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Dash for dollars

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Abstract

We document a 'dash for dollars' in corporate bond markets during the Covid-19 turmoil period. Within-firm variation of corporate bond spreads and transaction volumes reveals that US dollar-denominated bonds experienced larger spread increases and selling pressures relative to non-dollar bonds. To interpret these findings, we quantify the importance of two different hypotheses linked to the dollar's hegemony in the international financial system, namely its superior liquidity and its dominance as a funding currency. Our results highlight the importance of the funding hypothesis, which suggests that investors sold their dollar-denominated assets to meet immediate dollar obligations.

Key words: Corporate bonds, heterogeneity, credit spreads, liquidity, dash-for-cash, dollar demand, Covid-19, trading volumes.

JEL classification: E44, E58, G01, G12, G15, G18, G23.

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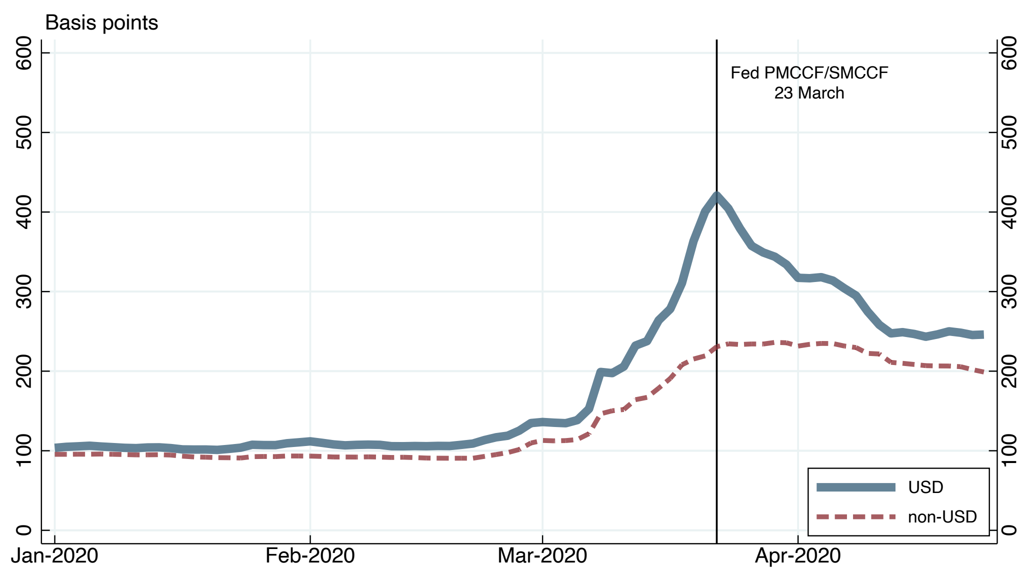
1 Introduction

Global corporate bond markets were under severe distress during the outbreak of the Covid-19 pandemic in early 2020. Heightened economic and financial market uncertainty sparked a global dash-for-cash, as investors rushed to sell securities to meet sudden liquidity demands and to build cash buffers. As a result, corporate bond spreads widened sharply between late February, when the rate of expansion of Covid-19 accelerated worldwide, and mid-March, when the Fed announced a series of measures to ease conditions in financial markets (see, e.g., Gilchrist et al., 2020; Haddad et al., 2021; Kargar et al., 2021; O'Hara and Zhou, 2021).

While the dramatic widening of credit spreads caught the attention of most commentators, another defining feature of the stress period was the heterogeneous increase in spreads across bonds denominated in US dollars versus bonds denominated in other currencies—a dimension that existing studies have so far overlooked. Figure 1 illustrates the average spread dynamics for dollar and non-dollar corporate bonds around the Covid-19 outbreak, using a large multi-country data set. As the pandemic accelerated in early March, spreads of dollar bonds rose significantly faster than the spreads of non-dollar bonds. In this paper, we ask whether investors' sell-off of corporate bonds was more severe for dollar-denominated bonds and, if so, what are the reasons that can explain this pattern.

Figure 1 Corporate Bond Spreads During Covid-19



Note. Average of option adjusted corporate bonds spreads (weighted by size) across all outstanding bonds in the ICE Bank of America Merrill Lynch's Global Corporate Index, issued in US dollars (solid blue line) and non-dollar currencies (dashed red line), respectively. Source: ICE Bank of America Merrill Lynch.

Simple unconditional averages (as those reported in Figure 1) are of course only illustrative.[1] To pin down the driving forces of the selloff in corporate bonds, we exploit the granularity of two complementary data sets: a global *bond-level* data set with information on corporate bond credit spreads at daily frequency; and a regulatory UK *transaction-level* data set on corporate bond trades in the secondary market. To inform our empirical estimates, we exploit a unique feature of our data, namely that firms often have multiple outstanding bonds issued in different currencies. By exploiting this within-firm variation, we circumvent problems associated with unobserved confounding factors that are hard to control for—for example, whether certain types of firms systematically issue bonds with particular characteristics.

Daily variation in spreads across different bonds of the same issuer shows that US dollar-denominated bonds experienced a larger increase in spreads during the Covid-19 crisis. The economic magnitude of the effect is large: in the last week of the turmoil period, the daily increase in bond spreads was on average almost 20bps larger for dollar bonds relative to non-dollar bonds of the same firm. Using our transaction data, we then test whether the sharp rise in dollar spreads is associated with an increased selling of dollar bonds. Importantly, the granularity of our data set allows us to compare trades of the same client, on the same day, across different bonds of the same firm. We find that a given investor's daily sell volumes in the last week of the turmoil period was on average £4m higher for dollar bonds compared to non-dollar bonds of the same firm—a relatively large amount considering that the median trade size is £360k.

We conjecture that these patterns are ultimately related to the role of the US dollar as a 'dominant currency' in the international monetary and financial system. In particular, we consider two non-mutually exclusive hypotheses to interpret our findings. The first one is centered on the dollar's superior liquidity (e.g., Eichengreen and Xia, 2019). To minimize the adverse price impact of fire sales, investors tend to follow a 'pecking order of liquidity' and sell their most liquid assets first, as shown by previous studies (e.g., Haddad et al., 2021; Ma et al., 2022). According to the dollar liquidity hypothesis, investors would therefore have an incentive to sell their dollar bonds first in response to sudden liquidity demands. If intermediaries do not have the capacity or willingness to absorb the resulting increase in supply, such selling pressure can lead to the price dynamics observed in the data, in which more liquid securities end up displaying larger increases in spreads than less liquid ones. A second facet of the US dollar hegemony in the international financial system is its clear

[1] For instance, they could be driven by selection dynamics, leading firms to issue bonds of a specific size or maturity when doing so in US dollars. Similarly, at a more aggregate level, a larger widening in the spreads of US dollar bonds could be driven by riskier firms choosing to issue US dollar bonds.

dominance as a funding currency. One aspect of this property is the widespread denomination of financial and real liabilities in US dollars, which means that agents need to secure US dollars when these liabilities become due, particularly in stress periods—for example, to meet margin calls or investor redemptions. When faced with an increased likelihood of having to meet immediate dollar-denominated liabilities, investors can choose between liquidating their dollar assets or, alternatively, selling their non-dollar assets and swapping the proceeds into US dollars. The cost of hedging such exchange rate risks, however, typically increases sharply during periods of stress, as shown by large widenings of CIP deviations.[2] Therefore, our second hypothesis is that investors did not only require cash in general, but US dollar cash in particular, and that they were forced to sell dollar-denominated assets to secure it.

Our granular transaction-level data set allows us to shed light on both hypotheses. By comparing effective bid-ask spreads of dollar and non-dollar bonds issued by the same firm, we can test the implications of the dollar liquidity hypothesis—thereby exploiting a dimension of liquidity that previous studies on the Covid-19 period (which focused exclusively on dollar bonds) overlooked. The data show that bid-ask spreads of dollar bonds are lower than those of non-dollar bonds in the period *preceding* the Covid-19 market turmoil. However, during the crisis period, this pattern reverses: it is now dollar bonds that have significantly higher bid-ask spreads compared to non-dollar bonds. The results therefore suggest a "liquidity inversion" during the crisis: while individual investors may have initially chosen to sell US dollar bonds due to their (ex ante) superior liquidity, the aggregate effect of these actions appears to contradict the original premise.[3]

To test our second hypothesis, which puts the dominance of dollar funding at the forefront, we exploit a particular feature of the Covid-19 crisis, namely that UK insurers were exposed to high and unexpected liquidity demands due to large variation margin (VM) calls on their derivative positions (Czech et al., 2021). Importantly, investors are typically required to meet VM calls in the currency of the derivative contract, and many UK insurers have large exposures to dollar-denominated contracts. Our analysis shows that insurers with a high share of dollar-denominated derivative contracts had significantly lower net trading volumes in dollar bonds, supporting the notion that these insurers faced a higher likelihood of having to meet dollar-denominated liabilities.

What does this evidence tell us about the driving forces of the dash for dollars? When investors require US dollar funds, they have two options. On the one hand, they can sell

[2]Avdjiev et al. (2020); Bahaj et al. (2020); Eren et al. (2020) and Ferrara et al. (2022), among others, provide extensive evidence on the widening of CIP deviations during the Covid-19 episode.

[3]Haddad et al. (2021) and Ma et al. (2022) document a similar liquidity inversion using maturity (rather than currency) as a measure of liquidity.

dollar-denominated assets, likely incurring higher transaction costs given the liquidity inversion. On the other hand, they can sell a non-dollar asset and hedge the resulting exchange rate risk, which entails increased hedging costs that are typically observed during periods of financial stress. To rationalize the selling pressure in US dollar assets that we document, one would need to observe that the cost of the first alternative (i.e. dollar bond liquidation costs, which we can measure from our transaction-level data) is smaller than that of the second alternative (i.e. FX hedging costs, proxied by CIP deviations) during the crisis period. This is indeed what we find in the data, thus lending support to an interpretation that puts the undisputed dominance of the dollar as a funding currency at the forefront.

Our empirical results and proposed interpretation have useful implications for policymakers and investors. As financial and real liabilities are widely denominated in US dollars, investors may choose to liquidate dollar-denominated assets in stress periods to obtain dollar cash. The yield spikes induced by this selling pressure, if unarrested, may ultimately limit the ability of firms to issue or roll-over dollar-denominated debt. To avoid such an adverse scenario, our findings emphasize the crucial role of Federal Reserve dollar swap lines as a policy tool. By reducing dollar funding strains and CIP deviations (Bahaj and Reis, 2021), swap lines can effectively mitigate the severity of selling pressures in dollar-denominated securities.

2 Related literature

Our findings speak directly to studies analyzing the dynamics of corporate bond spreads and liquidity during the Covid-19 pandemic (e.g., Ebsim et al., 2020; Gilchrist et al., 2020; Haddad et al., 2021; Kargar et al., 2021; O'Hara and Zhou, 2021; Boyarchenko et al., 2022).[4] In particular, Haddad et al. (2021) highlight the role of the "dash for cash" in explaining the dynamics of corporate bond spreads during the outbreak, in turn linking it to a "reverse flight to liquidity" (see also Ma et al., 2022). According to this interpretation, investors in need of cash sold their most liquid securities first to minimize the price impact of their fire sales, thereby exerting downward pressure on the prices of these liquid bonds. We further refine those explanations by providing evidence that investors' behavior did not constitute a dash for cash in general, but a dash for US dollars in particular. We also provide evidence for the underlying drivers of the selling pressure in dollar bonds.

[4] A broader literature has exploited the variation in asset prices induced by the Covid-19 outbreak to learn about a variety of transmission mechanisms. See, for example, Croce et al. (2020), Gormsen and Koijen (2020) and Jiang et al. (2022), among others.

Furthermore, unlike prior studies on the US corporate bond market that use low-frequency investor holdings and anonymous trading data (e.g., Haddad et al., 2021; Kargar et al., 2021; O'Hara and Zhou, 2021; Boyarchenko et al., 2022; Ma et al., 2022), we exploit the regulatory MiFID II bond transaction database from the UK. The main advantage of our data is that we are able to observe the identities of both counterparties involved in a trade, hence allowing us to delineate the trading patterns and motives during the Covid-19 crisis: which groups of investors were buying, which were selling, and the associated impact on prices and liquidity. Importantly, we are then also able to link trading patterns back to the nature of investors' balance sheets—and we show that the selling pressure was partly due to investors having to meet dollar liabilities.

Our results therefore provide complementary evidence to studies analyzing US dollar shortages around the Covid-19 outbreak (see, among others, Avdjiev et al., 2020; Bahaj and Reis, 2020; Eren et al., 2020), but our focus is on corporate bond markets instead of exchange rate markets. In a related paper, Liao (2020) studies the link between within-firm corporate bond spread differentials across currencies and deviations from the CIP condition in FX markets. While he focuses on relative currency dynamics at the business cycle frequency, we instead point to absolute directional differences between the US dollar and other currencies during a period of stress. Additionally, Liao (2020) puts emphasis on the consequences for corporate bond issuance, while being agnostic about the origin of pricing anomalies in bond spreads and FX derivative markets. We instead analyze a period during which the market for issuance was effectively shut, and therefore naturally focus on investors' rather than issuers' behavior. Our work is also complementary to Caramichael et al. (2021), who analyze the characteristics of US dollar corporate bonds relative to bonds issued in other currencies, without putting emphasis on periods of stress.

Lastly, our paper contributes to the growing literature on the special role of the US dollar and dollar assets, for instance, studies on the exorbitant privilege (e.g., Gourinchas and Rey, 2007; Maggiori, 2017), convenience yield (e.g., Krishnamurthy and Vissing-Jorgensen, 2012; Jiang et al., 2021), and global safe assets (e.g., Caballero et al., 2008; He et al., 2019). In particular, our results complement the findings of He et al. (2022) on the "inconvenience yield" of US Treasuries during the Covid-19 market turmoil.

3 Data

We employ two complementary data sets in our analysis: a global data set with information on corporate bond credit spreads at daily frequency; and a regulatory UK transaction-level data set on corporate bond trades in the secondary market. Below we describe each data source in turn.

3.1 A Bond-level Data Set on Corporate Bond Credit Spreads

We build a large global data set of individual corporate bond spreads at daily frequency from January 2020 to April 2020. We collect information for the constituents of a comprehensive global index of investment grade corporate bonds, the ICE Bank of America Merrill Lynch's Global Corporate Index.

Our initial data set includes daily data for more than 14,500 investment grade bonds with a residual maturity above one year, issued by about 2,900 companies in 60 countries. The main variable of interest for our study is a bond's Option Adjusted Spread (OAS).[5] The data set also contains information on other bond characteristics, such as the maturity of the bond, its currency of denomination, coupon, seniority and rating. The included bonds are denominated in a range of currencies. US dollar-denominated bonds dominate, comprising 65.7% of the sample, followed by euro (23.6%), sterling (4.8%), Canadian dollar (4.3%), and Australian dollar (1.7%).

