JPY positions. During the COVID-pandemic, there was a spike in the USD and JPY positions. Overall, the directionality of this sector has largely stayed unchanged around the pandemic period.

6.1.4 Pension funds

Most pension funds in our sample are non-U.S. based, accounting for over three-fourths of the net notional. Pension funds invest in a globally diversified portfolio, but their liabilities are (almost) exclusively in the domestic currency, where they have promised safe and stable returns to pension beneficiaries. Pension funds use FX derivatives to mitigate this currency mismatch between their asset and liabilities. Given the dominance of U.S. assets in global portfolios, USD is the dominant currency for pension funds swap positions.

The number of active pension funds in our data declined during the sample period (Panel A of Figure 8), whereas the gross notionals increased and net notional (i.e., after bilateral netting) remained rather stable (Panel B of Figure 8). Panel C of Figure 8 shows that the pension funds in our sample had significantly more short-USD (i.e., pay-USD) positions than long-USD positions. The short-USD positions have been increasing over time. Although the short USD of around \$0.5 trillion (dotted red line in the USD column) is ostensibly large enough to potentially face a liquidity freeze during rollover, (i) the client sector actually needs to roll over long-USD positions in the aggregate, and (ii) the requisite amounts (\$0.5 trillion) are a fraction of dealer net positions (around \$8 trillion).

[Figure 8 here]

6.1.5 Insurance companies

US-based insurance companies represent nearly a third of the net notional in our data. Like pension funds, insurance companies use FX swaps to manage currency mismatches between their assets and liabilities. The liabilities of insurance companies are primarily domestic currency payments to policyholders and stakeholders. In contrast, their assets are predominantly USD- and EUR-denominated, even for non-U.S. insurance companies.

More than 300 insurance firms in our data used FX OTC derivatives, and this number has been declining over the sample period (Panel A of Figure 9). Bilateral netting reduces the risk exposure of insurance companies by approximately a third across all major currencies (Panel B of Figure 9).

[Figure 9 here]

Panel C of Figure 9 shows the net FX swaps open positions of insurance firms for the major currencies. Insurance firms are generally long JPY and short USD, and short EUR. Most insurance companies with significant net positions in our sample are from the Asian region. Long-JPY and short-USD swap positions allow these companies to manage the currency risk between their assets (predominantly in USD and EUR) against their liabilities in local currency, predominantly JPY.

6.1.6 Sovereign and supranational institutions

More than a hundred entities in this category held FX swaps positions in our data, and that number has remained relatively stable (Figure 10, Panel A). These entities played an important role in providing U.S. dollar liquidity worldwide. In response to the COVID-related market shock, the Federal Reserve initiated U.S. dollar liquidity swap lines with many central banks to ease strains in global dollar funding markets. These initiatives improved global U.S. dollar funding markets by serving as an important liquidity backstop.¹⁵ Cross-currency swaps are one of the primary FX sub-products used by this category in our data. Many central banks around the world reported using cross-currency swaps as a primary U.S. dollar funding tool (e.g., Maruyama and Washimi, 2021).

[Figure 10 here]

Panel C of Figure 10 shows that sovereign and supranational institutions significantly increased their long-USD positions during our sample period. The long-USD position in FX derivatives provides access to USD funding against payment in local currency. These findings support the results from a survey conducted by Greenwich Associates in association with ISDA of 170 market participants, which reported an overall liquidity improvement in FX OTC markets after the central bank interventions (Greenwich Associates and ISDA, 2020).

6.1.7 All other entities

In addition to the categories described above, about 20,000 firms in the “other” category have a combined gross notional and entity-netted notional of \$10 trillion and \$4 trillion, respectively,

¹⁵ “Federal Reserve announces the extension of its temporary U.S. dollar liquidity swap lines with nine central banks through December 31, 2021,” Federal Reserve Board’s press release, June 16, 2021, available at <https://www.federalreserve.gov/newsevents/pressreleases/monetary20210616c.htm>.

for USD. In addition to a few corporates and non-dealer banks, most other firms cannot be definitively classified with the information available. These firms generally have small notional amounts and exhibit no specific change in their FX OTC positions during the pandemic.

6.2 FX OTC trading volume

6.2.1 Trading volume by firm type, currency pair, and sub-product

The FX derivative instrument with the highest trade volumes is the OTC FX swaps/forwards. We find that trade volumes spiked during the COVID period, peaking around the second week of March 2020, and this trend reversed after the introduction of the stabilizing monetary policy on March 23, 2020.¹⁶

However, the average trade size of FX swaps and forwards, as measured by the USD notional amount, started to decline with the onset of the pandemic. The average trade size dropped from more than \$40 million at the beginning of 2020 to about half of that amount by mid-March 2020. This reduction in average trade size is consistent with the Greenwich and ISDA's survey findings, where the sell side responded to the crisis by offering smaller trade sizes (Greenwich Associates and ISDA, 2020). Studying the weekly trade notional by top currency pairs reveals that USD-EUR and USD-JPY have the largest trade volumes.

6.2.2 Trading volume by tenor

We also attempt to understand the impact of COVID market stress on the tenor of the FX OTC derivatives. To this end, we focus on the plain-vanilla USD/EUR forwards and swap contracts in our transactions data. Studying the average tenor of all USD/EUR OTC forward and swaps for each trading week in the first half of 2020, we observe that the average FX swaps tenors, which were relatively stable at around 20 days, dropped sharply during the pandemic, indicating a shortening of tenors in response to market volatility. The average tenors bounced back in April and remained more volatile relative to the pre-pandemic period, indicating heightened uncertainty.

7 FX futures and spot market analysis

This section focuses on exchange-traded currency futures using the CFTC regulatory data. Weekly summaries of these data are published in CFTC's Commitment of Traders report. Our analysis uses more granular and comprehensive data, but the final results presented in this section closely mirror the results derived from using the Commitment of Traders report. For most currencies discussed here, the exchanges also offer options on futures; however, the trade volumes and

¹⁶ The figures that support the results reported in this subsection are not included due to space considerations but are available from the authors upon request.

open interest are low for these options. This section also highlights the main takeaways from studying the spot market data on trading volume—both overall and for individual currency pairs.

7.1 FX futures open interest

The most active futures contracts in the U.S. are in EUR, JPY, GBP, CAD, AUD, and CHF denominated in USD. The highest open interest is in the Euro contracts. One EUR futures contract is for 125,000 euros, thus going long one EUR/USD contract is equivalent to going long 125,000 euros.

We analyze the change in EUR futures' open interest against the backdrop of EUR depreciating relative to USD during the COVID market stress and in the wake thereof. Figure 11 shows the overall activity in the Euro futures market (top panel) and the underlying USD/EUR exchange rate (bottom panel). For Euro futures, overall market open interest is plotted on the right axis and the net position of dealers, asset managers and leveraged funds are plotted on the left axis. Open positions are converted into dollar amounts using the contract size and the prevailing exchange rate. We observe that the dealers went short in the Euro futures contracts (red line in the top panel of Figure 11) post-pandemic, whereas the leveraged funds switched their net positions from short-Euro to slightly long-Euro.

[Figure 11 here]

Figure 12 plots the weekly change in the open interest for the EUR held by investment funds, measured in the number of contracts. Before the pandemic, the leveraged funds sector in the aggregate was predominantly short-Euro, i.e., they had significantly more contracts with short Euro positions than long Euro contracts. However, this trend changed during the pandemic, and leveraged funds reduced their short-Euro positions and increased their long-Euro futures. In OTC markets we observe a similar decline in short Euro positions during the sample period, as shown earlier in Panel C of Figure 6 for hedge funds.

[Figure 12 here]

We also analyze open positions at the weekly frequency from January 2019 to December 2020 for various currencies and investor categories. The open interest for the leveraged money funds in other FX futures shows no significant change in trading patterns during the pandemic.¹⁷

7.2 FX futures trading

The FX futures markets are quite active in terms of the number of trades relative to the open interest. For example, for the CME Euro FX contract, trade volumes could be as high as half the

¹⁷ Supporting graphs are available from the authors upon request.

open interest for that day. Focusing on the dealers, we observe high trading volumes, but the longs and shorts almost mirror each other, leaving only a slight change in net open interest positions by the end of the day. As expected, trade volumes are considerably higher around the quarterly roll dates.¹⁸

7.3 FX spot market

As has been mentioned above, we acquired the FX spot market settlement data from the CLS Bank. Total FX spot settlements spiked during the COVID pandemic as the exchange rates of most currencies experienced heightened market volatility against the U.S. dollar (Figure 13). The spike in settlement volumes is most prominent in the USD/EUR and USD/JPY currency pairs.¹⁹

[Figure 13 here]

8 Case study: Use of euro swaps and futures by hedge funds

As mentioned earlier, FX futures markets are the most transparent regarding public reporting compared to OTC and spot markets. Not surprisingly, most media commentaries rely on trading in the currency futures market to infer market trends. This section examines if currency futures trading is a good proxy for overall FX markets. To do so, we focus on the most liquid market, i.e., USD/EUR trades by the most active traders—namely, the leverage funds (hedge funds).

In Section 7.1 we showed that the aggregate hedge fund (leveraged fund) category has a similar trend of declining EUR short positions in both futures and OTC markets. In this case study, we focus on the sample of funds that are active in both OTC and futures markets to study the relationship between the change in their futures and OTC positions.

We analyze the use of economically similar EUR swaps/forwards (OTC) and exchange-traded futures by hedge funds active in both markets to study the differences across these venues. The average tenor of USD/EUR swaps is one month. CME Euro futures are physically settled, and most volume is in the near-month contract. These features make the Euro futures trades similar to the USD/EUR OTC trades of the hedge funds. Some funds exclusively use bilateral OTC derivatives, whereas some others are active only in the exchange-traded futures. We estimate that roughly 40% of hedge funds, measured by swap/forward notional, are active in both OTC and exchange markets. This estimate is based on analyzing the hedge fund's USD/EUR swap/forward positions as of the end of the third quarter of 2020.

We observe an increase in trading activity in both listed FX markets and bilateral FX markets by this select group of hedge funds during the peak COVID month of March 2020, as highlighted in

¹⁸ The relevant graph is not included due to space considerations but is available from the authors upon request.

¹⁹ The figures behind these results are not included to preserve space but are available from the authors upon request.

Table 10. The spike is observed in the total notional amount (in USD) as well as in the number of trades. Separately, there is an overall increase in trading volumes in the futures markets during the sample period, which could be due to increased market volatility. Since the trade volume of long and short futures almost mirror each other each month, the aggregate futures open position remained relatively stable throughout the period.

[Table 10 here]

Table 10 also shows that these select hedge funds are active traders in the exchange-traded futures markets, making thousands of trades daily. Indeed, this behavior is remarkably different from these hedge funds' trading activity in the bilateral OTC trades with dealers. These hedge funds are directional in the OTC markets, having many more short EUR trades than long EUR trades. The average number of transactions is much smaller in the OTC markets relative to the number of transactions in the futures markets. However, the average trade size is much bigger in the OTC market than in the futures markets.²⁰

The average trade size in the futures markets is about one contract, i.e., about \$0.2 million, whereas the average trade size in the OTC market is more than a hundred times larger. The respective average trade sizes remained relatively stable during the sample period. Most trading activity involves rolling the existing contracts in both futures and the OTC market.

Although more direct evidence would be required to make definitive statements, the results presented in Table 10 suggest that the bilateral OTC market is the preferred space for FX risk transfer, whereas the exchange-traded derivatives market appears to serve the price discovery and immediacy functions for smaller trades. In the OTC market, hedge funds can fill large orders at a single price, while there might be price uncertainty in the futures market for these large orders.

These findings are in line with a theoretical model of Viswanathan and Wang (2002), which suggests that a risk-averse customer prefers to trade in a dealership market over a limit-order book market when the number of market makers is large and when the average order size is large. We have shown earlier that the number of dealers is large in the OTC markets. This case study shows that futures are a heavily traded, relatively transparent segment of the FX markets, but the liquidity seems low as large orders are fulfilled primarily bilaterally with a dealer. Rosenberg and Traub (2009), among others, show that a market that is dominated in terms of the overall trading volume, such as the futures market, can still play an important role in price

²⁰ These numbers can be easily computed by dividing trading volumes by the average numbers of trades, all of which are reported in Table 10.

discovery if it offers greater anonymity, lower transaction costs, faster execution, and/or greater transparency.

