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It's what you say and what you buy: A holistic evaluation of the corporate credit facilities

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Staff Report No. 935
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Abstract

We evaluate the impact of the Federal Reserve corporate credit facilities (PMCCF and SMCCF). A third of the positive effect on prices and liquidity occurred on the announcement date. We document immediate pass-through into primary markets, particularly for eligible issuers. Improvements continue as additional information is shared and purchases begin, with the impact of bond purchases larger than the impact of purchases of ETFs. Exploiting cross-sectional evidence, we see the greatest impact on investment grade bonds and in industries less affected by COVID, concluding that the improvement in corporate credit markets can be attributed both to announcement effects of Federal Reserve interventions on the economy and to the specific differential impact of the facilities on eligible issues.

Key words: corporate credit facilities, bond liquidity, credit spreads, purchase effects

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To view the authors' disclosure statements, visit https://www.newyorkfed.org/research/staff_reports/sr935.html.

1 Introduction

> "The effect of the programmes is more psychological than financial... The Fed has totally achieved their target."
>
> *Financial Times*, May 28, 2020.

The corporate bond market experienced historic turmoil in March 2020. As investors shed risky assets in response to the COVID pandemic and associated shutdowns, U.S. investment grade corporate bond issuance slowed to levels not seen since the global financial crisis. On March 23, 2020, as part of an extensive set of measures to support the U.S. economy, the Federal Reserve announced its first ever corporate credit facilities (CCFs) in order to support the supply of capital market credit to the non-financial sector. The facilities were designed with a two-pronged approach, facilitating access to primary markets through direct lending in the Primary Market Corporate Credit Facility (PMCCF) and acting in secondary markets through purchases of individual bonds and exchange-traded funds (ETFs) through the Secondary Market Corporate Credit Facility (SMCCF).

In this paper, we calculate the impact of the announcements of the CCFs and quantify the direct impact of secondary market purchases. We offer a holistic evaluation of the impact of the facilities announcements and purchases on: i) Secondary bond market functioning, both in spread and liquidity terms, ii) Market expectations of default, iii) Primary market functioning, both in quantity and spread terms, and iv) Intermediation activity in both secondary and primary markets. The key contribution of this paper is to use comprehensive bond- and dealer-level data to overcome the identification issue, and to extract both the overall announcement effect on market prices and liquidity as well as the direct impact of purchases, calculating the impact on eligible securities and the corporate bond market more broadly.

Theory suggests a number of channels for the facilities to impact corporate credit markets. First, as part of a suite of Federal Reserve actions, announcements may improve prospects

for the U.S. economy, reducing the quantity of corporate credit risk and the prices investors are willing to pay for that risk. Second, the facilities may reduce indiscriminate asset sales by reducing the information sensitivity of eligible bonds. Third, facilities may impact intermediation, arising from dealers' increased willingness to provide liquidity in a market that now has a buyer of last resort. Fourth, there may be an additional direct impact on eligible securities from purchases and the presence of a backstop lending facility. We use different features of the facilities and the announcements, as well as daily data on ETF and individual bond purchases by the Fed to shed light on the relative importance of these channels, but do not view them as mutually exclusive. We find evidence for each of these channels, with both pricing and liquidity dramatically impacted by the initial announcements, and credit spreads more influenced by direct purchases.

We document a dramatic improvement in average duration-matched spreads of 140 basis points in the three months after the initial announcement of the facilities. We estimate that a third of the improvement occurred on March 23, the initial announcement date of the facilities. A further third happened by April 9 when the facility term sheet was revised and additional information provided, and the last third only after the commencement of facility purchases on May 12. Expected default frequencies did not fall nearly as quickly, suggesting that the initial announcement acted to reverse the increase in the price of credit risk, rather than the market expectations of the amount of credit risk. Adjusting credit spreads for default probabilities, the initial improvement around March 23 was actually higher (168 bp), suggesting risk premia decreased even more than spread levels. Similarly, almost half of the approximately 200 bps improvement in average effective bid-ask spreads between March 20 and June 26 occurred on March 23, and another 60 bps by April 9. Though average bid-ask spreads continued to improve, SMCCF purchases of ETFs had no discernible improvement on bid-ask spreads. Bid-ask spreads on bonds bought directly by the facility improved 2.5 bps per every million of cash bond purchases, more than 5 percent of the baseline improvement.

In addition to looking at the impact on secondary markets, this paper is the first to doc-

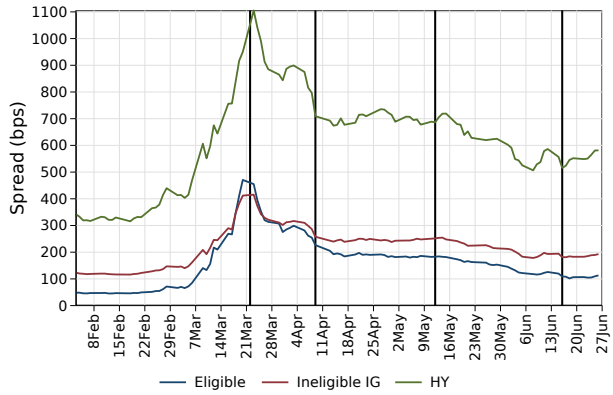
ument formally how interventions in secondary markets affect primary market functioning. Improvements in secondary market conditions pass-through to the primary market in two ways: *directly* as primary market pricing is usually benchmarked to secondary market prices of similar bonds, and *indirectly* by increasing the willingness of dealers to underwrite bond issuance. Consistent with this hypothesis, we find an immediate improvement in primary market issuance and pricing after the facility announcement, particularly for issuers eligible for the facility. By the end of June, investment grade issuers issued more than $702 billion of senior unsecured and secured bonds, nearly double issuance by the same point in 2019. We document, however, that the existence of the facility does not distort issuance decisions, with issuers not changing maturity of issued bonds to target SMCCF eligibility, nor does it appear to distort relative pricing across issuer riskiness.

In order to understand the channels through which the CCFs affect credit markets, we estimate differences in the impact on eligible and non-eligible securities. The approach is illustrated by the three bond "indices" shown in Figure 1: investment-grade rated bonds eligible for direct purchases by the facility; investment-grade rated bonds ineligible for direct purchases by the facility; and high-yield rated bonds. The left panel shows duration-matched spreads while the right panel shows effective bid-ask spreads. Comparing changes across the three indices, we see the biggest improvements in spreads and bid-ask spreads of bonds eligible for direct purchases by the facility, with a noticeable acceleration in improvement around the commencement of cash bond purchases on June 16. Thus, Figure 1 summarizes some of the basic findings of our paper: though market conditions have improved for all traded bonds, improvements have been biggest for bonds eligible for direct purchases by the facility and, in particular, for bonds bought in greater volumes by the facility. These differential improvements are most pronounced in spread space, with less differentiation in liquidity improvements across different parts of the bond market.

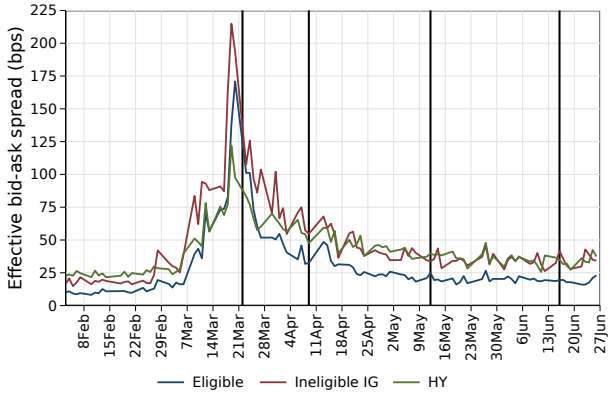
Although Figure 1 shows the aggregate effects, it masks the significant variation over time which bonds trade and in the composition of the sample. In regressions we unpack

Figure 1. Largest impact for bonds eligible for purchases. This figure plots the average duration-matched spreads (left panel) and effective bid-ask spreads (right panel) for three bond indices: investment-grade rated bonds eligible for direct purchases by the facility; investment-grade rated bonds ineligible for direct purchases by the facility; and high-yield rated bonds. Spreads computed as equal average across all available bonds. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

(a) Duration-matched spreads



(b) Effective bid-ask spreads



the differences in eligibility between ratings and maturity and add controls for bond characteristics such as the size of the bond, its age and other characteristics associated with pricing. Generally, if the impact of the initial announcement was on economic conditions more broadly, we would expect high yield issuers to be more affected, as increases in income would have greater impact on issuers closer to default. In contrast, if the impact is from the direct interventions by the facility, it should be seen mostly on eligible issuers. Consistent with the importance of the announcements to the overall economy, the announcement effect on spreads is actually smaller for investment-grade bonds. This differential impact arises despite an increased demand for investment grade bonds, as we find that net customer flows were persistently lower for high yield bonds at this time relative to the start of the year. Interestingly, looking at bid-ask spreads, there is little differential impact across eligibility criteria, until facility purchases begin. Once ETF purchases begin, bid-ask spreads on investment grade bonds bought indirectly through ETFs decrease faster than those on their high yield counterparts, with bid-ask spreads on investment grade bonds roughly 7 bps lower

than bid-ask spreads on high yield bonds bought at the average purchase pace.

An alternative interpretation of the differential improvements in investment grade bonds arises from characteristics of indiscriminate asset sales. These may occur when asset owners need liquidity, but buyers need to invest in producing information on "safe" securities which were previously information insensitive. Indeed, Gorton and Ordonez (2014) argue that this sudden regime shift in information sensitivity of securitized assets during the financial crisis led to the ABS fire sales in fall of 2007. Figure 1 shows the dramatic increase in March 2020 in bond spreads of the highest rated issuers, which is consistent with this type of regime shift, since the highest rated issuers are not more sensitive to the COVID shock. We find that while deteriorations in pricing and bid-ask spreads were uniform across issuers, improvements in secondary market conditions for bonds eligible for facility purchases are larger for issuers that were least affected by the shock (those that have experienced smaller deteriorations in profitability in the first quarter of the year). This is consistent with the facilities providing a backstop to the market and removing some of the need to produce information about investment grade assets.

Another eligibility difference is in bond maturity, as both facilities target shorter maturities (the maximum maturity of bonds purchased is 4 years for the PMCCF and 5 years for the SMCCF). To the extent that the COVID shock differentially increased the information sensitivity of bonds of issuers with near-term refinancing needs, issuers eligible for the facilities should experience a reduction in price and default risk, as the facilities provide certainty for those issuers' ability to refinance at reasonable prices. Consistent with this hypothesis, we find that spreads decrease the most for bonds maturing before September 2025, both across and within issuers. This spread improvement occurs although neither bid-ask spreads nor net customer flows are differentially affected. This suggests that the improvements in credit spreads for shorter maturity bonds are primarily due to improvements in perceptions of risks of those bonds rather than actual increases in trading activity.

The performance dichotomy between credit spreads and trading activity measures begs

the question – what role did dealers play in the March market dislocations and the subsequent recovery? Comparing intermediation by bank-affiliated and stand-alone dealers, we find that, although both groups reduced their net positions in late February and early March, stand-alone dealers exhibited "flight to intermediation safety" behavior, differentially reducing their net positions in shorter maturity and high yield bonds. Bank-affiliated dealers, instead, did not differentially change their net positions in these riskier securities. The withdrawal of stand-alone dealers from the market for riskier securities lead to increased concentration of intermediation activity in shorter maturity and high yield bonds. This increased concentration persists until the commencement of facility purchases on May 12, despite a more rapid rebound in net positions, suggesting that facility purchases played a role in percolating the willingness to intermediate in riskier securities to a broad set of dealers. Similarly, in the primary market, we find that stand-alone dealers only restarted their underwriting activity when facility purchases began.

A number of recent studies have focused on the disruptions in asset markets in March 2020. Duffie (2020), Schrimpf et al. (2020), and He et al. (2020) study the disruptions in the Treasury market, focusing on the role that margins and intermediary constraints more generally played in Treasury market illiquidity that arose due to arbitrageurs' precipitous exit from Treasury-futures trades. More closely related to our work, D'Amico et al. (2020), Kargar et al. (2020), Haddad et al. (2020), Nozawa and Qiu (2020), and O'Hara and Zhou (2020) all study the disruptions in the secondary corporate bond market and the improvement in secondary corporate bond market functioning following the facilities announcement. Our study differs from these contemporaneous papers along five dimensions. First, we study multiple dimensions of secondary market functioning – priced spreads, expected default frequencies, effective bid-ask spreads, and net customer flows – at the *bond-level* and show that the improvements are not uniform across different metrics. Using granular, bond-level data allows us to document these improvements at the individual bond level, not just at the market or credit rating level. Second, we utilize the design of the facility, in particular, the

eligibility criteria for direct purchases by the secondary market facility, to isolate the direct effect of the announcement from the overall improvements in market conditions. Gilchrist et al. (2020) confirm our findings of a significant differential improvement in secondary market spreads and liquidity for facility-eligible bonds. Third, we use the volume of purchases by the facility, both indirectly through ETF purchases and directly through cash bond purchases, to disentangle the effect of actual purchases from the announcement effect. Fourth, we shed light on the role of banks' balance sheet constraints played in March dislocations and subsequent recovery by studying changes in the liquidity provision by dealers in the market. We use the regulatory version of TRACE, which allows us to identify bank-affiliated dealers, and study changes in intermediation at the dealer-bond level. Finally, we document the improvement in primary market conditions for corporate issuers. Unlike Acharya and Steffen (2020), we find that issuance has increased across the credit spectrum since the facilities announcement, and not just for issuers at the top of the credit spectrum.

This paper is also related to the literature studying the impact of the European Central Bank's (ECB) Corporate Sector Purchase Programme (CSPP) on corporate bond markets in the European Union. Grosse-Rueschkamp et al. (2019) and Todorov (2020) document that the announcement on the CSPP reduces bond yields of firms with eligible bonds. Grosse-Rueschkamp et al. (2019) show that this leads to a substitution away from bank loans, relaxing bank balance sheet constraints and leading to a re-allocation of bank credit to small and medium enterprises (Ertan et al., 2018). From a market financing perspective, Todorov (2020) shows that both market and funding liquidity of bonds eligible for purchases by the CSPP improves on announcement of the program. This differential improvement in funding and trading conditions for eligible bonds incentivized issuers to modify characteristics of their issuance to match eligibility criteria (De Santis and Zaghini, 2019). Relative to this literature, we show that, although secondary market functioning improved on the CCF announcement differentially more for facility-eligible bonds, liquidity improvements were not localized to eligible bonds, and issuers do not seem to tailor characteristics of newly issued bonds to

facility eligibility criteria. This is perhaps not surprising: while the CSPP is a monetary policy tool, in the United States, the purpose of the CCFs is instead to improve the functioning of the private corporate bond market, with facilities' purchases expected to terminate by September 30, 2020 (subsequently extended to December 31, 2020).

More broadly, this paper is related to the literature on the effect that intermediary constraints play in equilibrium risk premia (see e.g. He and Krishnamurthy, 2012, 2013; Adrian et al., 2014; Brunnermeier and Sannikov, 2014; Adrian and Boyarchenko, 2012) and market liquidity provision (see e.g. Gromb and Vayanos, 2002; Brunnermeier and Pedersen, 2009; Gromb and Vayanos, 2010). In the corporate bond market in particular, Adrian et al. (2017b) document a contemporaneous stagnation of dealer balance sheets, dealer deleveraging, and improvement in traditional metrics of secondary market liquidity after the 2007 – 2009 financial crisis. Measuring the relationship between dealer balance sheet constraints and bond-level liquidity, Adrian et al. (2017a) document that the relationship between balance sheet constraints and liquidity provision in the secondary corporate bond market changes after the implementation of post-crisis banking regulation. We contribute to this literature by measuring the extent to which liquidity facility announcements and purchases pass through facility counterparties to the rest of the corporate bond market.

The paper proceeds as follows: In Section 2, we describe the facilities and related announcements. Section 3 describes the data used in this paper. In Section 4, we study the impact of the announcements on secondary market credit spreads and measures of market functioning, and the impact of the announcements on primary market functioning in Section 5. Next, in Section 6, we explore variation in the impact of the facilities by looking at industries that were differently affected by the COVID shock. We then look directly at the impact of the purchases in Section 7, and explore changes in intermediation in the primary and secondary markets in Section 8. Finally, we conclude in Section 9. Additional results and technical details can be found in the Appendix.

2 Corporate Credit Facilities

On March 23, 2020 the Board of Governors of the Federal Reserve System announced a number of interventions to respond to the economic and market dislocations of the pandemic and related shutdowns. With respect to capital markets corporate credit, pursuant to the Board's authorization, the Federal Reserve Bank of New York established the Primary Market Corporate Credit Facility (PMCCF) and the Secondary Market Corporate Credit Facility (SMCCF).[1] We summarize the key dates of announcements related to the corporate credit facilities in Appendix Tables A.1 (PMCCF timeline) and A.2 (SMCCF timeline). The facilities were designed to work together to support market functioning for corporate bonds and syndicated loans, with an overarching goal of facilitating credit provision to the non-financial corporate sector of the U.S. economy. The announcement included term sheets for both facilities that outlined key terms and applicability. Key features of the term sheet included the following eligibility conditions for issuers: rated investment grade by at least one nationally recognized statistical rating organizations (NRSROs) and, if rated by multiple NRSROs, investment grade rated by at least two of them, headquartered in the United States and with material operations in the United States. Issuers must not receive direct financial assistance under pending federal legislation. The SMCCF would purchase bonds up to a 5 year maturity, while the PMCCF would purchase new debt with up to a 4 year maturity. In addition, the SMCCF announced that it would purchase eligible bond portfolios in the form of exchange traded funds (ETFs).

At the same time the Federal Reserve announced a number of actions including: 1) purchasing Treasuries and Agency securities, 2) establishing the Term Asset-Backed Securities

[1]Both facilities were authorized by the Board under the authority of Section 13(3) of the Federal Reserve Act, with approval of the Treasury. To implement these facilities, the New York Fed formed a special purpose vehicle (SPV) and the Treasury, using funds appropriated to the Exchange Stabilization Fund (ESF) through the CARES Act, made an equity investment in the SPV. Under the PMCCF and the SMCCF, the New York Fed will lend to the SPV, and the SPV will use the proceeds of such loans to purchase eligible assets. The New York Fed's loans to the SPV will be secured by all the assets of the SPV, including the Treasury's equity investment in the SPV.

Loan Facility (TALF), 3) establishing the Primary Dealer Credit Facility (PDCF), 4) expanding the Money Market Mutual Fund Liquidity Facility (MMLF) to include a wider range of securities, including municipal variable rate demand notes (VRDNs) and bank certificates of deposit, and 5) expanding the Commercial Paper Funding Facility (CPFF) to include high-quality, tax-exempt commercial paper as eligible securities and reduced the pricing of the facility.

In addition to the initial announcement, we identify dates on which the Federal Reserve shared additional details about key terms of the corporate credit program, focusing on statements which affect the eligibility of certain issues or issuers. On April 9, 2020, the size of the combined facilities became larger with an increase in Treasury capital from $10 billion to $75 billion, with one half of the commitment currently funded and an agreement to fund the remainder as specified in the relevant facility agreement. Updated term sheets added concentration limits and clarified the definition of eligibility to include firms that were rated investment grade as of March 22, 2020 but no lower than BB- when purchased by facility ("fallen angels"). The SMCCF also extended purchase eligibility to high yield ETFs.[2] On June 15, details on the approach of the SMCCF to purchasing individual corporate bonds were announced. This stated that the facility aims to purchase a broad market index of individual bonds from corporations that satisfy a few simple criteria: bond maturity of 5 years or less; issuers created or organized in the United States or under the laws of the United States; issuer not an insured depository institution, depository institution holding company, or subsidiary of a depository institution holding company; and issuer meets the issuer rating requirements. This was in contrast to the previous market interpretations that the facility would require issuers to self-certify eligibility.

The SMCCF began purchasing ETFs on May 12, 2020 and cash bonds on June 16, 2020.

[2]The updated term sheets also made certain changes to the eligibility requirements. They specified that issuers must not be insured depository institutions, depository institution holding companies, or subsidiaries of such holding companies; nor must they have received specific support pursuant to the CARES Act or any subsequent federal legislation. In addition the term sheets added a requirement that the issuer must satisfy the conflict of interest requirements under section 4019 of the CARES Act.

The PMCCF was launched on June 29, 2020, concurrent with an update to the PMCCF term sheet.

3 Data

3.1 Secondary market corporate bond data

We use corporate bond transactions data from a regulatory version of the Trade Reporting and Compliance Engine (TRACE), which contain price, uncapped trade size, and buyer and seller identities as well as other trade terms. Registered FINRA dealers are identified by a designated Market Participant Identifier (MPID), and non-FINRA members are identified either as C (for client), or as A (for a non-member affiliate). Transactions are required to be reported in real-time, with 15 minutes delay, which at times need to be cancelled or corrected. In the regulatory version of TRACE cancelled and corrected records are linked with a control number, so we keep the most up to date record of the trade. We also address multiple reporting of interdealer trades, as well as trades that were executed through a non-exempt Alternative Trading System (ATS) as described in Adrian et al. (2017a). Additional details on cleaning of TRACE data are available in Appendix B.1.

Using traded prices and quantities from TRACE, we construct bond-day level measures of priced spreads (see Section 3.3 for details) and secondary market liquidity (see Section 3.4).

3.2 Bond and issuer characteristics

We use bond and issuer characteristics from Mergent FISD. For time-varying bond characteristics, such as the amount outstanding and the credit rating of the bond, we use information contemporaneous with the trading date. We coalesce bond-level ratings by multiple rating agencies into a single number based on the plurality rule: if a bond is rated by more than

one agency, we use the rating agreed upon by at least two rating agencies and use the lowest available rating otherwise.

In addition to characteristics from Mergent FISD, we obtain one year expected default frequencies (EDFs) from Moody's KMV,[3] available at the bond-day level. EDFs measure the probability of a firm's bond experiencing a credit event (failure to make a scheduled principal or interest payment) over the following year, constructed from a Merton (1974)-style model. EDFs thus provide a timely measure of the credit worthiness of both the firm as a whole and the firm's individual bonds.

Finally, we use two measures of stress faced by issuers due to the COVID-19 epidemic. At the industry level, we sort 3-digit NAICS industries into quartiles based on the 3 month decline in the total number of employees from January to April 2020, as reported by the Bureau of Labor Statistics, and compare bonds issued by issuers in industries in the bottom quartile (most affected) to those in the middle two quartiles (moderately affected) and those in the top quartile (least affected) of employment changes.[4] At the issuer level, we sort firms into quartiles based on the Q1 2020 percentage growth rate of EBITDA, as reported by Compustat, and compare bonds issued by issuers in the bottom quartile (most affected) to those in the middle two quartiles (moderately affected) and those in the top quartile (least affected) of Q1 2020 income growth rate.

3.3 Corporate bond spreads

We compute duration-matched spreads at the bond-trade level, similar to Gilchrist and Zakrajšek (2012). Given a bond-trade-level duration-matched (or "Z" spread) on bond b on trade date t, $z_{b,k,t}$, we aggregate to the bond-trade day level by averaging using trading

[3]See `https://www.moodysanalytics.com/-/media/products/edf-expected-default-frequency-overview.pdf`.

[4]Figure A.11 in the Appendix plots the distribution of employment growth by industry.

volume weights:

$$z_{b,t} = \frac{\sum_{k \in \mathcal{K}_{b,t}} z_{b,k,t} V_{b,k,t}}{\sum_{k \in \mathcal{K}_{b,t}} V_{b,k,t}},$$

where $\mathcal{K}_{b,t}$ is the set of all trades in bond b in on trading day t and $V_{b,k,t}$ is the volume of the kth trade in bond b on trade date t.

Duration-matched spreads measure the spread differential between corporate bonds and Treasuries with similar duration, capturing risk premia for both the differential credit and liquidity risk between Treasuries and corporate bonds. To separate these two components, similar to Gilchrist and Zakrajšek (2012), we estimate the duration-matched spread that would be predicted based on bond and issuer characteristics including measures of default probability such as the bond-level expected default frequency based on Moody's KMV. The default-adjusted spread for bond b on date t (or "D"-spread), $d_{b,t}$, is then calculated as the difference between the priced and the predicted duration-matched spread on bond b on date t

$$d_{b,t} = z_{b,t} - \hat{z}_{b,t},$$

where $\hat{z}_{b,t}$ is the predicted duration-matched spread. Details of both of these calculations are available in Appendix B.2.

3.4 Liquidity measures

Given the heterogeneity of corporate bonds, and the skewed distribution of trading frequency, calculating prices and therefore measuring liquidity at the bond-day-level is not straightforward. However, this level of granularity is needed for estimating the short-term impact of the facilities. Our baseline sample covers 9,765 corporate bonds, associated with 5,493,948 trades. In the 100 days of our sample, a bond is traded in 49 days on average, the 5% most traded bonds are traded on all 100 days, and the 5% least traded bonds are traded only once

or twice. On average, conditional on a trade, each bond in the sample is traded 9 times each day, with $643,524 average trade size.

These limitations on the availability of traded prices led us to focus on two liquidity measures: effective bid-ask spread, and net customer volume. Effective bid-ask spread is the difference between volume-weighted buy price and volume-weighted sell price. For the calculation of the spread, we consider dealer-client trades between 8 am and 6 pm, excluding weekends and SIFMA holidays. Net customer volume is the difference between buys and sells from the client's perspective, so that the net customer volume is positive if customers buy more bonds than they sell. It measures the net buying pressure, which drive the interdealer flow and overall trading activity. For the calculation of the net flow, we condition on dealer-client trades, where trades after 6 pm are counted towards the following day net flow calculation. Based on various robustness checks, and the number of trades in the "after-market" hours, the measures are not sensitive to the choice of time thresholds. In our regressions, we standardize net customer flow by the gross customer trading volume (sum of customer buy and customer sell volume) to address heterogeneity in average levels of trading activity across bonds.