A unique feature of our data set, which is central to our identification strategy, is the fact that many firms have multiple outstanding bonds at any given point in time. As the main focus of the analysis is on a bond's currency of denomination, we only keep 'multi-currency' firms in our sample, i.e. firms that have at least one dollar-denominated bond and one non-dollar-denominated bond. We further exclude bonds issued by firms in the banking and financial services industries, in order to focus on real economy firms.[6] As a result, the bonds in our data set are typically issued by large, global non-financial corporates.[7] Finally, to avoid capturing differences in legal characteristics, we only keep bonds of the same seniority, i.e. senior unsecured bonds.[8]

[5]The OAS is defined as the number of basis points that the government spot curve is shifted to match the present value of discounted cash flows to the corporate bond's price. For details on the calculation of the OAS, see https://www.theice.com/market-data/indices.

[6]In Panel C of Table B.9, we show that our results also remain robust to the inclusion of financial bonds.

[7]As highlighted by Coppola et al. (2021), global firms often finance themselves through shell companies in "tax havens". However, the ICE BoAML data allocate the country of issuance based on the location of the majority of the holding company's operating assets, hence mitigating potential concerns related to the wrong assignment of issuance countries. If we exclude bonds issued in "tax havens" (97 in total), our results remain virtually unchanged.

[8]As noted by Gopinath et al. (2020), the bonds of global corporate issuers (as the ones that populate our sample) often have 'pari passu' clauses implying that bonds in different currencies are treated equally on a legal basis. Gopinath et al. (2020) also highlight that it is unlikely that other idiosyncrasies with respect to covenants or disclosure requirements vary systematically with the currency of denomination.

The sample period in our baseline empirical exercise runs from February 28th to March 20th 2020. The starting date of February 28th is an arbitrary point that aims to capture the end of relatively tranquil market conditions, as shown in Figure 1. The end date of March 20th corresponds to the last trading day before the Fed's announcement of its corporate bond purchase programs.[9]

The final daily data consists of 3,107 bonds issued by 225 firms in 29 countries. Section A in the Appendix provides more details on the data and a set of additional summary statistics and stylized facts.

3.2 A Transaction-level Data Set on Corporate Bond Trades

We collect corporate bond trades data from the transaction-level MiFID II database, which is maintained by the UK's Financial Conduct Authority (FCA). The MiFID II data provide detailed reports of all secondary-market trades that meet one of the following conditions: i) trades carried out on a UK trading venue, and ii) trades where at least one counterparty is an FCA-regulated entity. While less comprehensive than our global corporate spread data set in terms of country coverage, the MiFID II database has information on a diverse set of corporates, both in terms of geography and industry.

Each transaction report contains information on the transaction date and time, ISIN, execution price, transaction size, and the legal identities of the buyer and seller. The sample covers the period from January 2018 to May 2020, and we obtain information on $\sim$ 2.1m trades in 7.4k corporate bonds. After excluding financial bonds and interdealer trades, so as to align the sample with the bond spreads data set, we are left with approximately 650k trades by 30k investors in 925 corporate bonds.[10] We also merge our transaction-level data with information on bond characteristics (issuer, rating, etc.) from S&P Capital IQ. Section A in the Appendix provides more details on the data and a wide range of additional summary statistics.

Finally, for a subset of investors, we are able to match the transaction data with granular balance sheet information. More precisely, we collect supervisory data on the derivative holdings of insurance companies regulated by the UK's Prudential Regulation Authority (PRA) and subject to the Solvency II Directive. Insurers within scope of the Solvency II Directive are required to submit annual and quarterly returns, with the exception of some smaller

[9]While the Fed intervention period is not crucial for the main results of this paper, in Appendix B we extend our analysis to the period following March 20.

[10]Dealers tend to have distinctive motives for trading in the interdealer market (e.g. for re-balancing of inventories), and we therefore exclude these trades from our sample (see also Bongaerts et al., 2017).

firms with quarterly waivers. The reports include detailed information on the holdings of a given insurer, such as the identity of the counterparty, underlying security, notional amount, derivative category (e.g. FX forward), and swap delivered/received currencies. Section A in the Appendix provides more details on the data and additional information on insurers' derivative holdings.

4 The Dash for Dollars: Spreads

In this section, we analyze the role of the US dollar in explaining the heterogeneous response of corporate bond spreads to the outbreak of the Covid-19 pandemic.

4.1 Baseline Results

We start by estimating the following simple cross-sectional regression:

$$\Delta s_b = \alpha + \alpha_i + \beta_1 USD_b + \Gamma X_b + \varepsilon_b \quad (1)$$

where Δs_b is the change between February 28th and March 20th in the (option-adjusted) spread of bond b issued by firm i.[11] USD_b is our main variable of interest, i.e. an indicator variable that identifies US dollar-denominated bonds. X_b include a set of additional bond-level control variables, including the bond face value, initial spread level as of February 28th, coupon type, time-to-maturity and amortization type. Finally, α_i is a firm fixed effect, i.e. an indicator variable that controls for unobserved time-invariant heterogeneity at the firm level.

It follows that, in equation (1), the coefficient β_1 is estimated using *within* firm data, i.e. exploiting variation across bonds issued by the same firm in different currencies.[12] This constitutes one of the main advantages of our approach and data, and plays an important role in the interpretation of our results. Exploiting variation within firms, the β coefficients in our regression are estimated keeping the fundamentals of the firm fixed.[13] This means that

[11]As equation (1) employs only cross-sectional variation, the variables have no time subscripts.

[12]In a related paper, Maggiori et al. (2020) also rely on firm fixed effects to identify clientele effects for investor holdings of bonds denominated in different currencies issued by the same firm. This segmentation of investor holdings enhances the plausibility of the differential price effects across currencies uncovered in our study.

[13]For example, Gilchrist and Zakrajsek (2012) regress credit spreads on a measure of distance to default computed using Merton's model. Our approach would absorb the change in the default probability of a firm without taking a particular stance on the right measure of default probability to use. We discuss these issues in more detail in Section 4.2.

the different behavior of spreads in the dollar and non-dollar buckets cannot be attributed to a systematic relation between currency of denomination and firms' characteristics (which would arise, for example, if low-risk firms would systematically issue non-dollar bonds).

The results from specification (1) are reported in column (1) of Table 1. The coefficient estimates show that US dollar-denominated bonds are associated with a larger increase in corporate bond spreads, in line with the unconditional evidence reported in Figure 1. Specifically, spreads of dollar bonds increased by about 120bps more than non-dollar bonds of the same firm over the period from February 28 to March 20.

Table 1 BOND SPREADS WIDENING: THE ROLE OF THE US DOLLAR

	(1)	(2)
US dollar (β_1)	120.41***	7.84***
	(7.68)	(2.56)
Observations	2927	50685
R squared	0.649	0.356
Firm FE	yes	no
Firm × Day FE	no	yes

NOTE. The dependent variable in Column (1) is the total change in bond spreads between February 28th and March 20th, while Column (2) uses the daily spread increase during this period. Robust standard errors clustered at the firm (Column 1) and firm-day level (Column 2) are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, fixed effects, level of credit spread at the beginning of the sample, coupon type dummies, amortization type dummies, bond face value, and maturity not reported.

Next, we exploit the daily nature of our data set and estimate the following panel specification:

$$\Delta s_{b,t} = \alpha + \alpha_{i,t} + \beta_1 USD_b + \Gamma X_b + \varepsilon_{b,t} \tag{2}$$

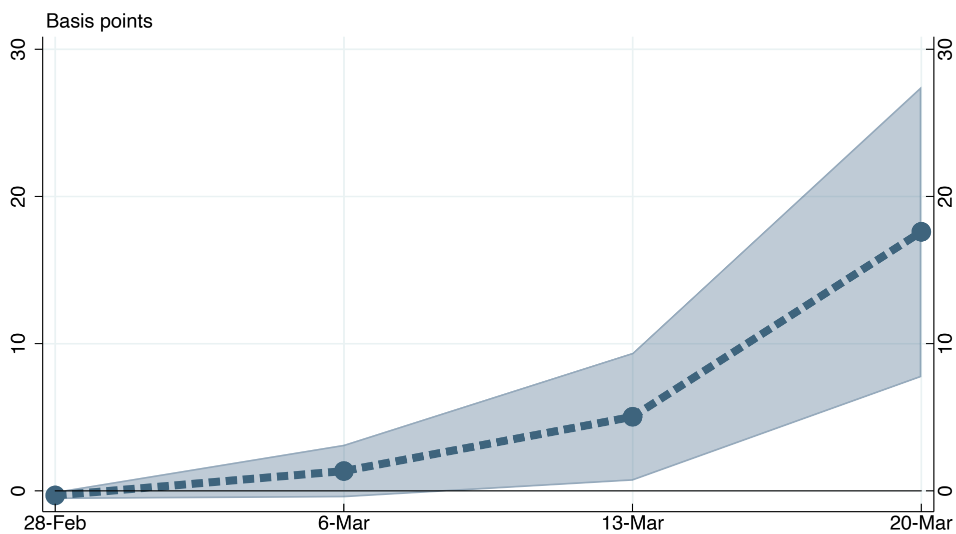
where $\Delta s_{b,t}$ is the daily change in the (option-adjusted) spread of bond b issued by firm i over the period from February 28 to March 20. Different from the cross-sectional specification (1), the panel specification (2) includes a firm-day fixed effect ($\alpha_{i,t}$) which controls for unobserved *time-varying* heterogeneity at the firm level. That is, the effect of currency of denomination is estimated exploiting the variation of spreads within a firm on a given day (rather than in the whole stress period window as before). The results from this specification (reported in column (2) of Table 1) paint a similar picture relative to those from the cross-sectional specification. The estimate of β_1 is positive and significant, at around 8bp—a magnitude consistent with column (1) considering that specification (2) is estimated using daily spread changes over a period of 16 business days.

How did the dash for dollars evolve over time? We further leverage the daily nature of the data to provide a finer analysis of different phases of the crisis. For this purpose, we estimate the following specification:

$$\Delta s_{b,t} = \alpha + \alpha_{i,t} + \alpha_w \times \beta_1 USD_b + \Gamma X_b + \varepsilon_{b,t} \tag{3}$$

where the only difference relative to specification (2) is the presence of α_w, a week fixed effect that allows us to capture the evolution of β_1 over time (on average, by week). The results from this specification are reported in Figure 2. The figure shows that the relative increase in dollar spreads, as captured by the β_1 coefficient, increases over time and peaks at almost 20bp in the week before the announcement of targeted measures by the Fed on March 23rd.

Figure 2 Bond Spreads Differentials: Time-varying Estimates



Note. The figure shows weekly estimates of the differential increase in spreads of dollar-denominated bonds vis-a-vis non-dollar bonds using, using the following specification: $\Delta s_{b,t} = \alpha + \alpha_{i,t} + \alpha_w \times \beta_1 USD_b + \Gamma X_b + \varepsilon_{b,t}$. The shaded areas display 90 percent confidence intervals based on robust standard errors.

4.2 Identification Challenges & Robustness

Our data set has the key advantage that companies tend to issue a large number of bonds in a range of currencies. As discussed above, this means we can use within-firm variation to identify the role of a bond's currency of denomination in explaining the heterogeneity in spread dynamics—in other words, we keep firms' characteristics fixed. There are, however, a number of identification challenges that complicate our task, which we describe next.

Identification challenges First, there may be other bond characteristics that are correlated with a bond's currency of denomination. For example, if dollar bonds have systematically shorter maturities than non-dollar bonds, our specification could be wrongly assigning the effect of bond maturity to the currency of denomination. Tables B.1 and B.2 in Appendix B show that our main result—namely, the larger increase in bond spreads of dollar bonds relative to non-dollar bonds—is still present after controlling for a bond's maturity. The tables also show that, within the group of dollar bonds, shorter maturity bonds are associated with a larger increase in spreads, consistent with the findings in previous studies that focused on US data (Haddad et al., 2021). We also show that the spread widening is less pronounced for bonds that mature after most of the issuer's other bonds in Table B.3. In other words, the spread widening of dollar bonds is negatively correlated with the bond-level credit risk based on the issuer's maturity structure (Bao and Hou, 2017).

Second, firm fixed effects do not ensure that identification comes exclusively from within-firm information. The fixed effects absorb the average spread variation for each firm, but the remaining across-firm heterogeneity is still used to obtain the coefficient estimates. In Table B.4 we take the within-firm argument to the limit and find that our baseline results hold on a firm-by-firm basis—i.e. for a single firm (such as Apple or AT&T) in isolation.

Third, as our sample includes bonds issued by firms headquartered in many countries around the world—and regulation and balance sheet practices of these firms may be heterogeneous—there is a risk that the documented patterns are not truly global, but specific to a particular geography. In Table B.5 we report exercises that show that our benchmark results hold for samples of (i) advanced economies, (ii) US, (iii) non-US, (iv) advanced economies excluding the US and (v) European Union headquartered firms. That is, dollar-denomination is a central variable for understanding the spread dynamics of corporate bonds issued by companies both inside and outside the United States.

Fourth, given the unique episode we consider (namely, the financial turmoil induced by the Covid-19 pandemic), it is not obvious that the dynamics we uncover are common to other crisis episodes. In Table B.6 we explore the behavior of corporate bond spreads in the second half of 2008, at the height of the Global Financial Crisis (GFC). Our results show that it was indeed US dollar-denominated bonds that displayed the largest widening in spreads during that period, mirroring the dynamics during the Covid-19 market turmoil. In terms of magnitudes, the coefficients are similar in size to those reported in Table 1.

Robustness We also run a battery of additional robustness checks. First, we add high-yield bonds to our sample, and find that the effect is substantially smaller for high yield bonds (74bps, see Table B.7), consistent with studies documenting the "reverse flight to liquidity" at the time (Ma et al., 2022). Moreover, we find that in the week following the announcement of PMCCF/SMCCF, when the market for corporate bonds 'turned', spreads of dollar-denominated bonds compressed the most, even when accounting for unobserved firm heterogeneity (see Table B.8 and Figure B.2). This is consistent with a reversion of the dynamics during the dash for dollars episode uncovered in Section 4.1.

As another important cross-check, we also exclude local currency bonds in Panel A of Table B.9. The intuition is that the default risk might potentially be higher for foreign currency bonds than for local currency bonds, so the increase in dollar spreads would then be driven by compensation for this additional risk. We therefore compare dollar bonds of non-US firms with other foreign-currency bonds of the same firm (for example, dollar vs. pound sterling bonds of euro area issuers), and we find that our results remain robust. In Panels B and C of Table B.9, we show that our results also remain robust to the inclusion of financial bonds, as well as to the exclusion of callable bonds.

Finally, as a further robustness check of our baseline results, we run a variant of our baseline regression model using the change in transaction prices as the dependent variable. Consistent with our spread results, we find that dollar bonds traded at significantly lower prices in the UK corporate bond market relative to non-dollar bonds of the same firm (Table C.1). Importantly, this test helps to mitigate concerns about the potential staleness of bond spreads used in our baseline regression.

In sum, in this Section we have established that US dollar-denominated bonds experienced a larger increase in spreads than their counterparts in other currencies during the Covid-19 market turmoil. To investigate whether the increase in spreads we document is indeed associated with investors' pronounced selling pressure, we now turn to inspecting trading volumes.

5 The Dash for Dollars: Trading Volumes

In this section we further develop our analysis by exploiting the richness of our MiFID II transaction-level database. Despite a narrower bond coverage relative to our global bond-level data set, transaction-level data have the advantage of providing insights regarding trading volumes, as well as on the characteristics of buyers and sellers.