Simultaneously looking at the weekly change in the futures open positions with the weekly change in swap positions of our sample of hedge funds, we observe virtually no relationship between the two. Figure 14 depicts the scatter plot of the weekly change in Euro futures open interest and the weekly change in USD/EUR swaps open position, expressed in millions of USD, for the funds in this case study for the entire sample period. One can infer from the scatter plot that there is hardly any relationship. The correlation coefficient is -4.6% and is statistically insignificant at any conventional level of significance. Thus, in our weekly data there is no discernable relationship between the changes in futures open interest and the changes in the swap positions for this sample of hedge funds.

[Figure 14 here]

Thus, we do not find compelling evidence that hedge funds are substituting one product for another.²¹ We observe that changes in futures positions provide little insight into the aggregate change in risk transfers, which happens primarily in the bilateral OTC markets. Differences in the relative cost of risk transfer in the futures market versus the dealer OTC market may be driving these results. However, since we do not have information on the margins required by the OTC dealers, a comparison could not be made with the margins required by exchanges for similar futures products. All in all, in answering the general research question posed at the outset of this section, we find that currency futures trading is unlikely to be a good proxy for the overall FX markets activity.

9 Conclusions

Our study attempted to alleviate the paucity of detailed information regarding FX derivatives trading and positions held by various market participant groups in various product categories, tenors, and currency pairs. Leveraging our access to the CFTC's regulatory data on FX swaps, forwards, and futures, we provided heretofore unreported disaggregated statistics on FX markets and highlighted key developments in these markets before, during, and in the aftermath of the COVID-induced market stress. In particular, we reported gross, net, and directional positions, as well as trading by the key FX markets participants, including dealers, hedge funds, asset

²¹ One can hypothesize that there are two opposing effects: there could be more demand for hedging across all instruments (which would be reflected in a positive correlation), but there could also be substitution between swaps and futures depending on the relative costs of using one vis-à-vis the other (which would manifest in a positive correlation).

managers, pension funds, insurance companies, and sovereign and supranational institutions across various market segments and periods.

FX products considered in this study include all three broad categories—over-the-counter (OTC) derivatives, exchange-traded products, and spot exchange rates. While the exchange-traded futures and options on futures trade on multiple exchanges worldwide, the OTC space is bilateral and includes various products such as outright forwards, swaps, options, and customized instruments. The market changes are analyzed against the backdrop of the U.S. dollar (USD) appreciation and depreciation vis-à-vis the major currencies, including the Euro, the Sterling, and the Yen, and during and around the COVID market stress. We argue that gross notional is an inflated measure of currency risk, and that bilateral netting used in our study provides a more accurate picture of the FX OTC markets. Netting was found to significantly reduce the overall market size, especially for dealers.

The key results presented in this paper are as follows. Almost all FX OTC trades have a registered swap dealer on one side, and dealers maintain relatively flat positions in most major currencies. The number of FX dealers and their market concentration has remained stable over our sample period, whereas the number of clients has declined. The clients are a heterogeneous group in terms of size and directionality of their FX positions. There is heterogeneity within the client sector as well, as not all firms in a sector follow a similar strategy. Some are directionally long a currency, while some other firms in the same sector follow the opposite approach. As the demand for the U.S. dollar increased during the market stress of March 2020 and its immediate aftermath, hedge funds and sovereigns increased their long-USD derivatives positions. Trading volumes spiked for a few products and currencies during COVID but reverted quickly to normal levels. Finally, futures are a heavily traded and relatively transparent segment of the FX markets, although the liquidity appears to be low as large orders are fulfilled primarily bilaterally with a dealer.

We believe our paper helps market participants, researchers, and policymakers to better understand FX market trends as well as risk exposures and risk transfers within each segment of the FX market as well as across segments. This, in turn, would inform risk management practices, theoretical and empirical work in the FX space, and policy design and rulemaking.

Appendix A: Reporting fragmentation

As has been mentioned in the main text, FX derivatives reporting is fragmented and limited, with the most comprehensive information to date being compiled in the BIS' surveys of dealers. This Appendix describes other sources of information on FX derivatives.

A.1 CFTC regulatory data

In the U.S., the CFTC has reporting jurisdiction over most FX derivatives, as delineated in Title VII of the Dodd-Frank Act. CFTC regulatory data are broadly divided into two categories: (i) futures data, which include data on exchange-traded futures and options on futures, and (ii) swaps data, which refer to data on all OTC products. Using the term “swaps” for all OTC products, such as swaps, forwards, and OTC options, can be confusing. Swaps (OTC) data related to positions and trades come as separate datasets, as described in Part 45 of the CFTC regulations.²² Part 45 data are provided by the registered swap dealers to swap data repositories (SDRs), which relay these data to CFTC. In light of the sensitive nature of information in the Part 45 data, these granular datasets are not available to the public. However, CFTC provides high-level summaries of Part 45 data in Weekly Swaps Reports (WSRs) and Entity-Netted Notionals (ENNs) reports.²³

Limited information about non-physically delivered FX trades is reported to the public in real time under Part 43 of the CFTC regulations. Part 43 public reporting excludes physically delivered forwards, swaps, and options, which account for nearly ninety percent of the FX OTC traded notional. Part 43 data contain basic information such as price and volume, but they do not provide counterparty information. Therefore, inter-affiliate trades and duplicate messages for the same trade cannot be filtered out using Part 43 public data. Further, spot and physically delivered FX derivatives are exempt from Part 43 reporting.²⁴

A.2 SEC-regulated funds

Funds and registered investment companies regulated by the U.S. Securities and Exchange Commission (SEC) report their holdings, including bilateral derivative positions, on form N-PORT, a portion of which is available to the public at the quarterly frequency.

A.3 Insurance companies

Insurance regulators in some U.S. states require insurance companies registered in their states to publicly disclose all of their portfolio holdings, including derivative positions. Given the disparate reporting requirements across different states, aggregating derivatives data for insurance firms at the national level is challenging.

A.4 Financial statements of firms

The financial statements of public firms provide limited information about their derivative positions and trades. An FX swap is similar to borrowing a currency against a collateral posted in another currency. However, unlike collateralized repurchase agreements (repos), the

²² 17 CFR Parts 45, 46, and 49, available at <https://www.ecfr.gov/current/title-17/chapter-I/part-45>.

²³ Weekly Swaps Report and Entity Netted Notional reports are available on the Reports of the Office of the Chief Economist website at <https://www.cftc.gov/About/EconomicAnalysis/ReportsOCE/index.htm>.

²⁴ For further details on the FX regulatory framework in the US, including its evolution, see Aron, Bullitt and Doench (2017).

information about bilateral FX derivatives is not directly available from a firm's financial statements. FX swaps—and generally all bilateral derivative contracts—are considered off-balance-sheet items and are reported at fair market value. The balance sheet does not report the liability created by a contract, nor is the collateral recognized as an asset. Given the risk transfer nature of the FX swaps, their market value is generally zero at the time of origination—i.e., the asset and the liability created at the trade time match each other. Over time, the derivative contract may gain or lose value. A bilateral master agreement lists all derivatives contracts as a portfolio. The claim is not on an individual derivative position but on the net portfolio value of all derivatives under the bilateral master agreement. Accordingly, the firm's financial statements recognize the change in the market value of the entire derivatives portfolio. Inferring the derivative trading activity or positions held by a firm is practically impossible based on the reported change in the market value in the firm's financial statements. Thus, from this standpoint as well, we believe that our study offers a unique and helpful perspective on the FX activity of firms.

A.5 Non-U.S. jurisdictions

Many non-U.S. dealers are registered with CFTC and report their activity to CFTC. Entities regulated by other jurisdictions have different reporting requirements for FX derivatives. For example, the European Market Infrastructure Regulation (EMIR) requires EU entities engaging in derivatives transactions to report them to trade repositories authorized by the European Securities and Markets Authority (ESMA). These data are generally reported only to the regulators and the general public has little visibility into the EU derivatives markets.

A.6 Futures reporting

Futures and options on futures are traded on regulated exchanges that provide regular reporting on the volume, price, maturity, and open interest for each currency contract. Futures is the most transparent segment of the FX derivatives markets and is the source for most market commentaries on FX markets. However, as we show in our study, futures represent a very small fraction of the overall FX market.

Appendix B: Currency abbreviations

AUD	Australian dollar
BLR	Brazilian real
CAD	Canadian dollar
CHF	Swiss franc
CNY	Chinese yuan
CZK	Czech koruna
DKK	Danish krone
EUR	Euro
GBP	Pound sterling
INR	Indian rupee
JPY	Japanese yen
KRW	Korean won
NZD	New Zealand dollar
RUB	Russian ruble
SEK	Swedish krona
SGD	Singapore dollar
TWD	New Taiwan dollar
USD	U.S. dollar
ZAR	South African rand

References

Aron, D., P.G. Bullitt, and J. Doench, 2017, “Regulation of US currency transactions,” *Journal on the Law of Investment and Risk Management Products*, 37(5), 1-25.

Avdjiev, S., E. Eren, and P. McGuire, 2020, “Dollar funding costs during the Covid-19 crisis through the lens of the FX swap market,” *BIS Bulletin*, 1-6, April, available at <https://www.bis.org/publ/bisbull01.htm>.

Borio, C., R.N. McCauley, and P. McGuire, 2022, “Dollar debt in FX swaps and forwards: Huge, missing and growing,” in *BIS Quarterly Review*, December, 67-73, available at https://www.bis.org/publ/qtrpdf/r_qt2212h.htm.

CFTC, 2022a, *Weekly Swaps Report*, Commodity Futures Trading Commission, available at <https://www.cftc.gov/MarketReports/SwapsReports/index.htm>.

CFTC, 2022b, *CDS and FX Entity-Netted Notionals (ENNs) Report*, Commodity Futures Trading Commission, available at <https://www.cftc.gov/About/EconomicAnalysis/ReportsOCE/index.htm>.

Drehmann, M., and V. Sushko, 2022, “The global foreign exchange market in a higher-volatility environment,” in *BIS Quarterly Review*, December, 33-48, available at https://www.bis.org/publ/qtrpdf/r_qt2212f.htm.

Ehlers, T., and B. Hardy, 2019, “The evolution of OTC interest rate derivatives markets,” in *BIS Quarterly Review*, December, 69-82, available at https://www.bis.org/publ/qtrpdf/r_qt1912i.htm.

Greenwich Associates and ISDA, 2020, “The impact of COVID-19 and government intervention on swaps market liquidity,” Greenwich Report, Q2, available at <https://www.isda.org/a/YfbTE/The-Impact-of-COVID-19-on-Swaps-Market-Liquidity.pdf>.

Hasbrouck, J., and R.M. Levich, 2017, “FX market metrics: New findings based on CLS bank settlement data,” NBER working paper 23206.

King, M.R., C. Osler, and D. Rime, 2012, “Foreign exchange market structure, players, and evolution,” in J. James, I.W. Marsh and L. Sarno, eds., *Handbook of Exchange Rates*, 3-44, John Wiley & Sons, Inc.: Hoboken, New Jersey

Maruyama, R., and Washimi, K., 2021, “Cross-currency swap market through the lens of OTC derivative transaction data: Impact of COVID-19 and subsequent recovery,” *Bank of Japan Review*, 2021-E-1.

Rosenberg, J.V, and L.G. Traub, 2009, “Price discovery in the foreign currency futures and spot market,” *Journal of Derivatives*, 2009, 17(2), 7-25.

Viswanathan, S., and J.J.D. Wang, 2002, “Market architecture: Limit-order books versus dealership markets,” *Journal of Financial Markets*, 5(2), 127-167.

