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CORPORATE BOND LIQUIDITY DURING THE COVID-19 CRISIS

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Corporate Bond Liquidity During the COVID-19 Crisis

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ABSTRACT

We study liquidity conditions in the corporate bond market since the onset of the COVID-19 pandemic. We find that in mid-March 2020, as selling pressure surged, dealers were wary of accumulating inventory on their balance sheets, perhaps out of concern for violating regulatory requirements. As a result, the cost to investors of trading immediately with a dealer surged. A portion of transactions migrated to a slower, less costly process wherein dealers arranged for trades directly between customers without using their own balance sheet space. Interventions by the Federal Reserve appear to have relaxed balance sheet constraints: soon after they were announced, dealers began absorbing inventory, bid-ask spreads declined, and market liquidity started to improve. Interestingly, liquidity conditions improved for bonds that were eligible for the Fed's lending/purchase programs and for bonds that were ineligible. Hence, by allowing dealers to unload certain assets from their balance sheet, the Fed's interventions may have helped dealers to better intermediate a wide variety of assets, including those not directly targeted.

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So when Mr. Rao called senior executives for an explanation on why [broker-dealers] wouldn't trade, they had the same refrain: There was no room to buy bonds and other assets and still remain in compliance with tougher guidelines imposed by regulators after the previous financial crisis [...] One senior bank executive leveled with him: "We can't bid on anything that adds to the balance sheet right now."—**The Wall Street Journal**, (May 20, 2020, "The Day Coronavirus Nearly Broke The Financial Markets" [Baer, 2020](#))

1 Background and Motivation

The COVID-19 pandemic has wrought havoc on the global economy. In mid-March, as both the scope of the pandemic and the duration of its effects became apparent, financial markets around the world entered a period of turmoil. As the price of equities and debt plummeted, reports of illiquidity in key financial markets emerged.¹ In the United States, the Federal Reserve responded with a variety of interventions aimed at different markets within the financial sector.

In this note, we attempt to shed light on recent trading conditions in one such market: the market for US corporate bonds. This market, nearly \$10 trillion in size, serves as a primary source of funding for large US corporations. However, with the prospect of widespread downgrades and possible defaults, the cost of issuing debt increased dramatically in mid-March, and investors withdrew their money from corporate bond funds in record numbers.² In the midst of this turmoil, former Federal Reserve chairs Bernanke and Yellen described the corporate bond market as "under significant stress" ([Bernanke and Yellen, 2020](#)), while a March 18 report from Bank of America deemed the market "basically broken" ([Idzelis, 2020](#)).

In response, the Federal Reserve introduced several facilities to lower the costs of intermediating corporate debt and to bolster liquidity. On the evening of March 17, the Federal Reserve introduced the Primary Dealer Credit Facility (PDCF), offering collateralized overnight and term

¹In fact, reports of trading difficulties even reached the market for Treasuries, in what [Chappatta \(2020\)](#) described as a "stunning lack of liquidity in what's often billed as the world's deepest and most liquid bond market."

²For example, between March 5 and March 20, the ICE Bank of America AAA US Corporate Index Option-Adjusted spread increased by about 160 basis points (bps), while the corresponding spread for high yield corporate debt (HY) increased by more than 500 bps. See [Ebsim, Faria-e Castro, and Kozlowski \(2020\)](#) for a comprehensive analysis of credit spreads during this time period. Also see [Haddad, Moreira, and Muir \(2020\)](#) for a study of credit market disruptions during the COVID-19 crisis. They document large discounts for corporate bonds and bond ETFs relative to their CDS spreads and NAVs, respectively, which are more pronounced for the safer end of the credit spectrum.

lending to primary dealers. By allowing dealers to borrow against a variety of assets on their balance sheets, including investment grade corporate debt, this facility intended to reduce the costs associated with holding inventory and intermediating transactions between customers. On March 23, the Federal Reserve proposed even more direct interventions in the corporate bond market through the Primary and Secondary Market Corporate Credit Facilities (PMCCF and SMCCF, respectively). These facilities were designed to make outright purchases of corporate bonds issued by investment grade US companies, along with US-listed exchange-traded funds (ETFs) that invested in US investment grade corporate bonds. On April 9, these corporate credit facilities were expanded in size and extended to allow for purchases of ETFs that invested in high yield corporate bonds.³

To study the effects of these interventions on trading conditions, we explore several dimensions of market liquidity. We start with perhaps the most common metric, the bid-ask spread, which [Demsetz \(1968\)](#) famously defined as “the cost of making transactions *without delay*.”⁴ However, in the corporate bond market, dealers actually offer two types of transaction services: “principal trades,” where the customer trades quickly against dealers’ inventory; and “agency trades,” where the customer typically waits for dealers to locate another customer to take the other side of the trade. Principal trades are fast, high quality transaction services as envisioned by Demsetz, while agency trades represent a slower, lower quality version.⁵ Naturally, then, the prices of these distinct transaction services can differ significantly, and the frequency with which each type is used can depend on both market conditions and prevailing regulatory requirements.