We begin by documenting the selling pressure affecting US dollar bonds, which we previously put forward as the main driver behind the pronounced spread increase. In particular, we run the following within-investor-firm specification:

$$NetVol_{b,j,t} = \alpha + \alpha_{i,j,t} + \beta_1 USD_b + \Gamma X_{b,t} + \ \varepsilon_{b,j,t} \tag{4}$$

where $NetVol_{b,j,t}$ is investor j's daily net trading volume (in terms of quantities) of bond b issued by firm i; α is a constant; $\alpha_{i,j,t}$ is a firm-investor-day fixed effect; USD_b is an indicator variable for USD-denominated bonds; and X_b are a set of additional controls which include the bond's time-to-maturity, time-since-issuance, coupon type, and rating. We are therefore able to compare the trades of the same investor, on the same day, across bonds of the same issuer. As before, we focus on the period between February 28 and March 20. Furthermore, we also run regressions separately for investors' buy and sell volumes, depending on whether investor j was a net buyer or net seller of bond b on a given day. The focus is once more on estimates of β_1, which provide insights regarding the role of the US dollar in driving trading volumes.

Table 2 Bond Trading Volumes: The Role of the US Dollar

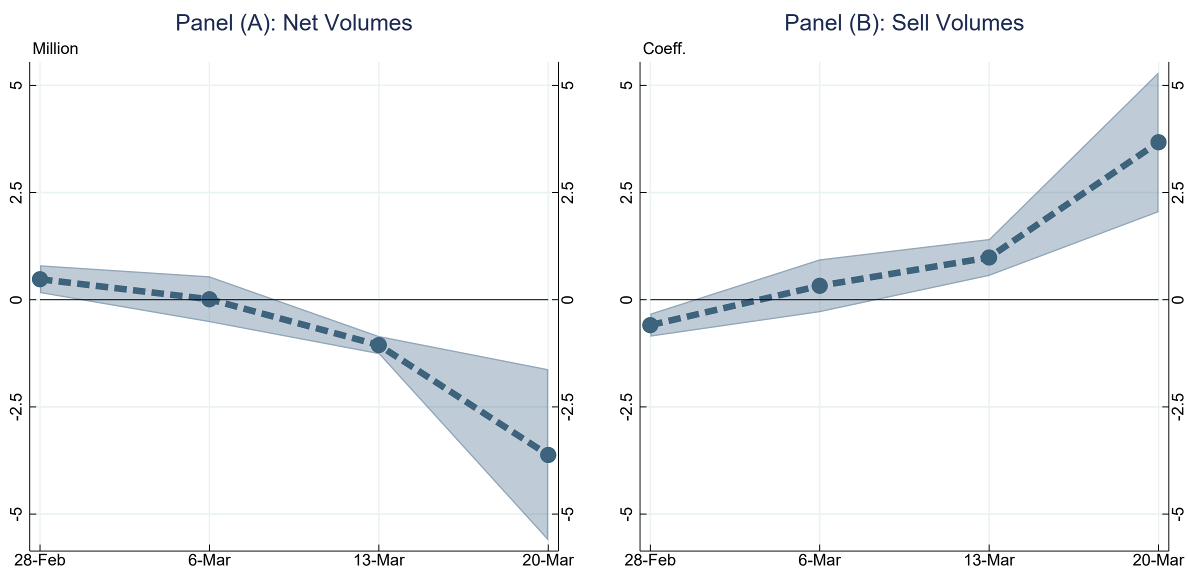
	(1)	(2)	(3)	(4)	(5)	(6)
	Net Volumes		Buy Volumes		Sell Volumes	
US dollar (β_1)	-0.90***	-0.54***	-0.04	-0.03	0.86***	0.51***
	(0.21)	(0.05)	(0.08)	(0.11)	(0.23)	(0.06)
Observations	7323	1444	7323	1444	7323	1444
R squared	0.390	0.770	0.573	0.810	0.234	0.752
Firm FE	yes	no	yes	no	yes	no
Day FE	yes	no	yes	no	yes	no
Investor FE	yes	no	yes	no	yes	no
Firm × Day × Investor FE	no	yes	no	yes	no	yes

Note. Net volumes (in millions) are measured on the investor-day-bond level in the period between February 28th and March 20th. Buy (Sell) volume is equal to net volume if the given investor is a net buyer (seller) of investment grade bond b on day t, and zero otherwise. Robust standard errors clustered at the firm level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, control variables and fixed effects not reported.

The results, reported in Table 2, show that investors' net trading volumes are significantly lower for dollar bonds compared to non-dollar bonds. Importantly, we find that the lower net trading volumes are driven by investors' higher sales of dollar bonds, rather than by increased purchases of non-dollar bonds. In terms of the economic magnitude, a given investor's daily sell volumes are on average £500k higher for dollar bonds compared to non-dollar bonds of the same firm—a relatively large amount considering that the median trade size is £360k. In other words, there is strong evidence that the pronounced fall in US dollar bond prices is indeed linked to investors' selling pressure.

To investigate the timing of this pattern in more detail, we repeat the estimation using weekly fixed effects interacted with the US dollar indicator, similar to our analysis of the spread dynamics in Section 4. The coefficients are reported in Figure 3, which shows that investors' net trading volumes in dollar bonds were indistinguishable from trading volumes in non-dollar bonds during the build-up of the Covid-19 crisis, i.e. in late February / early March 2020. However, starting in the week ending March 13th, investors sold dollar bonds in significantly higher quantities than non-dollar bonds. The results therefore emphasize the pronounced selling pressure in dollar bonds during the peak of the Covid-19 market turmoil.

Figure 3 Bond Trading Volumes Differentials: Time-varying Estimates



Note. The figure shows weekly estimates of the difference in investors' net trading volumes between dollar bonds and non-dollar bonds, using the following specification: $NetVol_{b,j,t} = \alpha + \alpha_{i,j,t} + \alpha_w \times \beta_1 USD_b + \Gamma X_{b,t} + \varepsilon_{b,j,t}$. The net trading volumes are measured on the investor-bond-day level. The shaded areas display 90 percent confidence intervals based on robust standard errors.

The granularity of our data also allow us to investigate whether a certain class of investors are driving the patterns that we document—something that will be important when we turn to understanding the mechanisms behind our findings in the next section. By re-estimating a variant of our specification (4) using sector-level net volumes, we formally show that the selling pressure in US dollar bonds during the stress period was concentrated in the ICPF sector.[14] The results (reported in Table 3) show that the coefficient on the dollar dummy (β_1) is statistically highly significant for ICPFs, while we find no statistical significance for any of the other investor types. As discussed in more detail below, a potential driver for ICPFs' pronounced selling of dollar bonds could be the pressure to obtain dollar cash to meet variation margin calls on their dollar-denominated derivative contracts.

Table 3 Corporate bond trading volumes by Sector

	(1) ICPFs	(2) Asset Managers	(3) Non-dealer Banks	(4) Hedge Funds
US dollar (β_1)	-5.44***	-0.35	-0.23	18.59
	(1.60)	(0.34)	(0.41)	(26.69)
Observations	662	3145	841	56
R squared	0.524	0.391	0.149	0.877
Investor FE	yes	yes	yes	yes
Firm × Day FE	yes	yes	yes	yes

Note. Net volumes (in millions) are measured on the investor-day-bond level in non-financial investment grade bonds in the period between February 28th and March 20th, separately for each client type. Robust standard errors clustered at the issuer level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, control variables, and fixed effects not reported.

6 Inspecting the Mechanism

What does the empirical evidence around the role of the US dollar in explaining dynamics in the corporate bond market tell us about the nature of the shock and its transmission mechanism? In a tail event such as the one induced by the Covid-19 shock, investors require cash to meet margin calls, redemptions, and other immediate obligations (either as a realization or in expectation), thus generating a dash for cash (see Haddad et al., 2021, among others). Our baseline results, which show that dollar bonds experienced larger price drops than non-dollar bonds, suggest that investors in need of cash sold their dollar-denominated assets first.

We put forward two non-mutually exclusive hypotheses (and associated mechanisms) that can explain our findings, both of which are ultimately related to the role of the US

[14] Consistent with these results, when analyzing the unconditional sectoral trading volumes, we find that the ICPF sector was the largest net seller of dollar bonds during the Covid-19 period, while dealer banks and asset managers were the main net buyers (see Figure C.1 in Appendix C).

dollar as the dominant currency in the international monetary and financial system.[15] The first hypothesis puts emphasis on the superior liquidity of the US dollar, a reflection of its dominance as a medium of exchange. The second is linked to the pervasiveness of the dollar as a funding currency, which instead stems from its dominance as a unit of account. In what follows, we describe these hypotheses in more detail, and provide empirical support for each of them. Our results, however, show that the dollar funding hypothesis is crucial to rationalize the dash for dollars we uncovered in the previous sections.

6.1 Dollar Liquidity (and its Inversion)

The US dollar serves as the undisputed vehicle currency for international debt issuance, cross border loans, FX turnover and reserve accumulation (Eichengreen and Xia, 2019). As discussed, among others, by Gourinchas et al. (2019), the widespread use of the US dollar is in part a consequence of its liquidity, i.e. the fact that large transactions can be conducted without a material impact on prices. Given this superior liquidity, the expected costs of selling dollar bonds should be lower than those of bonds denominated in other currencies. In response to sudden liquidity demands, investors would have an incentive to liquidate their dollar bonds first in order to minimize fire-sale losses. This behavior would imply that investors follow a 'pecking order of liquidity', selling their most liquid assets first in order to minimize the adverse price impact of their fire sales.[16] If intermediaries do not have the capacity or willingness to absorb the resulting increase in supply, such selling pressure can lead to larger falls in prices (i.e. increases in spreads) of more liquid securities compared to less liquid ones. This mechanism can therefore help rationalize the results in Table 1, as long as investors perceive US dollar bonds as more liquid than non-dollar bonds.

Our granular data allows us to shed light on this mechanism. As we observe dealers' bid and ask prices, we can test the implications of the pecking order of liquidity theory by focusing on a dimension of liquidity that previous studies—which focused exclusively on dollar bonds—overlooked, i.e. a bond's currency of denomination. Specifically, we can test whether the bid-ask spreads of dollar bonds were lower than those of non-dollar bonds by

[15] A growing literature has documented the hegemony of the US dollar for both goods and assets markets. Goldberg and Tille (2008) and Gopinath (2016) provide evidence on the extensive use of the dollar for trade invoicing. Ilzetzki et al. (2019) document the dominant role of the dollar as an anchor currency. It is also well known that banks and non-banks outside the US tend to borrow in US dollars (see, among many others, Shin, 2012; Bruno and Shin, 2015; Brauning and Ivashina, 2020) and invest in US dollar assets (Maggiori et al., 2020).

[16] Theory and evidence (where a bond's maturity is used as a proxy for liquidity) for this type of response are abundant in the literature, for example Chernenko and Sunderam (2016), Moreira and Savov (2017), Haddad et al. (2021), Ma et al. (2022), DeMarzo et al. (2021).

estimating the following within-firm specification:

$$BidAsk_{b,t} = \alpha + \alpha_{i,t} + \beta_1 USD_b + \Gamma X_{b,t} + \varepsilon_{b,t} \tag{5}$$

where $BidAsk_{b,t}$ is the effective bid-ask spread of bond b issued by firm i, which is defined as twice the difference between the trade price and the weighted bid/ask midpoint (the midpoint is viewed as a proxy for the fundamental value of the asset); $\alpha_{i,t}$ is a firm-day fixed effect; and the remaining variables are defined in the same way as in specification (4). We thus compare the daily bid-ask spreads of dollar bonds vs. non-dollar bonds issued by the same firm, similar to specification (2) in Section 4.

Table 4 Effective Bid-Ask Spreads: Before and During Covid-19

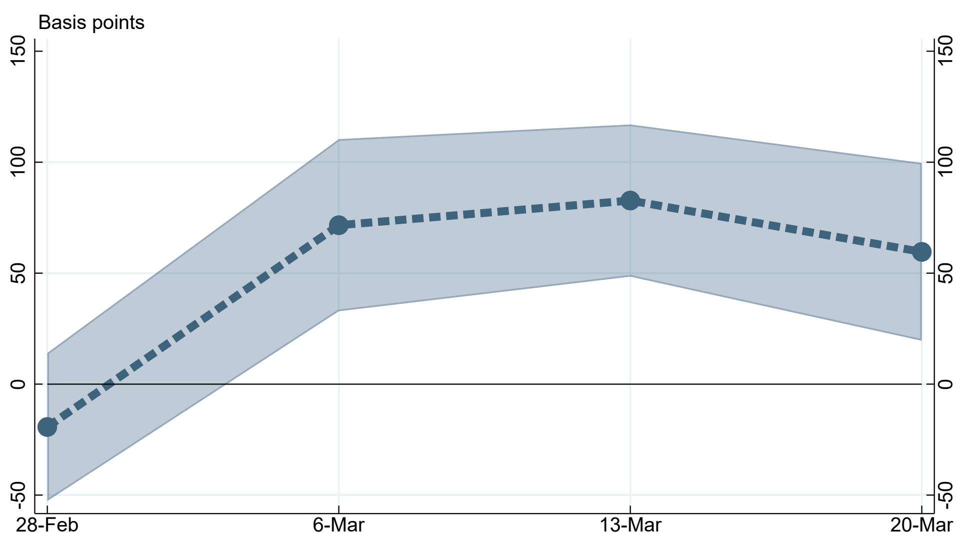
	(1)	(2)	(3)	(4)
	Tranquil times (pre 28 Feb 2020)		Baseline sample (28 Feb to 20 Mar 2020)	
US dollar (β_1)	-1.64	-2.93*	34.19***	37.33**
	(1.96)	(1.52)	(8.38)	(15.21)
Observations	14672	9173	502	327
R squared	0.180	0.262	0.289	0.438
Firm FE	yes	no	yes	no
Day FE	yes	no	yes	no
Firm × Day FE	no	yes	no	yes

Note. The effective bid-ask spreads (in bps) are measured on the bond-day level and defined as twice the difference between the trade price and the weighted bid/ask midpoint. In Columns (1) and (2), we focus on the pre-Covid period between January 3rd 2018 and February 27th 2020. In Columns (3) and (4), we focus on the Covid-19 period between February 28th and March 20th 2020. Robust standard errors clustered on the firm-day level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, control variables and fixed effects not reported.

The results are shown in Table 4. We start by estimating specification (5) in the period *preceding* the Covid-19 market turmoil, specifically from January 2018 (the starting date of our transaction-level data set) and 27 February 2020 (the last day before the start of our sample). The results, reported in columns (1) and (2), are consistent with the pecking order of liquidity theory: bid-ask spreads were on average 3bps lower for dollar bonds relative to non-dollar bonds. That being said, the effect is small and only weakly statistically significant. Moreover, when we estimate specification (5) in our baseline turmoil sample (Feb 28 - Mar 20), the pattern reverses: dollar bonds' bid-ask spreads were significantly higher than those of non-dollar bonds (columns (3) and (4) of Table 4). The effect is highly statistically significant and the economic magnitude is large: in our preferred specification, dollar bonds' effective bid-ask spreads were on average 37bps higher than those of non-dollar bonds during the Covid-19 crisis.[17]

The results suggests a "liquidity inversion" during the Covid-19 market turmoil: while individual investors may have decided to sell US dollar bonds first because of their (ex-ante) superior liquidity, the aggregate consequence of such actions seem to have resulted in a negation of the initial premise. We further investigate the timing of this liquidity inversion in Figure 4, which shows the weekly variation of the within-issuer difference in effective bid-ask spreads between dollar bonds and non-dollar bonds—in an analogous fashion to specification 3 for bond spreads. We find that the difference between effective bid-ask spreads of dollar bonds and non-dollar bonds flipped and started to widen in early March and reached its peak in the week ending March 13 (at around 80bps), before it started to close again towards the end of March. Our findings complement the evidence in Haddad et al. (2021) and Ma et al. (2022), who show that more liquid short-term bonds experienced larger price drops than their more illiquid long-term counterparts.