3.5 Sample

To capture the effect of the corporate credit facilities on the primary and secondary corporate bond markets, we focus on the evolution of the markets since February 2020. From the universe of corporate bonds with issue and issuer information in Mergent FISD, we exclude bonds issued in foreign currency, bonds issued as either Yankee or Canadian bonds, convertible and asset backed bonds, as well as bonds that remain unrated more than 2 weeks after the initial offering date. Finally, we only retain senior and senior secured bonds issued by issuers domiciled in the U.S.

4 Effect of facilities on secondary markets

We begin by evaluating the effect of the facilities on pricing and liquidity in the secondary market for corporate bonds. Our approach focuses on disentangling the impact of the initial announcements on the market for securities eligible for direct purchases by the SMCCF and the pass-through of that impact to the overall market. We concentrate on two main dimensions of CCF eligibility: the maturity date of the bond and the credit rating of the bond. Although we also control for whether the bond is issued by a bank or bank subsidiary, which is a third dimension of CCF eligibility, we do not find differential effects on bonds issued by banks and thus do not report those results in the paper.

4.1 Empirical design

To take into account the potentially long-lasting impact of the March 23 announcement on the secondary market, our main object of interest is the *cumulative* change in each metric relative to the corresponding peak during the week of March 16 - 20, 2020. This approach also has the benefit of creating an apples-to-apples comparison to secondary market conditions prior to the start of the COVID-19-related market disruptions in March. In particular, for each metric M for bond b trade date t, we estimate the following regression

$$\begin{aligned}\Delta M_{b,t} = \alpha_t + \beta_{b,t}\text{Bank issuer dummy}_b + \beta_{m,t}\text{Maturity before Sep 2025}_b \\ + \beta_{hy,t}\text{HY dummy}_{b,t} + \vec{\gamma}_t\text{Bond characteristics}_{b,t} + \epsilon_{b,t},\end{aligned} \tag{1}$$

where $\Delta M_{b,t}$ is the cumulative change in metric M relative to the peak in metric M for bond b during the week of March 16 - 20, 2020. Specification (1) thus estimates the improvements in secondary market pricing and functioning for each individual bond, as a function of bond and issuer characteristics. A negative estimate of $\beta_{m,t}$ and a positive estimate of $\beta_{b,t}$ and $\beta_{hy,t}$ indicates that secondary market conditions for bonds eligible for direct purchases by the

facility have improved more relative to secondary market conditions for bonds not eligible for direct purchases. In addition to the characteristics of interest – dummy for the bond maturing on September 30, 2025 or earlier, and high yield rating dummy – we control for standard bond characteristics: log age, log amount outstanding, log offering amount, 144a registration dummy, shelf registration dummy, callable dummy, and secured dummy. We also include a dummy for issuer being a bank or a bank subsidiary, as those issuers are also ineligible. We estimate specification (1) as a repeated panel for each trading date in the sample.

Issuers with multiple bonds may have both ineligible and eligible bonds, as bonds issued by the same issuer can have different maturity dates and different individual bond ratings. For these two characteristics, we can thus refine specification (1) to use the within-issuer variation in secondary market conditions

$$\begin{aligned}\Delta M_{b,t} = \alpha_t + \beta_{m,t}\text{Maturity before Sep 2025}_b + \beta_{hy,t}\text{HY dummy}_{b,t} \\ + \vec{\gamma}_t\text{Bond characteristics}_{b,t} + \text{Issuer fixed effect}_{b,t} + \epsilon_{b,t}.\end{aligned} \tag{2}$$

Specification (2) thus identifies the marginal improvements in secondary market conditions for bonds that are eligible for direct purchases by the SMCCF, over and above the improvement in secondary market conditions for bonds issued by the same issuer that are ineligible for direct purchases. For most of our exercises, the specification with issuer fixed effects has similar results as the specification without issuer fixed effects. In our discussion, we thus focus on the specification without issuer fixed effects and note if the results with issuer fixed effects differ materially.

4.2 Secondary market pricing

Figure 2 plots the estimated coefficients, together with 95 percent confidence bands, for characteristics of interest from the regression of improvements in duration-matched spread

for specification (1) (without issuer fixed effects, left column) and specification (2) (with issuer fixed effects, right column). Consider first the average effect α_t, reported in the first row. For both specifications and consistent with the index-level patterns we observed in Figure 1, average duration-adjusted spreads rose leading up to the announcement of the facilities on March 22, 2020, and have abated since. While, in aggregate, average spreads have retraced most of their gains from the start of the year, Figure 2b provides us with the first indication that these improvements have not been uniform across the universe of traded bonds, with within-issuer average credit spreads only retracing about half way relative to the levels of duration-matched spreads at the beginning of the year.

Turning next to eligibility, Figure 2c shows that spreads on bonds that mature prior to September 2025 have retraced more than spreads on the average bond, even once we include issuer fixed-effects (Figure 2d). That is, spreads on bonds of the same issuer that mature before September 2025 have retraced more than spreads on bonds that have more than five years of maturity remaining. Moreover, once cash bond purchases commence on June 16, spreads on bonds that mature before September 2025 more than retrace the 150 bps increase to March 16 - 20, 2020, suggesting that direct purchases by the facility serve to further reduce spreads on eligible bonds. We return to the question of the direct effect of purchases in Section 7.

Finally, Figure 2e shows that spreads on high yield bonds increased 400 bps more in the run up to the March 22 announcement than the average bond and have since retraced only 300 bps, with a small reversal at the commencement of the cash bond purchases. Once we control for issuer fixed effects, Figure 2f shows that, while there was little difference between investment grade and high yield bonds of the same issuer prior to the facilities announcement, spreads on high yield bonds have retraced more than spreads on investment grade bonds of the same issuer. However, the difference has shrunk once facility purchases commenced on May 12. If the only impact of the facility were through the direct channel, we would not expect to see these improvements in securities ineligible for facility purchases.

Overall, Figure 2 shows that, while duration-matched spreads have decreased on average, both across and within issuers, spread decreases have been biggest for bonds eligible for direct purchases by the facility. Figure 3 shows that the same patterns hold for the default-adjusted spreads as well, suggesting that the improvements in spreads we saw in Figure 2 are primarily due to a reduction in the default risk premium priced in corporate bond spreads. Figure 4 shows, however, that the announcement of the facilities also led to a decrease in one year expected default frequencies. Focusing first on the specification without issuer fixed effects, we see that, while the expected default frequency of the average bond is little changed since the start of the year, the expected default frequency of bonds maturing prior to September 2025 and the expected default frequency of high yield bonds rose ahead of the facilities announcement on March 22, started retracing after the April 9 term sheet update but remain elevated relative to the start of the year. Once we control for issuer fixed effects, Figure 4b shows that, for the average bond of the average issuer, expected default frequencies exhibit the same pattern of an increase ahead of the facilities announcement and a gradual decrease starting in the second week of April but to a level higher than at the start of the year. Figure 4d further shows that, although the expected default frequencies on bonds maturing before September 2025 rose more than the expected default frequencies of longer maturity bonds of the same issuer, the subsequent decline in expected default frequencies has been similar across bond maturities. That is, expected default frequencies of bonds maturing before September 2025 remain even more elevated relative to the start of the year than expected default frequencies of longer maturity bonds of the same issuer.

Taken together, Figures 2 – 4 show that, although the primary effect of the facilities announcement is to reduce the default risk premium charged in the secondary corporate bond market, with the biggest improvements in spreads for bonds eligible for direct purchases by the facility, the facility announcement has also served to mitigate somewhat the rise in one year expected default frequencies. Given the "bridge financing" nature of the facilities, however, the improvements in expected default frequencies are biggest for longer-maturity bonds

and for investment grade bonds: conditional on the issuers not defaulting in the short run, the expected default frequency of long term bonds is lower. The fall in the expected default probabilities and improvements in pricing for non-eligible bonds indicates that the announcement of the facilities acted to improve market participants' beliefs about the prospects for the U.S. economy, reducing the credit risk premium. Indeed, Figure 3 shows that the decrease in default-adjusted spreads was bigger than in credit spreads themselves, consistent with larger decreases in credit risk premia. The scale of announcement date effects relative to changes after purchases had begun highlights the importance of the risk reduction and information-sensitivity channels.

4.3 Secondary market liquidity

We turn now to the impact of the facilities on secondary bond market liquidity. Figure 5 plots the estimated coefficients, together with 95 percent confidence bands, for characteristics of interest from the regression of improvements in effective bid-ask spread for specification (1) (without issuer fixed effects, left column) and specification (2) (with issuer fixed effects, right column). Starting with the average effect α_t, we see that, on average, bid-ask spreads have retraced from their March highs, to nearly the levels at the start of the year. Figure 5c shows that, although bonds maturing before September 2025 are on average less liquid (have higher effective bid-ask spreads) than longer maturity bonds, their relative (il)liquidity has remained roughly constant since the start of the year. Similarly, in Figure 5e, we see that high yield bonds, while on average less liquid than investment grade bonds, did not become relatively more illiquid in early March and thus have not had relatively large improvements in liquidity since. Once we control for issuer fixed effects (Figure 5b), we see that the changes in bid-ask spreads on the average bond of the average issuer have been small since the start of the year, suggesting that the improvements in average bid-ask spreads we observed in Figure 5a are concentrated among particular issuers, rather than within bonds of particular issuers. Relatedly, Figure 5d shows that, although bonds maturing before September 2025

are less liquid on average than longer maturity bonds of the same issuer, the relative liquidity of the two groups of bonds is little changed since the start of the year. Finally, within the same issuer, there is little difference in liquidity between investment grade and high yield bonds.

The lens of net customer flow offers insights into the fundamental drivers of market liquidity. When net customer flow is larger (more positive), customers buy a greater volume of bonds than they sell to dealers in the market, corresponding to less stress on secondary market functioning. On average, net customer flow decreased prior to the facility announcement, indicating greater selling pressure from customers, both across issuers (Figure 6a) and within issuer (Figure 6b). The average net customer flow stabilized, albeit at a lower level than the start of the year, in April. The commencement of ETF purchases on May 12 stimulated an additional temporary increase in average net customer flow toward the end of May/beginning of June, and we also estimate an additional improvement following the commencement of cash bond purchases on June 16.

Comparing the improvements in net customer flows for bonds eligible for direct facility purchases, on average, bonds maturing prior to September 2025 face greater selling pressure, but that differential remains largely unchanged over the course of the year. There are, however, signs of improved net customer flow in the shorter maturity bonds once cash bond purchases commence on June 16, both across issuers (Figure 6c) and within issuers (Figure 6d). Interestingly, Figure 6e shows that, in the month prior to the facility announcement, high yield bonds experienced less selling pressure than investment grade bonds, suggesting that secondary market functioning was relatively less impaired for high yield bonds.[5] This is suggestive of the importance of the channel of Gorton and Ordonez (2014); Dang et al. (2013), as the shorter maturity bonds become more information sensitive when funding markets shut down, but are revived when the backstop facility removes refinancing uncertainty. In the

[5]Additionally, in unreported results, we find that, while the average trade size and number of trades remains roughly constant for high yield bonds in the month prior to the facility announcement, the number of investment grade trades increases but the average trade size decreases, suggesting greater disturbance in the liquidity of the investment grade market.

Appendix, we confirm that the results on shorter maturity bonds do not reflect differential liquidity in CDS as the liquidity of CDS markets across maturities was relatively unchanged.

Why do we see an immediate differential response in prices of eligible bonds but no similarly concentrated improvement in secondary market liquidity? The corporate credit facilities stand as "lender of last resort" facilities in the corporate bond market, providing a "buyer of last resort" in the secondary market. That is, the announcement of the facilities on its own is sufficient to reduce fire sales incentives in the market, effectively establishing a floor on secondary market prices of eligible bonds. Until the facility began purchases, especially the cash bond purchases, however, the facility was not a direct supplier of liquidity in the market, explaining both the lack of an eligible-bond-specific effect on liquidity prior to the start of cash bond purchases and the emerging signs of differential improvement in the liquidity of eligible bonds after June 16.

5 Effects on primary market issuance

While secondary markets lend themselves to quantifying the impact of facilities through the many bonds that trade each day, the goal of the corporate credit facilities is to support the provision of credit to non-financial corporations in the U.S. Therefore we turn to primary market issuance to see if the facilities have achieved that goal, focusing on the dollar amount of corporate bonds issued since the start of the year and the offering spreads paid by the issuers.

We make four changes relative to the methodology we used to evaluate the effect of the facilities on the functioning of the secondary market. First, reflecting the relatively low frequency of corporate bond primary issuance, we focus on the cumulative amount issued since the start of the year, instead of bond-level changes in metrics since the initial facility announcement on March 22, 2020. Second, instead of using bond-level credit ratings to determine CCF eligibility, we use issuer-level credit ratings (see details in Appendix B.3).

Third, since the PMCCF also includes a "majority U.S. operations" eligibility criterion, we examine differences in primary market issuance and pricing between issuers that do and do not satisfy this restriction, as well as the credit rating, maturity and issuer industry restrictions that are applicable for both CCFs. We describe our procedure for identifying issuers that are likely to satisfy the majority U.S. operations restriction in Appendix B.4, although we note that we are only approximating this restriction based on available data. Finally, the market convention is to price offering yields as spreads to nearest-maturity on-the-run Treasury yield. Thus, our measure of primary market spreads is the spread of the offering yield to the corresponding nearest-maturity on-the-run Treasury yield, as described in Appendix B.5, rather than either the duration-matched or the default-adjusted spreads we studied in the secondary market context.

5.1 Extensive margin: who has issued?

Figure 7 plots the cumulative amount issued in the primary corporate bond market since January 1, 2020, together with the cumulative amount issued by the same week last year. Starting in the top left panel, in Figure 7a, we see that the acceleration in the pace of issuance triggered by the announcement of the CCF is not concentrated in the five year or less maturities that are eligible for purchases by SMCCF. Instead, the year-to-date issuance in the more than 5 years maturity category in 2020 is nearly double relative to that issued during the same period last year ($660 billion in 2020 vs $340 billion in 2019). Similarly, the issuance of bonds with maturity of five years or below in 2020 is also nearly double relative to that issued during the same period last year ($340 billion in 2020 vs $155 billion in 2019). These results suggest that issuers are not issuing debt specifically targeting SMCCF purchase eligibility, as was the experience with the European Central Bank's Corporate Sector Purchase Program (CSPP) (see e.g. De Santis and Zaghini, 2019). Instead, consistent with the improved overall secondary market functioning we documented above and the continued demand for long-term fixed income assets by long-term investors, such as pension funds (see e.g. Greenwood and

Vayanos, 2010), issuers issue across the maturity spectrum.

Figure 7b shows that, prior to the March 22, 2020, issuance by investment-grade rated issuers was lagging relative to the pace of issuance in 2019. The announcement of the facilities, however, spurred a dramatic increase in the pace of investment grade issuance, with year-to-date investment grade issuance almost double what was issued during the same period in 2019. High-yield-rated issuers did not experience the same sort of slow down in issuance at the start of the year, partially since high yield issuance is in general slow at the start of the year, but neither has the pace of high yield issuance accelerated to the same extent after the facilities announcement. Thus, although the facilities announcement improves primary market conditions across the board, the improvement for issuers not eligible for the facilities has been more gradual. A similar pattern can be seen in Figure 7c, with issuers with majority operations in the U.S. accelerating their issuance after the facilities announcement more than issuers without majority of U.S. operations.

It is important to note that increased issuance does not necessarily translate into increased real activity, such as investment, by the issuers. Firms can issue new bonds while simultaneously calling existing bonds or re-paying credit from other sources, thereby re-optimizing their overall debt costs without changing materially their overall debt liabilities. In addition, firms can use bond issuance to build liquidity buffers in anticipation of future cash-flow shocks, self-insuring against future distress. We leave the study of the uses of funds raised through the unprecedented corporate bond issuance since March and how those uses compare to the uses of funds raised in "normal" recessions for future research.

5.2 Intensive margin: at what price?

One measure of market functioning is the price at which issuers have been able to issue debt in the primary market. Figure 8 plots the offering-volume-weighted average and interquartile range of offering spread to matched-maturity Treasuries for fixed coupon bonds issued since February 1, 2020. Across most characteristics, the offering spread has remained relatively

flat over the year. The clearest improvement in pricing since the facilities announcement is in the split between investment grade and high yield issuers (Figure 8b). Offering spreads rose for both investment grade and high yield issuers ahead of the facilities announcement on March 22, 2020, but especially so for the high yield issuers. Noticeably, the improvement in offering spreads for investment grade issuers only commenced after the April 9, 2020, term sheet update, reflecting perhaps the concern about continued eligibility of issuers that were investment grade rated as of March 22 but investors may have feared would be subsequently been downgraded.

Overall, the results in Figures 7 and 8 suggest that, while the announcement of the facilities has helped to get credit flowing to the corporate sector of the U.S. economy, the existence of the facilities does not seem to be distortionary. Issuers do not seem to be modifying their issuance behavior to target facility eligibility.

6 Have improvements been uniform across issuers?

The analysis so far has concentrated on improvements in market conditions for the average issuer. In this section, we study whether these improvements come from issuers affected differentially by the COVID-19 pandemic and associated economic disruptions. We consider measure the effect of the pandemic grouping issuers according to aggregate employment losses between January and April 2020 at the 3-digit NAICS industry level. We then compare secondary market conditions for issuers in more affected industries to those for issuers in less affected industries. [6] An information hypothesis would suggest that the more affected industries should improve more, as these industries would be those that became more information sensitive after the pandemic shock. If the impact is simply arising from direct support, then all eligible issuers should see the same improvements in market functioning, regardless of industry.

[6] As an alternative approach, we also sorted issuers based on Q1 2020 profitability, comparing secondary market conditions for issuers with relatively high Q1 2020 profitability with those with relatively low Q1 2020 profitability. Results are similar and shown in Appendix A.2.

We sort 3-digit NAICS industries into quartiles based on the 3 month decline in the total number of employees from January to April 2020, as reported by the Bureau of Labor Statistics. We consider industries falling in the bottom quartile (Q1) as being most affected by the COVID-19 related economic disruptions, industries falling in the middle two quartiles (Q2/Q3) as being moderately affected, and industries falling in the top quartile (Q4) of employment growth as being least affected. We evaluate whether secondary market improvements have been uniform across least and most affected industries by estimating the following regression:

$$\begin{aligned}\Delta M_{b,t} = \alpha_t &+ \beta_{b,t}\text{Bank issuer dummy}_b + \beta_{m,t}\text{Maturity before Sep 2025}_b \\ &+ \beta_{hy,t}\text{HY dummy}_{b,t} + \beta_{b,q_2,t}\text{Bank issuer dummy}_b \times \mathbb{1}_{Q2/Q3} \\ &+ \beta_{m,q_2,t}\text{Maturity before Sep 2025}_b \times \mathbb{1}_{Q2/Q3} + \beta_{hy,q_2,t}\text{HY dummy}_{b,t} \times \mathbb{1}_{Q2/Q3} \\ &+ \beta_{b,q_3,t}\text{Bank issuer dummy}_b \times \mathbb{1}_{Q4} + \beta_{m,q_3,t}\text{Maturity before Sep 2025}_b \times \mathbb{1}_{Q4} \\ &+ \beta_{hy,q_3,t}\text{HY dummy}_{b,t} \times \mathbb{1}_{Q4} + \vec{\gamma}_t\text{Bond characteristics}_{b,t} + \epsilon_{b,t},\end{aligned}$$

where $\mathbb{1}_{Q2/Q3}$ is a dummy for the issuer being in an industry falling in the middle two quartiles of employment growth distribution, and $\mathbb{1}_{Q4}$ is a dummy for the issuer being in an industry falling in the top quartile of employment growth distribution. Negative interaction coefficients $\beta_{\cdot,q_2,t}$ and $\beta_{\cdot,q_4,t}$ indicate that secondary market conditions have improved relatively more for bonds issued by firms in industries in the middle two quartiles and the top quartile, respectively, relative to bonds issued by firms in industries in the bottom quartile of the employment growth distribution.

Figure 9 plots the estimated coefficients, together with the 95 percent confidence bands, for characteristics of interest from the above regression of improvements in duration-matched (Z-spread, left column) and default-adjusted (D-spread, right column) spreads. Figures 9c and 9d show that the relatively bigger improvements in spreads – both on a duration-matched and default-adjusted basis – on bonds maturing before September 2025 are mostly uniform

across industries. Although spreads on shorter maturity bonds issued by issuers in moderately affected industries are on average higher than the spreads on similar bonds issued by issuers in most and least affected industries, the spread differential remains relatively flat over the course of the year.

Figure 9e documents instead that industry heterogeneity translates into heterogeneous improvements in the spread between investment grade and high yield bonds. While the spread between investment grade and high yield bonds was similar across issuers in different industries prior to the facilities announcement on March 22, since then, the biggest improvements in spreads on high yield bonds are for issuers in industries in the top quartile of the employment distribution, meaning industries where COVID related employment losses have been smaller. Comparing the improvements in duration-matched spreads to the improvements in default-adjusted spreads in Figure 9f, we see that the cross-industry heterogeneity in the high yield spreads improvement is more pronounced on a duration-matched basis. This suggests that the larger improvements in spreads on high yield bonds issued by issuers in least affected industries is to a large extent due to larger improvements in issuer expected default frequencies and, to a smaller extent, due to greater improvement of the default risk premium on such bonds. This is consistent with the information sensitivity hypothesis: for riskier bonds, issued by industries most affected by the pandemic, the facility announcement acted primarily be reducing the risk of those bonds. For higher quality bonds, instead, the facility announcement re-establishes their information insensitivity, acting primarily through decreases in default-adjusted spreads.

In contrast, Figure 10 shows that, while there is cross-industry heterogeneity in the sensitivity of bid-ask spreads and net customer flow to bond maturity and credit rating, that sensitivity has stayed constant over the course of the year. That is, the decline in bid-ask spreads and the increase in net customer flows since the March 22, 2020, announcement that we saw in Figure 5 – 6 are not concentrated in bonds issued by issuers in specific industries. Rather, as intimated by the lack of a differential improvement in liquidity conditions for

bonds eligible for direct purchases by the facility, there has been a broad improvement in secondary market liquidity since the facilities announcement.

Turning to heterogeneity in primary market issuance across industries (Figure 7d), we see that the facilities announcement has served to accelerate credit provision to the most affected industries and firms. Figure 7d shows that, although cumulative issuance before the facilities announcement for the most affected (Q1) and least affected (Q4) industries was below the amount issued by the same industries in a comparative period in 2019, the issuance pace has accelerated since. For issuers in the most affected industries (bottom quartile of employment loss distribution), the year-to-date issuance is 3.5 times larger than over the same period in 2019; for issuers in the moderately affected industries (middle quartiles of employment loss distribution), the year-to-date issuance is 2.8 times larger; and, for issuers in the least affected industries (top quartile of employment loss distribution), the year-to-date issuance is 1.5 times larger.

In contrast, in Figure 8d, we see that the biggest improvements in offering spreads are for firms in least affected industries (fourth quartile of the employment losses distribution) and for firms in the top quartile of Q1 2020 profitability distribution. Thus, although the announcement of the facilities has improved the ability of all firms to issue in the primary market, the improvements in offering spreads have been biggest for firms least affected by the COVID-19 pandemic. While offering spreads have decreased since the facility announcement, lower credit quality issuers, issuers in more affected industries, and issuers with lower Q1 2020 profitability continue to face higher offering spreads, suggesting that the existence of the facilities does not distort risk pricing in this market.

7 Purchase effects

Given the strong response of markets to the facilities' announcement, a natural question is to what extent purchases contributed to maintaining the improvements in positive secondary

market conditions. To help answer this question, we examine the response of secondary market spreads and liquidity to the facility purchases themselves.

7.1 It's not what you buy

We begin with a reduced-form estimate of the purchase effect, by exploring whether market conditions have improved differentially for bonds held by ETFs bought by the facility. In particular, we modify specification (1) and estimate

$$\begin{aligned}\Delta M_{b,t} = \alpha_t &+ \beta_{etf,t}\mathbb{1}_{\text{In ETF},b,t} + \beta_{b,t}\text{Bank issuer dummy}_b + \beta_{m,t}\text{Maturity before Sep 2025}_b \\ &+ \beta_{hy,t}\text{HY dummy}_{b,t} + \beta_{b,etf,t}\text{Bank issuer dummy}_b \times \mathbb{1}_{\text{In ETF},b,t} \\ &+ \beta_{m,etf,t}\text{Maturity before Sep 2025}_b \times \mathbb{1}_{\text{In ETF},b,t} + \beta_{hy,etf,t}\text{HY dummy}_{b,t} \times \mathbb{1}_{\text{In ETF},b,t} \\ &+ \vec{\gamma}_t\text{Bond characteristics}_{b,t} + \vec{\gamma}_{etf,t}\text{Bond characteristics}_{b,t} \times \mathbb{1}_{\text{In ETF},b,t} + \epsilon_{b,t},\end{aligned}$$

where $\mathbb{1}_{\text{In ETF},b,t}$ is a dummy for bond b held on trade date t by any ETF bought by the SMCCF. Negative estimates of the interaction coefficients $\beta_{\cdot,etf,t}$ indicate that secondary market conditions for bonds held by ETFs purchased by the facility have improved relatively more than bonds not held by ETFs.