At the height of the COVID-induced panic, with investors rushing to sell assets as quickly as possible and dealers hesitant to absorb assets directly onto their balance sheets, how much did dealers charge customers to trade immediately via principal trades? What was the cost of trading at a delay, via agency trades, that spared dealers from holding assets on their balance sheets? How did the Fed’s interventions affect dealers’ willingness to accumulate inventory, the price they charged for their transaction services, and the composition of principal vs. agency trades? These are the empirical questions that we attempt to answer below, as we provide an account of trading conditions in the corporate bond market that allows for this crucial distinction between different types of transaction services. In the Appendix, we provide a simple theoretical

³The April 9 update also allowed the SMCCF to make direct purchases of bonds that had been downgraded from investment grade to high yield status (so-called “fallen angels”) after March 22.

⁴The italics are part of the author’s quotation.

⁵See, e.g., [An and Zheng \(2018\)](#) and [An \(2019\)](#) for formal models.

framework to help interpret some of our empirical observations.

2 The Costs of Trading, Fast and Slow

To capture the average transaction cost for principal trades alone, we calculate the measure of spreads proposed by [Choi and Huh \(2018\)](#). More specifically, we calculate the average spread between the price that customers pay or receive when trading with a dealer, relative to a reference inter-dealer price, calculated each day for each bond and weighted by trade size. Importantly, we do *not* include trades in which the dealer who buys the bond from a customer holds it for less than 15 minutes. In doing so, we leave out those trades where the dealer had pre-arranged for another party (either a customer or another dealer) to buy the bond immediately.

To capture the average transaction cost of agency trades, we calculate a modified version of the Imputed Roundtrip Costs measure described in [Feldhütter \(2012\)](#).⁶ To construct this modified imputed roundtrip cost (MIRC), we first identify roundtrip trades, defined as two trades in a given bond with the same trade size that take place within 15 minutes of each other: a sale from a customer to a dealer, and a purchase by a customer from a dealer. Then, for each roundtrip trade, we calculate the MIRC as the percentage difference between the maximum and minimum prices. A daily estimate of average roundtrip cost is the average MIRC on that day across bonds, weighted by the value of each trade.

We construct the two series using dealers' reports to the Trade Reporting Compliance Engine (TRACE), which is made available by the Financial Industry Regulation Authority (FINRA), and plot the output in [Figure 1](#).⁷ In all of our plots, we include vertical dashed lines to highlight several key dates: February 19, when stock markets reached their all-time peaks; March 5, which marks the beginning of the extended fall in equity prices and rise in corporate credit spreads; March 9, the first day of trading after Saudi Arabia initiated an oil price war with Russia; March 18, the first day of trading after the announcement of the PDCF; March 23, the day that the PMCCF and SMCCF were announced; and April 9, the day that the size and scope of the corporate credit facilities were expanded.

⁶We provide additional details on the construction of this measure in the Appendix.

⁷We describe the data in greater detail, along with the specifics of our calculations, in the Appendix.