Figure 4 Effective Bid-Ask Spreads: Time-varying Estimates



Note. The figure shows the weekly estimates of the difference in effective bid-ask spreads between dollar bonds and non-dollar bonds, using the following specification: $BidAsk_{b,t} = \alpha + \alpha_{i,t} + \alpha_w \times \beta_1 USD_b + \Gamma X_{b,t} + \varepsilon_{b,t}$. The effective bid-ask spreads are measured on the bond-day level and defined as twice the difference between the trade price and the weighted bid/ask midpoint. The shaded areas display 90 percent confidence intervals based on robust standard errors.

[17] In Table C.2 of the Appendix, we find no significant difference in bid-ask spreads between dollar and non-dollar bonds in the case of high-yield bonds, hence highlighting that the liquidity inversion did not occur in this riskier and less liquid segment of the corporate bond market.

In sum, the results suggest that the selling pressure affecting US dollar bonds could have been driven by an ex-ante perceived superior liquidity of these bonds vis-a-vis non-dollar alternatives. The increase in the relative liquidation costs of dollar bonds during the height of the Covid-related market turmoil, however, poses a challenge for this interpretation. Specifically, for the liquidity mechanism to be the only force at play, one would need to believe that investors stuck to their usual pecking order despite the systematically higher bid-ask spreads of dollar bonds. An alternative interpretation is that investors were instead able to account for these price distortions in real time, but there were additional, complementary forces driving their behavior and the resulting selling pressure in US dollar bonds—a possibility that we turn to in the next section.

6.2 Dollar Liabilities

A second facet of the US dollar hegemony in the international monetary and financial system is its undisputed dominance as a funding currency. Around half of all cross-border bank loans and international debt securities are denominated in US dollars, and involve a diverse set of borrowers, lenders, and intermediaries (Gopinath and Stein, 2020). The widespread denomination of financial and real liabilities in US dollars means that agents need to secure US dollars when these liabilities become due, including during periods of stress—for example, to meet margin calls or investor redemptions. When faced with an increase in the likelihood of having to honor immediate dollar-denominated liabilities, investors can choose between liquidating their dollar assets or, alternatively, their non-dollar assets and swap the proceeds into US dollars. The cost of hedging the latter operation, however, typically increases sharply during periods of stress, as shown by large widenings of CIP deviations.[18] Our second hypothesis is therefore that investors did not only require cash in general, but US dollar cash in particular, and that they were forced to sell dollar-denominated assets to secure it. The resulting selling pressure on US dollar assets can, once more, lead to downward pressure on prices if intermediaries do not have the capacity or willingness to absorb the additional supply.

To test this complementary mechanism, we exploit a particular feature of the Covid-19 crisis, namely that UK insurers were in need of large quantities of cash due to exceptionally large variation margin (VM) calls on their FX hedging positions (Czech et al., 2021). Importantly, as investors are typically required to meet VM calls in the contract currency, we expect higher dollar bond selling pressure by investors with a larger share of dollar-

[18] Avdjiev et al. (2020); Bahaj et al. (2020); Eren et al. (2020) among others provide extensive evidence on the widening of CIP deviations during the Covid-19 episode. See Figure D.1 in the Appendix.

denominated derivative contracts. Using both the MiFID II bond transaction data and the supervisory Solvency II data on UK insurers' derivative holdings, we can match the bond trades of individual insurers with their pre-Covid derivative holdings.

To test this hypothesis, we estimate the following specification:

$$NetVol_{b,j,t} = \alpha + \alpha_b + \alpha_j + \alpha_{i,t} + \beta_1 USD_b \times DollarShare_j + \varepsilon_{b,j,t} \tag{6}$$

where $DollarShare_j$ measures the share of dollar-denominated derivative contracts of investor j at the end of Q4 2019; and the remaining variables are defined in the same way as in specification (4). We also include bond, investor, and firm-day fixed effects. To facilitate the interpretation of the coefficients, we transform $DollarShare_j$ by subtracting the cross-sectional average, before dividing it by the standard deviation. In an alternative specification, we divide the sample of investors into 'high' and 'low' holders of USD derivative contracts, depending on whether they lie above or below the median of the $DollarShare_j$ distribution.[19]

The results are reported in Table 5. We find that investors with a higher share of dollar-denominated derivative contracts had substantially lower net trading volumes in dollar bonds compared to non-dollar bonds. More precisely, Table 5 shows that an investor whose share of dollar-denominated contracts is one standard deviation above average sold between £18m and £26m more dollar bonds relative to the average investor on a given day (see columns (1) and (2)). Importantly, this result is highly statistically significant and robust to the inclusion of various fixed effects, which control for a range of unobserved time-invariant and time-varying factors. Therefore, the results lend strong support to the hypothesis that investors sold dollar assets to meet immediate dollar obligations.

In Section 5, we established that the UK insurance companies and pension funds (ICPF) sold dollar bonds in larger quantities than non-dollar bonds during the Covid-19 crisis, more so than any other investor type. What remains unanswered is whether the ICPF sector's selling pressure contributed to the more pronounced spread increases of dollar bonds during this period. To answer this question, we estimate the following specification:

$$\Delta s^{Dollar}_{b,t} = \alpha + \alpha_i + \alpha_t + \beta_1 OrderFlow_{b,t} + \Gamma X_{b,t} + \varepsilon_{b,t} \tag{7}$$

[19]Figure A.2 in the Appendix shows that a prominent share (on average around 20%) of UK insurers' derivative portfolios is denominated in dollars. Furthermore, as shown in Figure C.2, we find that insurers with a high share of dollar-denominated contracts faced almost identical VM demands during the dash for cash compared to the group with a low share of dollar contracts. In other words, both groups faced very similar liquidity pressures.

Table 5 USD DERIVATIVE CONTRACTS AND BOND TRADING VOLUMES

	(1)	(2)	(3)	(4)
US dollar × Dollar share (β_1)	-17.54***	-25.95**		
	(2.59)	(9.89)		
US dollar × High share (β_1)			-6.26***	-9.26**
			(0.95)	(3.53)
Observations	368	243	368	243
R squared	0.529	0.616	0.529	0.616
Bond FE	yes	yes	yes	yes
Investor FE	yes	yes	yes	yes
Day FE	yes	no	yes	no
Firm x Day FE	no	yes	no	yes

NOTE. Net volumes (in millions) are measured on the investor-day-bond level for the period between February 28th and March 20th. $DollarShare$ measures the share of dollar-denominated derivative contracts of investor j at the end of Q4 2019. To facilitate the interpretation of the coefficients, we transform the variable by subtracting the cross-sectional average, before dividing it by the standard deviation. To calculate $HighShare$, in Columns (3) and (4), we divide the sample of investors into below-average and above-average holders of USD derivative contracts, using the sample median as the cut-off point. Robust standard errors clustered at the firm-day level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant and fixed effects not reported

where $\Delta s_{b,t}^{Dollar}$ is the daily change in the (option-adjusted) spread of dollar-denominated bond b issued by firm i over the period from February 28 to March 20. For each investor type, $OrderFlow_{b,t}$ is defined as the sector's daily net volume in the given bond, divided by the bond's total daily trading volume across all investor types (measured on the bond-day level). $\Gamma X_{b,t}$ is defined in the same way as in specification (4). We also include firm and day fixed effects. To facilitate the interpretation of the coefficients, we again transform $OrderFlow_{b,t}$ by subtracting the cross-sectional average, before dividing it by its standard deviation.

We estimate equation (7) separately, using data for each investor type—namely ICPFs, assets managers, non-dealer banks, and hedge funds. Table 6 presents the results. We find that ICPF's selling pressure contributed to a sharp spread increase: dollar bonds with a daily order flow of insurers and pension funds that is one standard deviation below average experienced a 7bps larger increase in spreads, which is equivalent to 60% of the total daily

Table 6 ORDER FLOW BY SECTOR AND DOLLAR BOND SPREADS

	(1)	(2)	(3)	(4)
	ICPFs	Asset Managers	Non-dealer Banks	Hedge Funds
Order Flow (β_1)	-6.85***	0.44	2.27	-4.33
	(1.83)	(1.52)	(1.48)	(8.21)
Observations	85	505	551	29
R squared	0.628	0.342	0.280	0.587
Firm FE	yes	yes	yes	yes
Day FE	yes	yes	yes	yes

NOTE. For each investor type, order flow is measured on the bond-day level and defined as the investor type's daily net volume in the given bond, divided by the bond's total daily trading volume across all investor types. To facilitate the interpretation of the coefficients, we transform the variable by subtracting the cross-sectional average, before dividing it by the standard deviation. The dependent variable is the bond's spread change (in bps) from day $t-1$ to day t. Robust standard errors clustered on the firm-day level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, control variables and fixed effects not reported.

effect in the UK corporate bond market.[20,21] Importantly, we do not find significant coefficients for any of the other investor types, consistent with the fact that ICPFs were the main sellers of dollar bonds in the UK corporate bond market during this period.

In sum, the results in this section show that the selling pressure in US dollar bonds during the Covid-19 market turmoil was higher for investors facing larger needs to meet US-dollar-denominated liabilities. This evidence lends some empirical support to a channel that emphasizes the undisputed role of the dollar as a dominant funding currency.

6.3 Interpretation

The analysis in this section digs into the drivers of the selling pressure affecting US dollar bonds—the dash for dollars. We first show that, while individual investors may have decided to sell US dollar bonds because of their (ex-ante) superior liquidity, the aggregate consequence of such actions seems to have resulted in a negation of the initial premise—with dollar bonds' liquidation costs increasing more than those of their non-dollar counterparts during the turmoil period. Second, we show that investors facing a higher likelihood of

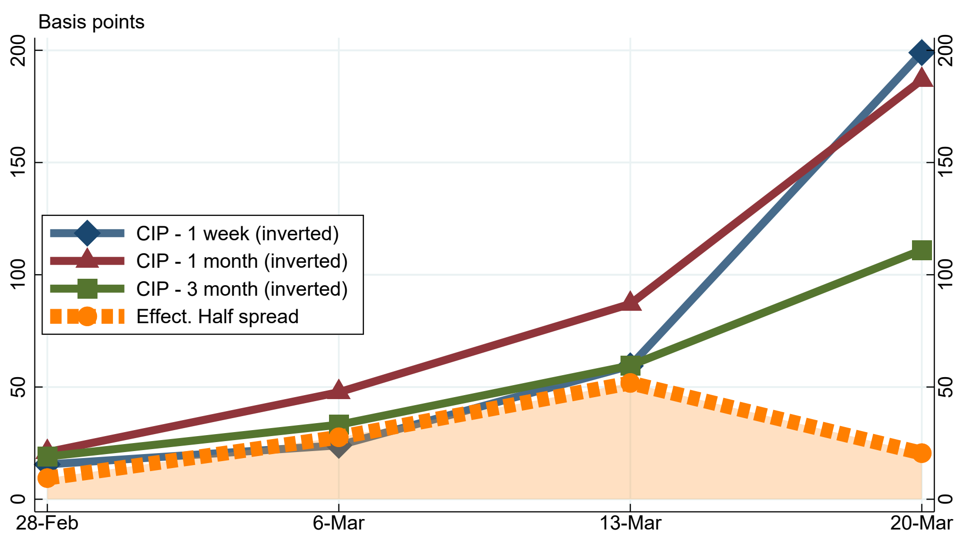
[20] When replicating our baseline results with bonds traded in the UK corporate bond market, the baseline effect increases from around 8bps to 12bps. The results are presented in Table C.1 in the Appendix.

[21] As shown in Table C.3 of the Appendix, the effect is fully reversed after ten trading days, emphasizing the non-fundamental nature of the sector's selling pressure.

having to meet dollar-denominated liabilities had substantially lower net trading volumes in dollar bonds compared to non-dollar bonds.

These two features of the data are of course not independent, but related quantitatively through the choices of those investors who are in need to secure cash dollars. When in need of US dollar funds, investors can choose to sell a dollar asset, facing the increased liquidity premia we document in Section 6.1, or sell a non-dollar asset and hedge the resulting exchange rate risk (i.e. obtain dollars "synthetically"), facing the increased hedging cost that is typical of periods of financial stress. In order to observe selling pressure in US dollar assets under this scenario, one would need to see that the cost of the first alternative (i.e. paying a liquidity premium) was smaller than that of the second alternative (i.e. paying an FX hedging cost) during our period of study. This is indeed what we find in the data, as shown in Figure 5.

Figure 5 EFFECTIVE HALF SPREAD VS. CIP PREMIUM



NOTE. The orange dashed line and shaded area plots the average daily effective half spread (defined as the difference between the trade price and the weighted bid/ask midpoint) for dollar-denominated bonds. The solid lines plot CIP deviations; defined as the difference between the dollar borrowing rate less the synthetic dollar borrowing rate, here inverted at different maturities.

Specifically, we measure liquidation costs of dollar bonds through the effective half spread, which is defined as the difference between the trade price and the bond's weighted bid/ask midpoint. To measure the costs of obtaining dollars synthetically, we calculate Covered Interest Rate Parity (CIP) deviations across different horizons.[22] CIP deviations are defined as the difference between the US interest rate less the synthetic dollar borrowing rate (which,

[22]In addition to the FX hedging cost argument, note that obtaining dollars synthetically also involves transaction costs in the FX spot market. In particular, there is evidence that FX markets faced severe liquidity strains during the Covid-19 crisis, and many (especially smaller) investors found themselves restricted in their access to dollar funding markets (Avdjiev et al., 2020).

in turn, is defined as the foreign interest rate, multiplied with the quotient of the FX forward rate divided by the spot rate). To calculate the CIP deviations, we use daily spot, forward and OIS benchmark rates for one-week, one-month and three-month maturities for euro and pound sterling against the US dollar from Bloomberg.

Figure 5 shows that the average effective half spreads of dollar bonds are less than or equal to CIP deviations throughout our entire sample period. In other words, the figure shows that it would not be more cost-efficient for investors to sell their non-dollar assets (while having to roll-over their hedges), rather than selling dollar assets outright. This holds true for relatively short hedging horizons (i.e. one week), but especially for longer horizons of one month or more. The relative cost dynamics suggest that investors would have preferred to sell dollar bonds—despite the increased transaction costs, rather than because of them—to meet immediate dollar obligations, in line with our hypothesis.

7 Conclusion

We document a 'dash for dollars' in corporate bond markets during the Covid-19 turmoil period, in which investors in need of cash dollars sold their dollar-denominated assets first, with a consequent impact on prices. We interpret these dynamics as a reflection of the dollar's special status as the dominant currency in the international monetary and financial system.