Table 1: The global FX derivatives market

Product	Daily trading volume (\$billions), as of April 2019	Notional outstanding (\$billions), as of December 2020
Spot market	1,987	0
Futures	112	320
Exchange-Traded Options	15	127
OTC Options	298	11,669
Outright Forwards	999	58,031
FX Swaps	3,203	
Currency Swaps	108	27,810
Total	6,722	97,957

Sources: Daily trading volume is from *Triennial Central Bank Survey of Foreign Exchange and Over-the-counter (OTC) Derivatives Markets in 2019*, Bank for International Settlements, available at <https://www.bis.org/statistics/rpfx19.htm?m=2617>; outstanding notionals are from “Statistics on global OTC derivatives market,” Table D5.1, Bank for International Settlements, available at <https://stats.bis.org/statx/srs/table/d5.1?p=20202&c>.

Table 2: Open interest of the exchange-traded FX derivatives (\$ billions)

	Jun 2020	Dec 2020
Global	372	450
North America	223	257
Europe	12	13
Other	137	180

Source: “Statistics on exchange-traded futures and options, by location of exchange,” Table D1, Bank for International Settlements, available at <https://stats.bis.org/statx/srs/table/d1?p=20204&c>.

Table 3: CFTC coverage of the global FX OTC derivatives by product and currency**Panel A: Global FX OTC outstanding (BIS)**

(\$ billions, as of June 2020)

Product/Currency	USD	EUR	JPY	GBP	CHF	TOTAL
Swaps and forwards	49,597	16,270	8,377	6,047	2,652	55,697
Cross-currency swaps	22,752	9,840	4,598	4,077	1,027	26,236
OTC options	10,260	3,709	2,617	731	462	11,819

Panel B: CFTC coverage

(\$ billions, as of June 2020)

Product/Currency	USD	EUR	JPY	GBP	CHF	TOTAL
Swaps and forwards	29,917	6,998	6,813	3,062	927	32,555
Cross-currency swaps	10,117	3,134	2,048	1,483	251	10,621
OTC options	4,937	1,273	1,120	205	125	5,683

Panel C: CFTC coverage as percent of global outstanding

Product/Currency	USD	EUR	JPY	GBP	CHF	TOTAL
Swaps and forwards	60%	43%	81%	51%	35%	58%
Cross-currency swaps	44%	32%	45%	36%	24%	40%
OTC options	48%	34%	43%	28%	27%	48%

Table 4: OTC FX average daily trading volume as of April 2019 (\$ billions)

	Global Trade Volume				CFTC coverage	
	USA	UK	Other	Total		
Forwards and swaps	832	2,265	2,463	5,560	1,485	27%
Options	63	167	132	361	94	26%
Spots	476	1,144	759	2,379	0	0%

Table 5: Average trading and settlement volumes for FX spot market (\$billion as of April 2019)

	BIS	CLS	CLS coverage
U.S. dollar	1,687	342	20%
Euro	616	49	8%
Yen	360	12	3%
Pound	240	2	1%

Table 6: USD FX OTC gross and net positions by sector
(positions as of 2020Q3; notionals in \$ billions)

Sector	Number of firms	Gross notional	Net long USD*	Net short USD*	Long - Short	Net long/Gross	Net short/Gross
1	2	3	4	5	6	7	8
Dealers	93	79,128	8,802	9,211	-409	11%	12%
Clients							
Total	37,503	25,115	4,966	4,558	409	20%	18%
Hedge funds	2,993	7,024	1,175	539	636	17%	8%
Asset managers	10,306	4,708	748	1,253	-505	16%	27%
Non-dealer banks	867	4,307	705	561	144	16%	13%
Corporates	4,607	2,390	888	421	467	37%	18%
Pensions	1,207	1,268	117	481	-364	9%	38%
Govt/Supranational	124	1,080	476	89	388	44%	8%
Insurance	344	674	148	246	-98	22%	36%
Other	17,055	3,665	709	967	-259	19%	26%

* Net notional amounts correspond to bilateral netting as calculated per the entity netted notional (ENN) methodology (CFTC, 2022b).

Table 7: Variation across entities within each sector (as of 2020Q3)

Sector	Number of firms	Net notional (\$ billion)	Exclusively long USD	Exclusively short USD	Both long and short USD
Swap dealers	93	18,014	0%	0%	100%
Asset managers	10,306	2,001	28%	47%	25%
Hedge funds	2,993	1,714	59%	20%	22%
Pension funds	1,207	598	12%	70%	17%
Insurance companies	344	394	20%	52%	28%
Sovereign/supranational	124	565	74%	7%	19%

Table 8: Empirical distribution of long EUR and short EUR positions of hedge funds (as of 2020Q3)

Percentile	Log (long EUR)	Log (short EUR)	Long EUR (\$ million)	Short EUR (\$ million)
10%	12.73	13.03	0.3	0.5
25%	14.85	14.91	2.8	3.0
50%	16.77	16.67	19.1	17.4
75%	18.52	18.46	110.0	103.6
90%	19.75	19.73	377.6	371.0

Table 9: Summary statistics of distributions of long EUR and short EUR positions of hedge funds (as of 2020Q3)

	Log(Long EUR)	Log(Short EUR)
Mean	16.47	16.48
Std Dev	2.84	2.78
N	715	1,087
Skewness	-0.69	-0.71
Kurtosis	0.88	1.10

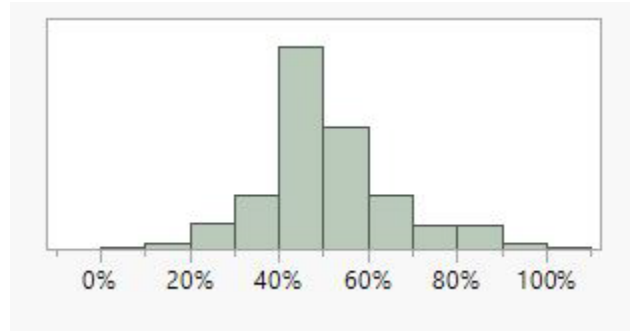
Table 10: Total FX derivative trading volume (\$ billion) and average number of trades per day for select group of hedge funds

		Total Trade Volume (\$billion)				Average # of Trades per day			
Year	Month	Futures Long	Futures Short	OTC Long	OTC Short	Futures Long	Futures Short	OTC Long	OTC Short
2018	Oct	24	25	4	285	5,969	6,397	11	626
2018	Nov	23	23	5	356	5,828	6,101	10	903
2018	Dec	23	22	23	372	4,646	4,479	14	842
2019	Jan	20	18	9	332	5,663	5,107	8	559
2019	Feb	15	14	7	364	4,049	3,908	6	834
2019	Mar	21	21	13	414	4,453	4,378	12	910
2019	Apr	17	15	6	286	4,408	3,905	9	495
2019	May	19	19	12	427	5,007	4,770	15	907
2019	Jun	16	18	15	374	3,949	4,292	16	1,041
2019	Jul	18	18	5	281	4,516	4,689	18	577
2019	Aug	44	44	6	303	10,518	10,342	19	1,037
2019	Sep	49	48	27	362	10,979	10,789	28	821
2019	Oct	46	44	22	258	10,524	9,849	20	591
2019	Nov	43	42	39	283	9,187	9,011	12	1,108
2019	Dec	50	51	15	248	9,069	9,204	15	697
2020	Jan	59	58	48	259	10,839	10,601	16	470
2020	Feb	77	75	15	357	15,229	14,709	19	976
2020	Mar	85	86	50	472	19,458	20,000	35	1,394
2020	Apr	44	47	50	312	11,306	12,105	17	561
2020	May	46	48	38	285	11,160	11,756	19	545
2020	Jun	70	70	8	339	16,867	16,963	12	972
2020	Jul	89	87	51	326	20,376	19,820	21	514
2020	Aug	90	92	14	338	20,010	20,470	15	1,157
2020	Sep	82	81	11	353	18,274	18,168	17	789

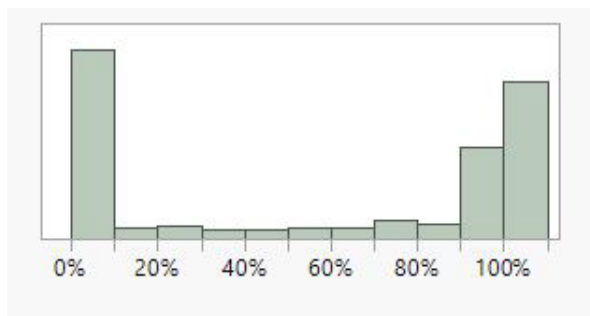
Figure 1: USD/EUR OTC notional distribution by sector, 2020Q3

(x-axis: directionality expressed as % long EUR; y-axis: proportion of total ENN for the sector)

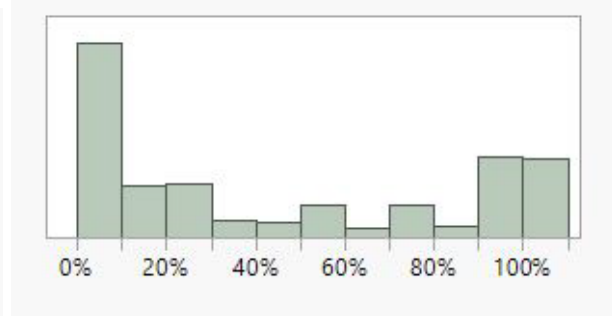
Panel A: Dealers



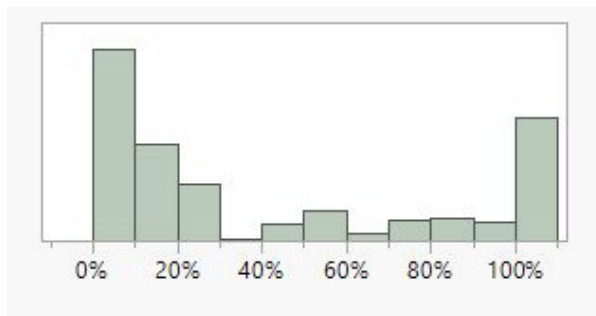
Panel B: Asset managers



Panel C: Hedge funds



Panel D: Insurance companies



Panel E: Pension funds

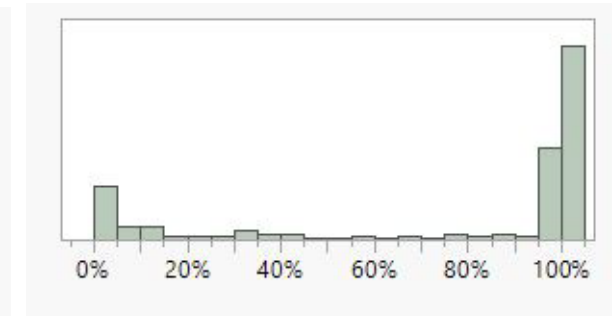


Figure 2: Distribution of natural log of USD/EUR notional for hedge funds as of 2020Q3