Figure 11 plots the estimated coefficients, together with the 95 percent confidence bands, for characteristics of interest from the above regression of improvements in duration-matched spreads since the facilities announcement for the specification with (right column) and without (left column) issuer fixed effects. Figures 11a and 11b show that, on average, the improvement in spreads on bonds held by ETFs purchased by the facility and other bonds has been similar, both across and within issuers. The biggest differential improvement is between bonds maturing by September 2025 held by ETFs and other shorter maturity bonds, with spreads on shorter maturity bonds held by ETFs retracing relatively less than spreads on other bonds of similar maturity. Figure 11d shows that this differential persists even after controlling for issuer fixed effects, so that spreads on shorter maturity bonds held by ETFs

have retreated less than spreads on similar maturity bonds issued by the same issuer that are not held by ETFs purchased by the facility. That is, there is not much differential improvement in the liquidity of the underlying bonds held by purchased ETFs; in fact, the opposite is true.

Turning to Figure 12, we see that on average, duration-matched and default-adjusted spreads have improved at a similar pace for bonds held by ETFs purchased by the facility as for other bonds. In fact, the improvement in spreads on bonds eligible for direct purchases by the facility that are held by ETFs purchased by the facility has been relatively more muted. Figure 12c shows that the increase in default-adjusted spreads on bonds maturing before September 2025 in the beginning of March was concentrated in bonds held by ETFs, with the differential to default-adjusted spreads on similar maturity bonds not held by ETFs purchased by the facility growing since ETF purchases commenced on May 12.

These results are similar in other measures, with similar or even more improvement in metrics of bonds not held by purchased ETFs. On average, bid-ask spreads on bonds held by ETFs purchased by the facility improved more since the facility announcement than bid-ask spreads on other bonds (Figure 13). Similarly, improvements in net customer order flow are similar across bonds held by ETFs purchased by the facility and other bonds (Figure 14). In fact, Figure 14e shows that the slower pace of net customer order flow for high yield bonds is concentrated in high yield bonds held by ETFs purchased by the facility. These counter intuitive results could reflect timing. Overall improvement in market functioning metrics occurring primarily in advance of the purchases actually commencing on May 12, could be potentially attributed to the extraordinary inflows into bond ETFs in April 2020.

In summary, we document that bonds held by eligible ETFs have smaller differential improvements in secondary market conditions across bond eligibility criteria, consistent with a pass-through from ETFs to the underlying bonds regardless of the eligibility of the underlying bonds. Intuitively, bonds ineligible for direct purchases by the facility benefit from purchases if they are held by an ETF purchased by the facility. This is because when additional ETF

shares are created, dealers should be purchasing portfolios of the underlying bonds. This again hints at the additional improvement in secondary market conditions for securities that receive direct support from the facilities over and above the general improvement in market conditions from the facilities announcement, consistent with the "buyer of last resort" nature of the facilities.

7.2 But how much you buy and how you buy it

We now turn to the impact of actual purchases, rather than purchase *eligibility* on secondary market conditions. To evaluate the impact of the actual *quantity* of purchases conducted by the facility,[7] we disaggregate the volume of ETF purchases into the implied volume of (indirect) bond purchases by the facility using trade-date-specific portfolio weights of each ETF. To simplify the interpretation of the estimated coefficients, we standardize the cumulative purchase volume within each trading date

$$\overline{Vol}_{b,t} = \frac{\sum_{s\leq t} Vol_{b,s} - \mathbb{E}_t\left[\sum_{s\leq t} Vol_{b,s}\right]}{\sigma_t\left(\sum_{s\leq t} Vol_{b,s}\right)},$$

where $\sum_{s\leq t} Vol_{b,s}$ is the cumulative volume of bond b bought by the facility up to date t either directly through cash bond purchases or indirectly through ETF purchases, $\mathbb{E}_t\left[\sum_{s\leq t} Vol_{b,s}\right]$ is the cross-sectional average of cumulative volume at date t, and $\sigma_t\left(\sum_{s\leq t} Vol_{b,s}\right)$ is the cross-sectional standard deviation of cumulative volume at date t.[8] We then estimate the relationship between the cumulative change in each secondary market conditions metric since the commencement of purchases on May 12, bond and issuer characteristics, and the

[7] See Figure A.13 for the time series of daily purchases by the facility, split by security type.

[8] Figures A.6 – A.9 in the Appendix report the results using non-standardized cumulative volume.

cumulative purchases of bond b up to date t:

$$\begin{aligned}\Delta M_{b,t} = \alpha_t &+ \beta_{vol,t}\overline{Vol}_{b,t} + \beta_{b,t}\text{Bank issuer dummy}_b + \beta_{m,t}\text{Maturity before Sep 2025}_b \\ &+ \beta_{hy,t}\text{HY dummy}_{b,t} + \beta_{b,vol,t}\text{Bank issuer dummy}_b \times \overline{Vol}_{b,t} \\ &+ \beta_{m,vol,t}\text{Maturity before Sep 2025}_b \times \overline{Vol}_{b,t} + \beta_{hy,vol,t}\text{HY dummy}_{b,t} \times \overline{Vol}_{b,t} \\ &+ \vec{\gamma}_t\text{Bond characteristics}_{b,t} + \epsilon_{b,t}.\end{aligned}$$

Negative estimates of the interaction coefficients $\beta_{\cdot,vol,t}$ indicate that improvements in secondary market conditions have been bigger for bonds bought at higher rates by the facility.

Figure 15 plots the estimated coefficients, together with the 95 percent confidence bands, for characteristics of interest from the above regression of improvements in duration-matched spreads since May 12 for the specification with (right column) and without (left column) issuer fixed effects. Figure 15a shows that facility purchases, on average, have had a meaningful impact on the bond duration-matched spreads, over and above the decline in credit spreads due to overall market improvements. This effect is both statistically and economically significant. While the spread on an average bond declined by roughly 75 bps since the start of purchases on May 12, a purchase pace of one standard deviation (approximately $1 million of cumulative purchases by June 26, 2020) above average is associated with 25 bps lower spreads, or a third of the baseline effect. The estimated purchase effect is also sizable relative to the cumulative 90 bps improvement in average spreads prior to the commencement of purchases, which reflected the facility announcement alone.

Figure 15b shows that the differential improvement in average spread due to purchases persists even after including issuer fixed effects, so that spreads on bonds bought more by the facility decline more than spreads on other bonds of the same issuer. In addition, comparing the estimated effect of cumulative purchases over time, Figures 15a and 15b show that the relative impact of cash bond purchases is substantially larger than the effect of ETF purchases, with a noticeable acceleration of the effect of cumulative purchases on

the average spread once cash bond purchases begin on June 16.[9] One potential concern with these estimates is the reverse causality of higher purchase paces of bonds in greater distress. However, although the aggregate purchase volume is a function of aggregate market conditions, the purchase volume of an *individual* bond is not a function of market conditions for that particular bond.[10] Thus, the faster pace of credit spreads declines we observe in Figures 15a and 15b for bonds bought at a faster pace are not driven by worse initial market conditions for those bonds.

Consider now the impact of facility purchases on effective bid-ask spreads, plotted in Figure 17. Figure 17a shows that, on average, ETF purchases have no discernible impact on effective bid-ask spreads.Turning to net customer order flow, Figure 18a shows that net customer order flow increases differentially more for bonds purchased at a higher rate by the facility. Within issuers, we see in Figure 18b that the differential improvement in net customer order flow accelerates when cash bond purchases commence, echoing the greater impact of cash bond purchases than ETF purchases on the corporate bond market that we saw in Figure 15.

The fact that we estimate a differential effect based on the dollar purchases on the underlying ETF holdings, but not on the indicator variable for portfolio inclusion suggests that the actual purchases of the bonds matter more than the signalling effect to the market of those purchases. However, the main contemporaneous effect of ETFs appears to be on prices, as the purchases seem to have less of an effect on liquidity measures such as bid-ask spreads, despite the positive impact on net customer flow. The small impact of ETF purchases on bond bid-ask spreads is consistent with sellers fulfilling facility ETF purchases from inventory rather than by buying underlying. Indeed, recall that Figure 13 shows a differential improvement in bid-ask spreads of bonds held by ETFs *ahead* of the commencement of

[9]Note that the facility may purchase more bonds of a particular issuer if they are held disproportionately by ETFs. For loose bond purchases, the facility aims to purchase a broad market index of eligible bonds of eligible issuers.

[10]See, for example, the description of the Broad Market Index at `https://www.newyorkfed.org/markets/primary-and-secondary-market-faq/corporate-credit-facility-faq`.

purchases on May 12.

8 Dealer intermediation and the facilities

In this Section, we examine the relevance of the intermediary constraints channel for post-announcement improvements in secondary market conditions. From the perspective of intermediary asset pricing, the facilities act by providing a "specialist" buyer of corporate credit, relaxing balance sheet constraints of marginal intermediaries in the corporate bond market. Improvements in balance sheet constraints of the marginal intermediary lead to a reduction in the intermediary's effective risk aversion, explaining both the substantial improvement in credit spreads and liquidity conditions.

8.1 Does intermediation become more concentrated?

We begin by examining whether market dislocations in March lead to less diversified intermediation. Less diversity in intermediation leads to more fragile market making, sowing the seeds for future rapid liquidity deterioration. To measure intermediation diversity, we construct the Herfindahl–Hirschman index (HHI) of gross dealer activity at the bond-date level

$$HHI_{b,t} = \sum_{d=1}^{\mathcal{N}_{b,t}} \left(\frac{Q^{\mathrm{B}}_{d,b,t} + Q^{\mathrm{S}}_{d,b,t}}{\sum_{j=1}^{\mathcal{N}_{b,t}} Q^{\mathrm{B}}_{j,b,t} + Q^{\mathrm{S}}_{j,b,t}} \right)^2,$$

where $Q^{\mathrm{B}}_{d,b,t}$ is the total (dollar) amount bought and $Q^{\mathrm{S}}_{d,b,t}$ is the total (dollar) amount sold by dealer d of bond b on trade date t. We estimate the following regression to track how

intermediation concentration has changed since February

$$
\begin{aligned}
HHI_{b,t} = \alpha_t &+ \beta_{vol,t}\text{Vol}_{b,t} + \beta_{b,t}\text{Bank issuer dummy}_b + \beta_{m,t}\text{Maturity before Sep 2025}_b \\
&+ \beta_{hy,t}\text{HY dummy}_{b,t} + \beta_{b,vol,t}\text{Bank issuer dummy}_b \times \text{Vol}_{b,t} \\
&+ \beta_{m,vol,t}\text{Maturity before Sep 2025}_b \times \text{Vol}_{b,t} + \beta_{hy,vol,t}\text{HY dummy}_{b,t} \times \text{Vol}_{b,t} \\
&+ \vec{\gamma}_t\text{Bond characteristics}_{b,t} + \epsilon_{b,t}.
\end{aligned}
$$

Figure 19 plots the estimated coefficients from the above regression without (left column) and with (right column) fixed effects. On average, the HHI of gross transacted volume remains relatively stable since February, indicating that, for an average bond, intermediation was no more concentrated through the March market dislocation than at the start of the year. When the facility began buying ETFs on May 12, dealer concentration increased in those bonds that were purchased indirectly via ETF purchases; the increase in concentration for bonds purchased directly (starting on June 16) is more modest.

In contrast, Figure 19c and Figure 19e show that concentration in intermediation of shorter maturity and high yield bonds increased in late February/early March, and remained elevated until the commencement of facility purchases on May 12. For shorter maturity bonds, ETF purchases did not have a differential impact on concentration; instead, concentration in intermediation of shorter maturity bonds decreases more for bonds bought directly by the facility. For high yield bonds, ETF purchases led to a temporary decrease in dealer concentration. That is, though ETF purchases were sufficient to incentivize increased intermediation diversity in high yield bonds, cash bond purchases were necessary to re-induce intermediation in shorter maturity bonds.

8.2 Do more constrained dealers intermediate less?

Figure 19 shows increased concentration of dealer activity for shorter term securities and for high yield bonds during March and April, leading to potential increased fragility in markets

for those security types. We now study whether these changes in concentration were driven by decreased intermediation of specific types of dealers in the market. In particular, we examine whether bank-affiliated dealers – whose intermediation decisions are more likely to reflect regulatory balance sheet constraints – differentially decreased their net inventories as compared to stand-alone dealers – whose intermediation decisions are more likely to reflect risk management considerations. Increases in dealers' net inventory represent increased willingness to extend balance sheet space to intermediate in the corporate bond market.

More specifically, we begin with net purchases $Q^{\text{net}}_{d,b,t}$ at the dealer-bond-day level, calculated as the difference between the quantity bought $Q^{\text{B}}_{d,b,t}$ and the quantity sold $Q^{\text{S}}_{d,b,t}$ of bond b by dealer d on day t. For each dealer-bond pair, we cumulate the net purchases since the start of the year to obtain the net position change up to date t:

$$NP_{d,b,t} = \sum_{s=\text{Jan 1}}^{t} Q^{\text{net}}_{d,b,s}.$$

We estimate the following regression for the cumulative changes in net dealer inventories[11] relative to March 22 as a function of bond and dealer characteristics:

$$\begin{aligned}\Delta NP_{b,d,t} = {} & \alpha_t + \alpha_d + \beta_{b,t}\text{Bank issuer dummy}_b + \beta_{hy,t}\text{HY dummy}_{b,t} \\ & + \beta_{m,t}\text{Maturity before Sep 2025}_b + \beta_{S,b,t}\text{Bank issuer dummy}_b \times \text{Eligible seller}_{d,t} \\ & + \beta_{S,m,t}\text{Maturity before Sep 2025}_b \times \text{Eligible seller}_{d,t} \\ & + \beta_{S,hy,t}\text{HY dummy}_{b,t} \times \text{Eligible seller}_{d,t} + \vec{\gamma}_t\text{Bond characteristics}_{b,t} + \epsilon_{b,t}.\end{aligned}$$

Here, $\text{Eligible seller}_{d,t}$ is a dummy equal to 1 if dealer d is an eligible seller to the facility as of date t,[12] with a positive estimate of $\beta_{S,m,t}$ and $\beta_{S,hy,t}$ indicating that dealers eligible to transact with the facility increase inventories in shorter term and high yield bonds more

[11] We explore changes in net inventory due to dealer-to-customer-and-affiliate transactions in Appendix Figure A.10.

[12] See Table A.4 for the list of eligible sellers and the facility registration dates up to June 26, 2020.

than those that dealers that are not registered with the facility.

Figure 20 reports the estimated coefficients from the above regression for bank-affiliated (left column) and stand-alone (right column) dealers. Figure 20a shows that, on average, both bank-affiliated and stand-alone dealers decreased inventory starting in late February, but started quickly rebuilding inventory after the initial facilities announcement on March 22. By the end of our sample, stand-alone dealers, on average, had more than doubled their net inventory relative to the start of the year, while the bank-affiliated dealers increased their net inventory at a slightly slower pace.

Turning next to differences across eligibility criteria, Figures 20c and 20d shows that stand-alone dealers but not bank-affiliated differentially increased inventory in bonds maturing before September 2025. Similarly, in Figures 20e and 20f, we see that stand-alone dealers decreased their inventory of high yield bonds while bank-affiliated dealers did not. That is, prior to the CCF announcement on March 22, all dealers decreased their net inventories on average, and stand-alone dealers reduced their inventory of riskier securities – those with longer maturities and those with lower credit ratings. Such intermediation "flight to safety" is consistent with a decreased appetite for bearing risk on behalf of stand-alone dealers. Bank-affiliated dealers, instead, decreased their inventories on average but not in particular inventories of riskier securities, suggesting that a simple balance sheet constraint is unlikely to be the key explanation for their role in the March dislocations.

After the facilities announcement, stand-alone dealers returned to the market for riskier securities, dramatically reducing their inventory of shorter maturity bonds and increasing their inventory of high yield bonds, even relative to the start of the year. Stand-alone dealers that are eligible sellers to the facility increase net inventory of high yield bonds at an even faster pace, and increase their net inventory of shorter maturity bonds. The facility thus acts as a "buyer of last resort", re-assuring the more risk-averse stand-alone dealers that a buyer will be available in the market in case of further market turbulence.

In contrast, bank-affiliated dealers did not differentially increase their net position in

high yield bonds after the facilities announcement, and, once facility purchases commenced, increased net inventory of shorter maturity bonds. Furthermore, eligibility to sell to the facility does not seem to have a substantial effect on the willingness of bank-affiliated dealers to hold bond inventories, which is again consistent with limited impact of bank balance sheet constraints. In related work, O'Hara and Zhou (2020) find that primary dealers bought investment grade bonds at a higher rate following the facility announcement. Our results suggest that that differential effect is potentially driven by the willingness of stand-alone dealers to re-enter the market for high yield intermediation, rather than an active re-allocation by bank-affiliated dealers to intermediation in investment grade bonds.

Taken together, Figure 20 shows that the increased dealer concentration in shorter-term and high yield securities that we saw in Figure 19 is due to a withdrawal of stand-alone dealers from those markets.

8.3 Underwriting activity

We conclude this section by examining how underwriting activity has changed since the facilities announcement on March 22, 2020. Similarly to the dealer activity in the secondary markets, we consider changes in underwriting activity for: bank-affiliated lead underwriters, lead underwriters that have subsidiaries that are registered as eligible sellers with SMCCF, and lead underwriters whose eligible seller subsidiaries represent the top 10 SMCCF counterparties by volume. Starting with the lead underwriter information from Mergent FISD, we hand-match each reported lead underwriter to the corporate parent and, if applicable, to the registered eligible seller. We rank eligible sellers based on the volume-to-date (as of June 30, 2020) sold to SMCCF across both ETF and cash bonds; the top 10 eligible sellers represent 84 percent of total volume of purchases made by the facility.

Figure 21 plots the cumulative issuance amount underwritten by different groups of underwriters, together with the cumulative amount underwritten by the same underwriters in 2019 in a comparative period, as well as the spreads to nearest-maturity Treasury. The right

column of Figure 21 shows that offering spreads have declined for issues underwritten by all types of underwriters. In quantity terms, however, we see that the amount underwritten by stand-alone underwriters has lagged relative to the amount such underwriters were responsible for in 2019. Indeed, smaller underwriters only re-commenced underwriting issues the week of the first ETF purchases by the facility (week ending May 16). Comparing the volume of issuances underwritten by eligible sellers to issuances underwritten by other institutions, we see that issuance underwritten by eligible sellers increased immediately following the facility announcement, while the issuance underwritten by other underwriters only accelerates at the commencement of ETF purchases on May 12. Finally, Figure 21e shows that this acceleration in issuance underwritten by eligible sellers is particularly pronounced for issuance underwritten by the top 10 sellers to the facility in the secondary market. Interestingly, the commencement of purchases does not seem to have had a differential effect on issuance underwritten by the eligible sellers.

9 Conclusion

The corporate credit facilities represent an unprecedented intervention by the Federal Reserve in corporate credit markets, and an opportunity to deepen our understanding of those markets. We document that there is a sizable announcement effect when the CCFs are announced, both for bonds that are eligible for the facilities and for those that are not. We find evidence both of reduced risk premia after announcement as well as increased intermediation from dealers, especially those which are eligible to transact with the facility. The impact on prices is differentially larger for eligible issuers, while the impact on liquidity appears to be more widespread. In addition to the impact on secondary markets, we document in this paper how these improvements in secondary markets are accompanied by improvements in access to credit in primary markets.

Given the scale of the announcement effect, it is natural to wonder if the presence of the

facility as a backstop would have been enough to ensure a recovery in market functioning, without any purchases. We estimate a statistically significant effect of the dollars of purchases, suggesting that the amount of purchases also matters, particularly for measures of liquidity such as spreads. However, individual bond purchases appear to have more of an effect than do ETFs. Whether there are nonlinearities between the impact of purchases that are small relative to market volumes and no purchases at all is, however, nearly impossible to estimate.

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Figure 2. Duration-matched spreads have retraced from March 22 highs. This figure plots the estimated coefficients from the regression of cumulative bond-level changes in duration-matched spreads on bank issuer, bond maturity prior to Sep 2025, and high yield rating dummies with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

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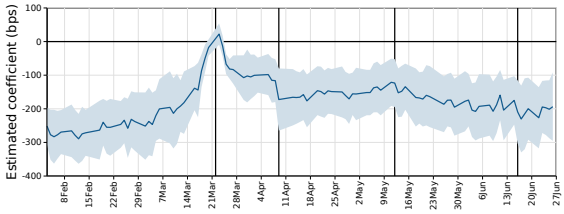

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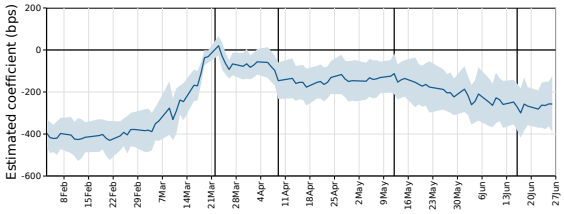

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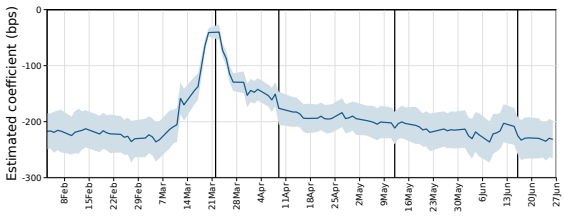

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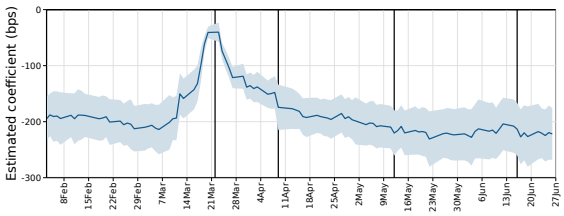

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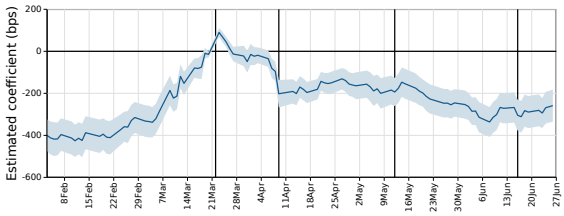

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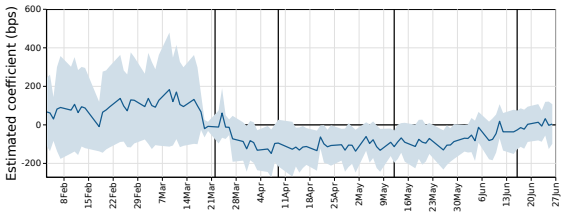

Figure 3. Default-adjusted spreads have retraced from March 22 highs. This figure plots the estimated coefficients from the regression of cumulative bond-level changes in default-adjusted spreads on bank issuer, bond maturity prior to Sep 2025, and high yield rating dummies with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

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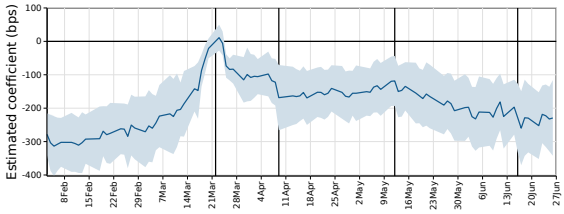

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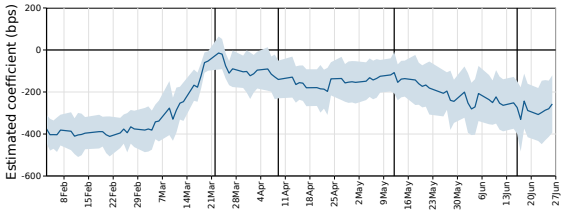

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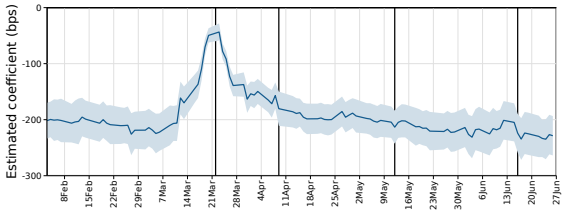

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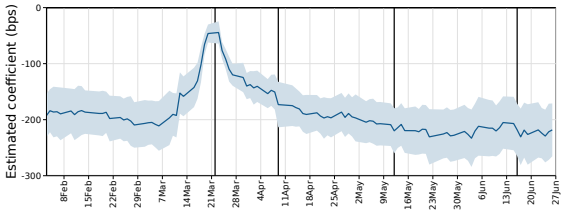

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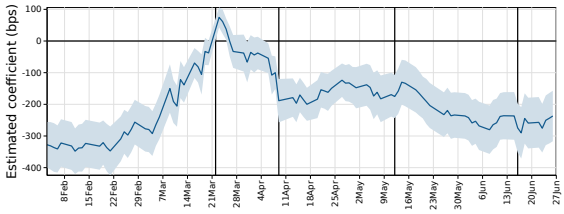

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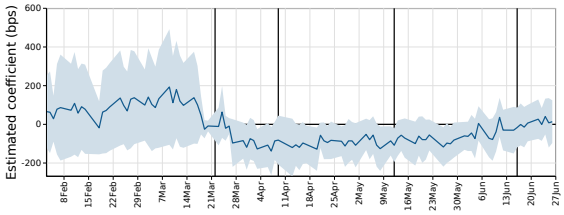