The dollar's superior liquidity may have led investors to sell their dollar-denominated assets first to minimize their sales' adverse price impact. The increase in the relative liquidation costs of dollar bonds during the height of the Covid-related market turmoil, however, opens up the question of whether there are alternative, complementary forces driving the selling pressure in US dollar bonds.

We propose an interpretation that puts the clear dominance of the dollar as a funding currency at the forefront. The data are consistent with the selling pressure in dollar bonds arising from investors trying to meet immediate dollar obligations—as the alternative option of obtaining dollars synthetically was more costly than liquidating dollar bonds.

Besides documenting a new aspect of the US dollar's international dominance, our results offer direct insights for policymakers. In particular, they speak to the crucial role of Federal Reserve dollar swap lines as a policy tool to mitigate the severity of financial markets turmoils. As shown by previous studies, the access to Federal Reserve dollar swaps is associated with significant declines in dollar funding strains (Bahaj and Reis, 2021). By dampening CIP deviations, dollar swap lines can reduce the severity of selling pressures affecting treasuries and corporate bonds.

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Appendix - Not for Publication

A Data: Additional Information & Summary Statistics

This section of the Appendix provides additional summary statistics for the various data sources used in the empirical analysis.

Bond-level Data Set on Corporate Bond Credit Spreads Table A.1 reports the summary statistics for the dollar and non-dollar bonds in our sample. As shown in Figure 1, dollar bonds experienced a larger increase in spreads. The table also shows that dollar bonds have a larger face value, a higher coupon, and a longer maturity than non-dollar bonds.

Table A.1 Summary Statistics: Dollar vs. Non-dollar Bonds

	Δ Spread (28feb-20mar)	Face value	Coupon	Maturity (years)
	Dollar bonds			
Mean	241	997	4.0	10.9
Median	207	750	3.9	6.9
Standard Dev.	171	756	1.3	9.2
25th Percentile	143	500	3.1	3.2
75th Percentile	297	1250	4.7	19.1
	Non-dollar bonds			
Mean	111	728	2.3	7.2
Median	94	674	1.8	5.7
Standard Dev.	84	334	1.6	5.6
25th Percentile	77	500	1.1	3.4
75th Percentile	122	1000	3.1	9.0

Note. Summary statistics for dollar and non dollar bonds. The sample period covers the period between 28th and March 20th 2020. The sample consists of 3,107 bonds issued by 225 firms in 29 countries.

Transaction-level Data Set on Corporate Bond Trades Table A.2 provides descriptive statistics for our regulatory MiFID II transaction database. Our sample covers the period from January 2018 to May 2020, and we obtain information on 2.2m trades in 7.4k corporate bonds.

After filtering out non-financial bonds and interdealer trades, we are left with 650k trades by $30k$ investors in 925 corporate bonds. On average, we observe a total trading volume of £1.6bn per day, with a trading volume of £293m in dollar bonds, £859m in pound sterling bonds, £472m in euro bonds, and £55m in bonds denominated in other currencies. While most of the trading volume is concentrated in sterling bonds, the majority of trades is in euro bonds (416 per day), followed by sterling bonds (343) and dollar bonds (226). We observe a total of 157 issuers and 925 bonds, with the majority of bonds issued in sterling (541), followed by dollar bonds (203) and euro bonds (170). In terms of credit quality, for dollar bonds, we observe 82 investment grade bonds, 75 high yield bonds and 46 unrated bonds. For sterling (euro) bonds, we observe 201 (93) investment grade bonds, 56 (31) high yield bonds and 284 (46) unrated bonds. The median residual maturity is 5.1 years for dollar bonds, 7.7 years for sterling bonds, and 5.7 years for euro bonds.

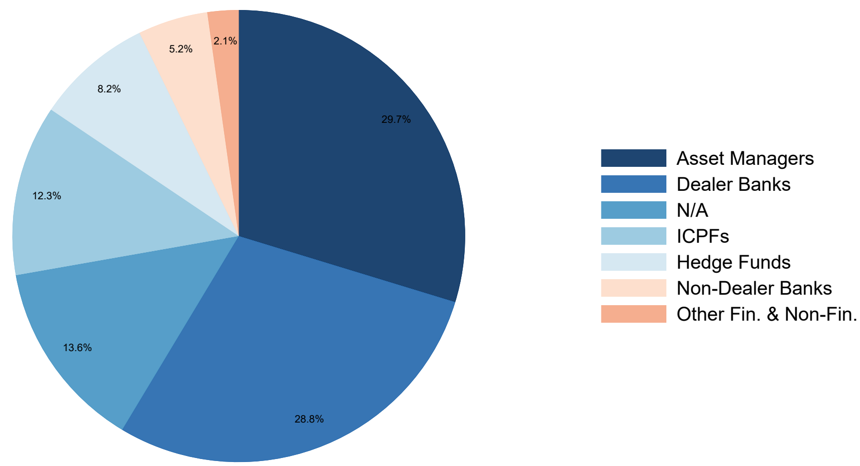
Table A.2 MiFID II transaction database: Descriptive Statistics

	USD	GBP	EUR	Others
Average Daily Volume (in £m)	292.92	859.47	472.07	8.40
Average Number of Trades (per day)	226.39	342.53	459.07	14.30
Number of Issuers	41	65	46	5
Number of Bonds	203	541	170	11
Investment Grade	82	201	93	7
High Yield	75	56	31	0
Not Rated	46	284	46	4
Median Residual Maturity (in Years)	5.11	7.68	5.69	5.51

Note. Notes: This table reports summary statistics for the regulatory MiFID II bond transaction data, covering the period from January 2018 to May 2020. "Average Daily Volume" refers to the average gross trading volume of bonds in different currencies (US dollar, UK pound sterling, Euro and others) in the UK corporate bond market per day in £m. "Average Number of Transactions" measures the average number of trades in the market per day. "Number of Bonds" and "Number of Issuers" measure the number of distinctive bonds and issuers in the sample. "Investment grade" refers to bonds with a credit rating of BBB- or higher. "High yield" refers to bonds with a credit rating of BB+ or lower. "Not Rated" refers to bonds without a rating. "Residual Maturity" measures the median time in years until a bond reaches its maturity date.

Furthermore, Figure A.1 shows the average market shares of different investor types in the UK market for non-financial corporate bonds. Dealer banks and asset managers each account for around 30% of the total trading volume, while ICPFs account for 12% of the total trading volume. Other important investor types include hedge funds & PTFs (8%) and non-dealer banks (5%). As some counterparties are not registered in the UK and hence not subject to the reporting requirement, the counterparty information is not available for around 14% of the total trading volume.

Figure A.1 Trading Volumes - Market Share by Sector

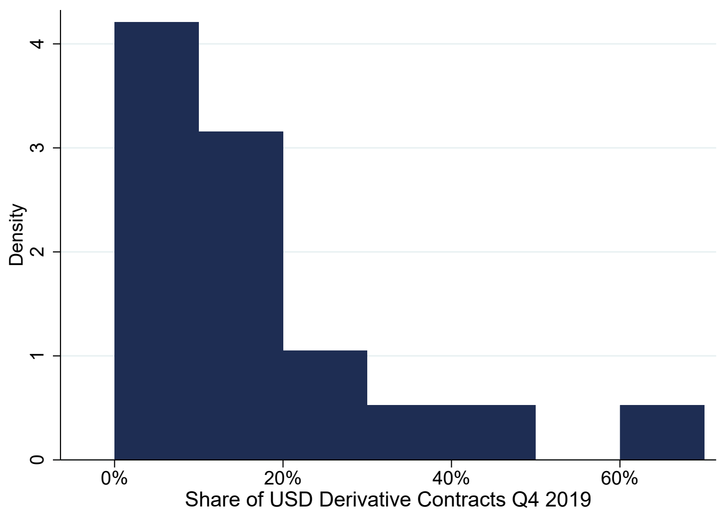


Note. Average market share (by trading volume) of different investor types in the UK market for non-financial corporate bonds. The investor types include: dealer banks, asset managers, non-dealer banks, hedge funds, other financial & non-financial firms, firms without a counterparty identifier (N/A) and insurers & pension funds (ICPFs). Source: MiFID II bond transaction database.

Insurers' Derivative Holdings Data Set We use granular data on derivatives holdings of insurance companies regulated by the UK's Prudential Regulation Authority (PRA) and subject to the Solvency II Directive. Insurers within scope of the Solvency II Directive are required to submit annual and quarterly returns, with the exception of some smaller firms with quarterly waivers. In total, we observe the quarterly derivative holdings of 79 UK insurers. The reports include detailed information on the derivatives holdings of a given insurer, such as the underlying security, notional amount, derivative category (e.g. FX forward), swap delivered/received currencies, and trade-level information on the identity of the counterparty. The data are available from 2016 Q1, and we consider both unit-linked and non-unit-linked portfolios. Czech et al. (2021) provide a more detailed description of UK insurers' asset and derivative holdings.

In Section 6, we hypothesize that insurers with a high share of dollar-denominated derivative contracts had to sell dollar bonds to meet VM calls (in cash dollars) during the dash for cash. Importantly, this hypothesis is based on the assumption that a significant share of UK insurers' derivative contracts is denominated in US dollars, hence accounting for a meaningful share of their total VM demands during the dash for cash. Reassuringly, Figure A.2 shows that a prominent share (on average around 20%) of UK insurers' derivative portfolios is denominated in dollars, which makes it the second most important contract currency after pound sterling (with a share of approx. 60%).

Figure A.2 Insurers' share of dollar-denominated derivative contracts



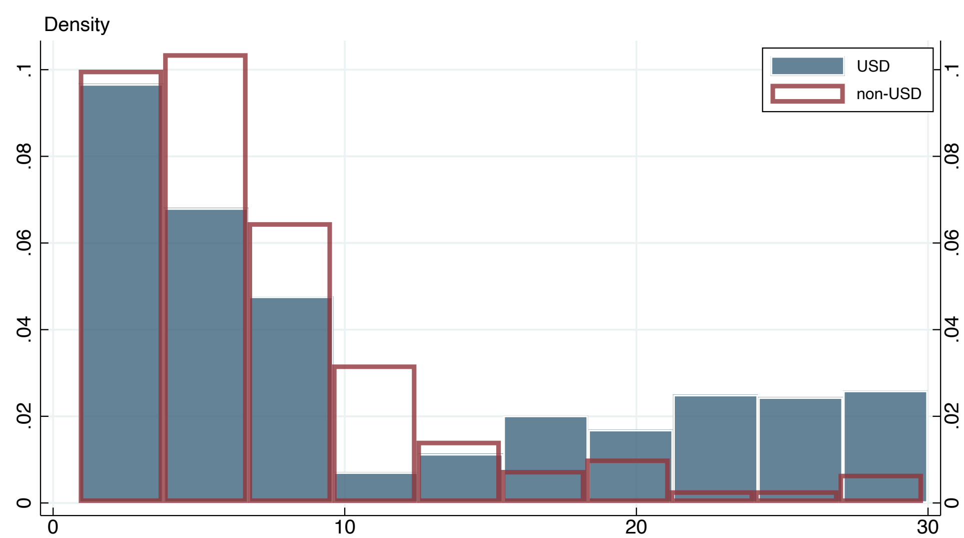
Note. Distribution of insurers' share of dollar-denominated derivative contracts at the end of Q4 2019. Source: Solvency II holdings database.

B Robustness: Bond-level Spread Regressions

The Role of Bond Maturity A bond's maturity and its currency of denomination both vary within-firm and could be correlated with each other. If this were to be the case, our interpretation of the empirical findings could be confounded by the role of maturity in explaining spread dynamics during the Covid-19 crisis. This concern is particularly important given the existing evidence that more liquid, shorter-term bonds experienced larger price drops than long-term bonds (see, among others, Haddad et al., 2021).

We address this concern by exploring the empirical relation between maturity and currency of issuance. Figure B.1 plots the distribution of bond maturity for dollar-denominated and non-dollar bonds in our sample. It shows that dollar bonds tend to have longer maturities than non-dollar bonds. Specifically, the average and median maturity is 11 and 7 years for dollar bonds; and 7 and 6 years for non-dollar bonds. This unconditional analysis of the data is reassuring: if the mechanism highlighted by Haddad et al. (2021) was also present in our sample—i.e. short-term bonds experiencing larger price falls than long-term bonds—then the omission of maturity would, if anything, result in an attenuation bias for the dollar effect.

Figure B.1 Distribution of Bond Maturity by Currency



Note. Distribution of bond maturity for dollar-denominated and non-dollar bonds in our sample. Average and median maturity is 11 and 7 years for dollar bonds; and 7 and 6 years for non-dollar bonds. The horizontal axis is in years.

A more formal exercise can help to shed some light on the distinctive effects of maturity and currency of denomination on bond spreads. Specifically, we estimate the following specification:

$$\Delta s_{b,t} = \alpha + \alpha_{i,t} + \beta_1 USD_b + \beta_2 Matu_{b,t} + \beta_3 \left(USD_b \times Matu_{b,t} \right) + \Gamma X_b + \varepsilon_{b,t} \qquad \text{(B.1)}$$

where $Matu_{b,t}$ is the remaining time-to-maturity of bond b issued by firm i, and all other variables are the same as in our baseline specification (2).

The results are reported in Table B.1. For ease of comparison, Column (1) only reports the coefficient of the dollar indicator variable, as in our baseline specification in Table 1. Column (2) reports the estimated coefficient of $Matu_{b,t}$, which is statistically not different from zero. Consistent with the unconditional evidence in Figure B.1, however, this result may be confounded by the correlation between currency of issuance and maturity. Column (3), which considers the currency and maturity dimensions jointly, shows that the coefficient on maturity becomes negative and statistically significant; that is, shorter maturity bonds indeed experience a larger increase in spreads, in line with the findings in Haddad et al. (2021). Importantly, the coefficient on the dollar indicator variable remains significant and the magnitude actually becomes slightly larger in comparison to our baseline results.

Table B.1 Bond Spreads Widening: The Role of Currency and Maturity

	(1)	(2)	(3)	(4)
US dollar (β_1)	7.54***		7.84***	10.44***
	(2.55)		(2.56)	(3.10)
Maturity (β_2)		0.04	-0.11**	0.19*
		(0.06)	(0.05)	(0.11)
US dollar × Maturity (β_3)				-0.34***
				(0.11)
Observations	50685	50685	50685	50685
R squared	0.355	0.350	0.356	0.356
Firm × Day FE	yes	yes	yes	yes

Note. The dependent variable is the daily change in bond spreads between February 28th and March 20th. Robust standard errors clustered at the firm-day level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, fixed effects, level of credit spread at the beginning of the sample, coupon type dummies, amortization type dummies, and bond face value not reported.

Finally, we incorporate an interaction term between bond maturity and the US dollar indicator variable ($USD_b \times Matu_{b,t}$). The results from this specification are reported in Column (4) of Table

B.1. We highlight three results. First, US dollar spreads increase by more than the spreads of bonds denominated in other currencies (independent of the maturity), as shown by the positive sign of the coefficient on the dollar indicator variable (β_1). Second, within the group of dollar bonds, shorter maturity bonds are associated with a larger increase in spreads, as indicated by the negative coefficient of the interaction term (β_3)—and consistent with the findings (and interpretation) in previous studies that focused on US data. Third and finally, longer maturity bonds experience larger increases in spreads in the non-dollar sample, as shown by the positive sign of the coefficient on maturity (β_2).