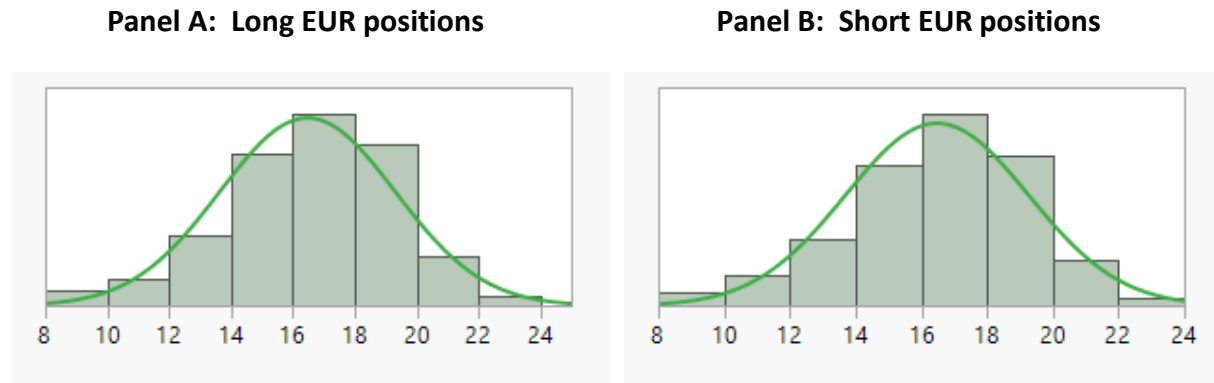
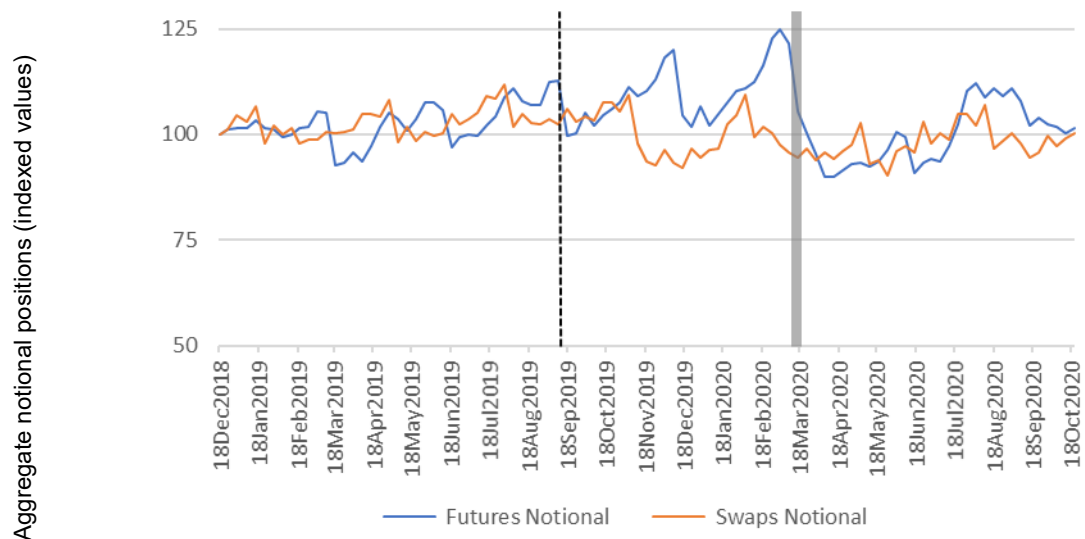


Figure 3: Aggregate FX derivative positions in futures (exchange-traded) and swaps (OTC) markets (indexed values)

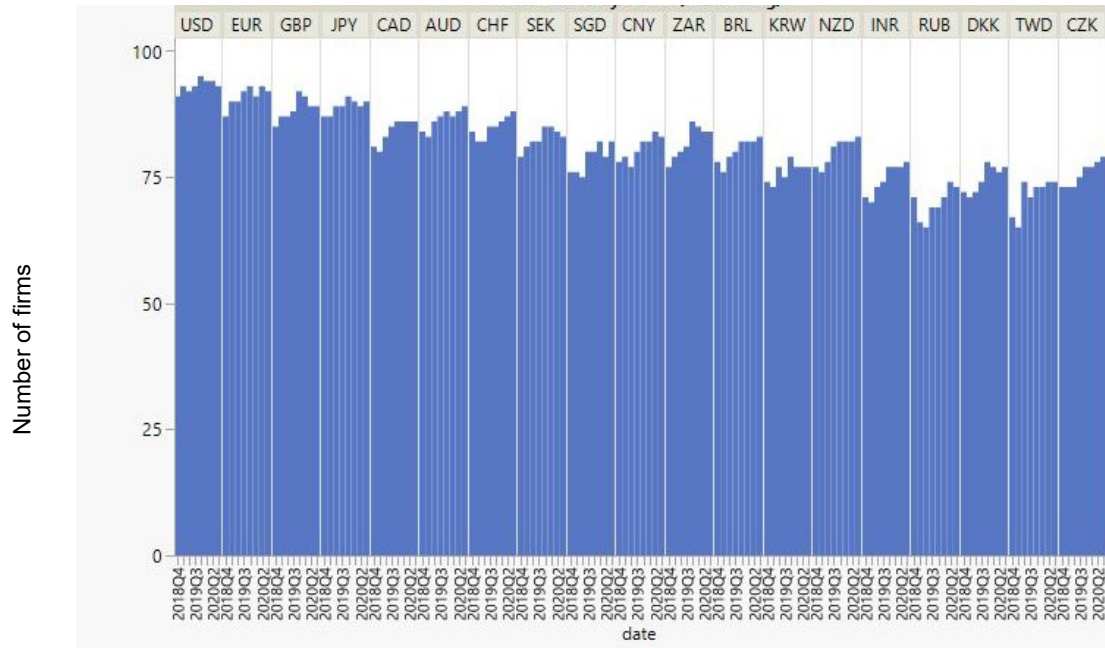


Sources: Swaps data—CFTC public Weekly Swaps Report (CFTC, 2022a), futures data—CFTC’s public Commitment of Traders report²⁵, and CFTC calculations.

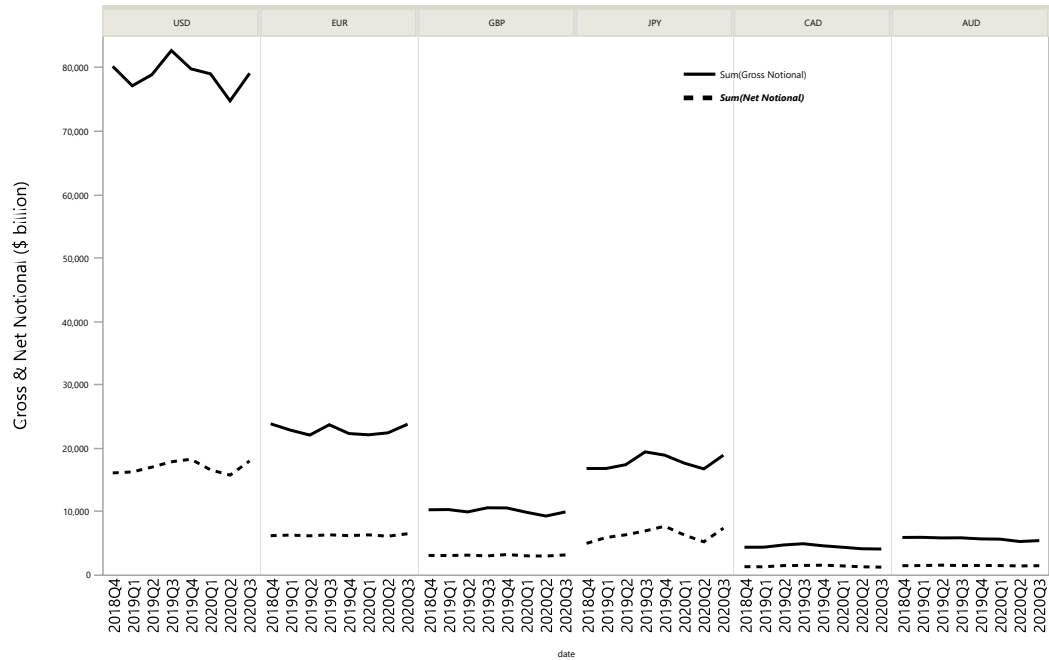
²⁵ Commitment of Traders report is available at <https://www.cftc.gov/MarketReports/CommitmentsofTraders/index.htm>.

Figure 4: Dealers

Panel A: Number of firms



Panel B: Gross and net notional



Panel C: Long and short net notional

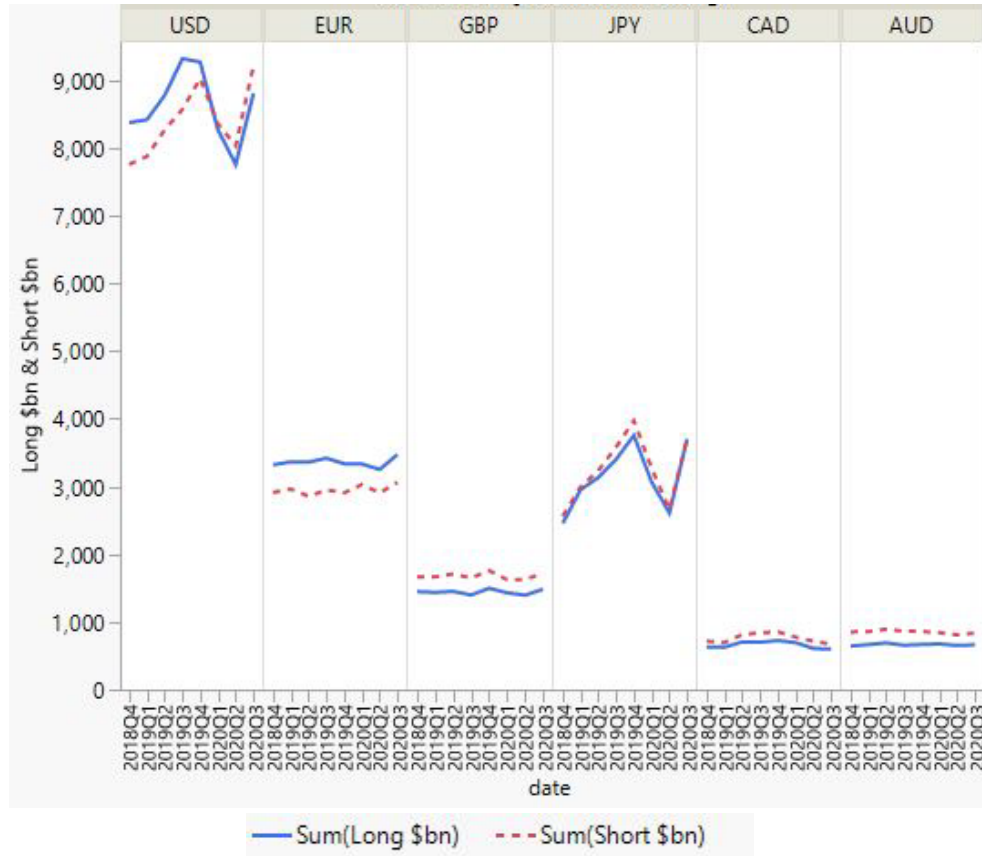


Figure 5: HHI for FX swap dealers over time.