Figure 4. Expected default frequencies have retraced from March 22 highs. This figure plots the estimated coefficients from the regression of cumulative bond-level changes in expected default frequencies on bank issuer, bond maturity prior to Sep 2025, and high yield rating dummies with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

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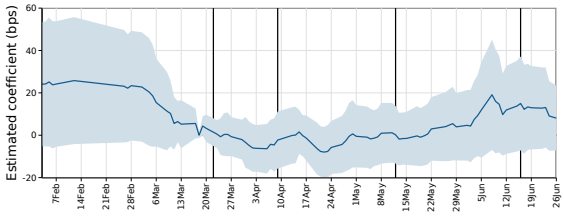

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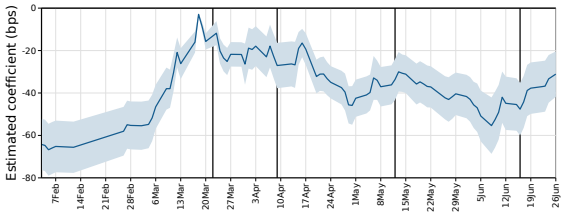

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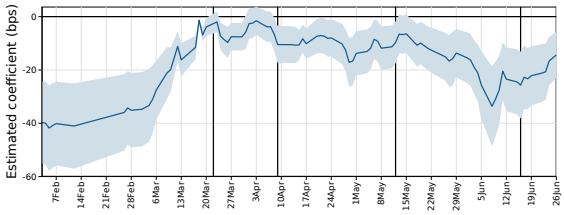

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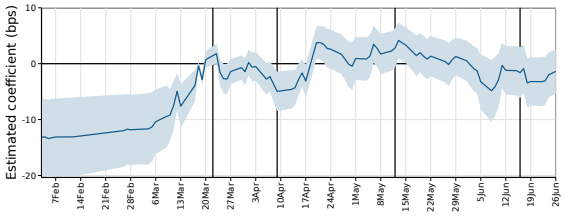

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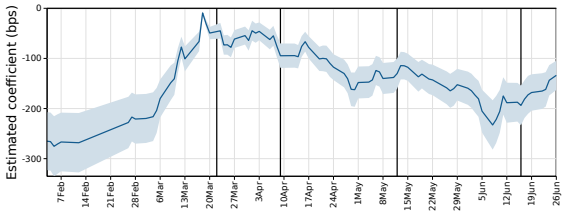

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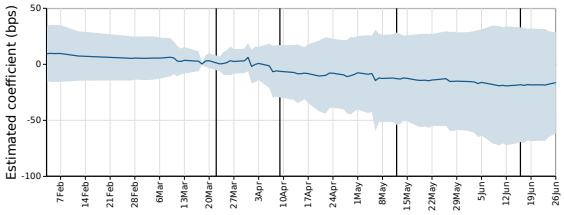
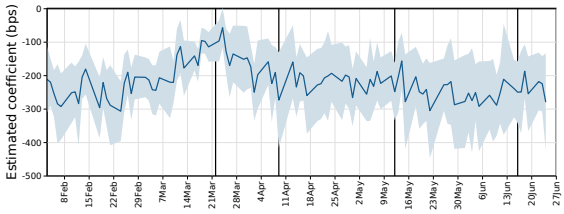
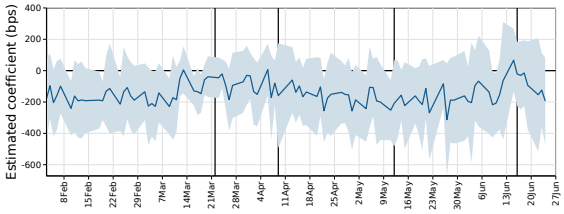


Figure 5. Effective bid-ask spreads have retraced from March 22 highs. This figure plots the estimated coefficients from the regression of cumulative bond-level changes in effective bid-ask spreads on bank issuer, bond maturity prior to Sep 2025, and high yield rating dummies with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

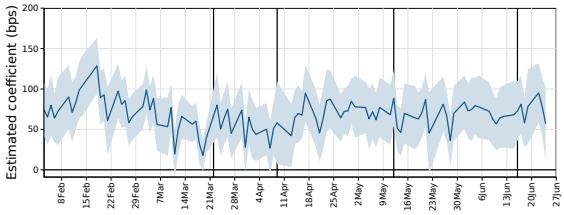
(a) Constant, no FE



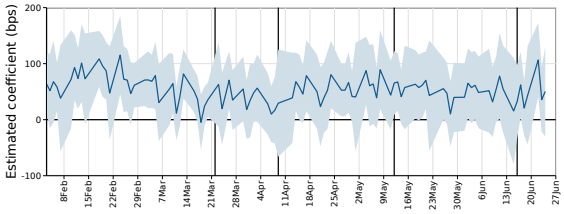
(b) Constant, FE



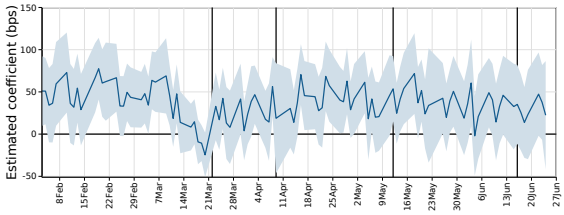
(c) Maturity dummy, no FE



(d) Maturity dummy, FE



(e) HY dummy, no FE



(f) HY dummy, FE

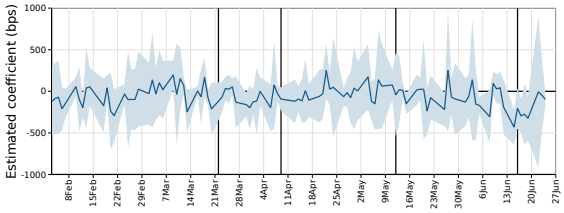
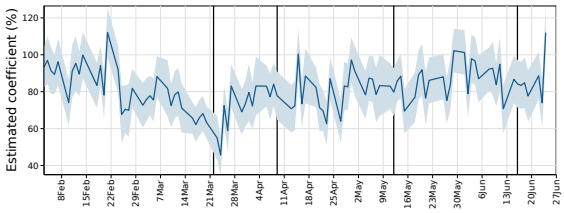
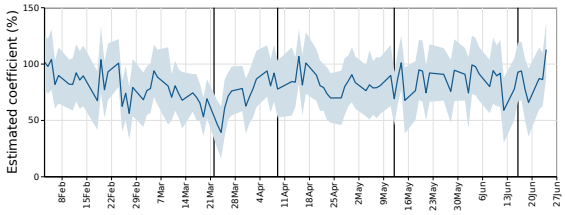


Figure 6. Customer net flow have increased from March 22 lows. This figure plots the estimated coefficients from the regression of cumulative bond-level changes in net customer flow as a fraction of total volume on bank issuer, bond maturity prior to Sep 2025, and high yield rating dummies with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

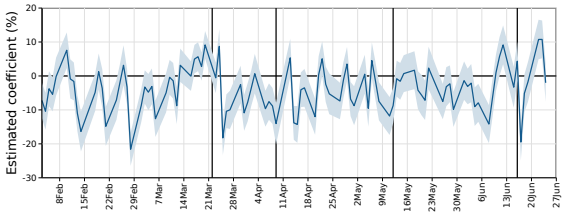
(a) Constant, no FE



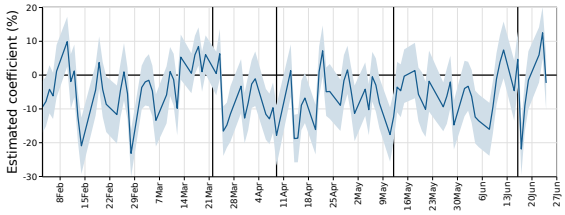
(b) Constant, FE



(c) Maturity dummy, no FE



(d) Maturity dummy, FE



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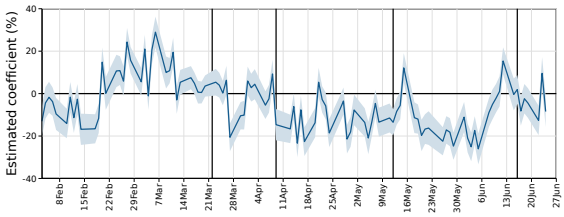


(f) HY dummy, FE

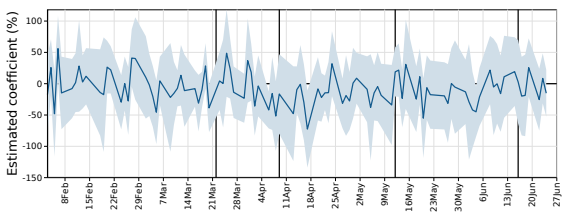
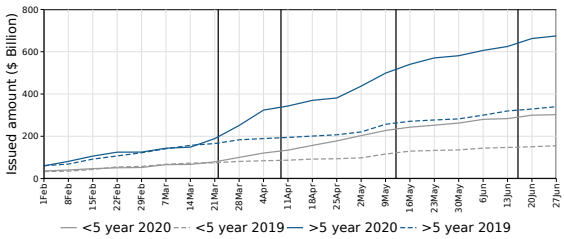
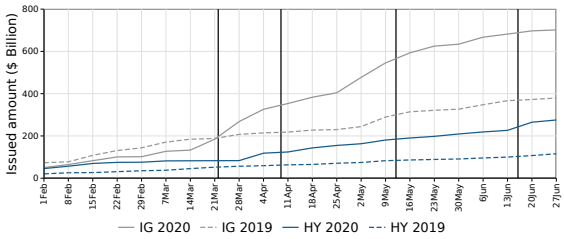


Figure 7. Primary market issuance improved since CCF announcement. This figure plots the year-to-date (through June 27, 2020) cumulative issuance in USD billion terms, together with the corresponding year-to-date cumulative issuance in 2019. Figure 7c: issuers classified as having majority of operations in the U.S. if at least half of their employees are reported to be in the U.S. in latest available data. Figure 7d: 3 digit NAICS industries ranked into quartiles based on total employment changes from January to April 2020, with Q1 the most affected. Figure 7e: issuers ranked into quartiles based on Q1 2020 earnings as a fraction of Q4 2019 total assets, with Q1 the most affected. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

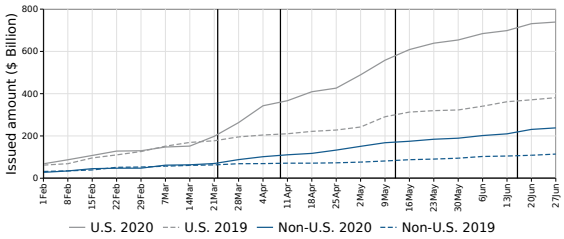
(a) By maturity



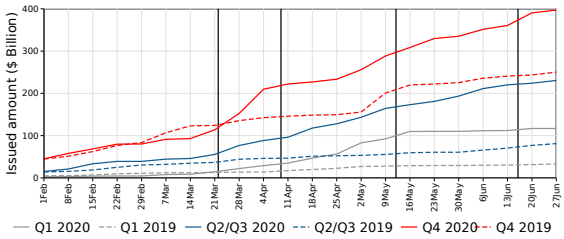
(b) By credit rating



(c) By U.S. operations



(d) By industry



(e) By profitability

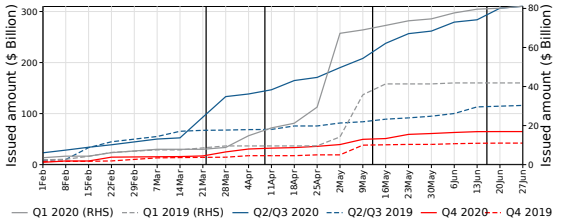
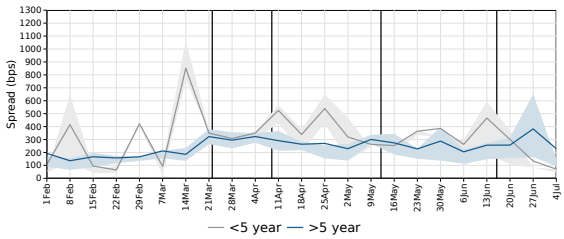
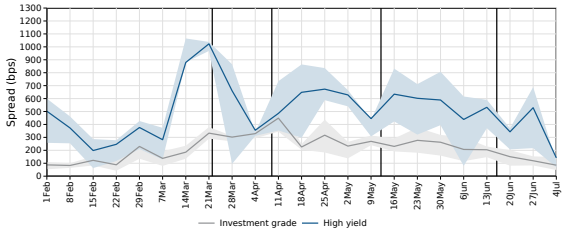


Figure 8. Primary market pricing flat since CCF announcement. This figure plots the average offering spread to nearest-maturity on-the-run Treasury yield for fixed coupon corporate bonds, together with the interquartile range in the spread. Average and interquartile range computed on an offering-amount-weighted basis. Figure 8c: issuers classified as having majority of operations in the U.S. if at least half of their employees are reported to be in the U.S. in latest available data. Figure 8d: 3 digit NAICS industries ranked into quartiles based on total employment changes from January to April 2020, with Q1 the most affected. Figure 8e: issuers ranked into quartiles based on Q1 2020 earnings as a fraction of Q4 2019 total assets, with Q1 the most affected. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

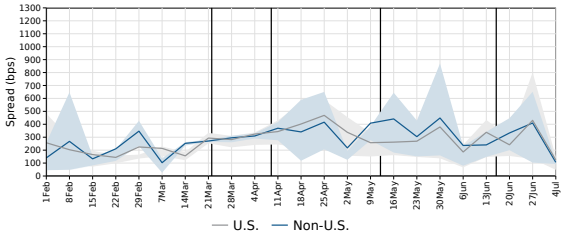
(a) By maturity



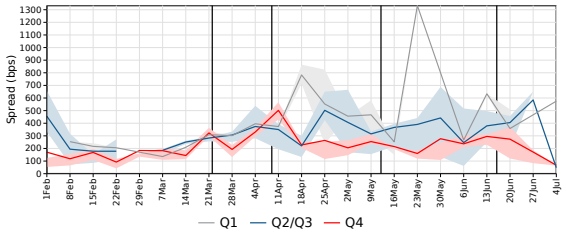
(b) By credit rating



(c) By U.S. operations



(d) By industry



(e) By profitability

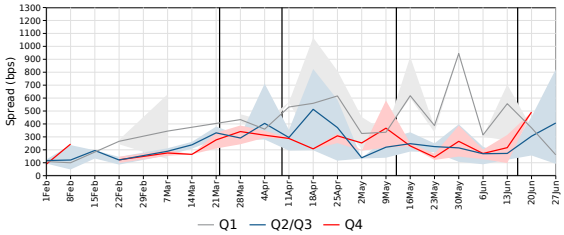
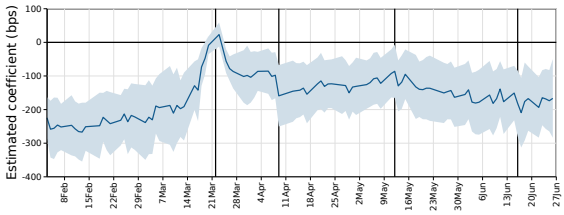
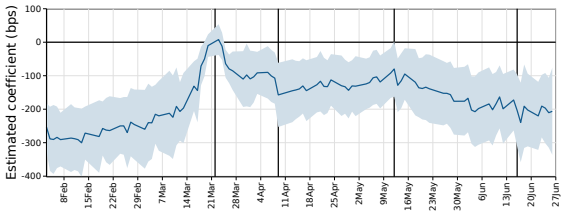


Figure 9. Spread improvements biggest for firms in least affected industries. This figure plots the estimated coefficients from the regression of cumulative bond-level changes in duration-matched (left column, Z-spread) and default-adjusted (right column, D-spread) spreads on bond maturity prior to Sep 2025 and high yield rating dummies, and interaction between maturity and industry rank dummies. 3 digit NAICS industries ranked into quartiles based on total employment changes from January to April 2020, with Q1 the most affected (biggest employment losses). All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

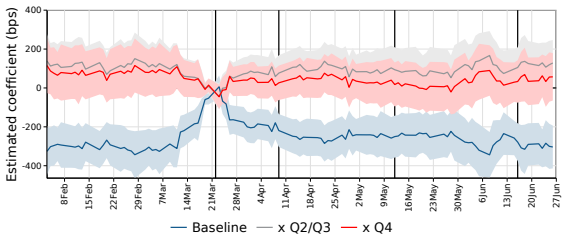
(a) Constant, Z-spread



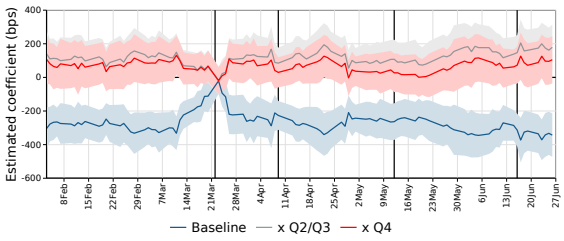
(b) Constant, D-spread



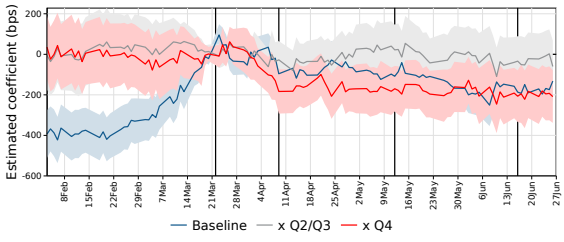
(c) Maturity dummy, Z-spread



(d) Maturity dummy, D-spread



(e) HY dummy, Z-spread



(f) HY dummy, D-spread

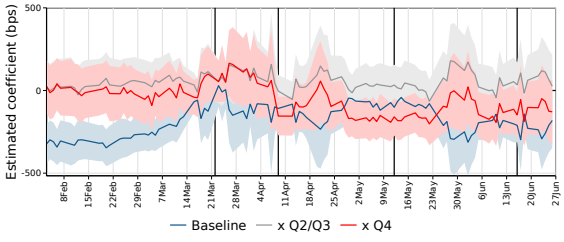
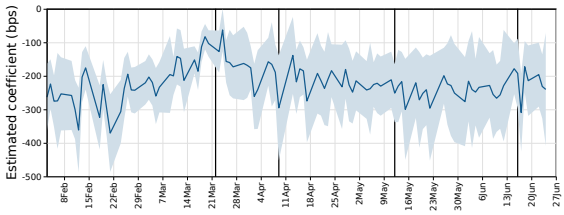
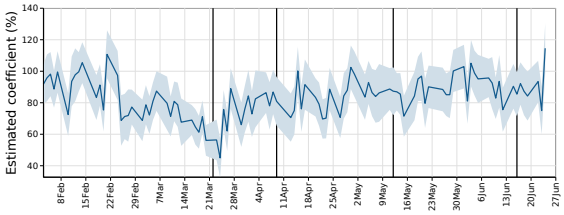


Figure 10. Liquidity improvements homogeneous across firms in different industries. This figure plots the estimated coefficients from the regression of cumulative bond-level changes in effective bid-ask spreads (left column) and net customer flow as a fraction of total customer volume (right column) on bond maturity prior to Sep 2025 and high yield rating dummies, and interaction between maturity and industry rank dummies. 3 digit NAICS industries ranked into quartiles based on total employment changes from January to April 2020, with Q1 the most affected (biggest employment losses). All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

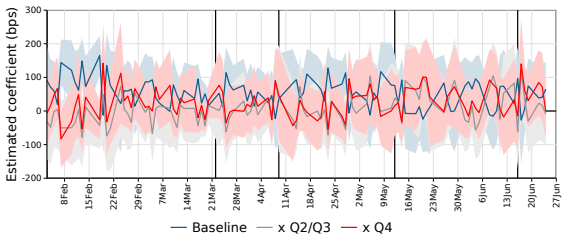
(a) Constant, BAS spread



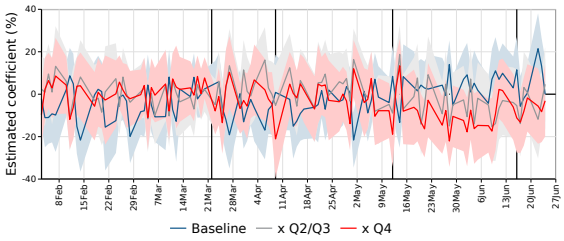
(b) Constant, net customer flow



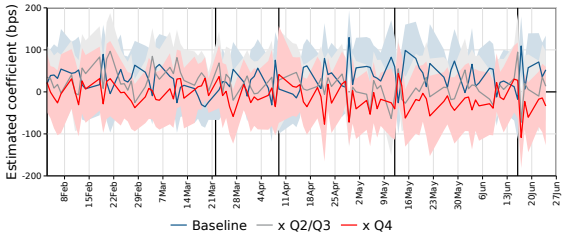
(c) Maturity dummy, BAS spread



(d) Maturity dummy, net customer flow



(e) HY dummy, BAS spread



(f) HY dummy, net customer flow

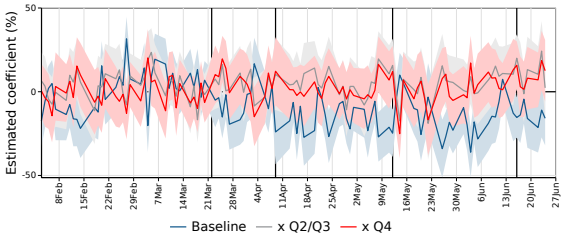
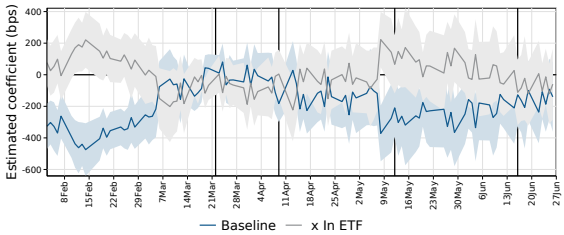
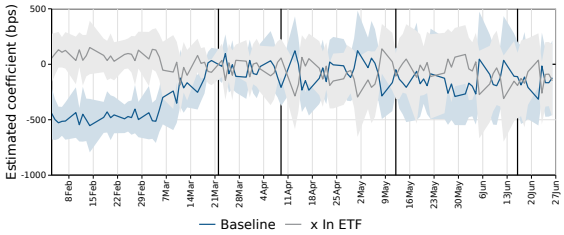


Figure 11. Improvements in duration-matched spreads biggest for eligible securities not held by ETFs. This figure plots the estimated coefficients from the regression of cumulative bond-level changes in duration-matched spreads on bank issuer, bond maturity prior to Sep 2025, and high yield rating dummies with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

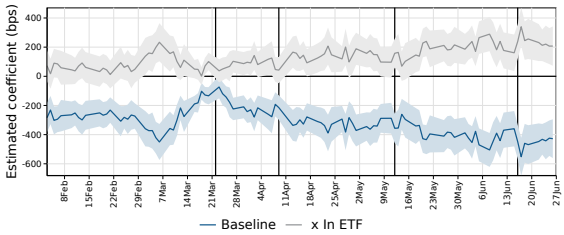
(a) Constant, no FE



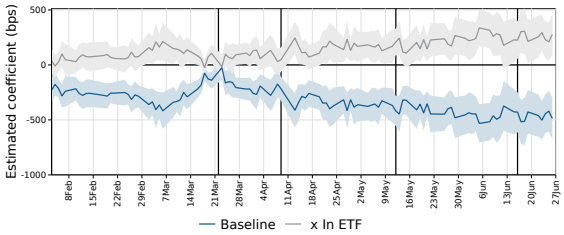
(b) Constant, FE



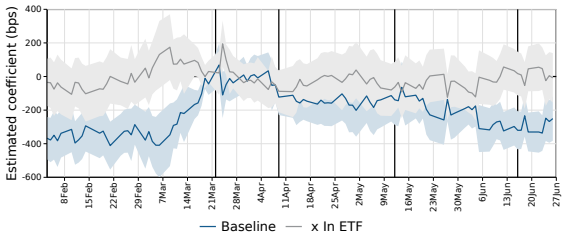
(c) Maturity dummy, no FE



(d) Maturity dummy, FE



(e) HY dummy, no FE



(f) HY dummy, FE

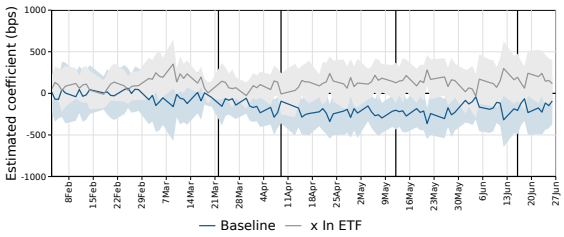
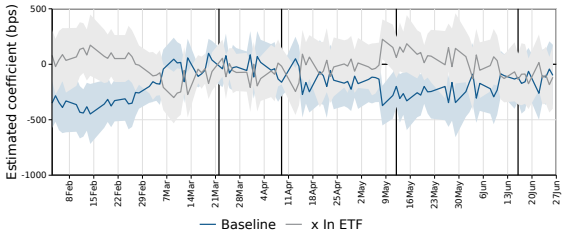
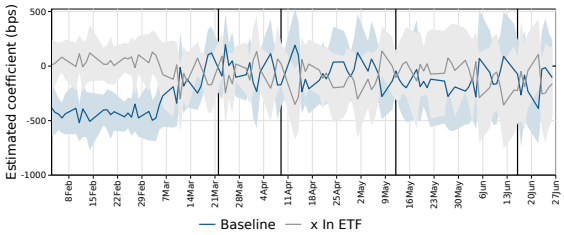