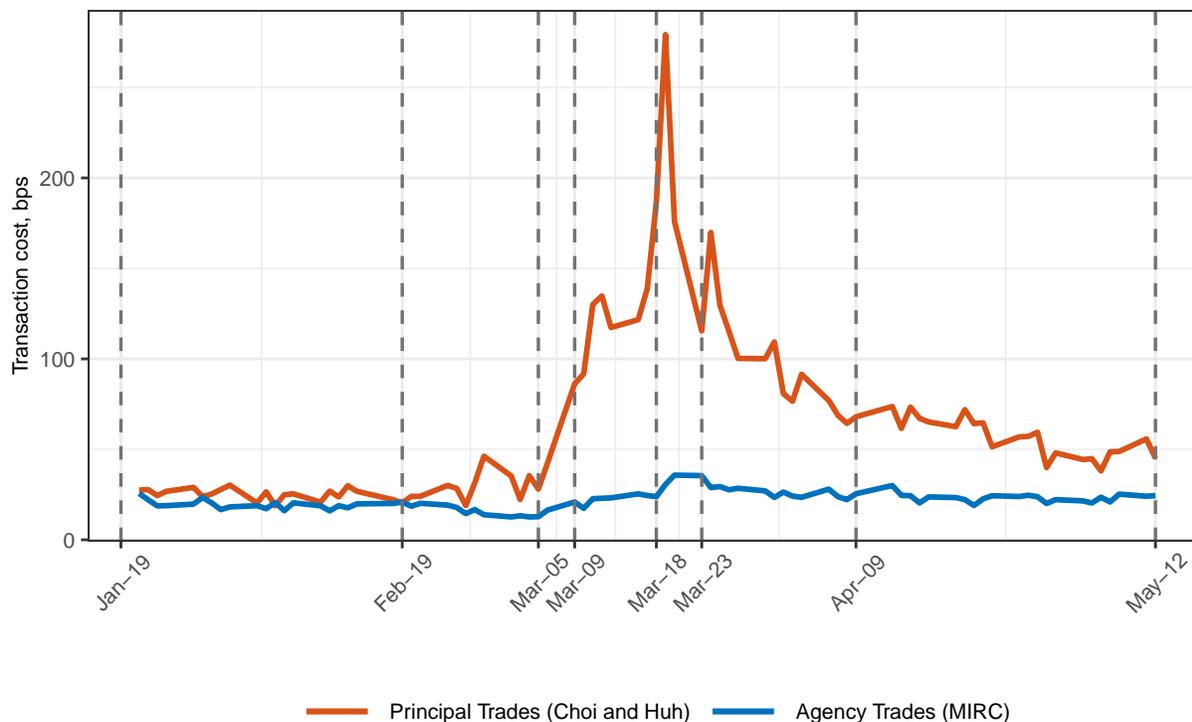


Figure 1. Transaction costs (Choi and Huh (2018) vs MIRC).

The two measures of transaction costs are relatively similar, and stable, through February 19. However, the cost of principal trades rises dramatically over the ensuing weeks, while the cost of agency trades is more muted. In particular, between Thursday, March 5, and Monday, March 9, the cost of principal trades roughly triples, to approximately 100 bps; over these three trading days, the S&P 500 Index declined more than 12%. A week later, during the most tumultuous period of March 16-18, this series continues to rise, reaching a peak of more than 250 bps, before beginning a steady decline after the announcement of the SMCCF on March 23. The MIRC measure, in contrast, increases from a baseline of approximately 20 bps to just under 40 bps, before receding back to pre-crisis levels.

To highlight the relative costs of principal and agency trades, we plot the ratio of the two series in Figure 2. One can see that the cost of trading immediately was considerably more responsive to both the heightened selling pressure induced by the pandemic in mid-March and the Fed’s interventions which followed. This evidence is broadly consistent with anecdotes from dealers (such as the one in the epigraph) that ascribe a central role to balance sheet costs in the determination of market liquidity. Moreover, despite considerable improvement in both metrics

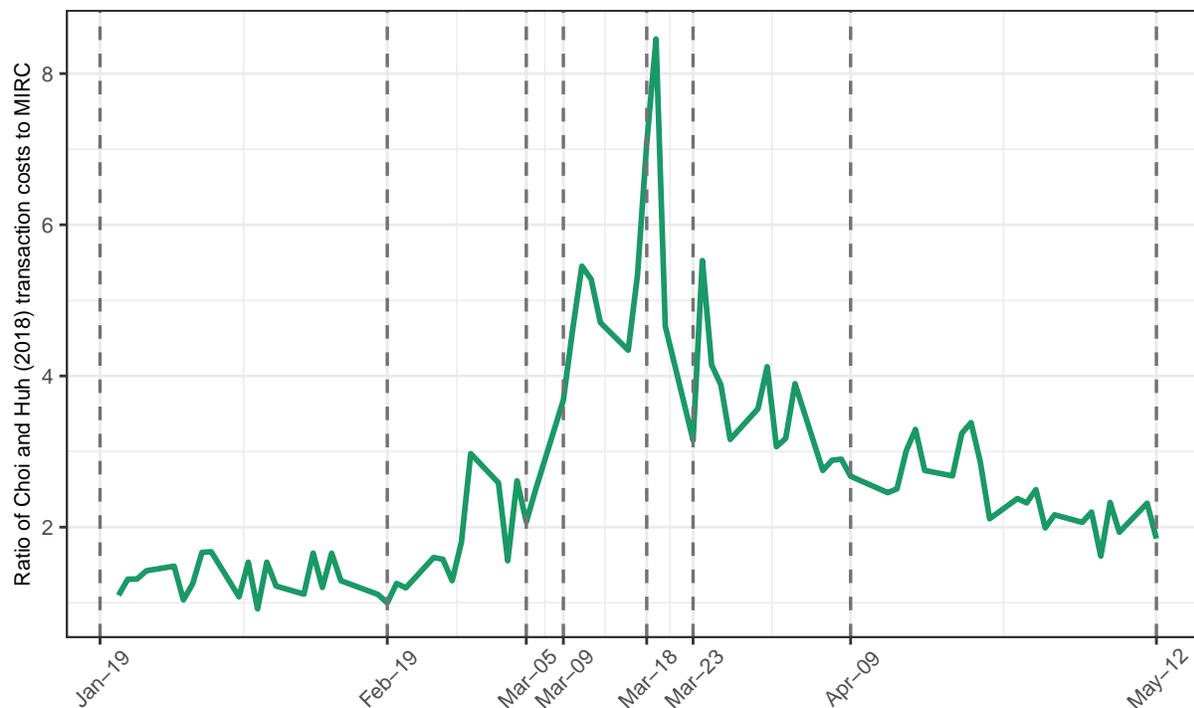


Figure 2. Ratio of Choi and Huh (2018) transaction costs to MIRC

during the month of April, note that the price of trading immediately remains elevated, which suggests that liquidity conditions remain somewhat strained.