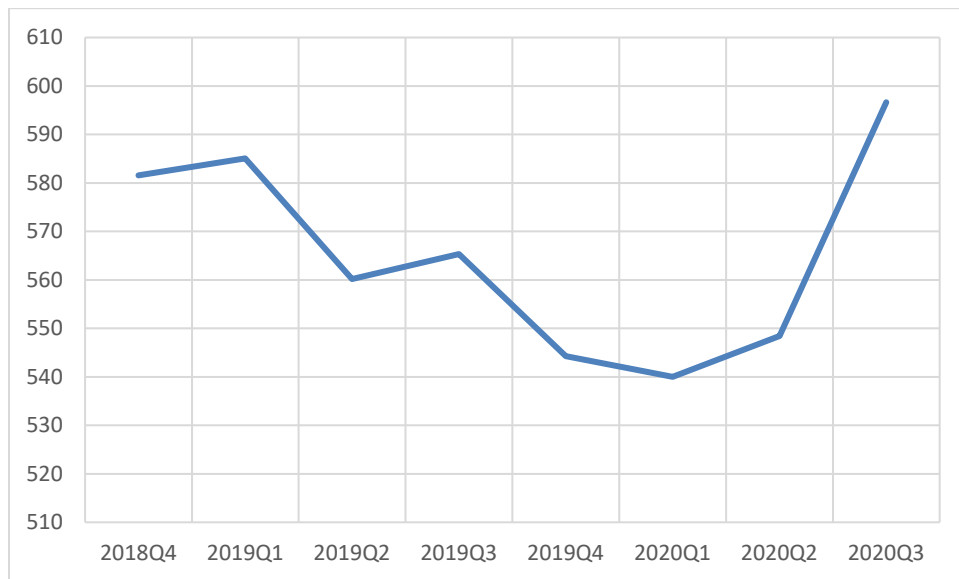
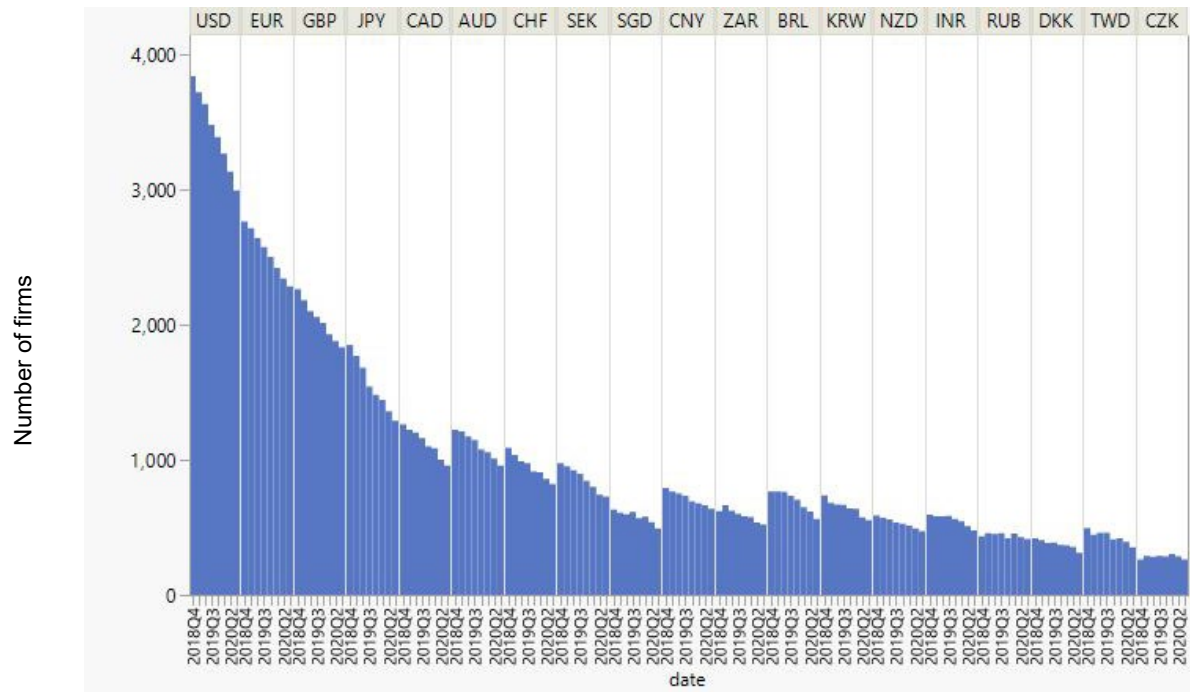
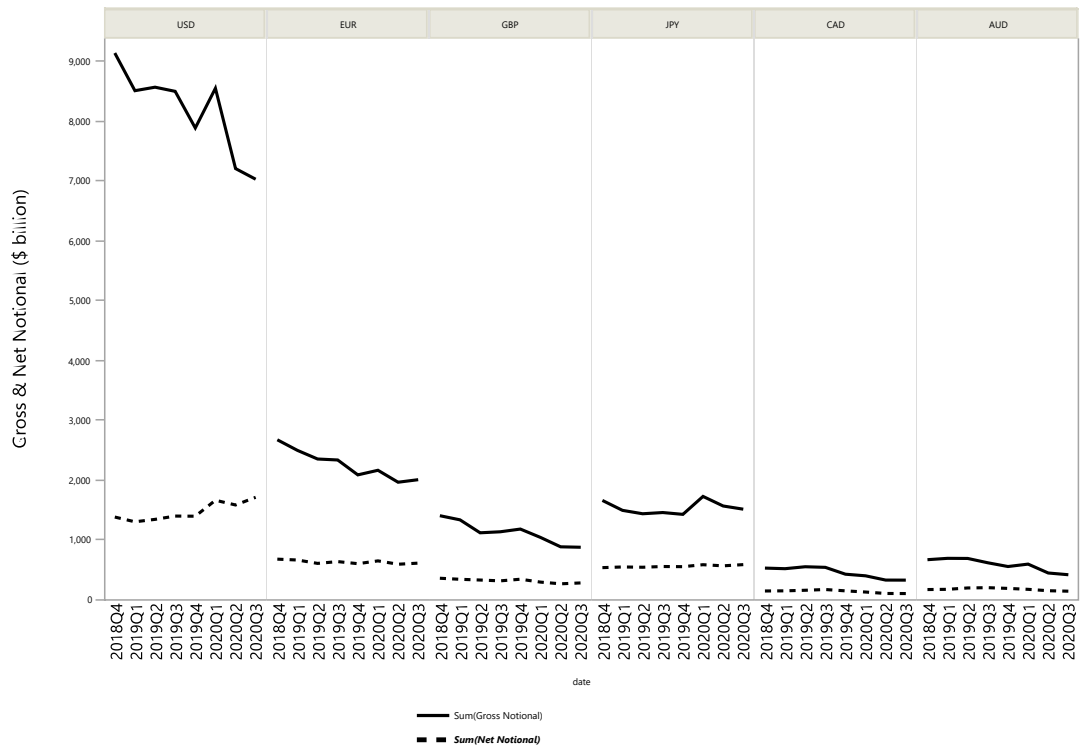


Figure 6: Hedge funds

Panel A: Number of firms



Panel B: Gross and net notional



Panel C: Long and short net notional

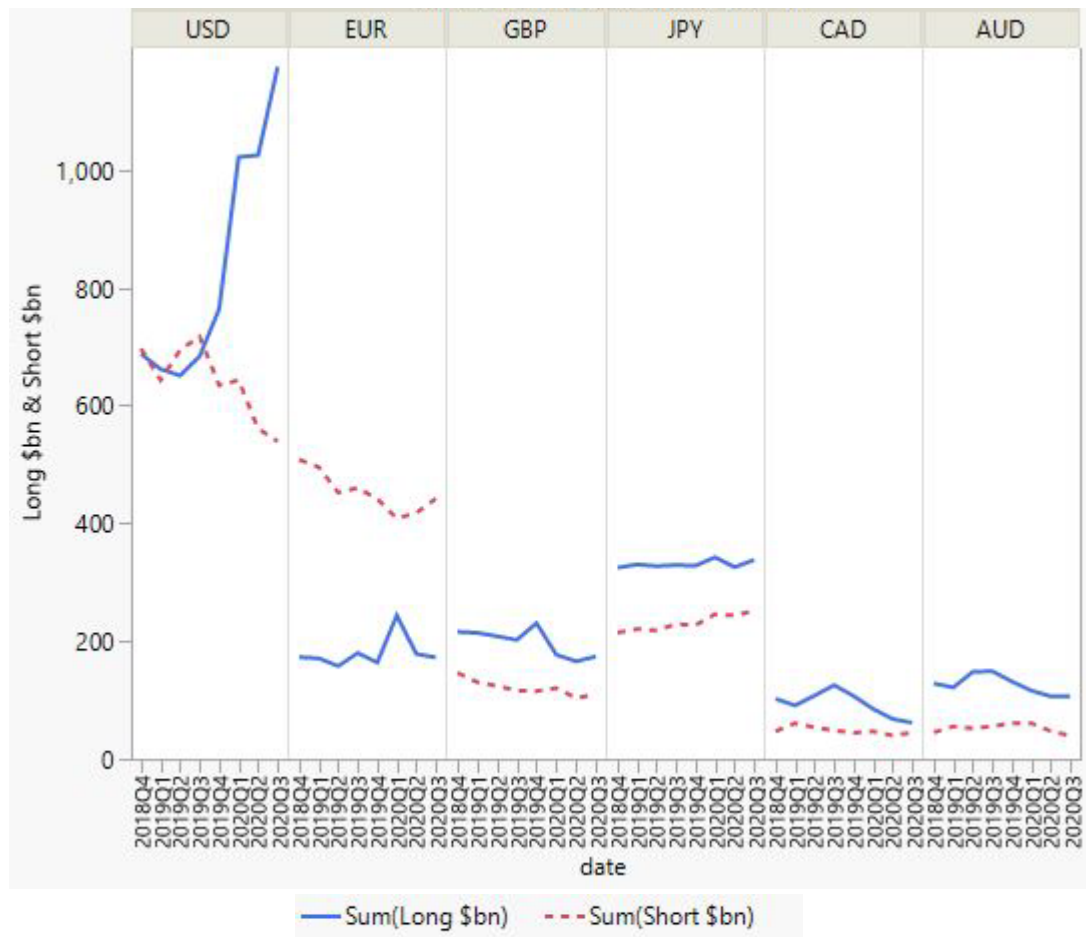
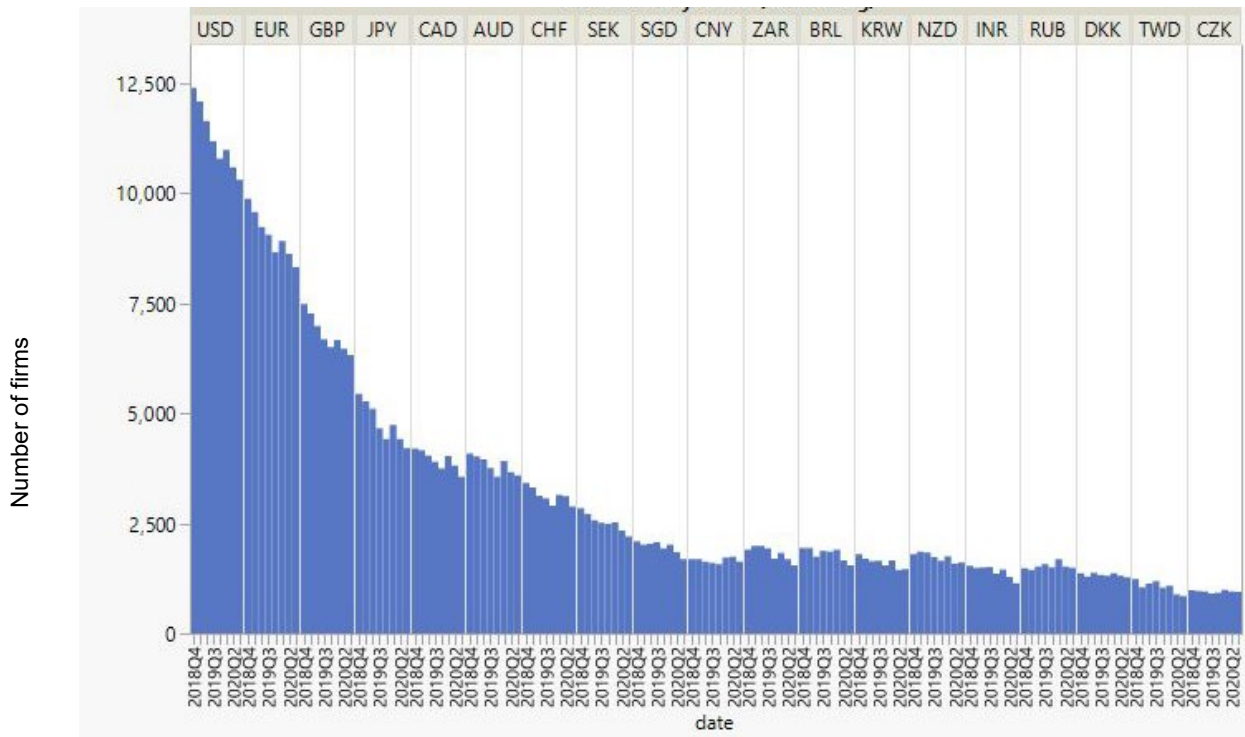
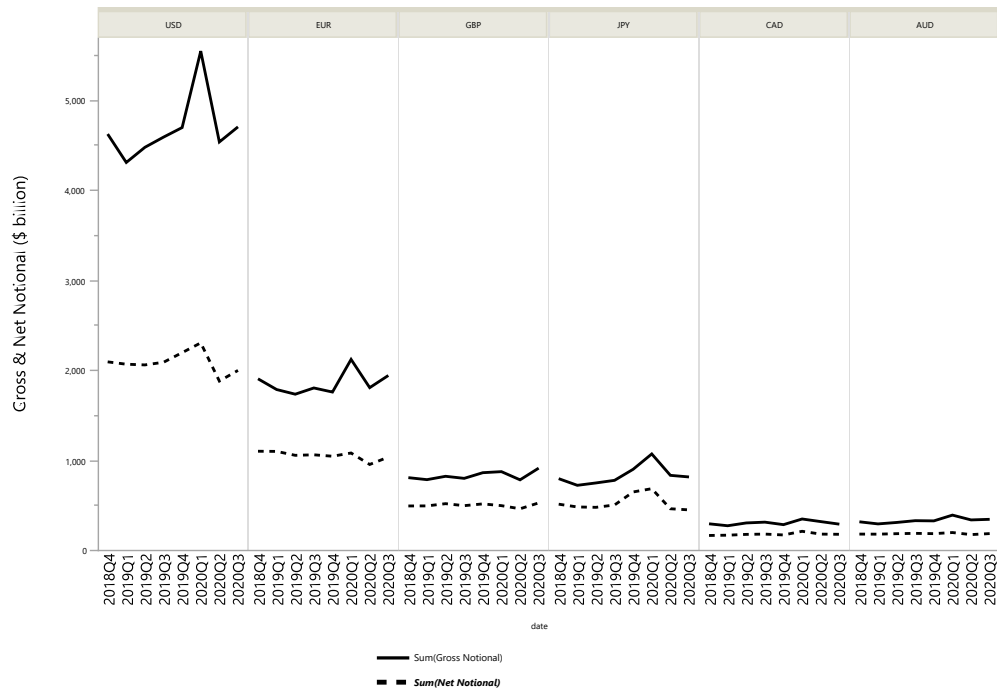