Figure 12. Improvements in default-adjusted spreads biggest for eligible securities not held by ETFs. This figure plots the estimated coefficients from the regression of cumulative bond-level changes in default-adjusted spreads on bank issuer, bond maturity prior to Sep 2025, and high yield rating dummies with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

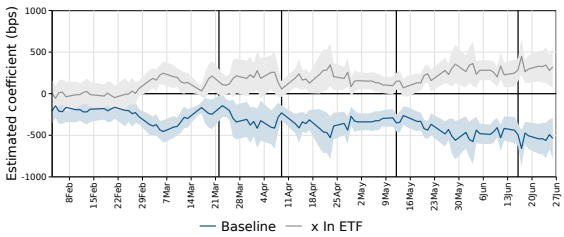
(a) Constant, no FE



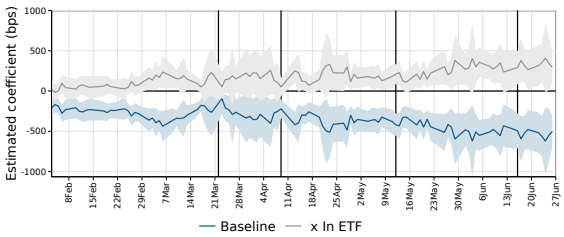
(b) Constant, FE



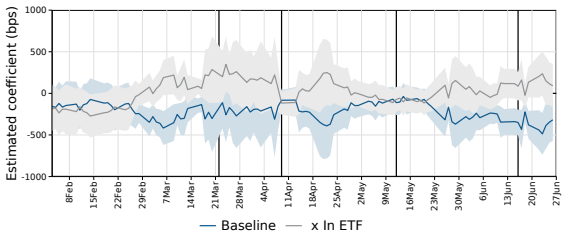
(c) Maturity dummy, no FE



(d) Maturity dummy, FE



(e) HY dummy, no FE



(f) HY dummy, FE

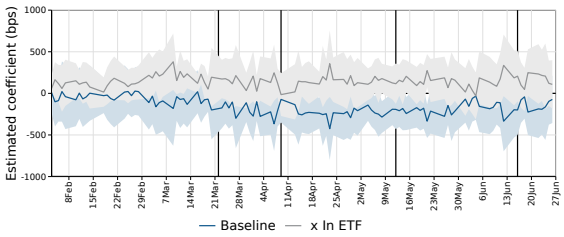
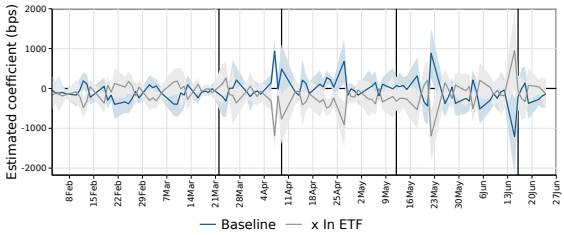
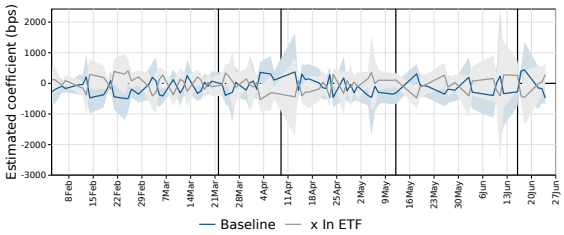


Figure 13. Improvements in effective bid-ask spreads biggest for eligible securities not held by ETFs. This figure plots the estimated coefficients from the regression of cumulative bond-level changes in effective bid-ask spreads on bank issuer, bond maturity prior to Sep 2025, and high yield rating dummies with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

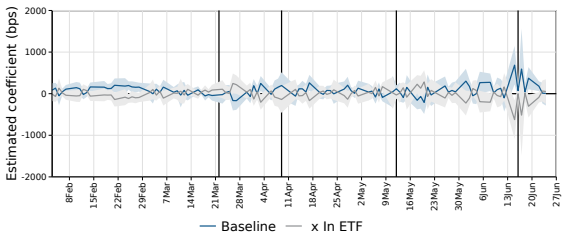
(a) Constant, no FE



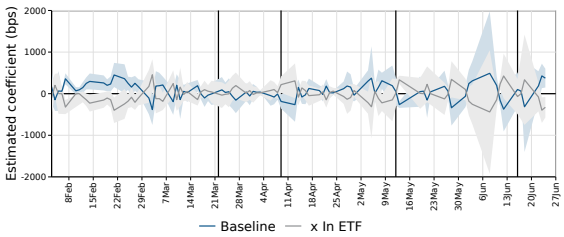
(b) Constant, FE



(c) Maturity dummy, no FE



(d) Maturity dummy, FE



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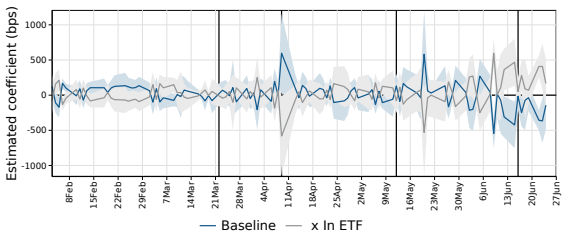

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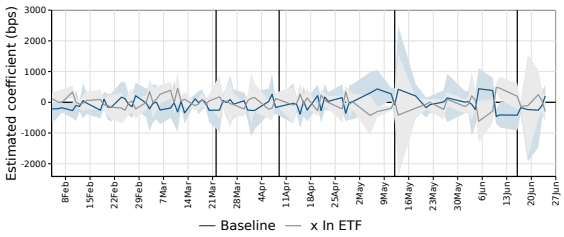
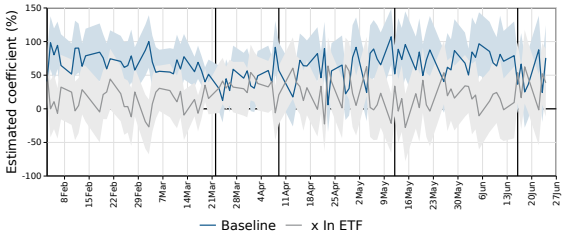
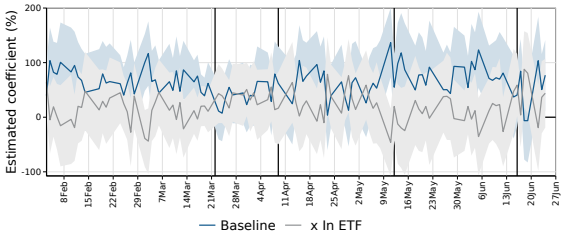


Figure 14. Improvements in net customer flow biggest for eligible securities not held by ETFs. This figure plots the estimated coefficients from the regression of cumulative bond-level changes in net customer flow on bank issuer, bond maturity prior to Sep 2025, and high yield rating dummies with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

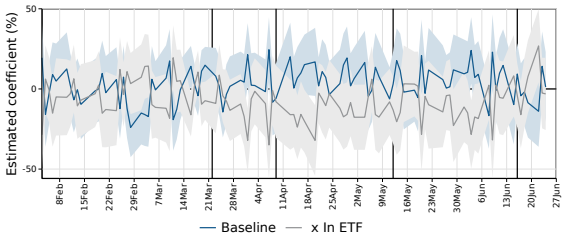
(a) Constant, no FE



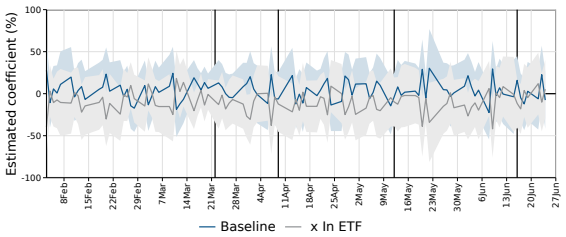
(b) Constant, FE



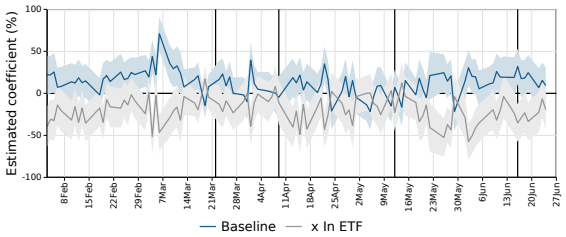
(c) Maturity dummy, no FE



(d) Maturity dummy, FE



(e) HY dummy, no FE



(f) HY dummy, FE

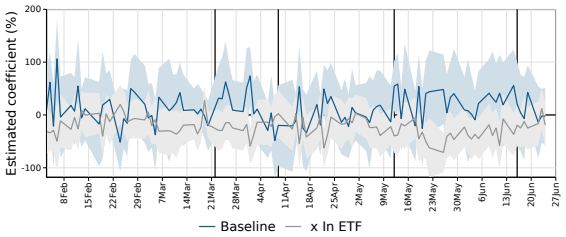
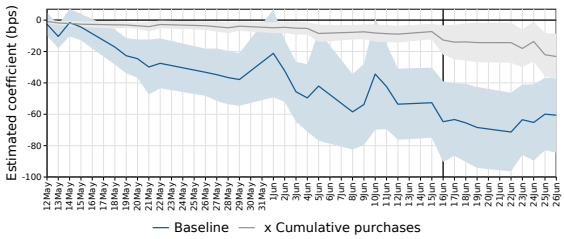
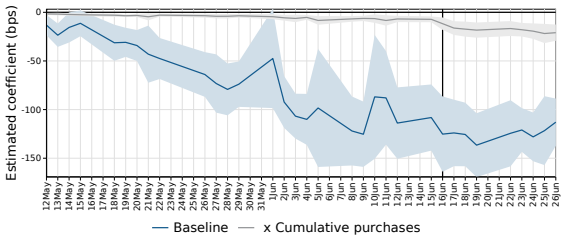


Figure 15. Purchase impact on duration-matched spreads. This figure plots the estimated coefficients from the regression of cumulative bond-level changes since the commencement of purchases in duration-matched spreads on bank issuer, bond maturity prior to Sep 2025, high yield rating dummies and standardized cumulative purchase volume with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event line at June 16 (commencement of cash bond purchases).

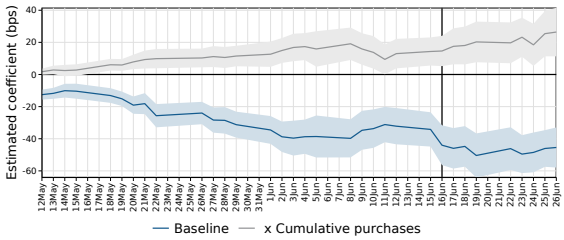
(a) Constant, no FE



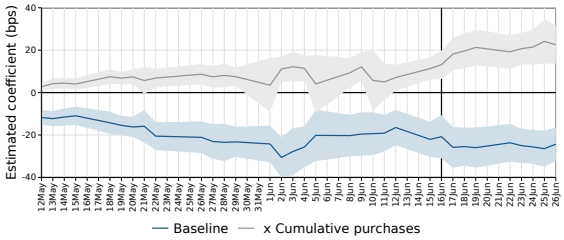
(b) Constant, FE



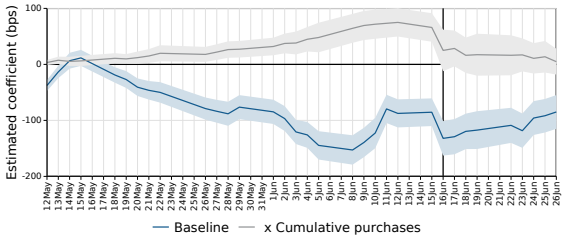
(c) Maturity dummy, no FE



(d) Maturity dummy, FE



(e) HY dummy, no FE



(f) HY dummy, FE

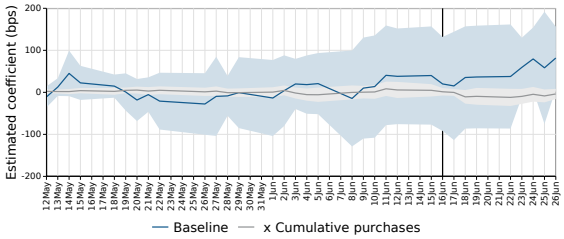
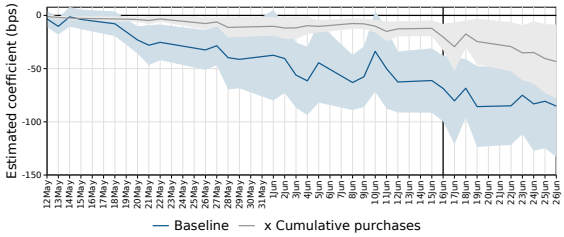
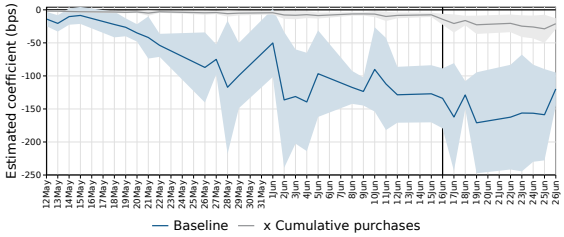


Figure 16. Purchase impact on default-adjusted spreads. This figure plots the estimated coefficients from the regression of cumulative bond-level changes since the commencement of purchases in duration-matched spreads on bank issuer, bond maturity prior to Sep 2025, high yield rating dummies and standardized cumulative purchase volume with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event line at June 16 (commencement of cash bond purchases).

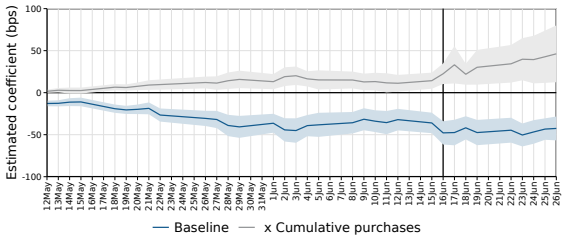
(a) Constant, no FE



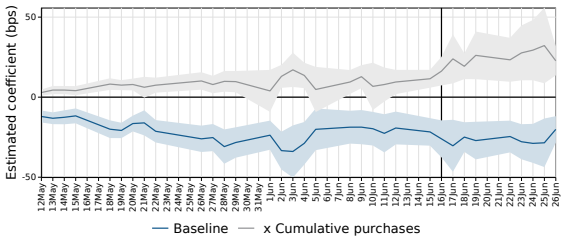
(b) Constant, FE



(c) Maturity dummy, no FE



(d) Maturity dummy, FE



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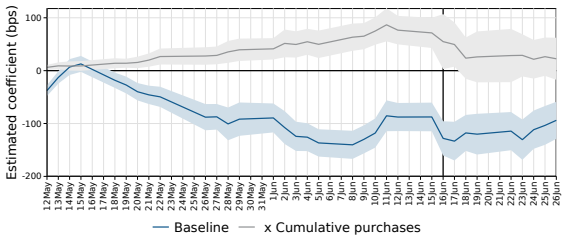


(f) HY dummy, FE

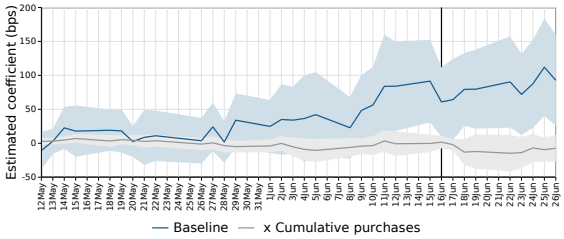
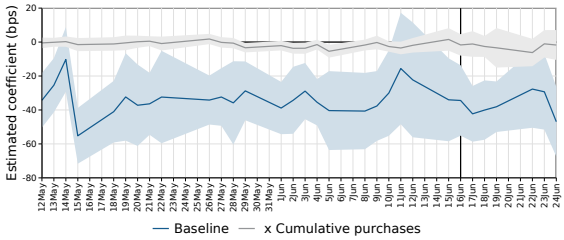
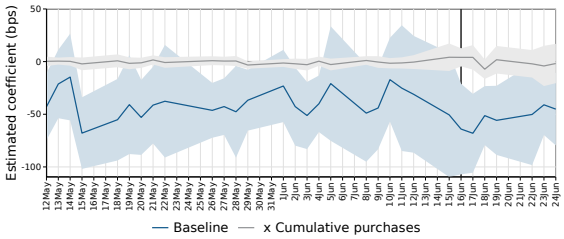


Figure 17. Purchase impact on effective bid-ask spreads. This figure plots the estimated coefficients from the regression of cumulative bond-level changes since the commencement of purchases in effective bid-ask spreads on bank issuer, bond maturity prior to Sep 2025, high yield rating dummies and standardized cumulative purchase volume with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event line at June 16 (commencement of cash bond purchases).

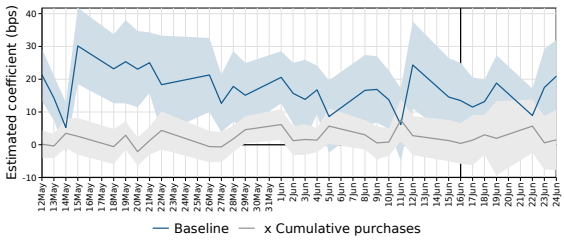
(a) Constant, no FE



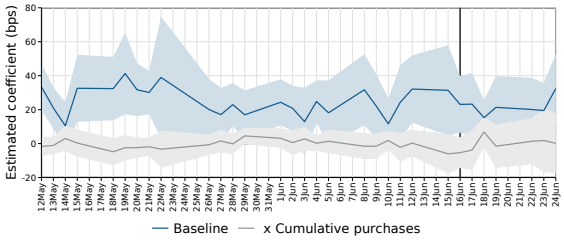
(b) Constant, FE



(c) Maturity dummy, no FE



(d) Maturity dummy, FE



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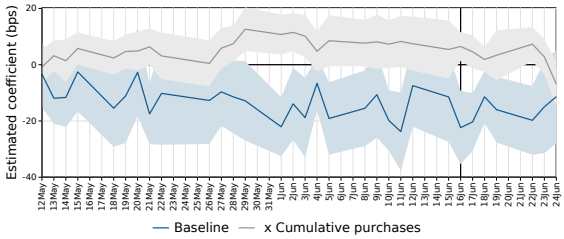


(f) HY dummy, FE

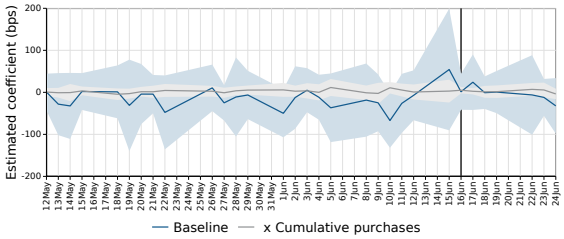
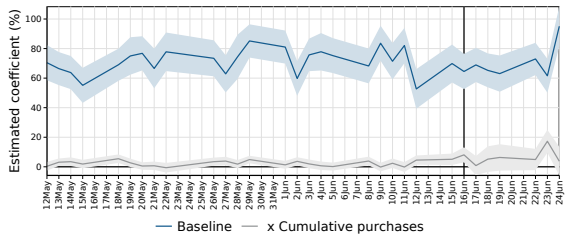
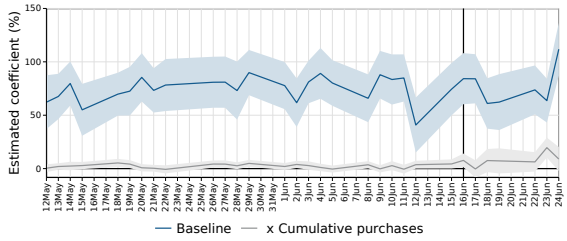


Figure 18. Purchase impact on net customer flow. This figure plots the estimated coefficients from the regression of cumulative bond-level changes since the commencement of purchases in net customer flow on bank issuer, bond maturity prior to Sep 2025, high yield rating dummies and standardized cumulative purchase volume with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event line at June 16 (commencement of cash bond purchases).

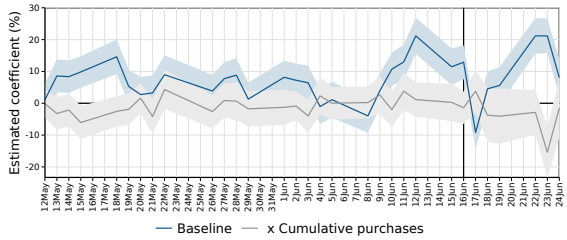
(a) Constant, no FE



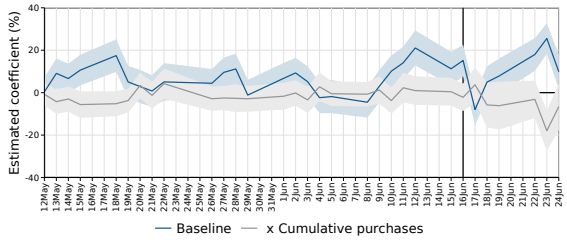
(b) Constant, FE



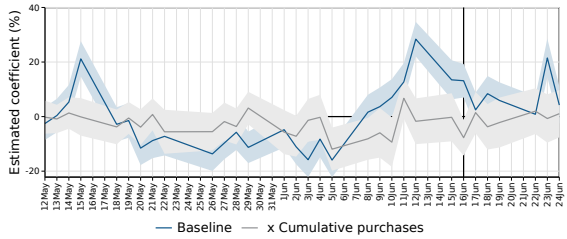
(c) Maturity dummy, no FE



(d) Maturity dummy, FE



(e) HY dummy, no FE



(f) HY dummy, FE

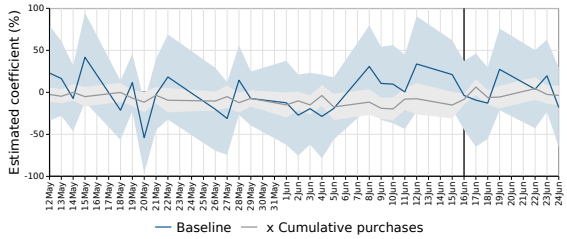
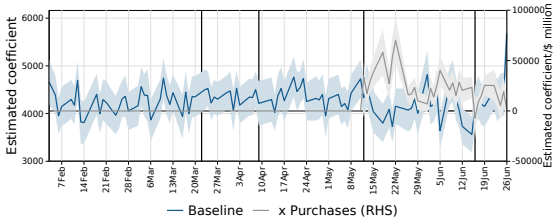
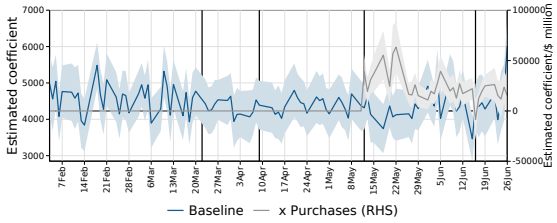


Figure 19. Increased concentration in dealer activity. This figure plots the estimated coefficients from the regression of bond-level HHI on bank issuer, bond maturity prior to Sep 2025, high yield rating dummies and daily facility purchases with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

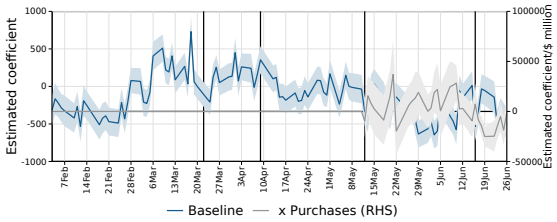
(a) Constant, no FE



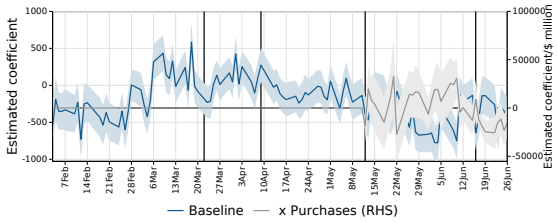
(b) Constant, FE



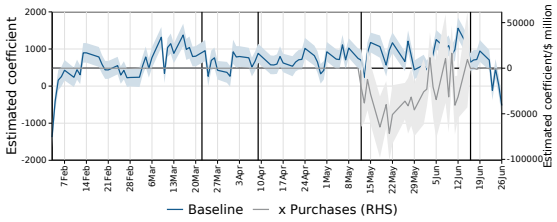
(c) Maturity dummy, no FE



(d) Maturity dummy, FE



(e) HY dummy, no FE



(f) HY dummy, FE

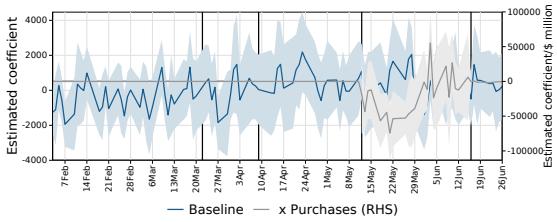
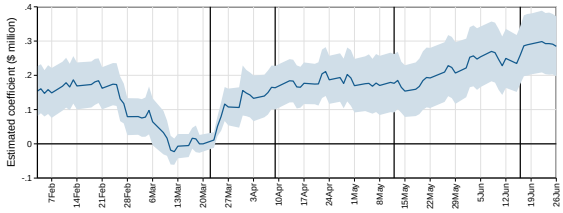
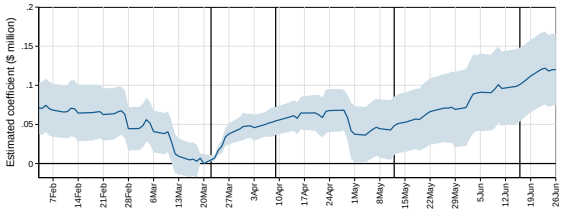