3 Did Dealers Lean Against the Wind?

Since dealers were charging considerably higher prices to trade immediately, one might expect customers to respond by substituting towards slower, agency trades. Figure 3 confirms that this was indeed the case during the most tumultuous weeks of trading in mid-March. For example, between March 5 and March 23, the fraction of agency trades measured by both number (left axis) and volume (right axis) increased by about 10 percentage points, before receding after the March 23 announcement of the corporate credit facilities. As a result, if one were to measure trading costs across all trades, they would underestimate the erosion in liquidity as the composition of trades shifted from faster, more expensive principal trades to less costly, but slower agency trades.

To summarize our results thus far, at the height of massive selling pressure in mid-March—when

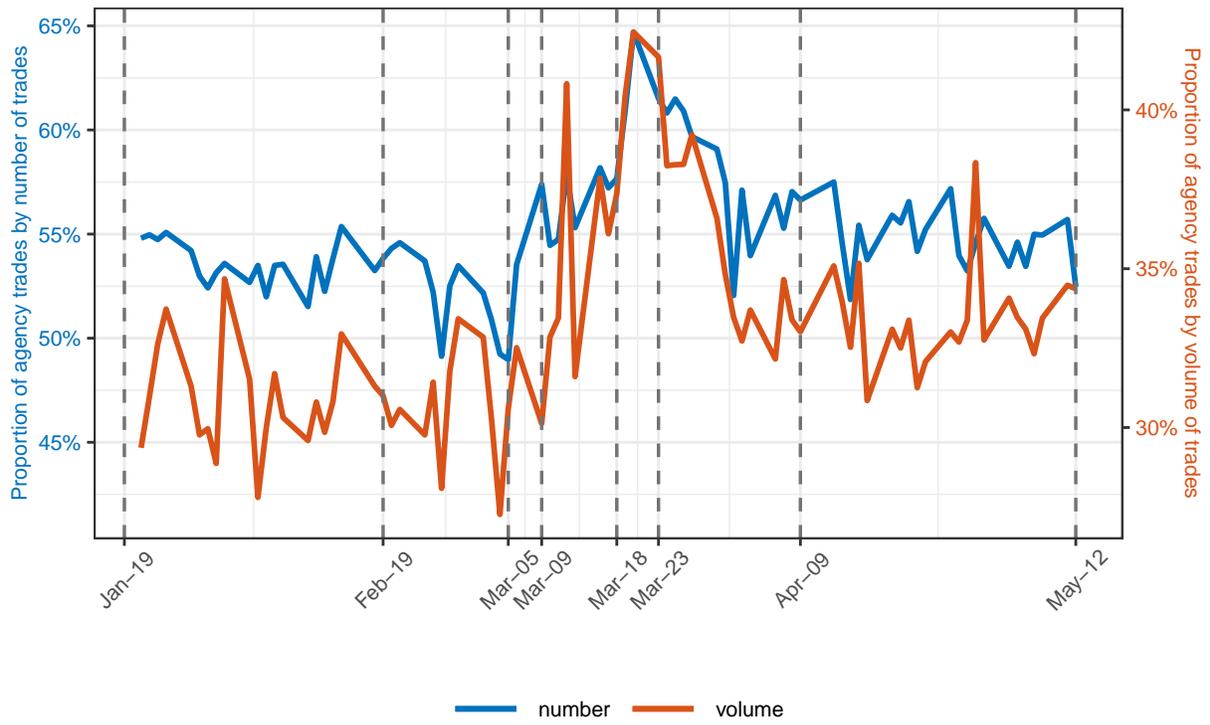


Figure 3. Proportion of Agency Trades, all bonds.

funds investing in investment-grade corporate bonds faced withdrawals of almost \$100 billion alone (Scaggs, 2020)—the price of trading immediately increased substantially, and the fraction of principal trades declined. In light of these observations, one might naturally wonder: who was providing liquidity in the corporate bond market? Were dealers “leaning against the wind” and absorbing some of the inventory during the selloff, as described in Weill (2007)? Or was the shift to agency trades sufficiently large that other customers were ultimately providing liquidity?