Figure 7: Asset managers

Panel A: Number of firms



Panel B: Gross and net notional



Panel C: Long and short net notional

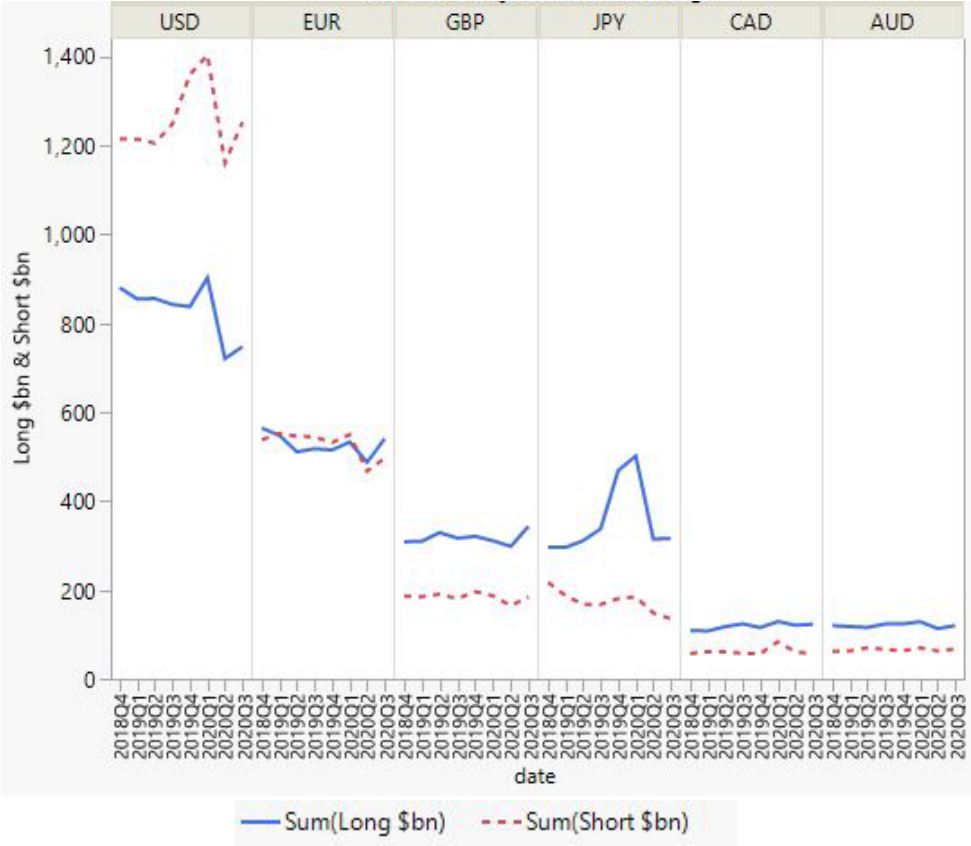
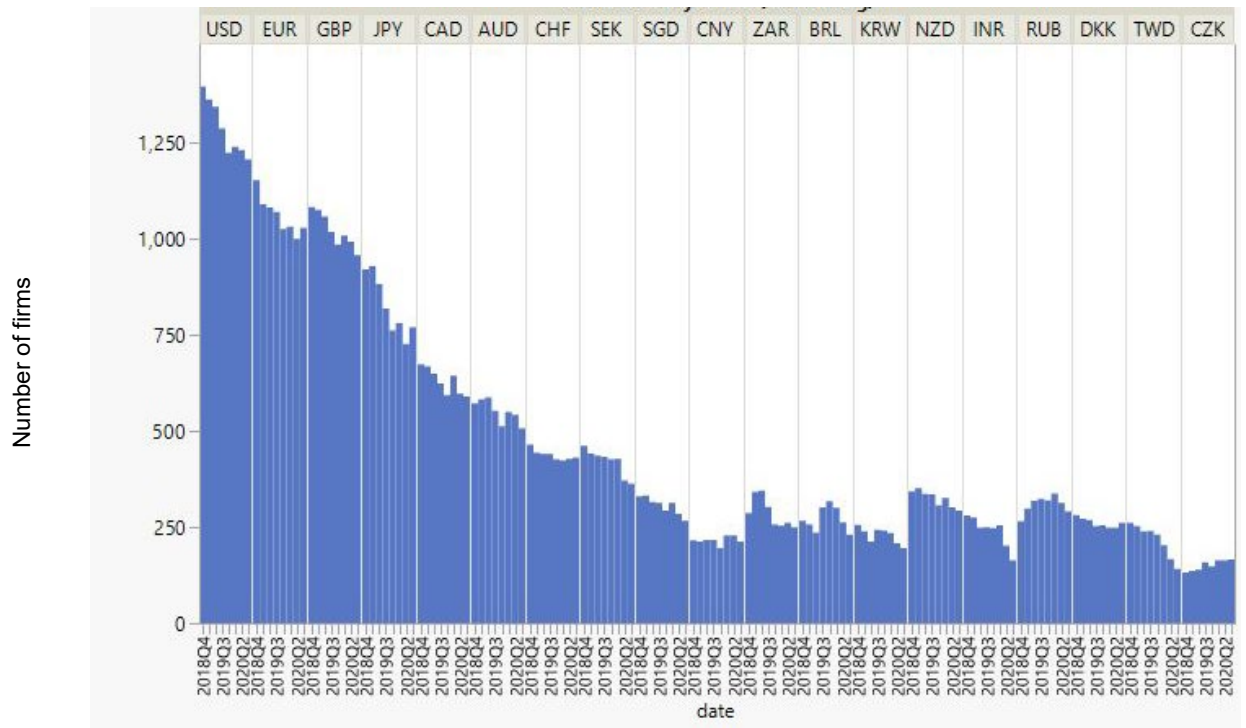
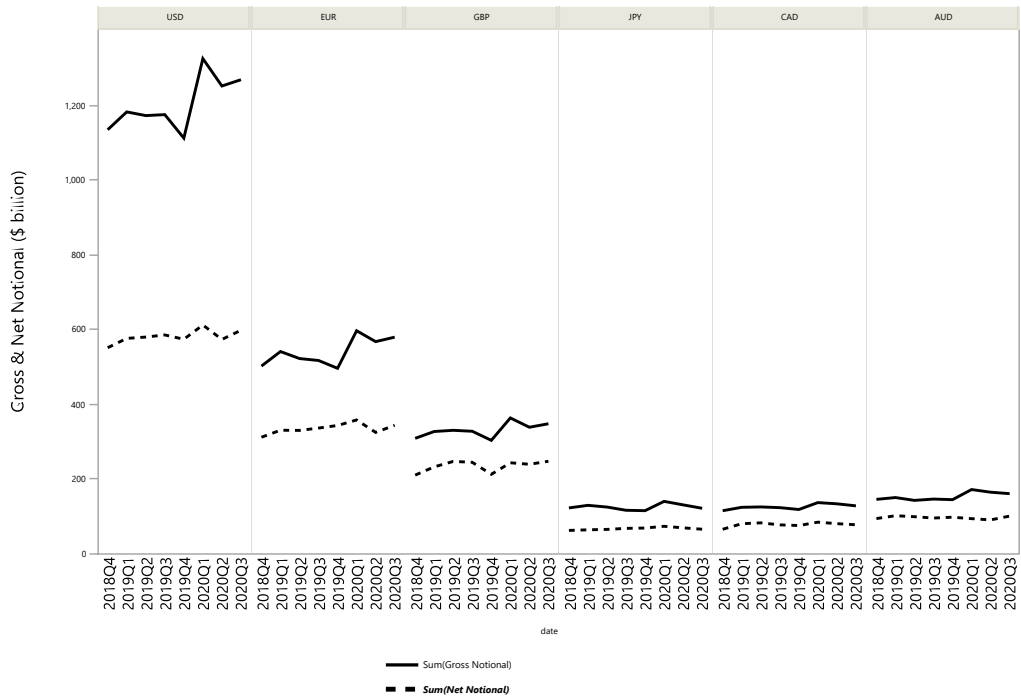