Figure 20. Bank-affiliated dealers increase net inventory since March. This figure plots the estimated coefficients from the regression of cumulative bond-level changes since March 22 in net position on bank issuer, bond maturity prior to Sep 2025, high yield rating and eligible seller dummies for bank-affiliated (left column) and stand-alone (right column) dealers. All regressions control for standard bond characteristics and dealer fixed effects. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

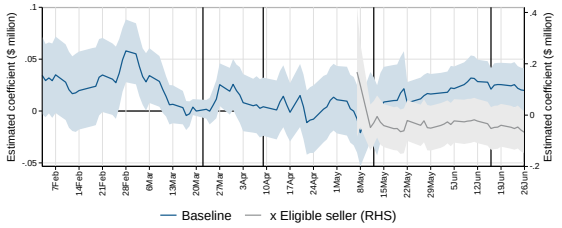
(a) Constant, bank-affiliated



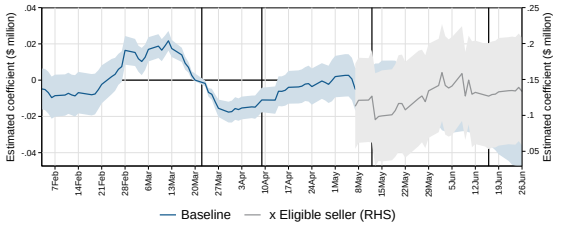
(b) Constant, stand-alone



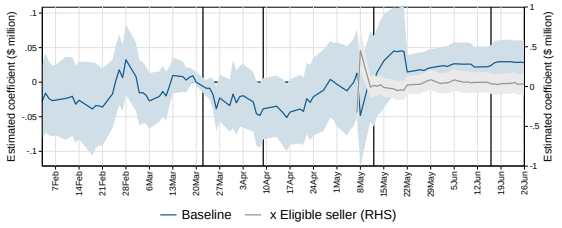
(c) Maturity dummy, bank-affiliated



(d) Maturity dummy, stand-alone



(e) HY dummy, bank-affiliated



(f) HY dummy, stand-alone

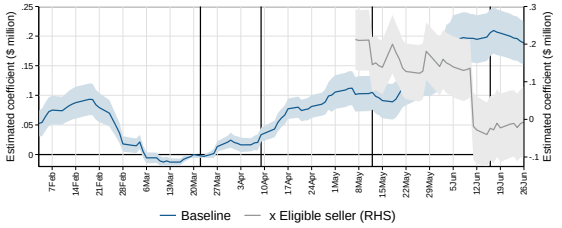
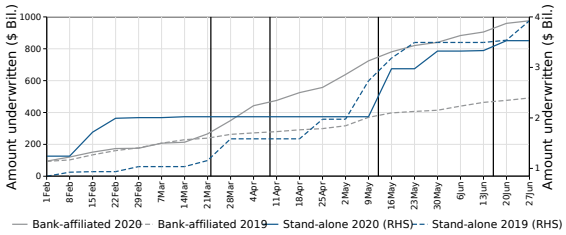
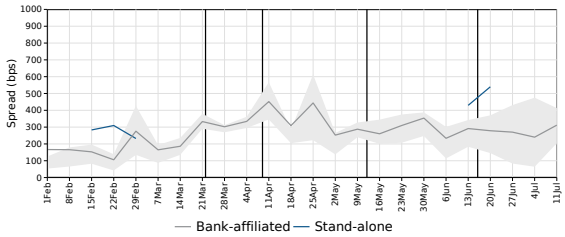


Figure 21. Gains in primary market issuance due to increased activity by large underwriters. This figure plots the year-to-date (through June 27, 2020) cumulative issuance in U.S.D billion terms, together with the corresponding year-to-date cumulative issuance in 2019. Right column plots the average offering spread to nearest-maturity on-the-run Treasury yield for fixed coupon corporate bonds, together with the interquartile range in the spread. Average and interquartile range computed on an offering-amount-weighted basis. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

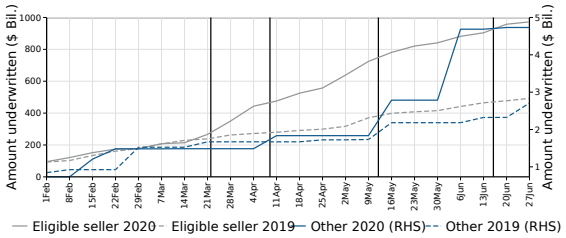
(a) Bank-affiliated underwriters



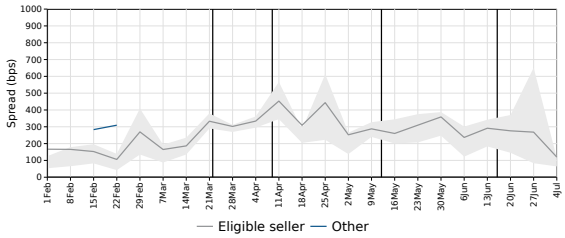
(b) Bank-affiliated underwriters



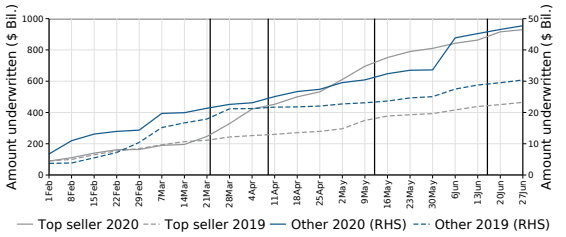
(c) Eligible sellers



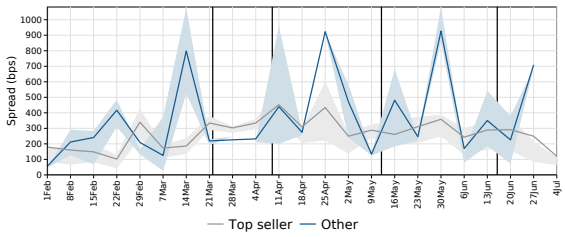
(d) Eligible sellers



(e) Top 10 sellers



(f) Top 10 sellers



A Additional results

A.1 Effect on CDS markets

Haddad et al. (2020) postulate that the increases in the CDS-bond basis in March for investment-grade issuers that were primarily driven by a lack of increases in CDS spreads suggest that the deterioration in spreads on corporate bond of the same issuers were not driven by increased riskiness of those issuers. In this section, we investigate to what extent the impact of the facilities that we document for corporate bonds spill-over into CDS markets.

CDS data Spreads and liquidity of single-name CDS and CDS indices at a daily frequency are sourced from Markit. For single-name CDS, we use spreads of CDS contracts written on USD-denominated senior unsecured debt (tier=SNRFOR) of U.S. firms, and the common no restructuring assumption (docclause=XR14). For the same entities, if the data is available, we also use some measures from Markit CDS liquidity report,[13] including index membership flag, bid-ask spread, dealers count per tenor, total number of end-of-day contributions, and weekly gross and net notional volumes and contracts from the Depository Trust and Clearing Corporation (Table 6). The liquidity data covers the universe of the most commonly traded single-name CDS contracts.

In addition to the single-name CDS contracts, which have experienced less liquidity since the global financial crisis and might not react to the facilities as quickly as other credit instruments, we also analyze the impact on CDX.NA.IG and the CDX.NA.HY indices, with 5-, 7-, and 10-year maturity. Although the 5-year maturity is typically the most liquid, we are interested in studying the facilities' impact across the term-structure curve given the 5-year maturity limit in the SMCCF. The CDX.NA.IG is a basket of 125 North American IG single-name CDSs, and the CDX.NA.HY is a basket of 100 North American HY single-name CDSs. We calculate the index-to-CDS basis, which is the difference between the price of a basket of single-name CDSs that replicates the cash flow and credit risk exposure of the index contract. The index-to-CDS basis is argued by Junge and Trolle (2015) to be a measure of overall liquidity of the CDS market, as it reflect the difference between the index spread and the intrinsic value implied by the spreads of its constituents. We analyze both on- and off-the-run indices.[14] For more details on single-name CDS and the indices, see Boyarchenko et al. (2020).

Changes in CDS market liquidity The results in Section 4.2 suggest that improvements in secondary market spreads have been particularly pronounced for bonds maturing prior to September 2025, even when comparing bonds issued by the same issuer. One potential

[13] In addition to the conditions we apply to filter the CDS spreads data, we apply two additional conditions to the liquidity metrics data. Specifically, PrimaryCoupon=Y and Range=Average. "PrimaryCoupon" indicates whether the running coupon is the primary coupon for the entity-tier; and, "Average" range represents the mean of entity-tier bid-ask spreads.

[14] If spreads for an index are available for two different versions of the same series simultaneously, we choose the version with the largest number of contributing dealers.

explanation for this differential improvement is differential liquidity of contracts on matched-maturity single name CDS contracts for shorter maturity bonds. Similar to specification (1), we estimate the relationship between the cumulative change in bid-ask spreads and net notional as a fraction of gross notional for single name CDS contracts relative to the peak in the week of March 16 – 20 and issuer characteristics:

$$\Delta M_{f,t} = \alpha_t + \beta_{b,t}\text{Bank issuer dummy}_f + \beta_{idx,t}\text{SN in IDX}_{f,t} + \beta_{hy,t}\text{HY dummy}_{f,t} + \epsilon_{f,t},$$

where $\text{SN in IDX}_{f,t}$ is a dummy equal to 1 if the single name CDS contract on issuer f is included in any series and version of either the North American investment grade or high yield (CDX.NA.IG or CDX.NA.HY) CDS index on date t.

Figure A.1 plots the estimated coefficients, together with the 95 percent confidence bands, for characteristics of interest from the above regression of improvements in effective bid-ask spreads on the 5 year single name CDS contracts (left column) and single name net notional outstanding as a fraction of gross notional (right column). Starting with the effective bid-ask spreads, Figure A.1a shows that, on average, effective bid-ask spreads on 5 year CDS contracts increased ahead of the facilities announcement but have not retracted substantially since. Even more puzzlingly, effective bid-ask spread on high yield single names rose relatively less (Figure A.1c) since the start of the year and have also stabilized at levels similar to those the week of March 16 – 20. That is, the liquidity of investment grade CDS contracts deteriorated at the beginning of March relative to the liquidity of high yield CDS contracts, suggesting that the muted response of investment grade CDS spreads documented by Haddad et al. (2020) may be due to illiquidity of the contracts. More broadly, the only segment of the five year single name CDS market that exhibits an improvement in effective bid-ask spreads relative to March levels are the contracts *not* included in a CDS index, which is traditionally the less liquid segment of the single name CDS market (Figure A.1e).

The right column of Figure A.1 shows that these patterns in the effective bid-ask spreads on 5 year CDS contracts are consistent with the overall trading activity in the CDS market. On average, net notional as a fraction of gross notional has not changed meaningfully since the beginning of the year (Figure A.1b), but selling pressure has relatively increased for high yield single names (Figure A.1d) and for single names included in an index (Figure A.1f). That is, while for the average issuer, net selling pressure has remained relatively stable over the course of the year, net selling pressure has increased for more risky names and more liquid names.

Turning next to the cross-maturity heterogeneity, Figure A.2 shows that these effects are bigger for shorter maturities. Indeed, for the three year contract, the relative improvement in effective bid-ask spreads on high yield single name CDS since the facilities announcement is even statistically significantly bigger than the improvement in spreads on investment grade bonds. That is, improvements in effective bid-ask spreads on single name CDS are bigger for shorter maturity contracts, written on either high yield single names or on names not included in an index or, in other words, contracts that traditionally are less liquid,[15] with little improvement in the effective bid-ask spreads on the average CDS name of any maturity.

[15]Boyarchenko et al. (2020) show that, post-crisis, the majority of both gross and net notional outstanding of single name CDS is concentrated in names included in an index, with the prevalence of single name contracts not included in an index declining over time.

Thus, if the differential improvement in secondary market bond spreads on bonds maturing before September 2025 were due to the relative ease of hedging of risks to those bonds in the CDS market, the improvements would be concentrated in spreads on bonds of issuers whose single name CDS contracts are not included in a CDS index. Instead, we see the differential improvement in spreads on shorter maturity bonds even within an issuer.

What leads to a differential improvement in effective bid-ask spreads for high yield single name CDS and CDS not included in an index? The net notional changes we documented in Figures A.1d and A.1f suggest that the causes are different across the two dimensions, with liquidity of CDS not in an index most likely improving due to increased interest in buying protection on those names. Figure A.3 suggests that the differential improvement in the liquidity of high yield single name CDS contracts may instead be due to relatively smaller dislocations between the single name and index CDS markets for high yield names. Although the index-single-name basis widened for both investment grade and high yield indices in late March (around the index roll date), the basis for the CDX.NA.HY index has returned to be close to 0 across all maturities, while the convergence of the index-single-name basis has been slower for the CDX.NA.IG index, especially for shorter maturities. The right column of Figure A.3 shows that this differential improvement in the index-single-name basis is partially due to increased willingness of dealers to provide quotes for the high yield but not the investment grade index. In addition, deviations in the pricing of the investment grade index may be bigger due to market participants' expectations of firm downgrades, which would lead to substantial revisions in the composition of the investment grade index before the next roll date in September. Thus, liquidity in high yield single name CDS improved differentially since March because of relatively smaller dislocations in the high yield CDX market, not because of increased hedging demand (buying pressure) stemming from the corporate bond market.

A.2 Cross-issuer heterogeneity in secondary market functioning

We now turn to cross-issuer heterogeneity in improvement in secondary market functioning since the facilities announcement on March 22. We sort issuers into quartiles based on 2020 Q1 quarter-over-quarter growth rate of EBITDA, as reported in Compustat.[16] We consider issuers falling in the bottom quartile (Q1) as being most affected by the COVID-19 related economic disruptions, issuers falling in the middle two quartiles (Q2/Q3) as being moderately affected, and issuers falling in the top quartile (Q4) of profitability as being least affected. We evaluate whether secondary market improvements have been uniform across least and most affected firms by estimating the following regression:

$$\begin{aligned}\Delta M_{b,t} = \alpha_t &+ \beta_{b,t}\text{Bank issuer dummy}_b + \beta_{m,t}\text{Maturity before Sep 2025}_b \\ &+ \beta_{hy,t}\text{HY dummy}_{b,t} + \beta_{b,q_2,t}\text{Bank issuer dummy}_b \times \mathbb{1}_{Q2/Q3} \\ &+ \beta_{m,q_2,t}\text{Maturity before Sep 2025}_b \times \mathbb{1}_{Q2/Q3} + \beta_{hy,q_2,t}\text{HY dummy}_{b,t} \times \mathbb{1}_{Q2/Q3} \\ &+ \beta_{b,q_3,t}\text{Bank issuer dummy}_b \times \mathbb{1}_{Q4} + \beta_{m,q_3,t}\text{Maturity before Sep 2025}_b \times \mathbb{1}_{Q4} \\ &+ \beta_{hy,q_3,t}\text{HY dummy}_{b,t} \times \mathbb{1}_{Q4} + \vec{\gamma}_t\text{Bond characteristics}_{b,t} + \epsilon_{b,t},\end{aligned}$$

[16] The distribution of 2020 Q1 quarter-over-quarter growth rate of EBITDA is plotted in Figure A.12.

where $\mathbb{1}_{Q2/Q3}$ is a dummy for the issuer falling in the middle two quartiles of Q1 2020 profitability growth distribution, and $\mathbb{1}_{Q4}$ is a dummy for the issuer falling in the top quartile of Q1 2020 profitability growth distribution. Negative interaction coefficients $\beta_{\cdot,q_2,t}$ and $\beta_{\cdot,q_4,t}$ indicate that secondary market conditions have improved relatively more for bonds issued by firms in the middle two quartiles and the top quartile, respectively, relative to bonds issued by firms in the bottom quartile of the Q1 2020 profitability growth distribution.

Figure A.4 plots the estimated coefficients, together with the 95 percent confidence bands, for characteristics of interest from the above regression of improvements in duration-matched (Z-spread, left column) and default-adjusted (D-spread, right column) spreads. The figure shows that the cross-firm heterogeneity only has a differential effect in spreads on bonds maturing before September 2025. While at the start of the year the maturity premium for bonds issued by more profitable issuers was half of the maturity premium for lower profitability issuers, the maturity premium after the facility announcement is more similar across issuers, suggesting that spreads on bonds maturing before September 2025 issued by more profitable firms have declined more than spreads on similar maturity bonds issued by more affected issuers. Similarly, Figure A.5c shows that, while there has been little differential improvement in effective bid-ask spreads on bonds maturing prior to September 2025 issued by least profitable issuers, effective bid-ask spreads for shorter maturity bonds of less affected issuers have retraced differentially more than spreads on longer maturity bonds. In contrast, the right column of Figure A.5 shows that improvements in net customer order flow are relatively homogeneous across differentially affected issuers.

Putting these results together, we have that, while deteriorations in pricing and bid-ask spreads were uniform across issuers, improvements in secondary market conditions for bonds eligible for facility purchases are larger for issuers that have experienced smaller deteriorations in profitability in the first quarter of the year. One potential explanation for the differential improvement across issuers is the differential information sensitivity of these securities (see e.g. Gorton and Ordonez, 2014; Dang et al., 2013). The economic uncertainty created by the rapid global spread of COVID-19 at the end of February and beginning of March lead to investors perceiving bonds of all issuers as being potentially risky, leading to a deterioration in pricing and liquidity across the board. The announcement of the facilities reduces the incentives to acquire information about securities eligible for direct purchases by the facility, especially for less affected firms, as the facility acts as a buyer of last resort in the market. This improves the relative pricing and the bid-ask spreads charged on the eligible bonds issued by less affected firms, without generating a differential increase in net customer order flow.

Turning next to primary market issuance, Figure 7e shows that the most affected firms (bottom quartile of Q1 2020 profitability) were unable to issue prior to the facilities announcement. These issuers were able to begin issuance following the April 9, 2020, with year-to-date issuance double the amount issued by the same issuers in a comparative period in 2019. For issuers in the middle two quartiles of the Q1 2020 profitability distribution, year-to-date issuance is 2.4 times larger than the 2019 issuance; and for issuers in the top quartile of the Q1 2020 profitability distribution, year-to-date issuance is 1.5 times larger.

In contrast, in Figure 8e, we see that the biggest improvements in offering spreads are for firms in least affected industries (fourth quartile of the employment losses distribution) and for firms in the top quartile of Q1 2020 profitability distribution. Thus, although the

announcement of the facilities has improved the ability of all firms to issue in the primary market, the improvements in offering spreads have been biggest for firms least affected by the COVID-19 pandemic.

B Technical appendix

B.1 TRACE data cleaning

In our analysis, we use TRACE data provided by FINRA at the end of each business day. Starting in July 2002, each registered FINRA member that is a party to a reportable transaction in a TRACE-eligible security has a reporting obligation. The reporting is done in real-time. The set of TRACE-eligible securities has changed throughout the years. We start our sample in 2005, when all investment-grade and high-yield U.S. corporate bonds were included in the TRACE-eligible securities definition (except for 144A). A trade report includes the security identifier, date, time, size (par value), and price of the transaction. A report also identifies the member firm's side of the transaction (buy or sell), their capacity as a principal or agent, and the other parties to the transaction. The required reporting time varies between categories of TRACE-eligible securities. Member firms must report a secondary corporate bond transaction as soon as practicable, no later than within 15 minutes of the time of execution. There a few issues that needs to be addressed:

1. **Correction and Cancellations.** A trade record that is corrected or cancelled at a later time because of misreporting remains on the tape, and additional records indicate its current status.

   What do we do? We keep the most recent status of each trade record based on the system control number and the record type.

2. **Interdealer Trades.** The reporting requirements require all registered broker-dealers (BDs) to report to TRACE. Hence, a trade between two BDs is reported twice, while a trade between a client and a BD is reported once.

   What do we do? To keep one record of each trade, we keep the sell side of an interdealer trade.

3. **Non-Member Affiliates.** While BDs are identified in trade records, clients' identities are masked, and all clients are reported as "C". Effective on November 2, 2015, firms are required to identify transactions with non-member affiliates , entering "A" instead of "C" if the affiliate is a non-FINRA member.

   The reporting rule amendment also requires firms to use an indicator to identify certain trades that typically are not economically distinct and, as such, would not provide investors useful information for pricing, valuation or risk evaluation purposes if disseminated publicly. Specifically, FINRA is requiring firms to identify trades with non-member affiliates that occur within the same day and at the same price as a trade between the firm and another contra-party in the same security. Thus, firms are required to use "non-member affiliate—principal transaction indicator" when reporting a

transaction to TRACE in which both the member and its non-member affiliate act in a principal capacity, and where such trade occurs within the same day, at the same price and in the same security as a transaction between the member and another counterparty. A firm is not required to append the indicator if it does not reasonably expect to engage in a same day, same price transaction in the same security with another counterparty as with a non-member affiliate.

What do we do? We exclude records where the field SPCL_PRCSG_CD is non-missing. In addition, for volume calculations, we break down dealer-to-client (DC) and dealer-to-affiliate (DA) trading activity. We exclude non-member affiliate trades with the same price and the same size that happen within 60 seconds of each other.

4. **Trades on Electronic Platforms.** With the growth of electronic trading platforms, we see more transactions being executed through such platforms. Electronic platforms may or may not have a reporting obligation. The reporting obligation of an electronic platform is dependent on whether the platform is a party to the trade, and a registered alternative trading system (ATS) with the SEC. An ATS platform is a party to all transactions executed through its system, and therefore has a reporting obligation. An electronic platform that is not an ATS is not necessarily a party to all trades executed through its system so may not always have a reporting obligation.

   Trades on an electronic platform which also has a reporting obligation increases the number of observations in the TRACE data. For example, a trade between two member firms on an electronic platform with a reporting obligation results in four observations in the TRACE data: a sell by the first member firm to the platform, a purchase by the platform from the first member firm, a sell by the platform to the second member firm, and a purchase by the second member firm from the platform. This needs to be addressed to avoid an upward-bias of trading activity, and a downward bias of price-based liquidity measures.

   What do we do? Depending on the analysis, one might want to flag such trades. We use the counterparties identities and FINRA's TRACE ATS identifiers list to flag such trades. We also construct an additional trade size variable that reset to 0 if the seller is an ATS platform. For trading volume calculations, for example, we use the ATS-adjusted volume variable. If we do not account for multiple trade reports, then we would include some trades more than once depending on whether the counterparties are FINRA members and whether an electronic platform also had a reporting obligation. This would result in an overestimation of the trading activity on electronic platforms with a reporting obligation (e.g., non-6732 ATSs), and an inaccurate comparison of the trading activity between platforms with different reporting obligations (e.g., 6732 ATSs and non-6732 ATSs). Overall, the filter that we apply to the TRACE data ensures that we include each trade only once in our sample.

B.2 Spreads calculation

We begin by computing duration-matched spreads at the bond-trade level. As in Gilchrist and Zakrajšek (2012), define the Treasury-implied yield $y_{b,t}^f$ on bond b on trade date t as

$$\sum_{s=1}^{2T} \frac{C_b}{2} Z_t\left(\frac{s}{2}\right) + 100 Z_t\left(T\right) = \sum_{s=1}^{2T} \frac{\frac{C_b}{2}}{\left(1+\frac{y_{b,t}^f}{2}\right)^s} + \frac{100}{\left(1+\frac{y_{b,t}^f}{2}\right)^{2T}},$$

where T is the time-to-maturity of the bond, C_b is the coupon on the bond, and $Z_t\left(s\right)$ is the Treasury zero-coupon bond price for time-to-maturity s. The trade-level duration-matched spread on bond b on trade date t is then

$$z_{b,k,t} = y_{b,k,t} - y_{b,t}^f,$$

where $y_{b,k,t}$ is the yield on bond b priced in trade k on trade date t. We aggregate to the bond-trade day level by averaging using trading volume weights:

$$z_{b,t} = \frac{\sum_{k \in \mathcal{K}_{b,t}} z_{b,k,t} V_{b,k,t}}{\sum_{k \in \mathcal{K}_{b,t}} V_{b,k,t}},$$

where $\mathcal{K}_{b,t}$ is the set of all trades in bond b in on trading day t and $V_{b,k,t}$ is the volume of the kth trade in bond b on trade date t.

Duration-matched spreads measure the spread differential between corporate bonds and Treasuries with similar duration, capturing risk premia for both the differential credit and liquidity risk between Treasuries and corporate bonds. To separate these two components, similar to Gilchrist and Zakrajšek (2012), we estimate the duration-matched spread that would be predicted based on bond and issuer characteristics using the following regression

$$\log z_{b,t} = \alpha + \beta \text{EDF}_{b,t} + \vec{\gamma} F_{b,t} + \epsilon_{b,t},$$

where $\text{EDF}_{b,t}$ is the one year expected default probability for bond b on day t estimated by Moody's KMV, and $F_{b,t}$ is a vector of bond and issuer characteristics: log duration, log amount outstanding, log age of the bond, log coupon rate, a dummy for call provision, and a 3-digit NAICS industry fixed effect. When bond-level EDFs are not available, we use the issuer-level EDF instead and include a dummy variable for whether bond- or issuer-level is used in the specification.

We estimate this regression separately for each credit rating category, allowing different credit ratings to have a different relationship between expected duration-matched spreads and bond characteristics. Table A.3 reports the estimated coefficients for the above regression for the full sample January 1, 2005 – June 30, 2020. The default-adjusted spread for bond b on date t is then calculated as the difference between the priced and the predicted duration-

matched spread on bond b on date t

$$d_{b,t} = z_{b,t} - \exp\left\{\alpha + \beta \text{EDF}_{b,t} + \vec{\gamma} F_{b,t} + \frac{\sigma^2}{2}\right\},$$

where σ^2 is the estimated variance of the idiosyncratic error $\epsilon_{b,t}$.