To answer this question, we construct a measure of the (cumulative) value of bonds that were absorbed over time by the dealer sector. In particular, using the daily Market Sentiment data from FINRA, we subtract the value of bonds that dealers sell to customers from the value of bonds that they buy from customers each day, and then calculate the cumulative sum of the net changes.⁸ Figure 4 plots the cumulative net change in inventory held in the dealer sector, both in levels (left axis) and as a fraction of pre-crisis outstanding supply (right axis), starting on February 19, 2020.

Several aspects of Figure 4 are striking. First, during the most tumultuous period of trading, the dealer sector absorbed, on net, *no* additional inventory despite the considerable selling pressure. Hence, during this period, it was indeed other customers that were supplying liquidity to the market. Second, dealers’ reluctance to absorb inventory appears to have changed substantially around the dates corresponding to the Fed’s announcement of the Primary Dealer Credit Facility (March 18) and the Primary and Secondary Market Corporate Credit Facilities (March 23). Lastly, dealers have continued to accumulate inventory through April and the first half of May. Indeed, since March 18, the data indicates that dealers have absorbed nearly \$50 billion in corporate debt, or roughly double the amount they held before the pandemic.⁹

4 Liquidity Across Ratings and Maturity

The evidence above suggests that improvements in corporate bond market liquidity coincided with the announcements of several significant interventions by the Federal Reserve, such as the PMCCF and the SMCCF. When these programs were first announced on March 23, the term sheets specified that the facilities could only purchase investment grade corporate debt with a

⁸See [FINRA TRACE Market Aggregate Information](#).

⁹From Table L.130 of the Flow of Funds, at the end of 2019Q4, security brokers and dealers held \$54 billion in corporate and foreign bonds on the asset side of their balance sheets.

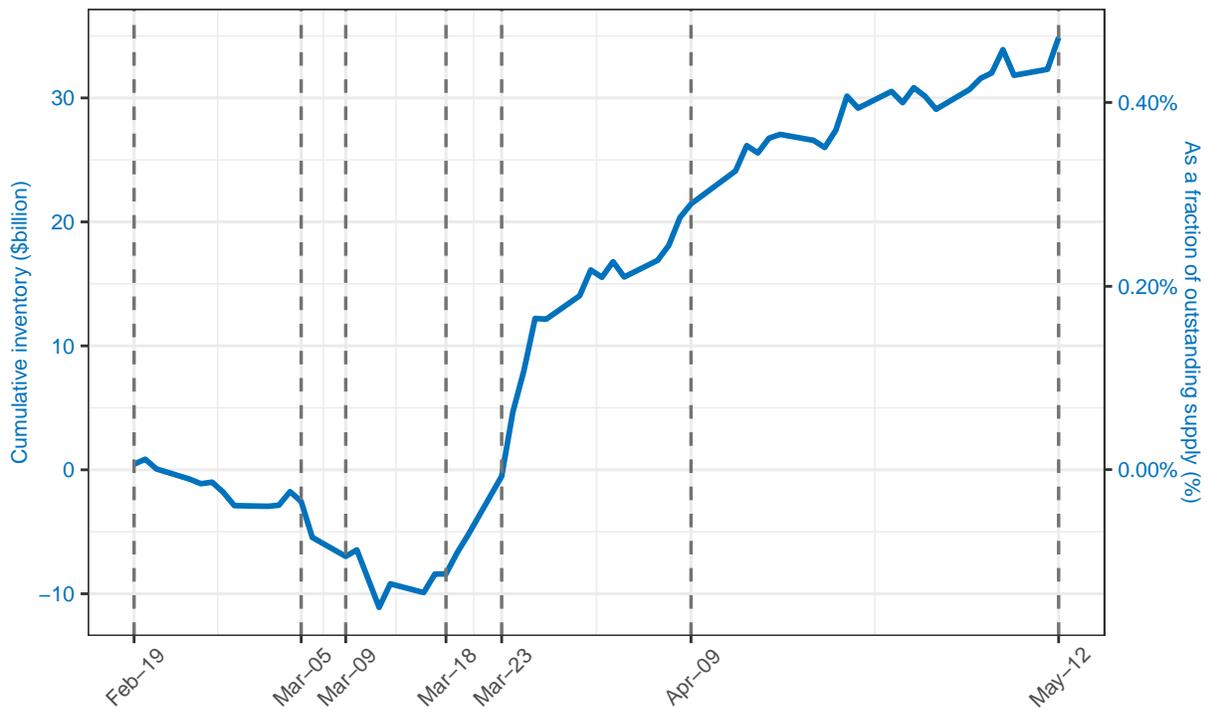


Figure 4. Cumulative inventory change (USD billions) in the dealer sector and as a fraction of total supply, according to FINRA market sentiment tables.

maturity of five years or less (the possibility of purchasing ETFs holding high yield corporate debt was introduced later, on April 9). To better understand the sources of illiquidity in the corporate bond market, and the potential effects of these interventions, we now explore the cost of trading eligible and non-eligible bonds since the onset of the pandemic.