To provide further insights into the heterogeneous dollar bond spread widening across different maturities, we now allocate bonds to five different maturity buckets: 0-3 years, 3-5 years, 5-10 years, 10-15 years and 15+ years. We run our baseline regression separately for these five different buckets, and the results are presented in Table B.2. Consistent with the previous test, we find the largest coefficient (11.7bps) for the 0-3 years maturity bucket. Our evidence highlights that the effect decreases monotonically for the longer-maturity buckets, in line with our previous findings.

Table B.2 Bond Spreads Widening: Maturity Buckets

	(1)	(2)	(3)	(4)	(5)
	0-3 years	3-5 years	5-10 years	10-15 years	15+ years
US dollar (β_1)	11.66***	11.21***	7.30**	7.46*	4.95*
	(3.36)	(3.27)	(2.56)	(3.70)	(2.56)
Observations	10034	8008	15046	2286	11469
R squared	0.523	0.469	0.498	0.791	0.592
Firm × Day FE	yes	yes	yes	yes	yes

Note. The dependent variable is the daily change in bond spreads between February 28th and March 20th. Robust standard errors clustered at the firm-day level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, fixed effects, level of credit spread at the beginning of the sample, coupon type dummies, amortization type dummies, bond face value, and maturity not reported.

A potential concern with our baseline results is that we do not control for the unobserved bond-level credit risk based on the place of a bond in its issuer's maturity structure (Bao and Hou, 2017). The intuition is that a bond that matures after most of the issuer's other bonds is de facto junior even if all of the firm's bonds have the same seniority. As shown in Table B.3, our results remain robust when we control for the proportion of an issuer's debt due before a given bond. Importantly, the effect is less pronounced for bonds that mature after most of the issuer's other bonds. In other words, during the Covid-19 market turmoil the spread widening of dollar bonds is negatively correlated with the bond-level credit risk based on the issuer's maturity structure.

Table B.3 Bond Spreads Widening: Maturity Structure

	(1)	(2)	(3)	(4)
US dollar (β_1)	7.84***		7.77***	11.28***
	(2.56)		(2.56)	(3.20)
Proportion due prior (β_2)		-4.40**	-2.40	1.14
		(1.79)	(1.66)	(2.05)
US dollar × Proportion due prior (β_3)				-8.59***
				(2.25)
Observations	50685	50685	50685	50685
R squared	0.356	0.350	0.356	0.356
Firm × Day FE	yes	yes	yes	yes

Note. The dependent variable is the daily change in bond spreads between February 28th and March 20th. *Proportion due prior* measures the proportion of an issuer's face value of debt due prior to a given bond. Robust standard errors clustered at the firm-day level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, fixed effects, level of credit spread at the beginning of the sample, coupon type dummies, amortization type dummies, bond face value, and maturity not reported.

Strengthening the Within-firm Identification To increase the relative importance of within-firm information in the identification of our baseline effect, we take the within-firm argument to the limit and estimate our baseline specification on a firm-by-firm basis—i.e. by exploiting information across a given firm's outstanding bonds. This exercise is made possible by the fact that some firms in our sample have a large number of outstanding bonds (for example, our sample contains data on 96 different bonds issued by AT&T). In the following, we use a set of individual firms that represent a broad range of different industries and countries of origin.

Table B.4 reports the results. The coefficient estimates are in line with our baseline specification. Specifically, we find that US dollar bonds experienced a larger increase in spreads, as evident from the positive and significant estimates of β_1 for all firms.

Geographical Heterogeneity One potential concern about our baseline results in Table 1 is that the effect might not be truly global in nature, but may instead reflect particular dynamics in a given geography. This could arise, for example, due to heterogeneity in regulations or balance sheet practices across different jurisdictions. To address this concern, and assess the robustness of our baseline results, we again use specification (2) and split our sample into different groups of countries.

Table B.4 Bond Spreads Widening: Firm-level Regressions

	(1)	(2)	(3)	(4)	(5)	(6)
	British Pet.	AT&T	Toyota	Walmart	Vodafone	Mc Donald's
US dollar (β_1)	8.26**	11.32***	5.55**	4.12**	7.66*	9.60***
	(3.99)	(1.53)	(2.63)	(2.04)	(4.41)	(3.29)
Observations	630	1582	595	612	595	647
R squared	0.035	0.031	0.023	0.003	0.067	0.031

Note. The dependent variable is the daily change in bond spreads between February 28th and March 20th. Robust standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, level of credit spread at the beginning of the sample, coupon type dummies, amortization type dummies, and bond face value not reported.

Table B.5 Bond Spreads Widening: Geographical splits

	(1)	(2)	(3)	(4)	(5)
	US	non-US	Advanced Ec.	Advanced Ec. excl. US	Euro
US dollar (β_1)	8.74**	6.98**	7.95***	6.63**	6.04***
	(3.00)	(2.42)	(2.64)	(2.42)	(2.01)
Observations	28565	22119	47946	19380	9753
R squared	0.338	0.395	0.334	0.317	0.227
Firm × Day FE	yes	yes	yes	yes	yes

Note. The dependent variable is the daily change in bond spreads between February 28th and March 20th. Robust standard errors clustered at the firm-day level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, level of credit spread at the beginning of the sample, coupon type dummies, amortization type dummies, and bond face value not reported.

Table B.5 reports the results from this exercise. It shows that our benchmark results hold for samples of (i) advanced economies, (ii) US, (iii) non-US, (iv) advanced economies ex-US and (v) European Union headquartered firms. More precisely, the dollar-denomination is a central variable for understanding the spread dynamics of corporate bonds issued by companies both inside and outside the United States.

Dynamics During the Global Financial Crisis Having established that corporate bond spreads displayed dynamics consistent with a 'dash for dollars' during the peak of the Covid-19 market turmoil, a natural question is whether this phenomenon is common to other crisis episodes.

In this section, we explore the behavior of corporate bond spreads in the second half of 2008, at the height of the Global Financial Crisis (GFC), to assess whether the patterns uncovered in Section 4 also hold in that period.

In particular, we estimate specification (2) for a sample of bonds included in the same corporate bond index as in our baseline results (i.e. investment grade bonds comprising the ICE Bank of America Merrill Lynch's Global Corporate Index).[23] We consider the change in spreads between June 16 (a local minimum for the Global Corporate Index, which precedes the sharpest acceleration on record) and December 8th (the all-time peak of the index). This period therefore covers the bankruptcy filing of Lehman Brothers in September 2008, a conventional reference point for analyzing GFC-related dynamics.

Our results, reported in Table B.6, show that it was indeed US dollar-denominated bonds that displayed the largest widening in spreads during the height of the GFC, mirroring the dynamic during the Covid-19 market turmoil. In terms of magnitudes, the coefficients are similar in size to those reported in Table 1, but are smaller in relative terms given the sharper increase in overall spreads in 2008: the intercept for the GFC sample is more than twice as large than the one for the Covid-19 period. Also, the currency of denomination explains a smaller share of the overall variation in spreads during the GFC period compared to Covid-19: the R^2 of our preferred specification, reported in Column (4) in both tables, is 19% for GFC and 26% for Covid-19.

These results reinforce our interpretation that, during periods of stress, investors try to secure US dollars in particular, rather than cash in general. As discussed in Section 4, we link this interpretation to the role of the US dollar as the dominant global currency—and, in particular, to its role as an international medium of exchange and unit of account. Moreover, the stronger effects seen during the Covid-19 pandemic compared to the GFC in 2008 (in terms of relative magnitude and share of variance explained) could reflect the increasing dominance of the US dollar, as documented by Maggiori et al. (2020).

Adding High Yield Bonds to the Sample In the following, we present additional results on the dash for dollars using an extended sample that also includes high yield bonds. The results from specification (1) are reported in Table B.7, columns (1), (3) and (5). The coefficient estimates

[23] Naturally, the overlap between the GFC and the Covid-19 samples is only partial due to the issuance of new bonds and the maturing of existing bonds. Despite the difference in the constituents, we note that the characteristics of the bonds considered for the exercise in this section are very similar to our baseline as reported in Section A.

Table B.6 Bond Spreads Widening: Global Financial Crisis

	(1)	(2)	(3)	(4)
Maturity (β_1)	-2.89***		-3.17***	0.39
	(0.38)		(0.39)	(0.58)
USD (β_2)		141.60***	149.28***	190.40***
		(19.81)	(19.82)	(23.57)
USD x Maturity (β_3)				-4.37***
				(0.80)
Observations	3,658	3,658	3,658	3,658
R squared	0.06	0.11	0.17	0.19

Note. Columns (1) to (3) report results from specification (1), namely $\Delta s_b = \alpha + \delta_i + \beta_1 Matu_b + \beta_2 USD_b + \Gamma X_b + \varepsilon_b$. Column (4) reports results from specification (B.1), namely $\Delta s_b = \alpha + \delta_i + \beta_1 Matu_b + \beta_2 USD_b + \beta_3 Matu_b \times USD_b + \Gamma X_b + \varepsilon_b$. Robust standard errors are reported in parentheses. Credit spread changes between 8th December and 16th June 2008 (dependent variable) are trimmed at the 1st and 99th percentiles. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to coupon type dummies and bond face value not reported.

confirm that US dollar-denominated bonds are associated with a larger increase in corporate bond spreads. Specifically, spreads of dollar bonds increased by about 116bps more than non-dollar bonds when using the whole extended sample. The effect is even larger for investment grade bonds with 120bps, while it is substantially smaller for high yield bonds (74bps).

Table B.7 Bond Spreads Widening: Sample incl. High Yield Bonds

	(1)	(2)	(3)	(4)	(5)	(6)
	Whole Sample		IG Only		HY Only	
US dollar (β_1)	115.85***	7.69**	120.41***	7.84***	73.66***	6.43
	(7.57)	(2.70)	(7.68)	(2.56)	(25.80)	(5.29)
Observations	3217	55029	2927	50685	289	4344
R squared	0.730	0.406	0.649	0.356	0.723	0.584
Number of Firms	276	281	276	281	276	281
Firm FE	yes	no	yes	no	yes	no
Firm × Day FE	no	yes	no	yes	no	yes

Note. The dependent variable in Columns (1), (3) and (5) is the total change in bond spreads between February 28th and March 20th, while Columns (2), (4) and (6) use the daily spread increase during this period. Robust standard errors clustered at the firm level (Columns 1, 3, 5) and firm-day level (Columns 2, 4, 6) are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, fixed effects, level of credit spread at the beginning of the sample, coupon type dummies, amortization type dummies, bond face value, and maturity not reported.

Results from specification (2), reported in columns (2), (4) and (6) of Table B.7, show that the sharper widening in spreads of US dollar-denominated bonds is robust to the tighter specification when using the extended sample. It is important to note, however, that the effect is insignificant in the high yield sample once we include firm-time fixed effects. Once again, these results emphasize the differential impact of the dash for dollars on investment grade vs. high yield bonds, consistent with our results in Section 6 and prior studies such as Haddad et al. (2021).

The Way Down On March 23rd, the Federal Reserve announced that it would explicitly take on credit risk (with a Treasury backstop) by directly buying investment grade corporate debt in primary (PMCCF program) and secondary markets (SMCCF) for the first time since Quantitative Easing was introduced in 2008.[24] This intervention, the first one directly targeting the asset class analyzed in our study, is associated with the end of the aggregate corporate spread widening documented in Figure 1. In this section, we analyze the dynamics of spreads in the subsequent compression phase.

We follow an approach that mirrors the one employed in our main analysis. Specifically, we estimate within-firm regressions matching those in Section 4 for the period following the PMCCF/SMCCF policy announcement date. Table B.8 reports the results. We run our baseline specification by focusing on the change in spreads in the first five trading days after the PMCCF/SMCCF announcement.[25] The results show that US dollar-denominated bonds experienced a larger fall in spreads than bonds denominated in other currencies, as shown by the (strongly significant) negative coefficient on USD_b. This emphasizes the reversion of the dash for dollar dynamics in the days following the PMCCF/SMCCF announcement.

Can the timing and characteristics of the spread compression be informative about the mechanisms at play? In principle, the Fed actions might have eased the dash for dollars through two complementary channels. First, the direct provision of US dollars to foreign central banks via swap lines might have eased access to US dollars for non-US financial institutions.[26] Second, any type of

[24]The March 23rd Fed announcement is available at this link https://www.federalreserve.gov/newsevents/pressreleases/monetary20200323b.htm. On April 9th, the scale of this program was increased, and eligibility was widened to include high-yield bonds, provided they were rated investment grade as of March 22nd (the so-called 'fallen angels'), see https://www.federalreserve.gov/newsevents/pressreleases/monetary20200409a.htm.

[25]The length of the window for this exercise is similar to past studies analyzing corporate spread dynamics. For example, Gertler and Karadi (2015) consider a 10-day window in an event study similar to ours. Our results remain robust when using a 10-day window.

[26]The Federal Reserve announced an improvement in the terms of its swap lines with the central banks on its standing network on March 15, an expansion of the network on March 19, and an increase in the frequency of operations for the original set of counterparties on March 20.

Table B.8 THE WAY DOWN

	(1)	(2)
US dollar (β_1)	-62.55***	-8.81**
	(7.75)	(3.66)
Observations	3314	33486
R^2	0.406	0.319
Firm FE	yes	no
Firm × Day FE	no	yes

NOTE. The dependent variable in Column (1) is the total change in bond spreads between March 23rd and April 3rd, while Column (2) uses the daily spread increase during this period. Robust standard errors clustered at the firm (Column 1) and firm-day level (Column 2) are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, fixed effects, level of credit spread at the beginning of the sample, coupon type dummies, amortization type dummies, and bond face value not reported.

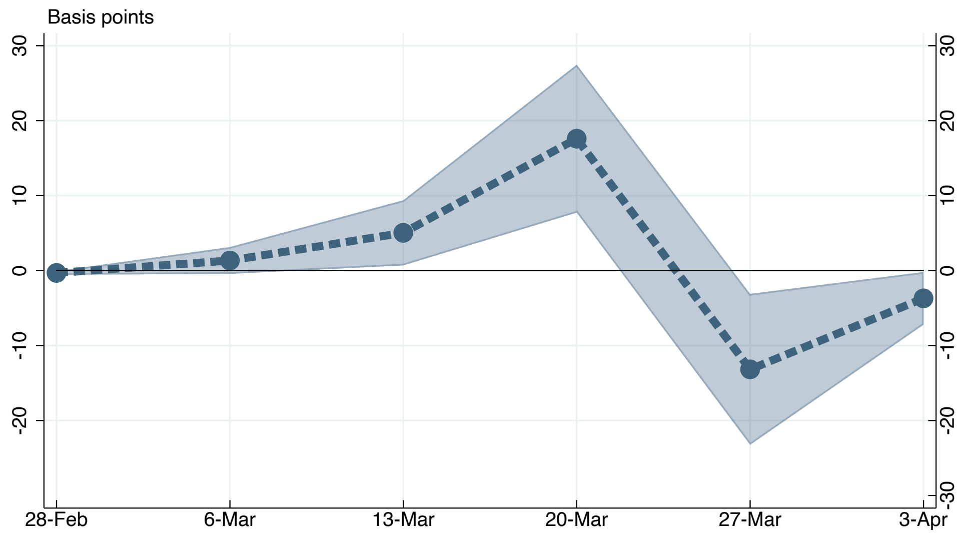
Fed action resulting in looser monetary and financial conditions might have also led to the easing of intermediaries' balance sheet constraints via a reduction in risk perceptions and an increase in prices across asset classes. With increased balance sheet capacity, financial intermediaries might have exploited the arbitrage opportunity provided by CIP deviations, thereby inevitably closing the gaps.[27] This, in turn, could have led to a reduction in the cost of accessing US dollars synthetically, therefore reducing the need to fire-sell dollar securities.