Figure 8: Pension funds

Panel A: Number of firms



Panel B: Gross and net notional



Panel C: Long and short net notional

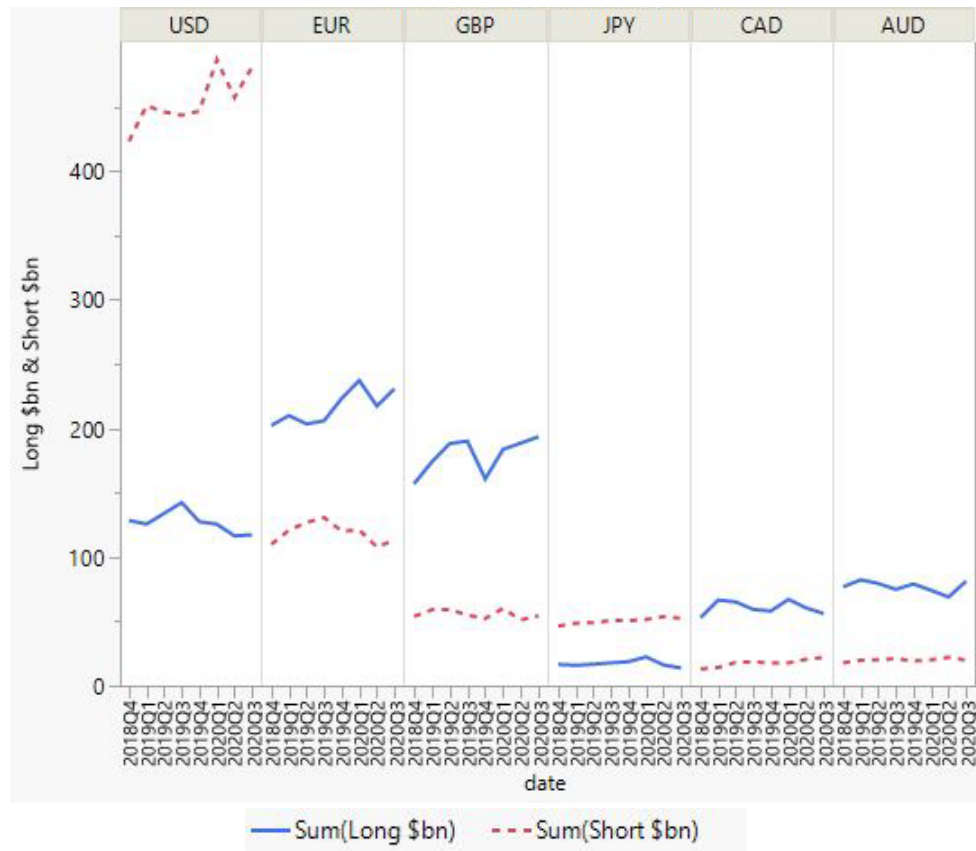
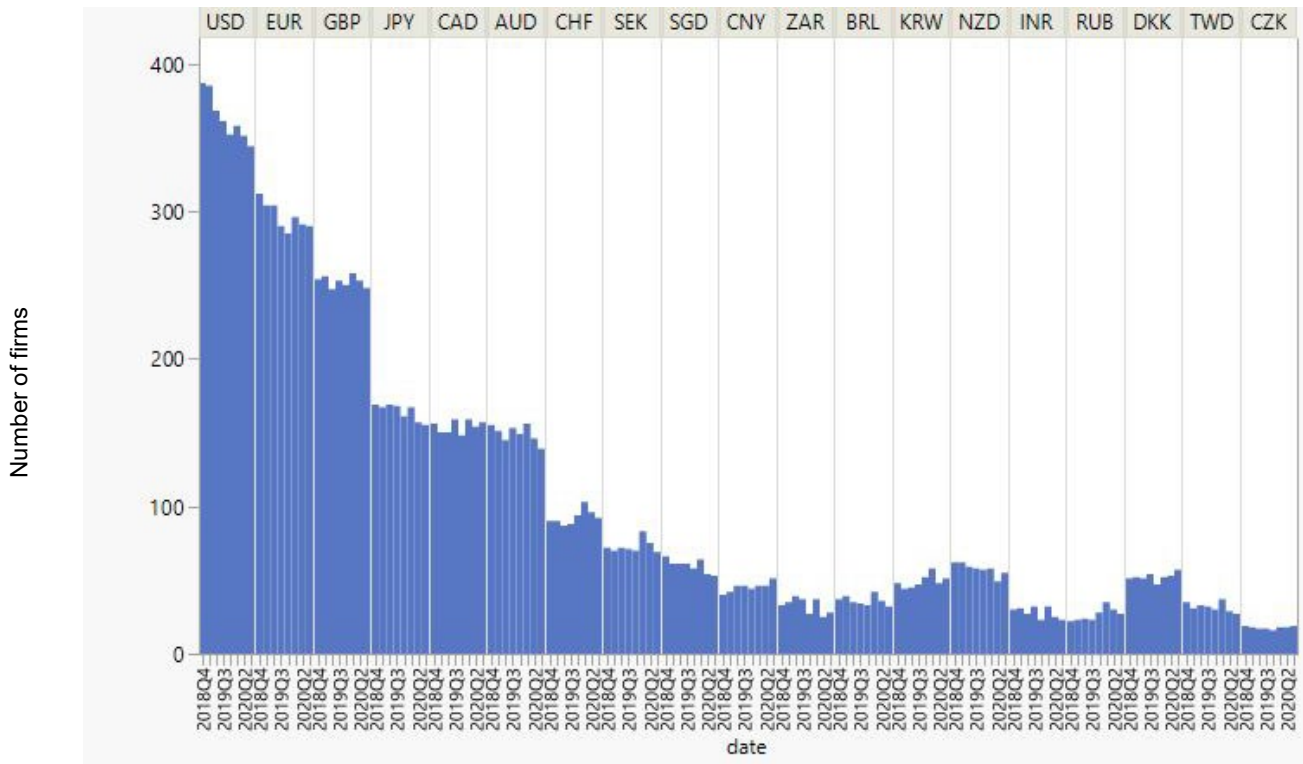
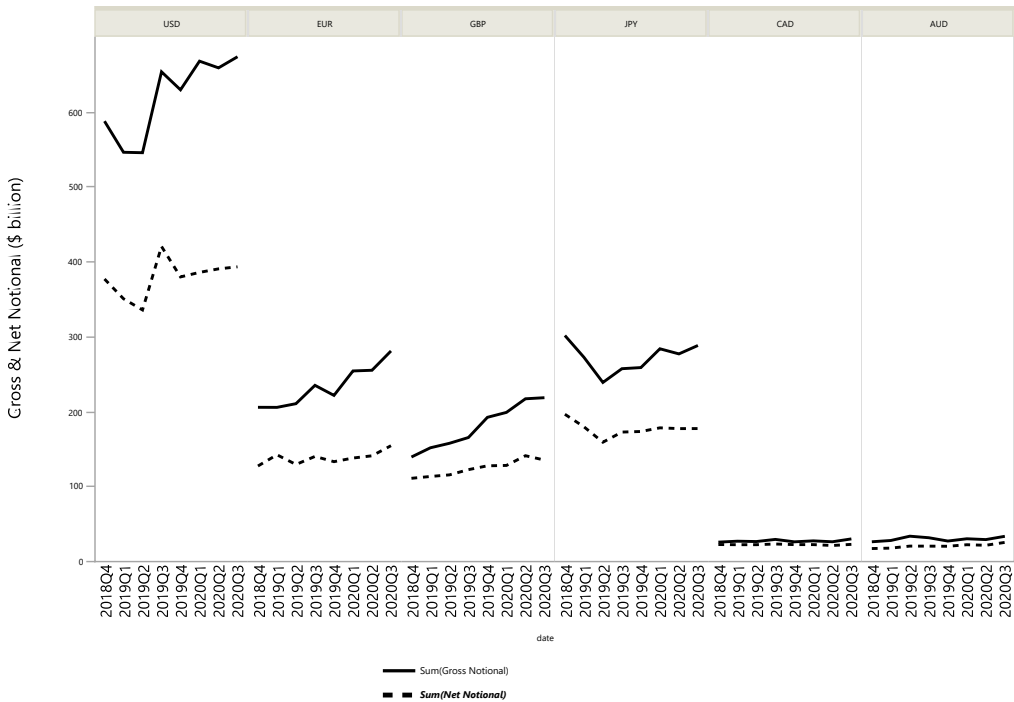


Figure 9: Insurance companies

Panel A: Number of firms



Panel B: Gross and net notional



Panel C: Long and short net notional

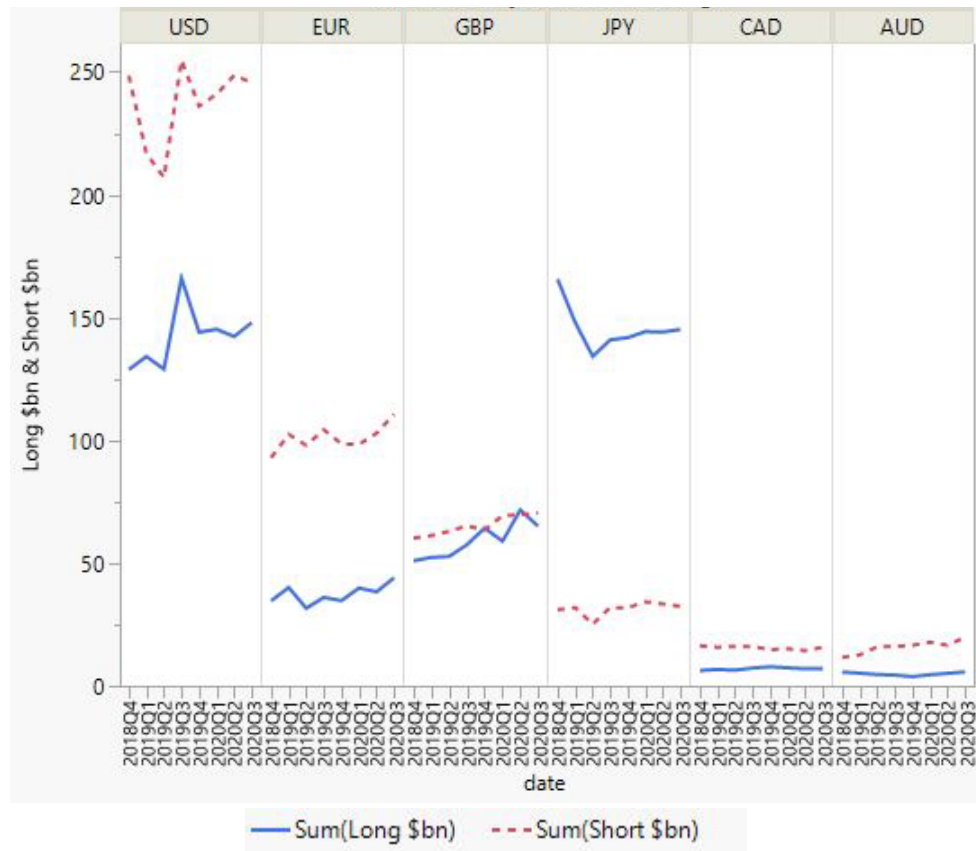
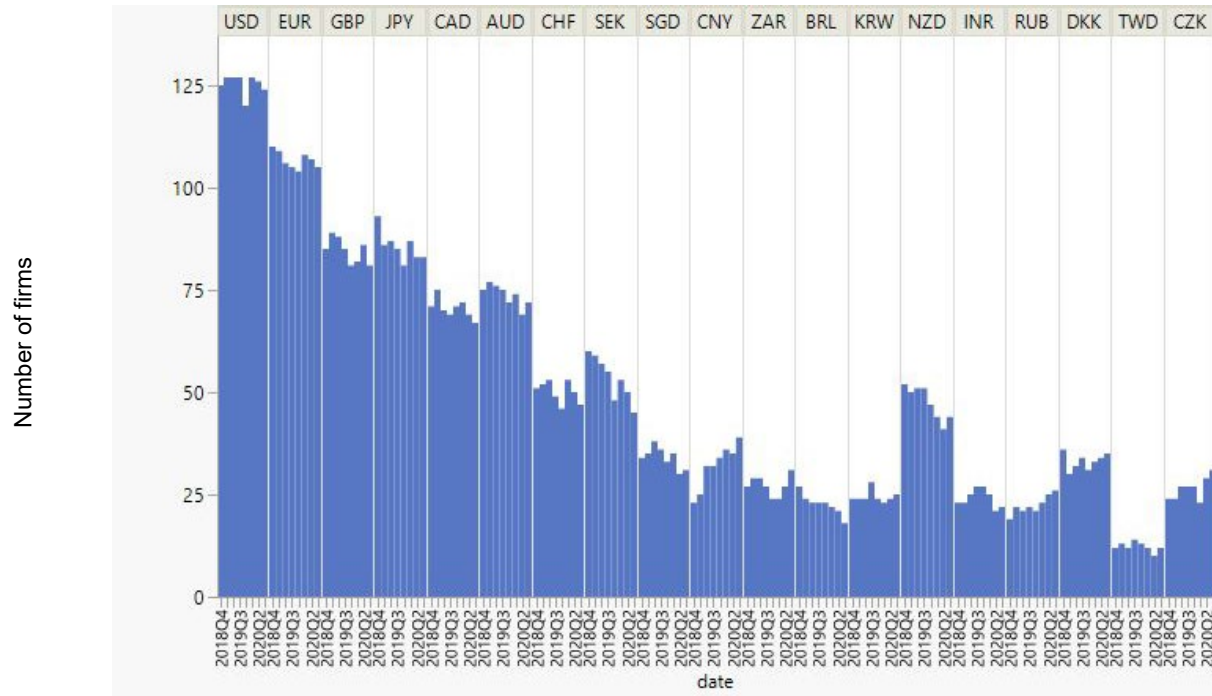
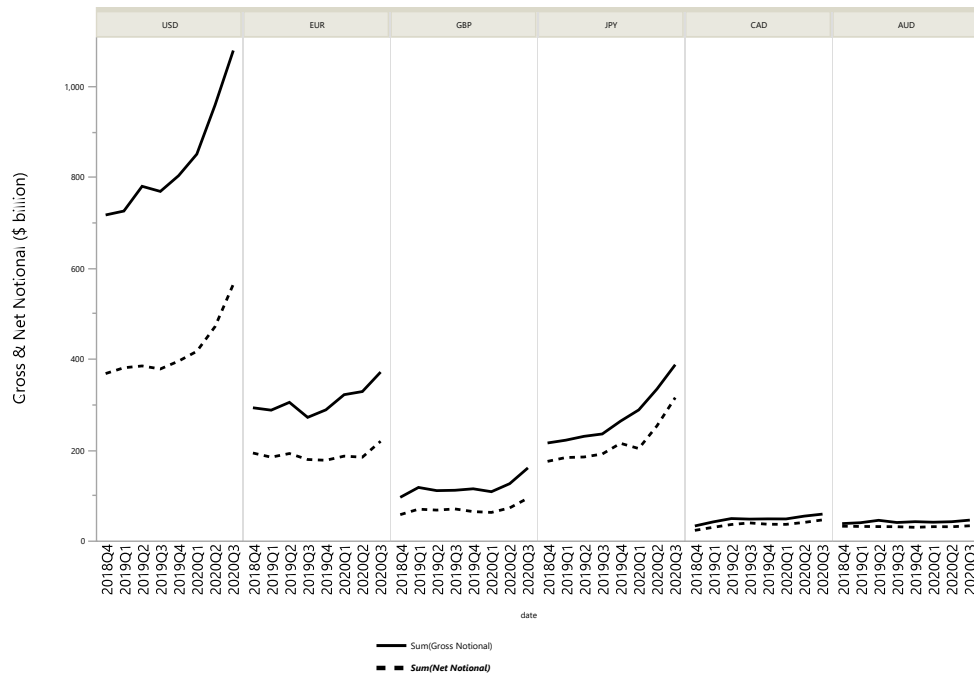