To start, Figure 5 plots the [Choi and Huh \(2018\)](#) measure of transaction costs for investment grade (IG) and high yield (HY) corporate bonds (left axis), along with the ratio of the two (right axis). Roughly speaking, the spreads for IG and HY bonds exhibit similar patterns over the sample period: they increase considerably between March 5 and March 23 (with HY bonds issued by firms in the energy sector spiking dramatically on March 9), before gradually receding through April and May. Interestingly, during the week of March 16-20, when markets were most illiquid, IG and HY bonds were *equally* illiquid. This observation is consistent with anecdotal evidence that dealers were unwilling to add *any* assets to their balance sheets in mid-March. It is inconsistent with, e.g., a theory of illiquidity based on adverse selection, since typically adverse selection would be more severe (and hence spreads would be larger) for more information-sensitive, HY bonds.

It is also noteworthy that the announcements of the Fed's interventions did not have drastically different effects on eligible and non-eligible bonds, as both IG and HY bonds spreads fell significantly after March 23, though the fall was more pronounced for eligible, IG bonds. This observation suggests that bond purchases could have important indirect effects, i.e., that enabling dealers to unload IG bonds from their balance sheet freed them up to intermediate all bonds (and, perhaps, other assets, too). We reach similar conclusions when we examine eligibility restrictions based on maturity. Figure 6 plots the transaction costs of principal trades for bonds with time-to-maturity (TTM) of less than 5 years (which were eligible for purchase by the SMCCF) and more than 5 years (which were not). Again, the ratio of spreads between the two classes of bonds does not indicate that liquidity conditions for eligible bonds improved more drastically than those for ineligible bonds.

5 Conclusion

This note explores liquidity conditions in the corporate bond market during the COVID-19 pandemic. Illiquidity has a direct negative effect on bond prices: for example, [Amihud and](#)