The data suggest that the spreads did not revert following the first Fed announcements—i.e. those covering 'standard' easing policies through rate cuts and traditional Quantitative Easing (i.e. the purchase of Treasuries and MBS), as well as those covering cheaper and more extensive swap lines. Indeed, credit spreads kept increasing until March 23 (see Figure 1), with US dollar bonds displaying the largest increases. The conditional analysis in Figure 2 shows that the dash for dollars dynamics intensified rather than abated in the days following those announcements. This, together with results in Table B.8, lends some weight to the hypothesis that the direct purchases of corporate bonds by the Fed led to a reversion of the dash for dollars dynamics documented in the widening period.

A series of studies, complementary to ours, focus more narrowly on the effect of the Fed interventions (PMCCF/SMCCF announcements in particular), but do not explore the role of the underlying bond characteristics beyond those warranting inclusion in the purchase programs. Specifically,

[27]This mechanism has been highlighted, among others, by Du et al. (2018).

Figure B.2 THE DASH FOR DOLLARS OVER TIME: THE WAY DOWN



NOTE. Time-varying (weekly) estimates of the differential spread increase for dollar-denominated bonds vis-a-vis non-dollar bonds in the specification with firm-by-day fixed effects (β_1). Shaded areas show 90% confidence intervals based on robust standard errors clustered at the firm-day level.

Haddad et al. (2021) find that investment grade bonds with maturities of five years and less (i.e. those targeted by the Fed) experienced particularly large gains on the day of the PMCCF/SMCCF announcement. Closer to our study, Gilchrist et al. (2020) use firm fixed effects and a longer time window to find that bonds included in Fed programs experienced more pronounced increases in prices than excluded bonds of the same firm. However, neither of these studies explore the currency dimension of the bond spread dynamics resulting from the Fed's actions.

In sum, the results in this section are insightful even without narrowly identifying the effect of a particular Fed program. They show that in the week following the announcement of PM-CCF/SMCCF, when the market for corporate bonds 'turned', spreads of dollar-denominated bonds compressed the most, even when accounting for unobserved firm heterogeneity. This is consistent with a reversion of the dynamics observed during the dash for dollars episode uncovered in Section 4.

Further Robustness Checks In this section we conduct a series of robustness checks for our main result that dollar bonds experienced larger spread increases than non-dollar bonds during the Covid-19 market turmoil. Specifically, we first run two additional tests excluding local currency bonds and callable bonds, before we run another test which includes financial bonds.

In Panel A of Table B.9, as an important cross-check, we exclude local currency bonds. The intuition is that the default risk might potentially be higher for foreign currency bonds than for local-currency bonds, so the increase in dollar spreads would then be driven by compensation for this additional risk. We therefore compare dollar spreads of non-US firms with other foreign-currency spreads (for example, dollar vs. pound sterling bonds for euro area firms), and find that our results remain robust.

As shown in Table B.9, our results also remain robust to the exclusion of callable bonds (Panel B), as well as to the inclusion of bonds issued by firms in the financial sector (Panel C). The coefficients on our main variable of interest remain statistically and economically highly significant in both the cross-sectional and panel regressions.

Table B.9 Robustness checks

Panel A: Excluding local currency bonds		
	(1)	(2)
US dollar (β_1)	109.31***	7.12**
	(13.05)	(2.92)
Observations	895	18105
R squared	0.707	0.429
Firm FE	yes	no
Firm × Day FE	no	yes
Panel B: Excluding callable bonds		
	(1)	(2)
US dollar (β_1)	90.00***	7.81**
	(16.19)	(3.05)
Observations	395	7077
R squared	0.806	0.430
Firm FE	yes	no
Firm × Day FE	no	yes
Panel C: Including financial bonds		
	(1)	(2)
US dollar (β_1)	126.37***	8.11***
	(6.04)	(2.64)
Observations	3953	68167
R squared	0.649	0.350
Firm FE	yes	no
Firm × Day FE	no	yes

Note. This table provides robustness checks for our baseline results. In Panel A, we exclude callable bonds from our baseline sample. In Panel B, we add financial corporate bonds to our baseline sample. Column (1) uses the total change in bond spreads between February 28th and March 20th, while Column (2) uses the daily spread increase during this period. Robust standard errors clustered at the firm-day level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, fixed effects, level of credit spread at the beginning of the sample, coupon type dummies, amortization type dummies, bond face value, and maturity not reported.

C Robustness: Transaction-level Regressions

Robustness Checks of Baseline Spreads Regressions using Transaction Data A potential concern with our baseline bond-level spread regression is the potential staleness of the ICE Bank of America Merrill Lynch credit spreads data. To address this concern, we merge the credit spread data with our transaction-level MiFID II data set, which covers the UK corporate bond market. This allows us to re-run our baseline regression model for bonds traded in the MiFID II data, and we can also use the change in transaction prices rather than credit spreads.

The results are presented in Table C.1. The first two columns show that our results continue to hold in the UK corporate bond market. The effect remains statistically highly significant, and the economic magnitude is with around 12bps even larger than in the global spread data set. Consistent with our baseline spread results, we also find that dollar bonds traded at significantly lower prices in the UK corporate bond market relative to non-dollar bonds of the same firm (columns (3) and (4)). The effect remains statistically highly significant (at the 1% level) and the economic magnitude is large with around 43bps higher transaction prices for dollar bonds. Importantly, this test helps to mitigate concerns about the potential staleness of bond spreads used in our baseline regression.

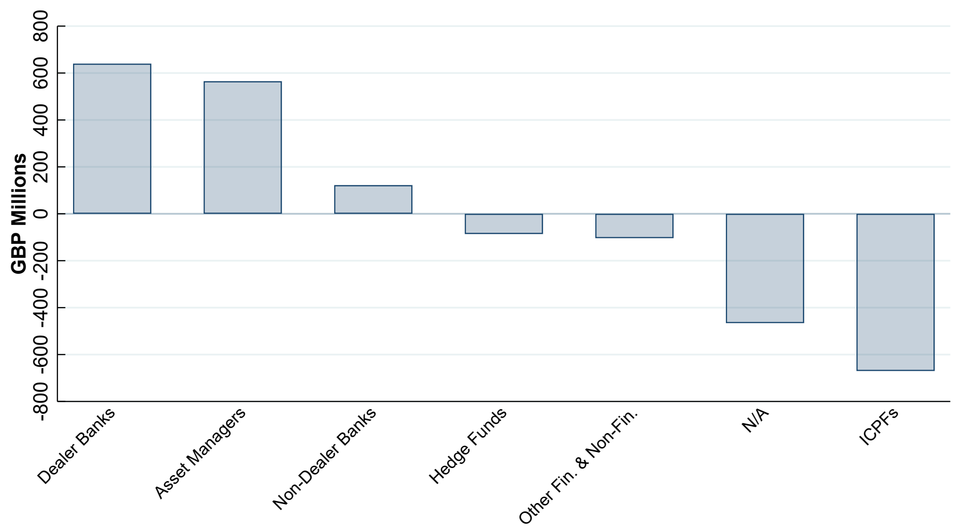
Table C.1 Baseline Regression using MiFID II Transaction Data

	(1)	(2)	(3)	(4)
	$\Delta s_{b,t}$		$\Delta p_{b,t}$	
US dollar (β_1)	12.14***	12.52***	-42.86***	-42.74***
	(3.08)	(3.36)	(8.48)	(6.64)
Observations	1869	1496	1276	961
R squared	0.398	0.620	0.317	0.438
Firm FE	yes	no	yes	no
Day FE	yes	no	yes	no
Firm × Day FE	no	yes	no	yes

Note. In the first two columns, we use changes in spread from the ICE Bank of America Merrill Lynch credit spreads data (in bps). In columns (3) and (4), we focus on changes in transaction prices, which are measured on the bond-day level and defined as the logarithmic change in the trade-weighted average price compared to the previous trading day (in bps). We focus on the Covid-19 period between February 28th and March 20th 2020. Robust standard errors clustered on the firm level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, control variables and fixed effects not reported.

Net Selling by Sector Figure C.1 shows the net trading volumes of different investor types in USD-denominated, non-financial corporate bonds in the UK bond market during the Covid-19 stress period (Feb 28 - Mar 20 2020). The figure shows that both dealer banks and asset managers were the main net buyers of dollar bonds during that period with combined net purchases larger than £1bn. We also find that ICPFs were the main net sellers of dollar bonds during that period with net sales of more than £700m.

Figure C.1 Dollar Corporate Bond Net Trading Volumes During Covid-19



Note. Net trading volumes of different investor types in USD-denominated, non-financial corporate bonds in the UK market during the Covid-19 stress period (Feb 28 - Mar 20 2020). The investor types include: dealer banks, asset managers, non-dealer banks, hedge funds, other financial & non-financial firms, firms without a counterparty identifier (N/A) and insurers & pension funds (ICPFs). Source: MiFID II bond transaction database.

Corporate Bond Liquidity incl. High Yield Bonds Furthermore, in Section 6.1, we find that dollar bonds experienced sharper increases in effective bid-ask spreads than non-dollar bonds. Importantly, this comes against the backdrop that dollar bonds are usually viewed as more liquid in non-stress periods, consistent with Table 4. In Table C.2, using our within-issuer regression specification (5), we provide further evidence for the liquidity of dollar bonds using our entire sample, i.e. including high yield bonds. We find that effective bid-ask spreads of a given issuer's dollar bonds are on average around three basis points lower than those of the issuer's non-dollar bonds in tranquil times. The effect is statistically significant for the whole bond sample and investment grade bonds, but insignificant in our sample of high yield bonds. These results therefore emphasize the superior liquidity of high-quality dollar bonds during quiet periods in the market.

In the Covid crisis period, however, we find that bid-ask spreads of dollar bonds rose significantly more than those of non-dollar bonds of the same firm. Importantly, this effect is absent for high-yield issuers, indicating that the dash for dollars was more pronounced for investment grade issuers, consistent with prior studies documenting a "reverse flight to liquidity" at the time.

Table C.2 Effective bid-ask spreads incl. high yield bonds

Panel A: Tranquil times (pre 28 Feb 2020)						
	(1)	(2)	(3)	(4)	(5)	(6)
	Whole Sample		IG Only		HY Only	
US dollar (β_1)	-1.50	-2.69***	-1.64	-2.93*	-1.77	0.58
	(1.23)	(0.82)	(1.96)	(1.52)	(3.75)	(1.71)
Observations	23528	13583	14672	9173	8055	3878
R squared	0.152	0.321	0.180	0.262	0.165	0.453
Firm FE	yes	no	yes	no	yes	no
Day FE	yes	no	yes	no	yes	no
Firm × Day FE	no	yes	no	yes	no	yes

Panel B: Baseline sample (28 Feb to 20 Mar 2020)						
	(1)	(2)	(3)	(4)	(5)	(6)
	Whole Sample		IG Only		HY Only	
US dollar (β_1)	25.09***	17.64***	34.19***	37.33**	10.25	-2.01
	(4.98)	(5.73)	(8.38)	(15.21)	(14.89)	(12.50)
Observations	972	639	502	327	366	239
R squared	0.213	0.420	0.289	0.438	0.159	0.468
Firm FE	yes	no	yes	no	yes	no
Day FE	yes	no	yes	no	yes	no
Firm × Day FE	no	yes	no	yes	no	yes

NOTE. Results from specification (5). In Panel A, we focus on the pre-Covid period between January 3rd 2018 and February 27th 2020. In Panel B, we focus on the Covid-19 period between February 28th and March 20th 2020. The effective bid-ask spreads are measured on the bond-day level and defined as twice the difference between the trade price and the bid/ask midpoint. Robust standard errors clustered on the firm-day level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, control variables and fixed effects not reported.

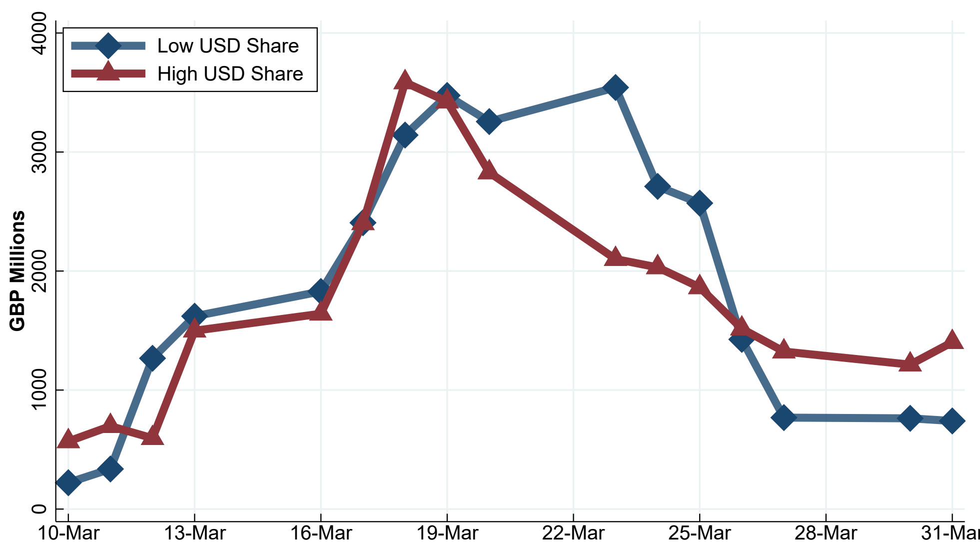
Insurers' Variation Margin Calls A potential concern about the analysis in Table 5 is that insurers with a high share of dollar-denominated derivative contracts were exposed to higher aggregate VM margin calls compared to insurers with a low share of dollar contracts, which would mean that the former group faced more severe liquidity pressures.

To analyze this more formally, we estimate VM calls for UK insurers using the EMIR Trade

Repository Data on interest rate swaps, forward rate agreements, inflation swaps, and cross-currency basis swaps. The estimates are based on the methodology used in Bardoscia et al. (2021). We observe derivatives trades meeting one of the following conditions: i) one of the counterparties is a UK-regulated entity, ii) any leg of the trade is denominated or paid for in Sterling, iii) the trade is cleared by a UK supervised CCP, or iv) the underlying security is a UK entity. As for the previous datasets, we allocate investors to an investor group using a best-endeavor sectoral classification.