B.3 Credit ratings

For secondary market functioning, we classify bonds into investment grade and speculative grade (high yield) categories based on the issue-level credit ratings reported in Mergent FISD. We coalesce bond-level ratings by multiple rating agencies into a single number based on the plurality rule: if a bond is rated by more than one agency, we use the rating agreed upon by at least two rating agencies and use the lowest available rating otherwise. For our purposes, a bond is identified as investment grade if its plurality rating is BBB- or higher on the S&P ratings scale, or equivalent, and as high yield if its plurality rating is between BB+ and C, inclusive, on the S&P ratings scale, or equivalent. In our sample, few bonds that were investment grade as of March 22, 2020, and have subsequently been downgraded to BB+/BB/BB-; to keep our definitions consistent with facility eligibility, we include those bonds in the investment grade category. Bonds that were investment grade as of March 22, 2020, and have subsequently been downgraded to below BB- on the S&P scale or equivalent but remain rated are included in the high yield category.

Similarly, for primary market functioning, we classify issuers into investment grade and speculative grade (high yield) categories based on the issuer-level plurality rating, with S&P, Moody's and Fitch issuer-level ratings collected from Thompson Reuters Eikon.

B.4 Identifying majority U.S. operations

We identify companies as having the majority of operations in the U.S. in 2020 if:

1. 50 percent or more of their employees are reported to be located in the U.S., according to the latest available information on employees.

2. For issuers that do not report a geographical split of their employees but report a geographical split of assets, we assume that the majority of their operations are in the U.S. if at least 50 percent of their total assets are located in the U.S.

3. Otherwise, we assume that the issuer has majority of their operations in the U.S. if at least 50 percent of their total debt issuance is U.S.D denominated and is issued as a non-Yankee, non-Canadian bond.

We collect geographical information on employees and assets from three sources:

1. Compustat Geographical Segments file. We manually clean the geographic segments information to identify segments corresponding to the U.S. or, if the reporting company does not report segments at that level of geographic granularity, segments corresponding to North America.

2. Compustat Annual file.

3. CapitalIQ U.S., global and total employees for public firms and private firms with public debt.

We match firms in Compustat and CapitalIQ to issuers in Mergent FISD based on issuer-level cusips. Additional matches are obtained by fuzzy-matching issuer legal names to company names reported in Compustat and CapitalIQ. We manually verify the quality of the fuzzy-matches, and add additional matches by manually searching public filings of the respective issuers.

B.5 Nearest maturity Treasury spreads

Primary market issuances are priced as a spread to nearest-maturity on-the-run Treasury yields. In particular, we use the following maturity matches in computing the offering spread to the on-the-run Treasury:

- For bonds with less that 4.5 month maturity, spread to the 3 month Treasury bill
- For bonds with maturity of 4.5 months or more and less than 9 months, spread to the 6 month Treasury bill
- For bonds with maturity of 9 months or more and less than 1.5 years, spread to the 1 year Treasury note
- For bonds with maturity of [1.5, 2.5) years, spread to the 2 year Treasury note
- For bonds with maturity of [2.5, 4) years, spread to the 3 year Treasury note
- For bonds with maturity of [4, 6) years, spread to the 5 year Treasury note
- For bonds with maturity of [6, 8.5) years, spread to the 7 year Treasury note
- For bonds with maturity of [8.5, 20) years, spread to the 10 year Treasury bond
- For bonds with 20 years maturity or more, spread to the 20 year Treasury bond

Note that we exclude bonds with more than 40 years maturity (including perpetual bond) from the offering spread summary statistics.

Table A.1: PMCCF Timeline of Major Events. This table summarizes the major events as of the time of writing for the Primary Market Corporate Credit Facility (PMCCF).

Date	Event
March 22, 2020	PMCCF approved unanimously by the Board of Governors and the Secretary of the Treasury[a]
March 23, 2020	Public announcement and initial Term Sheet published[b] *Key Facts*:[c] • The PMCCF and SMCCF are designed to work together to support the flow of credit to large investment-grade U.S. corporations so that they can maintain business operations and capacity during the period of dislocations relative to COVID-19.
April 9, 2020	Updated Term Sheet Published[d] *Key Facts*: • Treasury capital increased from $10B to $50B • Extended eligibility to firms that were rated IG as of March 22, 2020 and downgraded to no lower than BB- at the time of accessing the facility ("fallen angels") • The PMCCF will buy bonds and syndicated loans with maturities up to four years via two different mechanisms: 1. As the sole investor in newly issued corporate bonds 2. As a participant in a loan or bond syndication at issuance. Facility may purchase no more than 25 percent of any loan syndication or bond issuance.
June 29, 2020	Launch date[e] Updated Term Sheet Published[f] *Key Facts*: • Pricing of individual corporate bonds will be issuer specific, informed by market conditions, plus a 100 bps fee, and subject to minimum and maximum yield spreads over comparable U.S. Treasury Securities • Pricing of syndicated loans will be the same as that of other syndicate members, plus a 100 bps fee

[a] Federal Reserve Board: `https://www.federalreserve.gov/publications/files/primary-market-corporate-credit-facility-3-29-20.pdf`

[b] Federal Reserve Board: `https://www.federalreserve.gov/newsevents/pressreleases/files/monetary20200323b1.pdf`

[c] Federal Reserve Board: `https://www.federalreserve.gov/newsevents/pressreleases/monetary20200323b.htm`

[d] Federal Reserve Board: `https://www.federalreserve.gov/newsevents/pressreleases/files/monetary20200409a5.pdf`

[e] Federal Reserve Bank of New York: `https://www.newyorkfed.org/newsevents/news/markets/2020/20200629`

[f] Federal Reserve Board: `https://www.federalreserve.gov/newsevents/pressreleases/monetary20200629a.htm`

Table A.2: SMCCF Timeline of Major Events. This table summarizes the major events as of the time of writing for the Secondary Market Corporate Credit Facility (SMCCF).

Date	Event
March 23, 2020	Initial Term Sheet published[a] *Key Facts*: • The PMCCF and SMCCF are designed to work together to support the flow of credit to large investment-grade U.S. corporations so that they can maintain business operations and capacity during the period of dislocation related to COVID-19.[b] • The SMCCF can purchase ETFs or individual corporate bonds
April 9, 2020	Updated Term Sheet published[c] *Key Facts*: • Treasury capital increased from $10B to $25B • Extended eligibility to bonds issued by firms that were rated IG as of March 22, 2020 and no lower than BB- when purchased by facility ("fallen angels"). • Extended eligibility to high yield ETFs, with a "preponderance" in investment grade ETFs • Concentration limits apply (max 1.5% of CCFs; max 10% of issuers' bonds)
May 12, 2020	Began purchasing ETFs[d]
June 15, 2020	Updated Term Sheet published[e] Updated FAQs released[f] *Key Facts*: • The SMCCF will purchase corporate bonds to construct a corporate bond portfolio that tracks a broad market index developed for the SMCCF • The facility can purchase a broad market index of individual bonds from corporations that satisfy a few simple criteria: maturity of under 5 years, domiciled in the U.S., not an insured depository institution, and meets the issuer rating requirements for Eligible Individual Corporate Bonds • Individual issuer weights will form the basis of sector weights, with each issuer mapped to one of twelve sectors. Purchases of corporate bonds will track as closely as possible the sector weights in the index.
June 16, 2020	Began purchasing individual corporate bonds[g]

[a] Federal Reserve Board: `https://www.federalreserve.gov/newsevents/pressreleases/files/monetary20200323b2.pdf`
[b] Federal Reserve Board: `https://www.federalreserve.gov/newsevents/pressreleases/monetary20200323b.htm`
[c] Federal Reserve Board: `https://www.federalreserve.gov/newsevents/pressreleases/files/monetary20200409a2.pdf`
[d] Federal Reserve Bank of New York: `https://www.newyorkfed.org/newsevents/news/markets/2020/20200511`
[e] Federal Reserve Board: `https://www.federalreserve.gov/newsevents/pressreleases/files/monetary20200615a1.pdf`
[f] Federal Reserve Bank of New York: `https://www.newyorkfed.org/markets/primary-and-secondary-market-faq/corporate-credit-facility-faq`
[g] Federal Reserve Bank of New York: `https://www.newyorkfed.org/newsevents/news/markets/2020/20200615`

Table A.3: Estimated relationship between duration-matched spreads and characteristics. This table reports the estimated coefficients from the regression of log duration-matched spreads on bond-level 1 year expected default frequency (EDF) and bond issuer characteristics. Standard errors clustered at the issuer level reported in parentheses below the point estimates. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

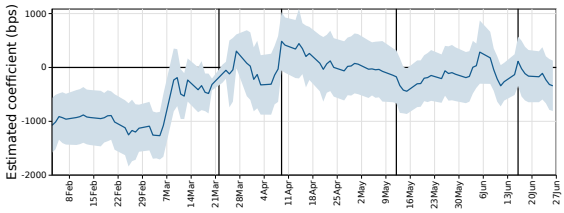
	AAA,AA	A+,A,A-	BBB+, BBB	BBB-	BB+, BB, BB-	B+ and Lower	All
Constant	-5.19***	-5.39***	-4.92***	-4.25***	-3.99***	-5.09***	-5.05***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
Log duration	0.34***	0.44***	0.45***	0.48***	0.42***	0.06***	0.29***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
Log coupon	0.53***	0.46***	0.43***	0.51***	0.53***	1.22***	0.77***
	(0.03)	(0.01)	(0.01)	(0.02)	(0.03)	(0.01)	(0.01)
Log amount outstanding	-0.07***	-0.05***	-0.06***	-0.11***	-0.09***	-0.05***	-0.06***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)
Log age	-0.06***	-0.05***	-0.05***	-0.02***	-0.03***	-0.08***	-0.08***
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Callable	-0.28***	-0.21***	-0.17***	-0.01	-0.10***	-0.25***	-0.19***
	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.01)
$EDF_{1y}\times$ Firm EDF dummy	0.03***	0.05***	0.04***	0.23***	0.08***	0.08***	0.07***
	(0.00)	(0.01)	(0.01)	(0.02)	(0.01)	(0.00)	(0.00)
$EDF_{1y}\times$ Bond EDF dummy	-0.07*	-0.04***	0.08***	0.10***	0.08***	0.06***	0.08***
	(0.04)	(0.02)	(0.02)	(0.02)	(0.01)	(0.00)	(0.00)
N. obs.	794,284	3,296,510	3,476,717	1,285,831	1,070,938	3,715,628	13,639,908
N. clusters	4,085	20,170	25,738	12,791	12,247	54,234	114,110
Adj. R^2	0.30	0.31	0.32	0.34	0.24	0.42	0.44

Table A.4: List of eligible sellers. This table reports the SMCCF eligible sellers together with the seller registration date with the facility. An eligible seller is considered to be an underwriter if any subsidiary of the corporate parent of the eligible seller is reported as a lead underwriter in any corporate bond issuance in either 2019 or 2020 in Mergent FISD. Source: Federal Reserve Bank of New York, `https://www.newyorkfed.org/medialibrary/media/markets/secondary-market-corporate-credit-facility-eligible-sellers`.

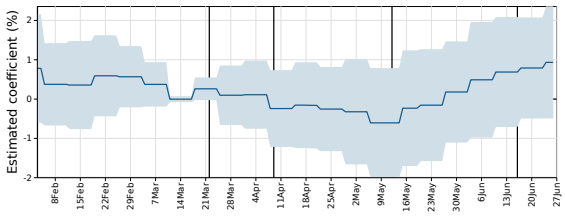
Eligible seller	Registration date	Underwriter?
BMO Capital Markets Corp.	May 7, 2020	Y
Cantor Fitzgerald & Co.	May 7, 2020	Y
Jefferies LLC	May 7, 2020	Y
NatWest Markets Securities Inc.	May 7, 2020	N
UBS Securities LLC	May 7, 2020	Y
Wells Fargo Securities, LLC	May 7, 2020	Y
Goldman Sachs & Co. LLC	May 8, 2020	Y
Barclays Capital Inc.	May 11, 2020	Y
BofA Securities, Inc.	May 11, 2020	Y
Morgan Stanley & Co. LLC	May 11, 2020	Y
BNP Paribas Securities Corp.	May 12, 2020	Y
Mizuho Securities U.S.A LLC	May 12, 2020	Y
TD Securities (U.S.A) LLC	May 12, 2020	Y
Amherst Pierpont Securities LLC	May 13, 2020	N
Deutsche Bank Securities Inc.	May 13, 2020	Y
Citigroup Global Markets Inc.	May 14, 2020	Y
Daiwa Capital Markets America Inc.	May 14, 2020	N
HSBC Securities (U.S.A) Inc.	May 15, 2020	Y
J.P. Morgan Securities LLC	May 22, 2020	Y
RBC Capital Markets, LLC	May 22, 2020	Y
Scotia Capital (U.S.A) Inc.	June 10, 2020	Y
Credit Suisse Securities (U.S.A) LLC	June 11, 2020	Y
SG Americas Securities, LLC	June 26, 2020	Y

Figure A.1. CDS liquidity. This figure plots the estimated coefficients from the regression of cumulative issuer-level changes effective single name CDS bid-ask spreads (left column) and net notional as a fraction of gross notional (right column) on bank issuer, bond maturity prior to Sep 2025, high yield rating, and inclusion in an CDS index dummies. 95% confidence bands based on heteroskedasticity-robust standard errors reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

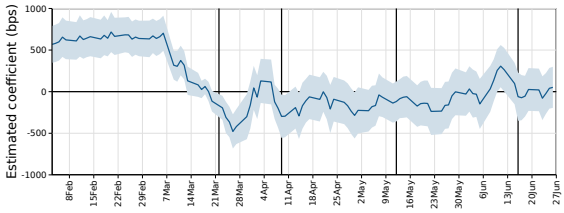
(a) Constant, 5 year BAS



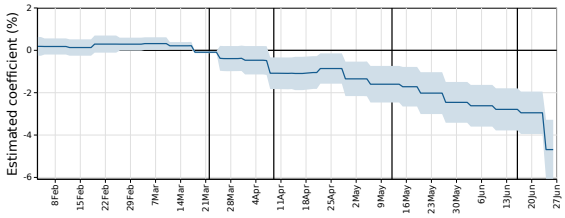
(b) Constant, Net notional



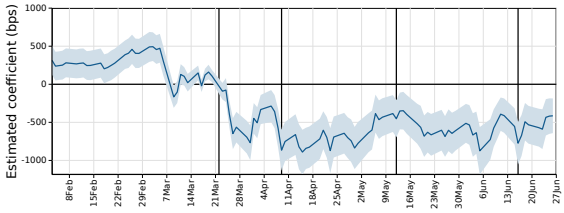
(c) HY dummy, 5 year BAS



(d) HY dummy, Net notional



(e) Not in IDX, 5 year BAS



(f) Not in IDX, Net notional

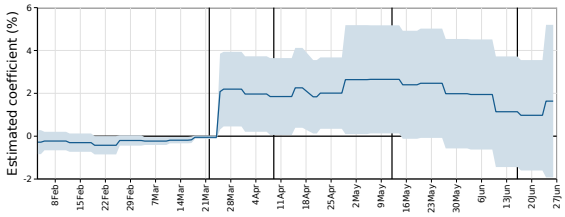
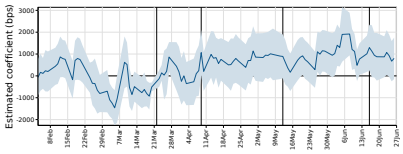
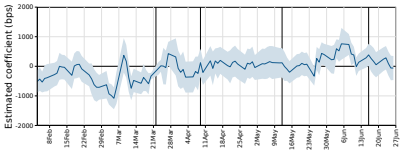


Figure A.2. CDS bid-ask spreads at different maturities. This figure plots the estimated coefficients from the regression of cumulative issuer-level changes effective single name CDS bid-ask spreads on 3 year (left column), 7 year (middle column), and 10 year (right column) contracts on bank issuer, bond maturity prior to Sep 2025, high yield rating, and inclusion in an CDS index dummies. 95% confidence bands based on heteroskedasticity-robust standard errors reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

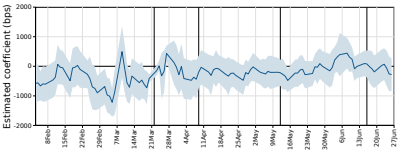
(a) Constant, 3 year



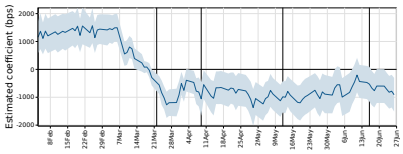
(b) Constant, 7 year



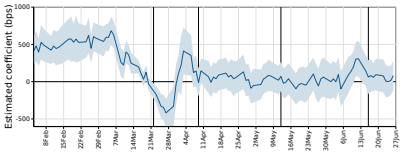
(c) Constant, 10 year



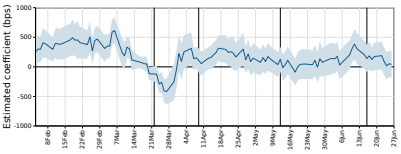
(d) HY dummy, 3 year



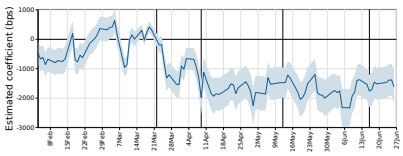
(e) HY dummy, 7 year



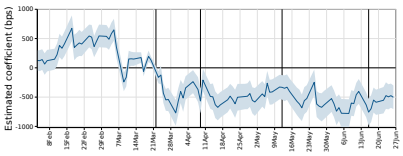
(f) HY dummy, 10 year



(g) Not in IDX, 3 year



(h) Not in IDX, 7 year



(i) Not in IDX, 10 year

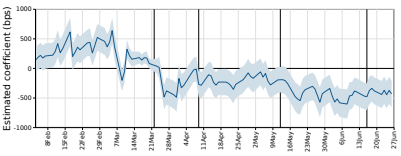
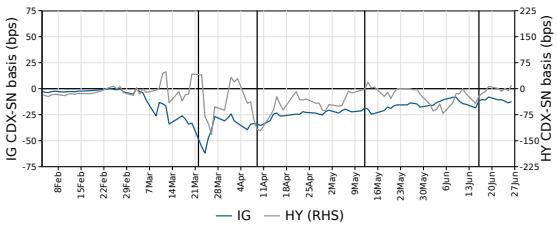
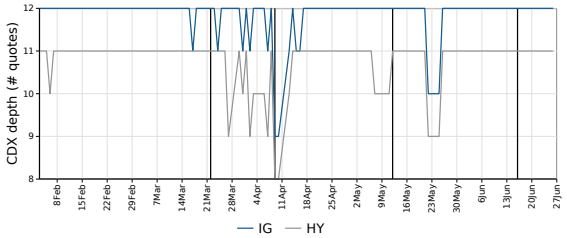


Figure A.3. CDX liquidity. This figure plots the index - single name basis (left column) and index depth (right column) for investment grade and high yield North American CDS indices. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

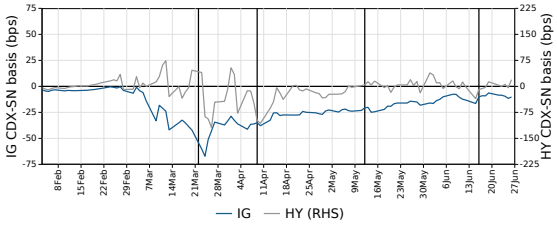
(a) Basis, 5 year



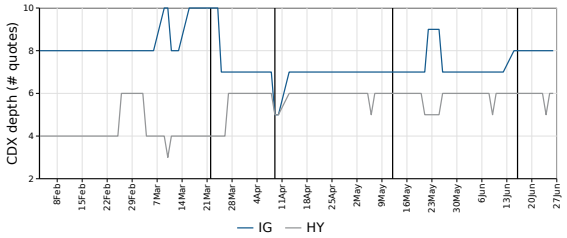
(b) Depth, 5 year



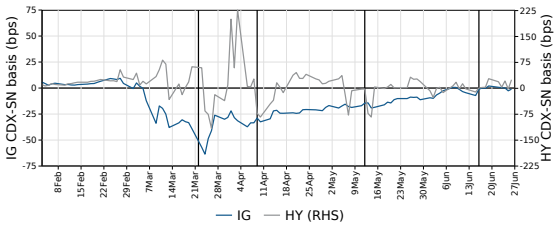
(c) Basis, 7 year



(d) Depth, 7 year



(e) Basis, 10 year



(f) Depth, 10 year

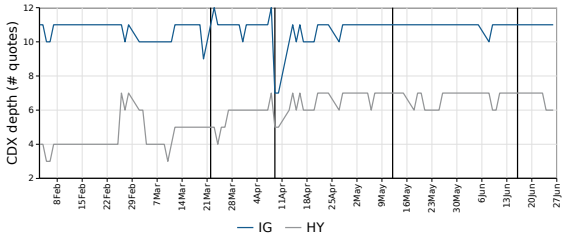
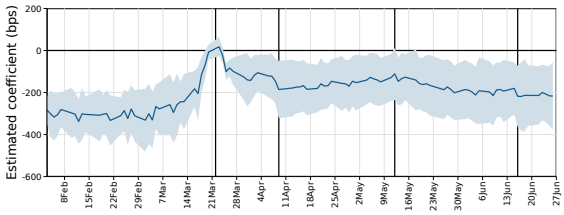
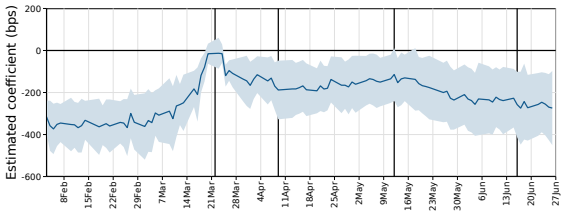


Figure A.4. Spread improvements biggest for least affected firms. This figure plots the estimated coefficients from the regression of cumulative bond-level changes in duration-matched (left column, Z-spread) and default-adjusted (right column, D-spread) spreads on bond maturity prior to Sep 2025 and high yield rating dummies, and interaction between maturity and issuer rank dummies. Issuers ranked into quartiles based on Q1 2020 change in earnings, with Q1 the most affected (lowest earnings growth). All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

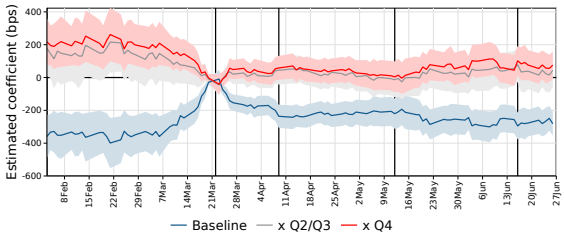
(a) Constant, Z-spread



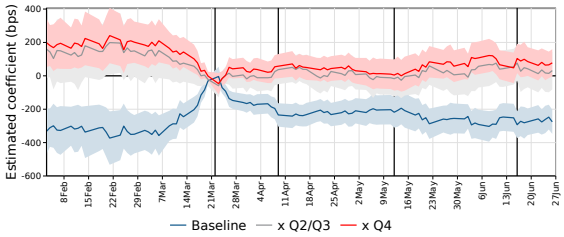
(b) Constant, D-spread



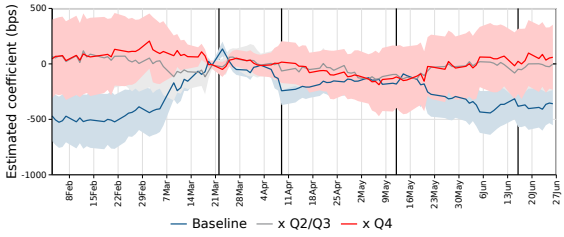
(c) Maturity dummy, Z-spread



(d) Maturity dummy, D-spread



(e) HY dummy, Z-spread



(f) HY dummy, D-spread

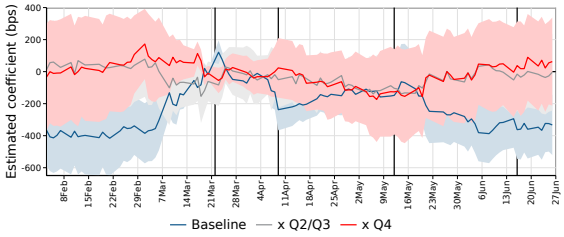
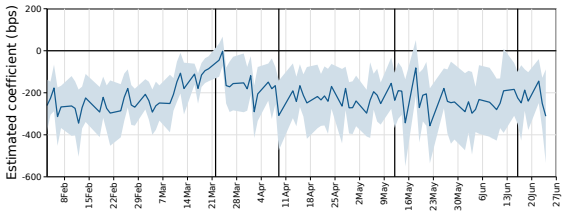
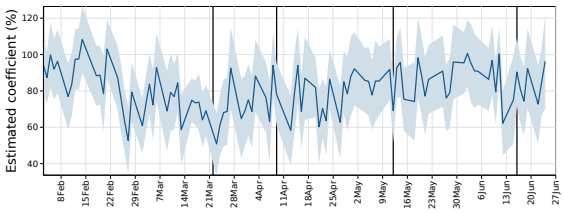


Figure A.5. Liquidity improvements biggest for least affected firms. This figure plots the estimated coefficients from the regression of cumulative bond-level changes in effective bid-ask spreads (left column) and net customer flow as a fraction of total customer volume (right column) on bond maturity prior to Sep 2025 and high yield rating dummies, and interaction between maturity and industry rank dummies. Issuers ranked into quartiles based on Q1 2020 change in earnings, with Q1 the most affected (lowest earnings growth). All regressions control for standard bond characteristics. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

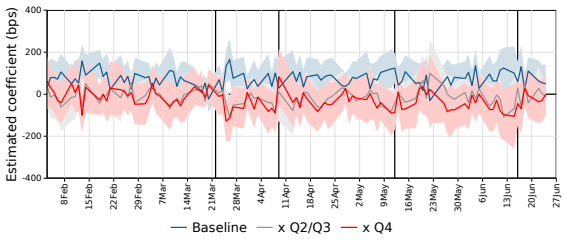
(a) Constant, BAS spread



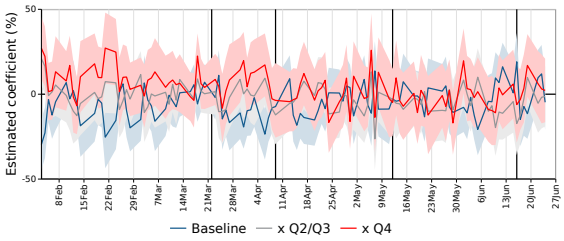
(b) Constant, net customer flow



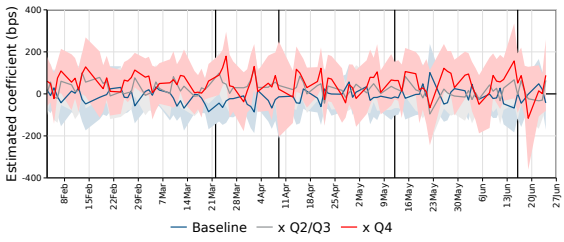
(c) Maturity dummy, BAS spread



(d) Maturity dummy, net customer flow



(e) HY dummy, BAS spread



(f) HY dummy, net customer flow

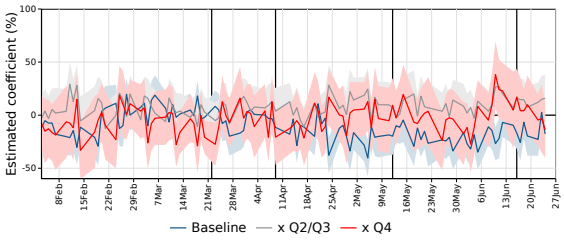
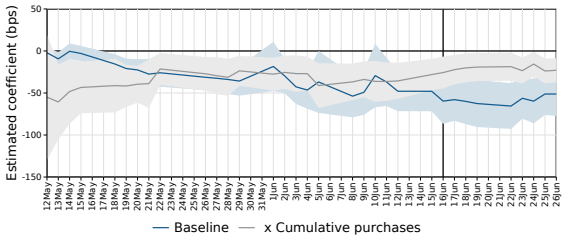
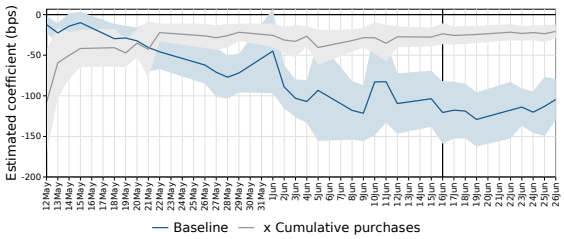


Figure A.6. Purchase impact on duration-matched spreads. This figure plots the estimated coefficients from the regression of cumulative bond-level changes since the commencement of purchases in duration-matched spreads on bank issuer, bond maturity prior to Sep 2025, high yield rating dummies and dollar cumulative purchase volume with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event line at June 16 (commencement of cash bond purchases).