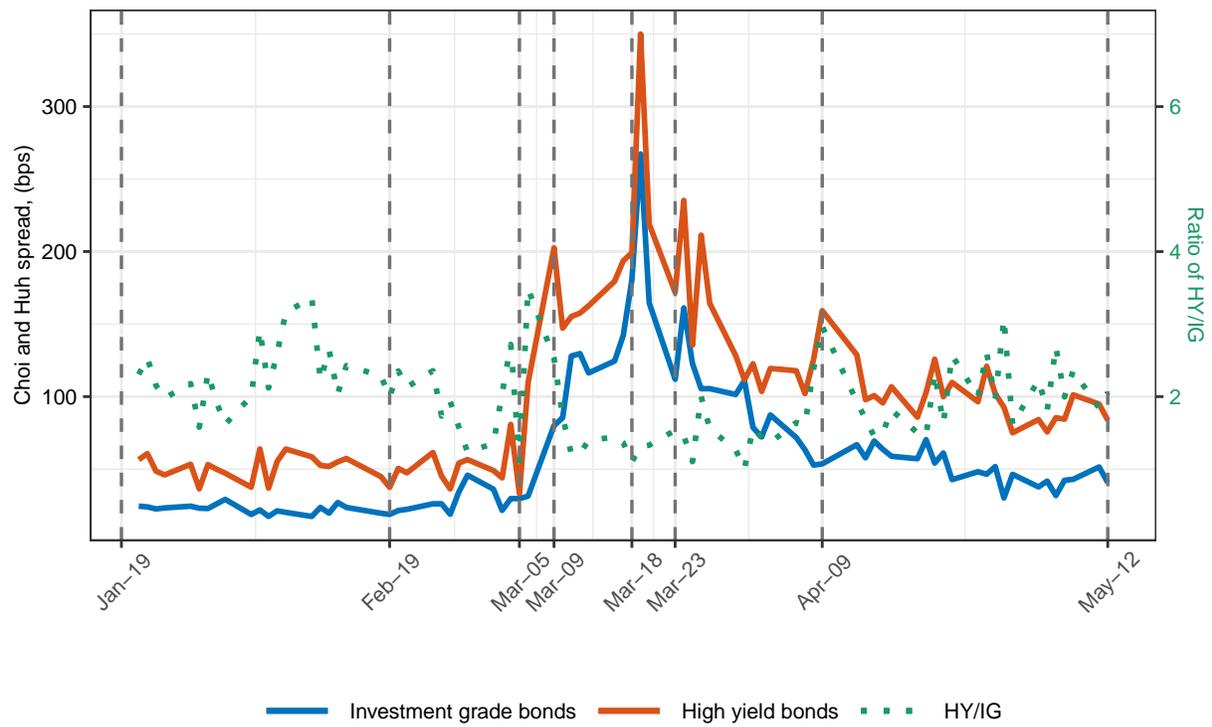


Figure 5. Choi and Huh spread across rating categories

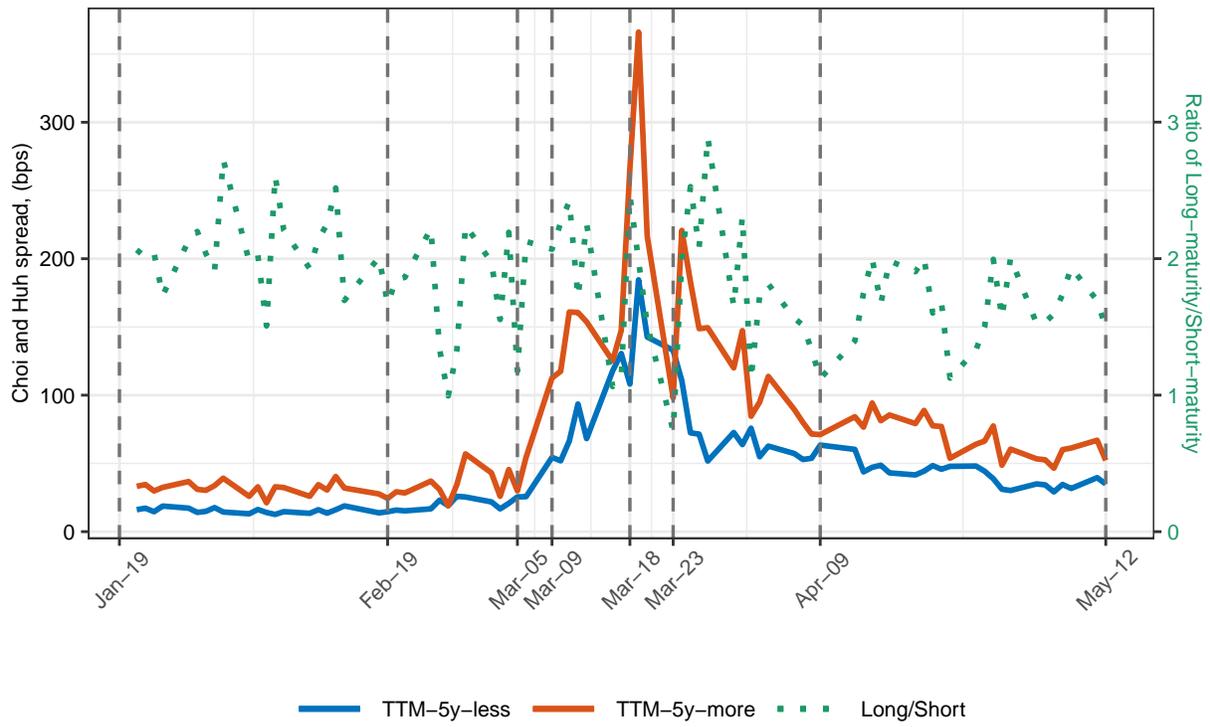


Figure 6. Choi and Huh spread across maturities

Mendelson (1986) have shown that, under natural conditions, illiquidity creates a price discount equal to the expected present value of transaction costs incurred by successive buyers. There are important indirect effects too: for example, He and Xiong (2012) and He and Milbradt (2014) show that such a price discount creates rollover losses and brings a firm closer to default.

Moreover, there are indications that the main source of illiquidity in the corporate bond market—namely, the inability of dealers to absorb inventory onto their balance sheets—was also an important factor in the markets for Treasuries, municipal bonds, and asset-backed securities.¹⁰ Hence, by understanding the behavior of dealers in the corporate bond market, and the effects of the Fed’s various interventions, we hope to provide insight into these other important, dealer-intermediated over-the-counter markets as well.

While the data provides an interesting, real-time assessment of market conditions, much work remains to be done. First, we would like to explore empirical strategies to better determine the causal relationship between policy interventions and market outcomes, as the current analysis is only suggestive, at best. Second, we would like to compare both credit spreads and transaction costs during the recent market turmoil to those observed during the Global Financial Crisis of 2008. By comparing the market’s reaction during these two episodes—which were induced by different shocks amid different regulatory regimes—we hope to shed light on the extent to which each episode should be viewed as a solvency crisis, as opposed to a liquidity crisis.

¹⁰See, e.g., Cheng, Wessel, and Younger (2020).

6 Appendix

6.1 Data Filtering

We first filter the report data following the procedure laid out in [Dick-Nielsen \(2014\)](#). We merge the resulting data set with the TRACE master file, which contains bond grade information, and with the Mergent Fixed Income Securities Database (FISD) to obtain bond fundamental characteristics. Following the bulk of the academic literature, we exclude bonds with optional characteristics, such as variable coupon, convertible, exchangeable, and puttable, as well as on-the-run bonds (issued less than 90 days ago), asset-backed securities, and private placed instruments. The final sample contains 6,104,089 transactions in 34,407 bonds, for a sample period running from January 1 to May 12, 2020.