Importantly, as shown in Figure C.2, we find that insurers with a high share of USD contracts faced almost identical VM demands during the dash for cash compared to the group with a low share of dollar contracts. The cumulative VM demands of both groups reached a peak of around £3.5bn on March 19. Furthermore, both groups faced a rapid succession of large VM calls in the eight trading days between March 10 and 19, consistent with their pronounced net sales of gilts and corporate bonds at the time (see also Czech et al., 2021).

Figure C.2 Insurers' cumulative variation margin demands



Note. This figure shows the dynamics of the total variation margin (VM) demands in March 2020 on derivatives of UK insurers with a high share of dollar-denominated derivative contracts vs. those insurers with a low share of dollar contracts, using the sample median as the cut-off point. VM calls are estimated using the EMIR Trade Repository Data on interest rate swaps, forward rate agreements, inflation swaps, and cross-currency basis swaps. Positive (negative) values mean that the investor group was a net payer (receiver) of VM. The estimates are based on the methodology used in Bardoscia et al. (2021). The variation margin demands are in £ billion.

ICPFs' Longer-term Price Impact In Section 6.2, the results show that the order flow of insurers and pension funds (ICPFs) has a significant negative correlation with contemporaneous spread increases. A potential concern with this result is that ICPFs trades are based on fundamental information, rather than due to liquidity pressures. According to this hypothesis, we should see a longer-term underperformance of the bonds that were sold by these investors. To mitigate these concerns, we again run our regression specification in equation (7), but for longer horizons of spread changes: five days, ten days, and twenty days. The results are presented in Table C.3. Consistent with the liquidity pressure hypothesis, we find a significant contemporaneous effect, which is fully reversed after ten trading days. The results therefore strengthen our interpretation that ICPFs traded due to liquidity pressures rather than fundamental information.

Table C.3 Longer-term impact of ICPF order flows on spreads

	(1)	(2)	(3)	(4)
	$\Delta s_{t-1,t}$	$\Delta s_{t-1,t+5}$	$\Delta s_{t-1,t+10}$	$\Delta s_{t-1,t+20}$
ICPF Order Flow (β_1)	-6.85***	-2.25	2.31	6.17
	(1.83)	(4.30)	(6.96)	(6.12)
Observations	85	85	85	85
R squared	0.628	0.630	0.788	0.891
Firm FE	yes	yes	yes	yes
Day FE	yes	yes	yes	yes

Note. For each investor type, order flow is measured on the bond-day level and defined as the investor type's daily net volume in the given bond, divided by the bond's total daily trading volume across all investor types. To facilitate the interpretation of the coefficients, we transform the variable by subtracting the cross-sectional average, before dividing it by the standard deviation. The dependent variable is the bond's spread change (in bps) from day $t-1$ to day $t+k$. Robust standard errors clustered on the firm-day level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, control variables and fixed effects not reported.

D Alternative Interpretations of the Dash for Dollars

In this section we consider two alternative explanations for the selling pressure in dollar bonds during the Covid-19 crisis, namely (i) a mechanical portfolio rebalancing effect and (ii) a change in the expected path for the dollar.

D.1 Portfolio Rebalancing

A potential concern with our main result is that the spread widening could be driven by a mechanical portfolio rebalancing channel. More precisely, investors may target a constant share of dollar assets over total assets, and the sharp appreciation of the dollar during the Covid-19 crisis may have induced them to rebalance their portfolios. The decision to buy or sell dollar assets may have therefore been driven by a mechanical rebalancing.

The first, and perhaps most obvious rebuttal is that managers of large portfolios (e.g. asset managers, pension funds, insurers etc.) rebalance their portfolios on a relatively low frequency, e.g. monthly or quarterly.[28] Second, the dollar spread tightening on the way down (as described in Section B) indicates a rapid reversal of the dash for dollars, which is inconsistent with the portfolio rebalancing hypothesis (especially given the continued strength of the dollar after the PMCCF/SMCCF announcements). However, to test the hypothesis more formally, we exploit the strength of the euro during the Covid-19 crisis and estimate the following regression:

$$Vol_{b,j,t} = \alpha + \alpha_{i,j,t} + \beta_1 EUR_b + \Gamma X_{b,t} + \varepsilon_{b,j,t} \tag{D.1}$$

where EUR_b is a euro bond indicator variable, and the remaining variables are defined as in equation (4). The results are presented in Table D.1. We find that despite the euro's sharp appreciation against, for example, sterling during the Covid-19 crisis, we find no significant sell-offs of euro-denominated bonds (vs. other non-USD bonds) in the UK corporate bond market. The test therefore helps us to rule out the portfolio rebalancing hypothesis, given that one would expect a similar selling pressure in euro bonds if our effect was driven by a mechanical rebalancing due to currency appreciations.

D.2 Exchange Rate Dynamics

CIP Deviations To provide further evidence supporting the dash for dollars hypothesis, we report some facts on CIP deviations in this section. CIP deviations measure the relative cost of obtaining US dollars 'synthetically', i.e. the difference between the dollar interest rate in the cash market and the implied dollar interest rate in the foreign exchange (FX) swap market. A negative CIP deviation means that borrowing dollars through FX swaps is more expensive than borrowing

[28] For more information on institutional rebalancing strategies, see Zilbering et al. (2015).

Table D.1 PORTFOLIO REBALANCING

	(1)	(2)	(3)	(4)	(5)	(6)
	Net Volumes		Buy Volumes		Sell Volumes	
Euro bond (β_1)	-0.20	-0.10	-0.16	0.15	0.04	0.25
	(0.15)	(0.19)	(0.13)	(0.19)	(0.07)	(0.19)
Observations	6354	1055	6354	1055	6354	1055
R squared	0.162	0.502	0.182	0.439	0.171	0.525
Firm FE	yes	no	yes	no	yes	no
Day FE	yes	no	yes	no	yes	no
Investor FE	yes	no	yes	no	yes	no
Firm × Day × Investor FE	no	yes	no	yes	no	yes

NOTE. Net volumes (in millions) are measured on the investor-day-bond level in the period between February 28th and March 20th. Buy (Sell) volume is equal to net volume if the given investor is a net buyer (seller) of investment grade bond b on day t, and zero otherwise. Robust standard errors clustered at the firm level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Coefficients corresponding to the constant, control variables and fixed effects not reported.

in the dollar money market.

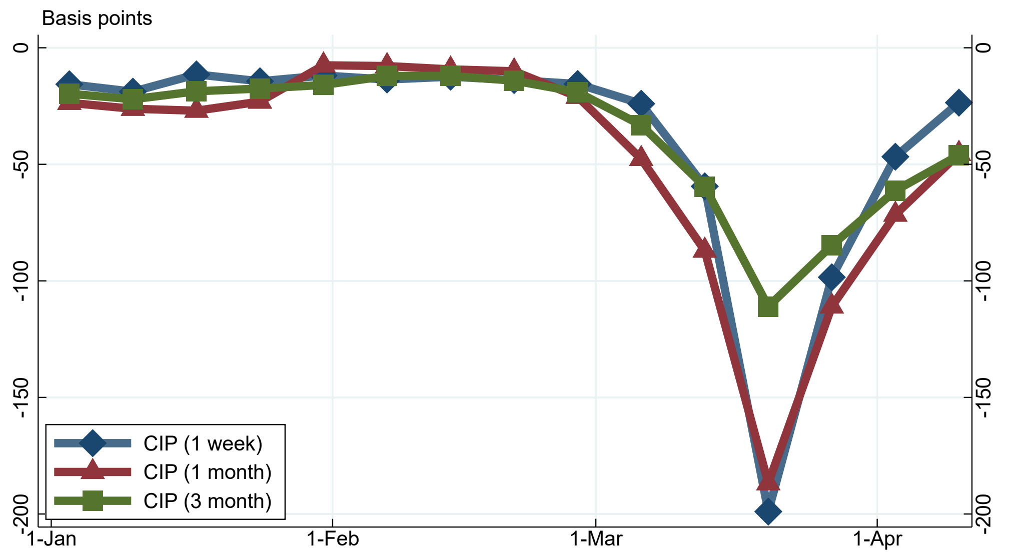
The interpretation of our results as a 'dash for dollars' is consistent with the dynamics in FX derivative markets. Figure D.1 shows the sharp increase in the relative cost of accessing US dollars 'synthetically' (i.e. via the use of FX derivatives) during the Covid-19 market turmoil, which has been interpreted as a sign of US dollar shortages (see Avdjiev et al., 2020; Eren et al., 2020; Bahaj and Reis, 2020). The magnitude of the CIP deviations was huge during this period: for example, the one-month and three-month CIP deviations reached a level of approximately 200bps.

Expectations of Dollar Depreciation Given the sharp appreciation of the dollar against most other currencies in March 2020, a potential concern is that the decision to sell dollar assets was driven by a expected subsequent dollar depreciation. To mitigate such concerns, we now conduct a test in which compare the strength of dollar appreciation and spread widening across currencies. In theory, we would expect a smaller spread widening for dollar bonds compared to bonds denominated in currencies that experienced a weaker depreciation against the dollar. We estimate the following specification:

$$\Delta s_{b,t} = \alpha + \alpha_{i,t} + \alpha_w \cdot \alpha_c \cdot \beta_1 USD_b + \Gamma X_{b,t} + \varepsilon_{b,t} \tag{D.2}$$

where α_c is a currency indicator variable. Figure D.2 presents the results. Reassuringly, we find no evidence that the strength of dollar appreciation is correlated with the spread widening across

Figure D.1 CIP Deviations by Maturity



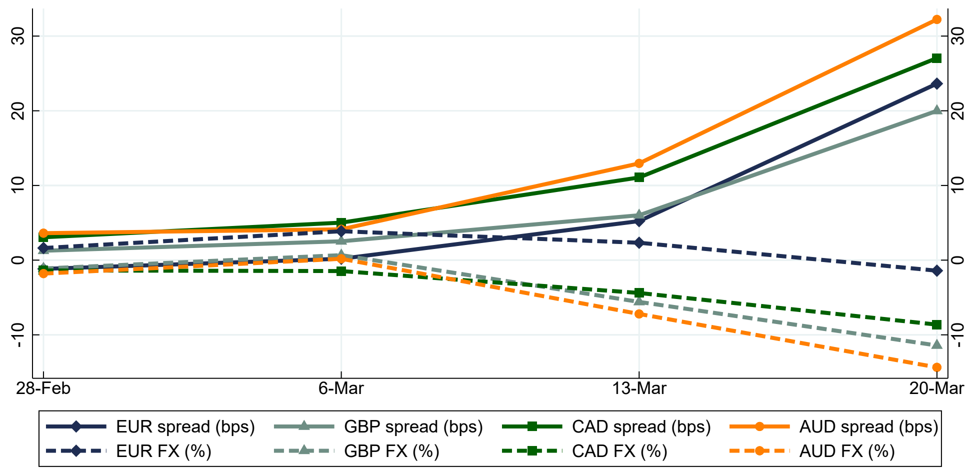
Note. Difference between the local dollar borrowing rate less the synthetic dollar borrowing rate. The local dollar borrowing rate is the US interest rate. The synthetic dollar borrowing rate is the foreign interest rate, multiplied with quotient of forward rate divided by spot rate. Daily spot, forward and OIS benchmark rates for 1 week, 1 month and 3 month maturities for EUR and GBP vs. USD. Source: Bloomberg.

currencies. For example, we find that dollar bond spreads widened significantly relative to euro bond spreads of the same firm, despite the fact that the dollar did not appreciate substantially against the euro throughout the Covid-19 crisis.

Changes in FX Forward-implied Paths In Figure D.3, we report the changes in the forward premium of the US dollar against other currencies in our sample period between February 28 and March 20 (i.e. the time window of our baseline regression). The forward premium is defined as the difference between the spot exchange rate and the exchange rate implied by the price of an FX forward. We report this measure for 5-year forwards in order to broadly match the median maturity of the bonds in our sample, but the picture looks very similar for alternative maturities. The bars measure the change of the difference between the spot exchange rate and the price of the 5-year forward exchange rate between end-February and March 20.[29] Exchange rates are defined as units of foreign currency per US dollar. Thus, negative bars signal a worsening of the path of a

[29]We report *changes* in the path to match the focus of our regressions on changes in bond spreads.

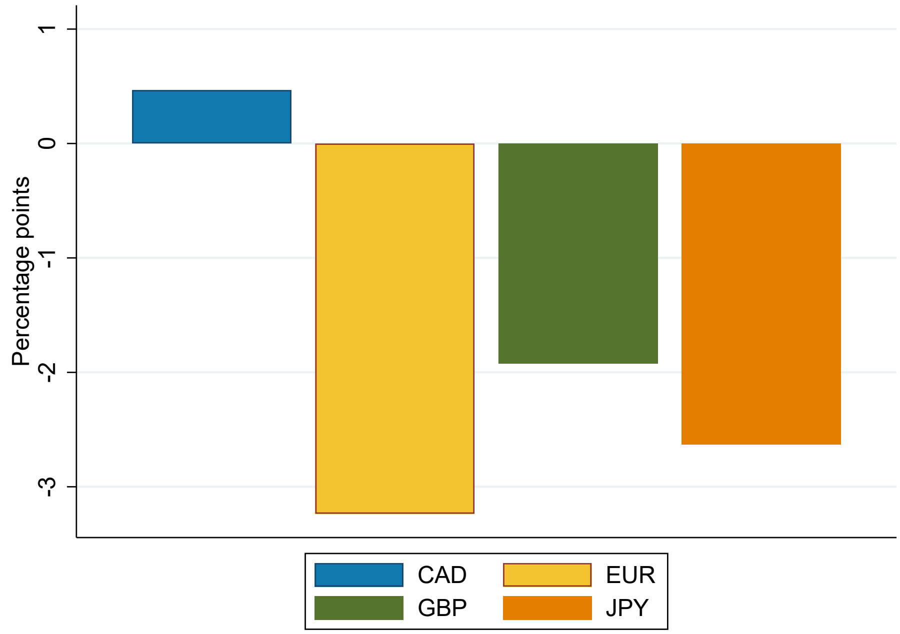
Figure D.2 Expectations of Dollar Depreciation



Note. The solid lines show the corporate bond spread differentials between dollar bonds and bonds denominated in other currencies, as estimated from the following specification: $\Delta s_{b,t} = \alpha + \alpha_{i,t} + \alpha_w \cdot \alpha_c \cdot \beta_1 USD_b + \Gamma X_{b,t} + \varepsilon_{b,t}$, where α_c is a currency indicator variable. The dashed lines show the cumulative FX changes against the US dollar (negative values represent a US dollar appreciation). Source: ICE Bank of America Merrill Lynch and Bloomberg.

currency vis-a-vis the US dollar between February 28 and March 20. While it is not possible to get a direct read on expectations from these paths given the prominence of FX risk premia, the figure shows that the implied paths for the US dollar improved against the euro, pound sterling and yen over this period, and worsened only marginally against the Canadian dollar. Therefore, in contrast to our mechanisms centered on the special role of the US dollar, it is unlikely that revised FX expectations drove the selling pressure in dollar-denominated bonds during the Covid-19 market turmoil.

Figure D.3 Changes in FX Forward-implied Paths Against the US Dollar



Note. Change of the difference between the spot exchange rate and the price of a 5-year forward between February 28 and March 20, across a range of currencies against the US dollar. Negative values signal worsening implied paths for the currencies analyzed against the US dollar. Source: Bloomberg.