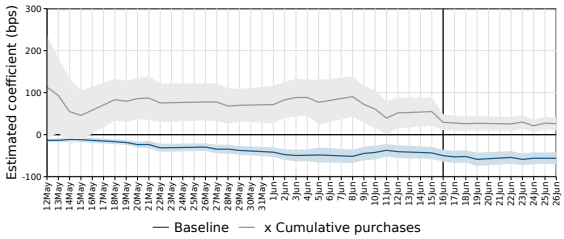
(a) Constant, no FE



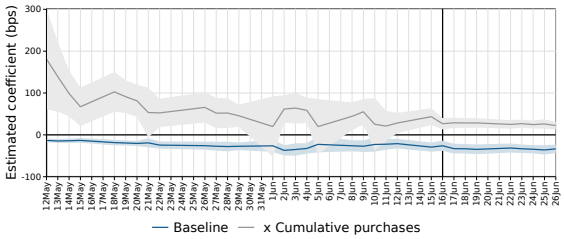
(b) Constant, FE



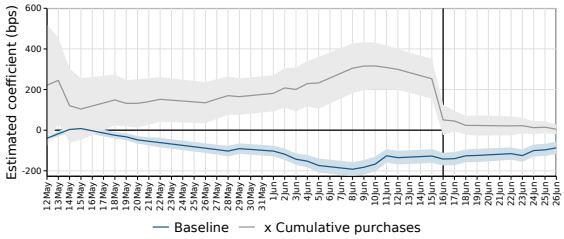
(c) Maturity dummy, no FE



(d) Maturity dummy, FE



(e) HY dummy, no FE



(f) HY dummy, FE

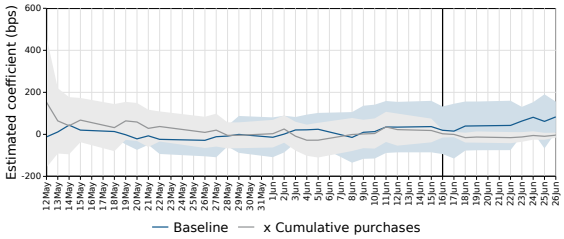
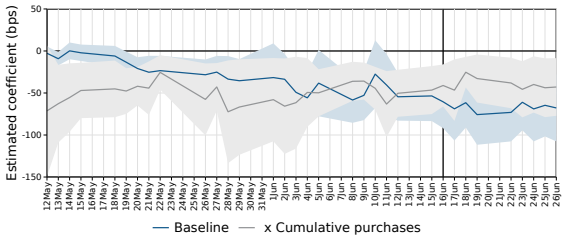
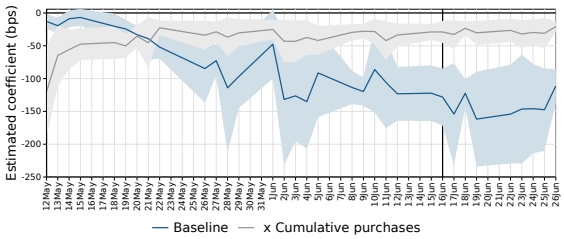


Figure A.7. Purchase impact on default-adjusted spreads. This figure plots the estimated coefficients from the regression of cumulative bond-level changes since the commencement of purchases in duration-matched spreads on bank issuer, bond maturity prior to Sep 2025, high yield rating dummies and dollar cumulative purchase volume with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event line at June 16 (commencement of cash bond purchases).

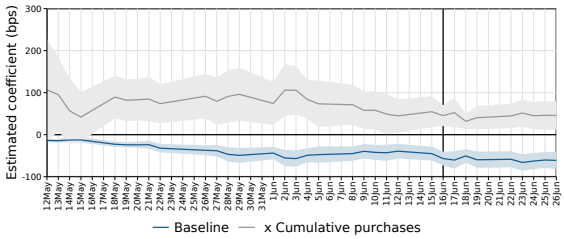
(a) Constant, no FE



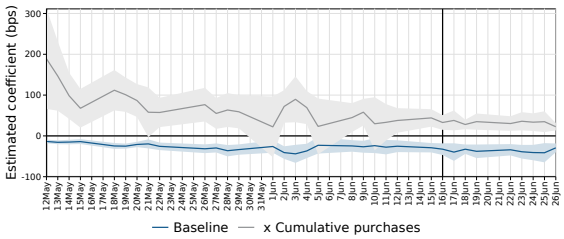
(b) Constant, FE



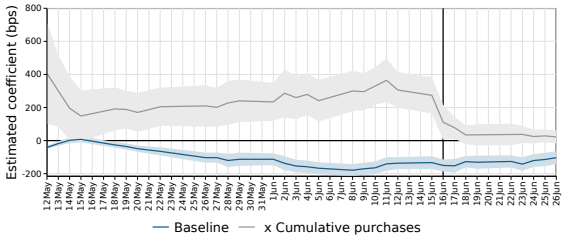
(c) Maturity dummy, no FE



(d) Maturity dummy, FE



(e) HY dummy, no FE



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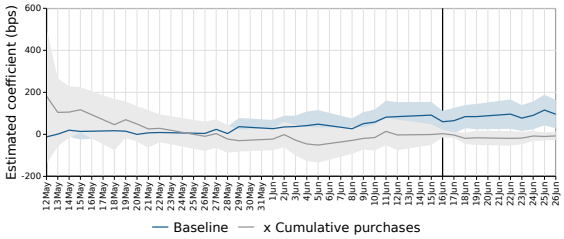
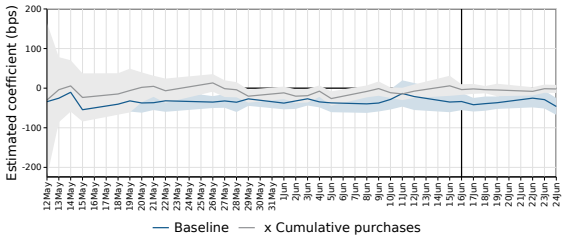
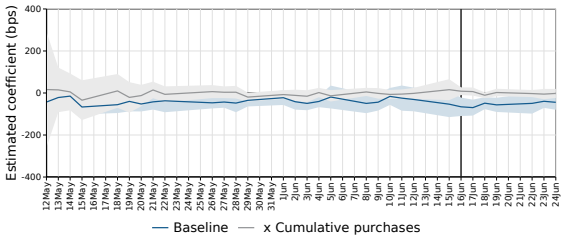


Figure A.8. Purchase impact on effective bid-ask spreads. This figure plots the estimated coefficients from the regression of cumulative bond-level changes since the commencement of purchases in effective bid-ask spreads on bank issuer, bond maturity prior to Sep 2025, high yield rating dummies and dollar cumulative purchase volume with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event line at June 16 (commencement of cash bond purchases).

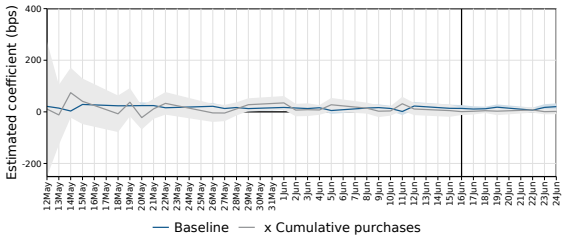
(a) Constant, no FE



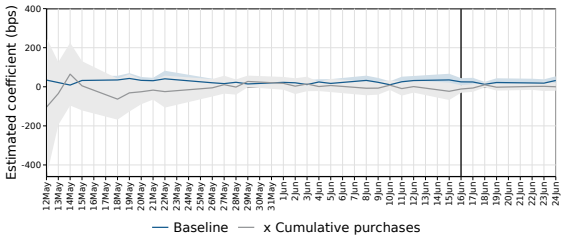
(b) Constant, FE



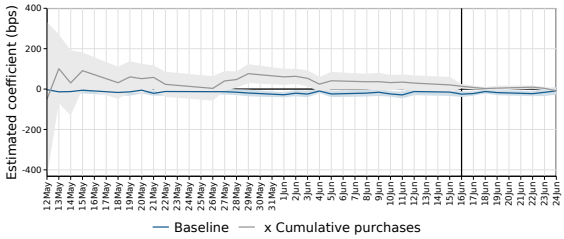
(c) Maturity dummy, no FE



(d) Maturity dummy, FE



(e) HY dummy, no FE



(f) HY dummy, FE

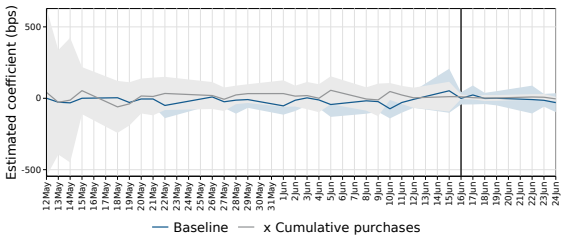
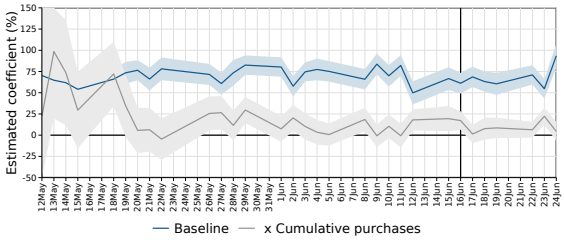
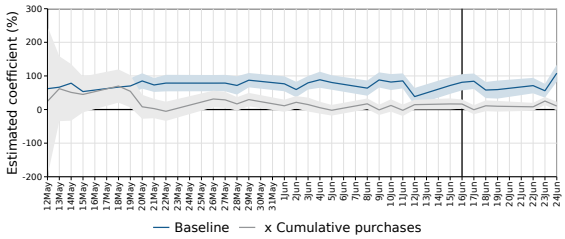


Figure A.9. Purchase impact on net customer flow. This figure plots the estimated coefficients from the regression of cumulative bond-level changes since the commencement of purchases in net customer flow on bank issuer, bond maturity prior to Sep 2025, high yield rating dummies and dollar cumulative purchase volume with (right column) and without (left column) issuer fixed effects. All regressions control for standard bond characteristics. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event line at June 16 (commencement of cash bond purchases).

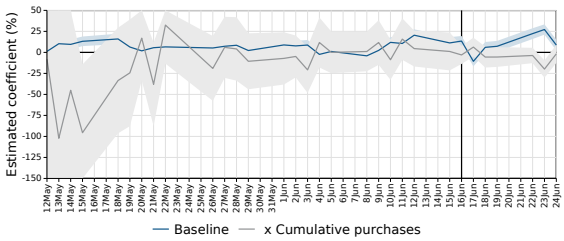
(a) Constant, no FE



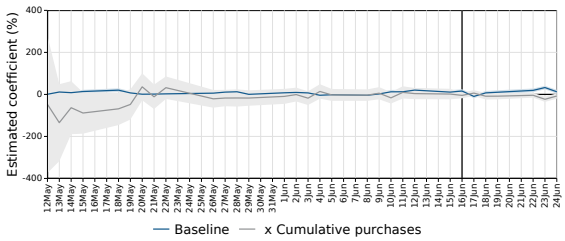
(b) Constant, FE



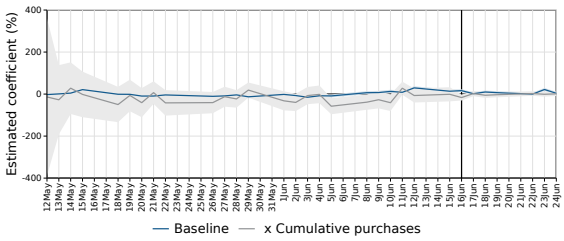
(c) Maturity dummy, no FE



(d) Maturity dummy, FE



(e) HY dummy, no FE



(f) HY dummy, FE

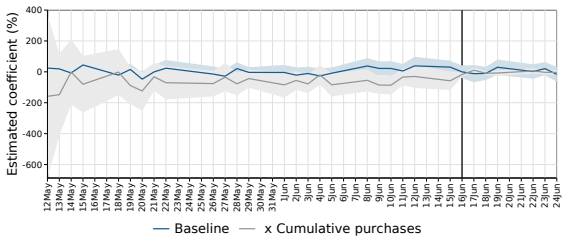
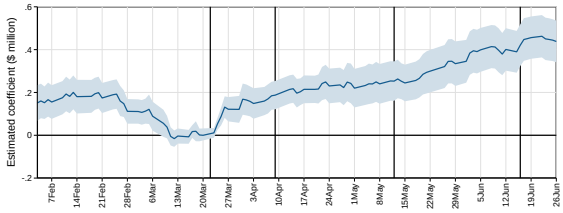
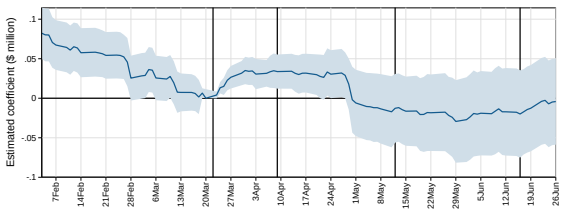


Figure A.10. Bank-affiliated dealers increase net inventory bought from customers since March. This figure plots the estimated coefficients from the regression of cumulative bond-level changes since March 22 in net purchases from customers on bank issuer, bond maturity prior to Sep 2025, high yield rating and seller eligibility dummies for bank-affiliated (left column) and stand-alone (right column) dealers. All regressions control for standard bond characteristics and dealer fixed effects. 95% confidence bands based on standard errors clustered at the issuer level reported as shaded areas around the point estimate. Regressions estimated as repeated cross-sections for each trading date in the sample. Event lines at: March 22 (initial CCF announcement); April 9 (first term sheet update); May 12 (commencement of ETF purchases); June 16 (commencement of cash bond purchases).

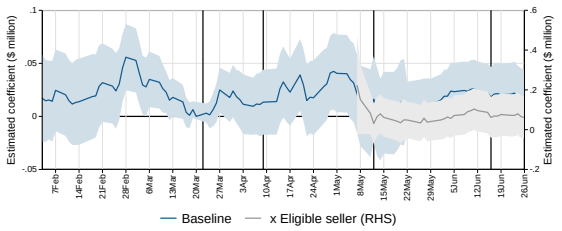
(a) Constant, bank-affiliated



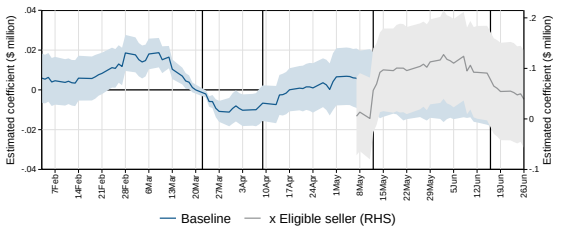
(b) Constant, stand-alone



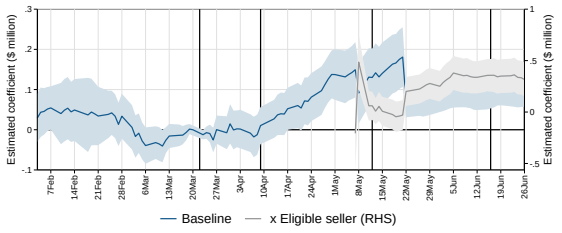
(c) Maturity dummy, bank-affiliated



(d) Maturity dummy, stand-alone



(e) HY dummy, bank-affiliated



(f) HY dummy, stand-alone

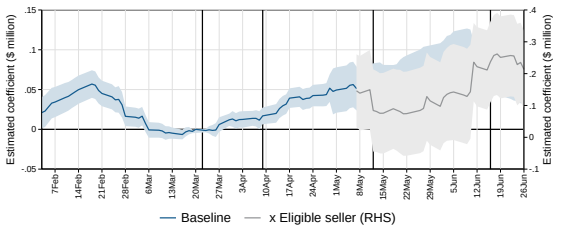


Figure A.11. Employment losses from January to April 2020. This figure plots the percentage employment losses from January to April 2020 by 3-digit NAICS industry. Monthly employment data from Bureau of Labor Statistics.

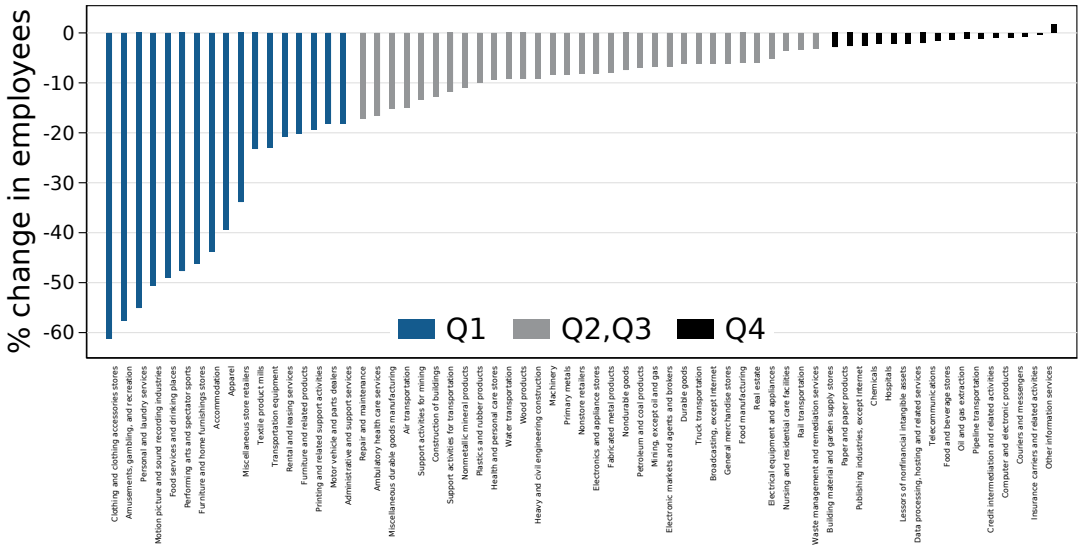


Figure A.12. Distribution of Q1 2020 profitability. This figure plots the distribution of Q1 2020 firm-level quarter-over-quarter EBITDA growth rate. Income and balance sheet data from Compustat.

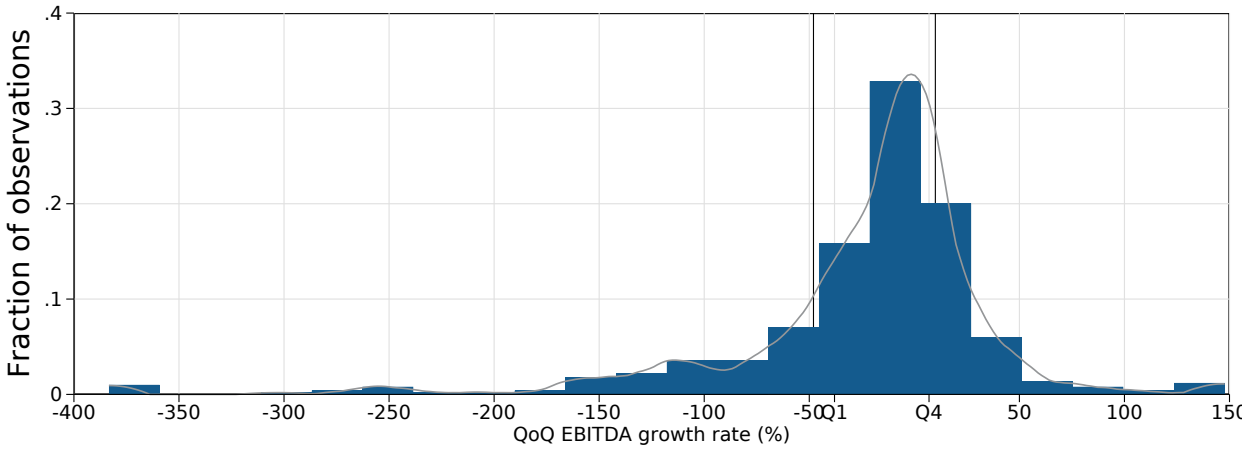
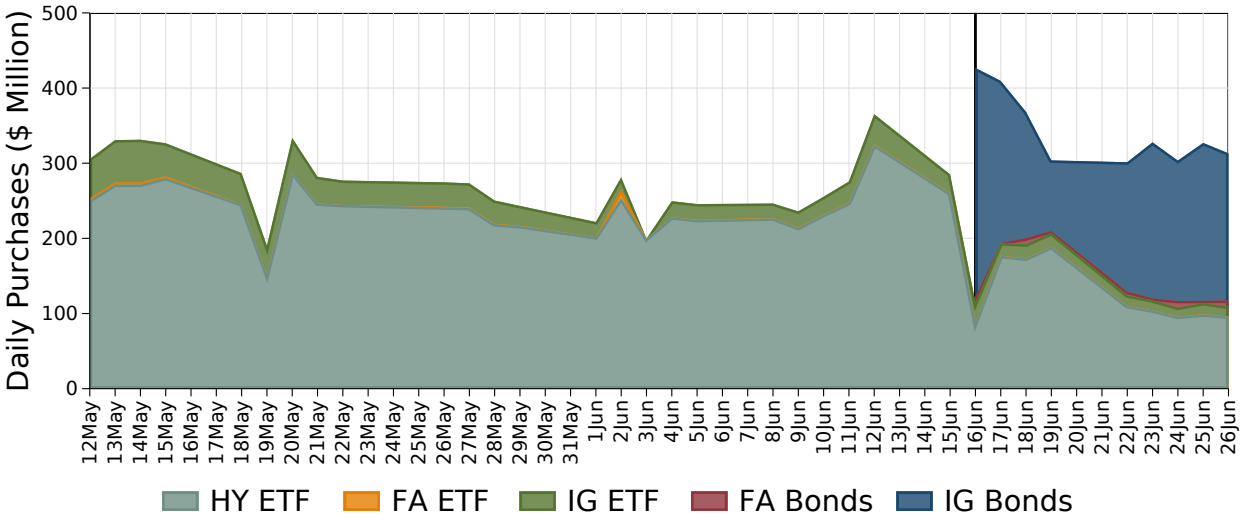



Figure A.13. Daily CCF purchase volume. This figure plots the time series of daily CCF purchase volume by asset class.