Figure 10: Sovereign and supranational institutions

Panel A: Number of firms



Panel B: Gross and net notional



Panel C: Long and short net notional

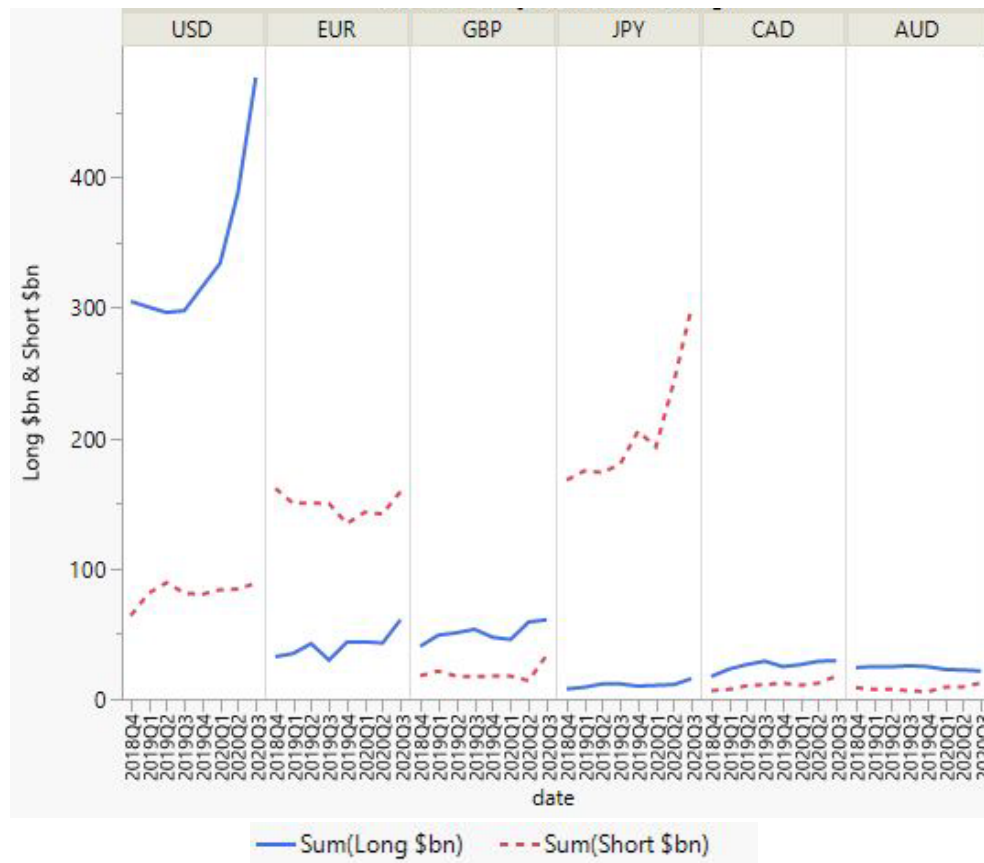
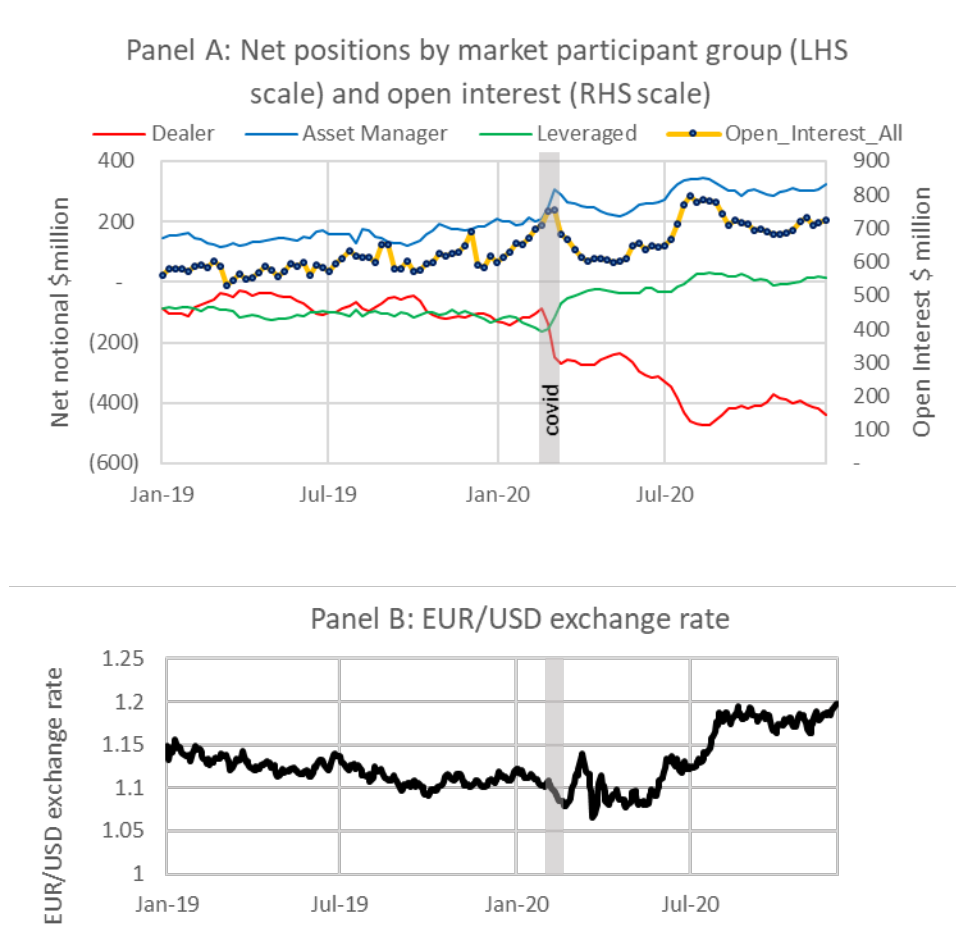


Figure 11: EUR futures open interest and net positions (\$million)



Source: EUR/USD exchange rates sourced from Bloomberg.

Figure 12: EUR futures open interest of hedge funds (number of contracts)

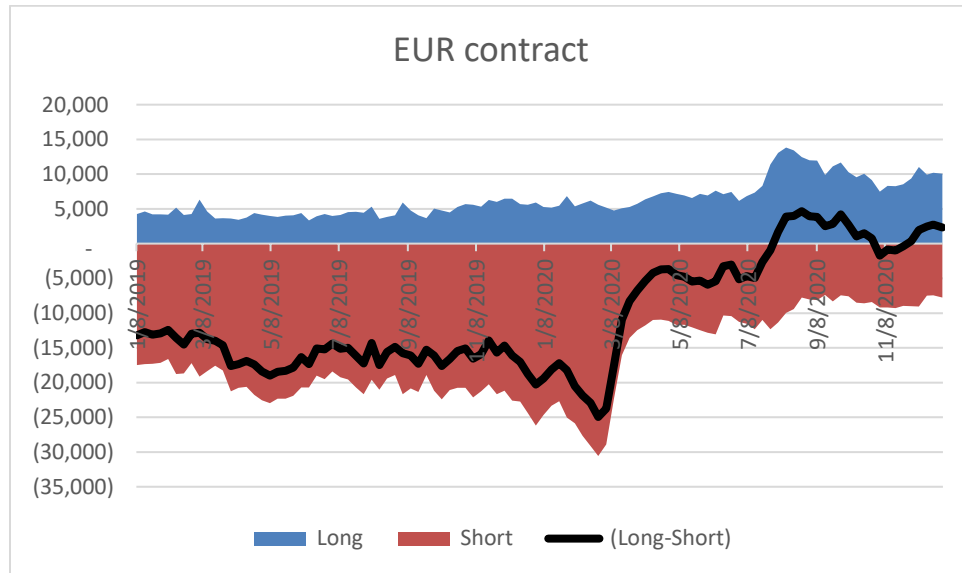


Figure 13: Total FX spot market settlement volume

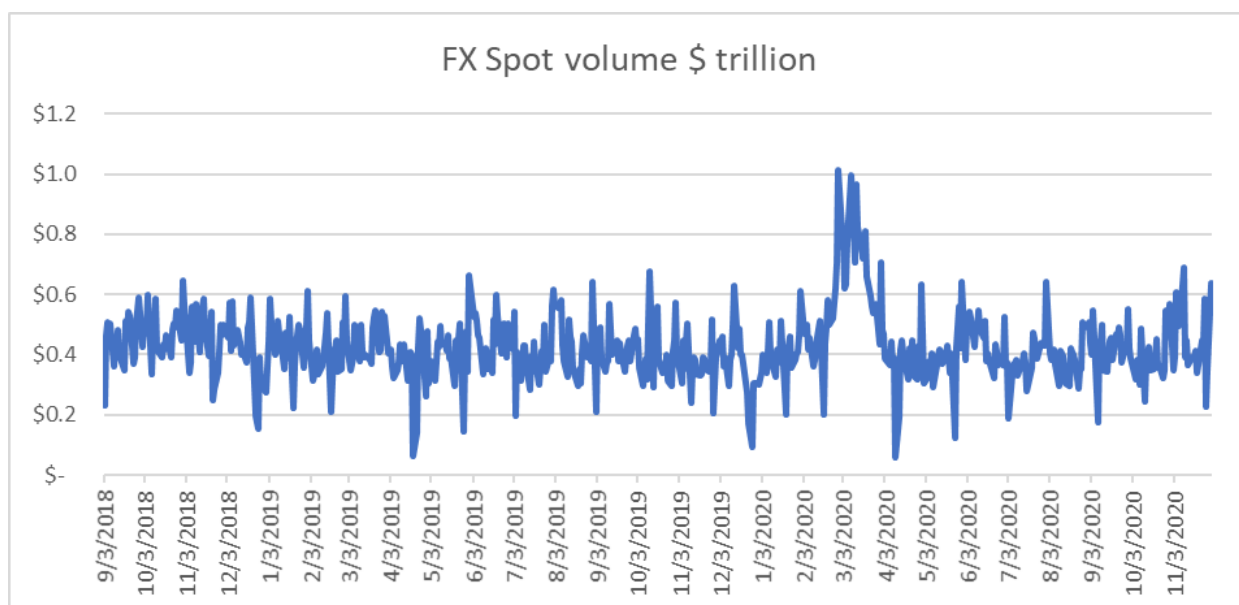


Figure 14: Correlation between change in futures positions and change in swaps positions