6.2 Dates Highlighted in the Figures

We choose the following dates to highlight in the figures with vertical, dashed lines:

January 19: beginning of the series, chosen to start the sample period one month before the stock market peak.

February 19 stock market peak.

March 5: beginning of extended fall in equity prices and rise in corporate credit spreads.

March 9: first day of trading after Saudi Arabia initiated an oil price war with Russia.

March 18: first day of trading after announcement of Primary Dealer Credit Facility (announced evening of March 17).

March 23: announcement of Primary and Secondary Market Corporate Credit Facilities.

April 9: expansion of PMCCF and SMCCF (in both size and scope).

6.3 Modified Imputed Roundtrip Trading Costs

We first construct pairs of Imputed Roundtrip Trades (IRT) as in [Feldhütter \(2012\)](#), but with several additional restrictions. To construct an IRT, we match a customer-sell trade with a customer-buy trade of the same size that takes place in a time window of 15 minutes. We do not include interdealer trades in IRTs, so that each IRT only includes one customer buy trade and one customer sell trade. Note that a particular bond may have multiple IRTs in a single day. Then, to compute the modified imputed roundtrip cost (MIRC), we calculate $(P_{max} - P_{min})/P_{max}$, where P_{max} is the largest price in the IRT and P_{min} is the smallest price in the IRT. Within each bond, we calculate the daily average roundtrip cost as the average of the bond's IRCs on that day, weighted by trade size. Finally, a daily estimate of average roundtrip cost is the average of roundtrip costs on that day across all bonds, weighted by bonds' total trading volumes.

6.4 Choi and Huh's Measure of Spreads

Following Choi and Huh (2018), we calculate $spread1 = 2Q \times \frac{\text{traded price} - \text{reference price}}{\text{reference price}}$, where Q is equal to +1 for a customer *buy* and -1 for a customer *sell*. For each customer trade, the reference price is taken to be the volume-weighted average price of interdealer trades larger than \$100,000 in the same bond-day, excluding interdealer trades executed within 15 minutes. The measure $spread1$ is calculated at the trade level for all customer principal trades (held in dealer inventories for more than 15 minutes) and is also calculated at the bond-day level by taking the volume-weighted average of trade level spreads.

6.5 A Simple Theoretical Framework

In this Appendix we develop a simple theoretical framework to interpret our empirical findings. We represent the COVID-19 crisis as an exogenous shock to the aggregate demand for transaction services in the corporate bond market.¹¹ We study the impact of this shock on the equilibrium quantities and prices of agency and risky-principal trades.

The Model

There are two types of agents: a measure N of customers and a measure one of dealers, all price takers. Each customer seeks to make a number of transactions normalized to one: therefore, in this model, the aggregate transaction demand is exogenous and equal to N . Although the total number of transaction is exogenous, the composition of transactions is not. Namely, we assume that customers demand vertically differentiated transaction services supplied by dealers at a convex cost: low-quality transaction services, interpreted as agency trades, and high-quality, interpreted as risky-principal trades.

Customers have quasi-linear utility for transaction services and for cash. Specifically, the problem of a customer is to choose how much low- and high-quality transaction services to demand from dealers in order to maximize:

$$u(x_l, x_h) - p_l x_l - p_h x_h,$$

subject to the constraint that the total number of transactions adds up to the exogenously desired level, $x_l + x_h = 1$. We assume that $u(x_l, x_h)$ is increasing, concave, twice continuously differentiable, and satisfies $u_h(x_l, x_h) - u_l(x_l, x_h) \geq 0$, where the h and l subscripts are short-hands for first partial derivatives with respect to x_h and x_l , respectively. This condition simply means that the customer values more high- than low-quality transaction services.

Assuming from now on interior solutions, the first-order optimality condition of the customer is:

$$u_h(x_l, x_h) - u_l(x_l, x_h) = p_h - p_l, \quad \text{where } x_l + x_h = 1.$$

On the other side of the market, dealers choose their supplies of transaction services, X_l and X_h , in order to maximize profits:

$$p_l X_l + p_h X_h - C(X_l, X_h),$$

¹¹According to the FINRA market sentiment tables referenced above, volume increased by about 50 percent between February 19th and March 31st, relative to the January 19th to February 19th period.

where $C(X_l, X_h)$ is some continuous, convex, and twice continuously differentiable cost function. This leads to the first-order optimality conditions

$$p_l = C_l(X_l, X_h) \quad \text{and} \quad p_h = C_h(X_l, X_h).$$

Finally, the market clearing conditions for transaction services are simply:

$$X_l = Nx_l \quad \text{and} \quad X_h = Nx_h.$$

An equilibrium given aggregate transaction demand N is a tuple $(x_l, x_h, X_l, X_h, p_l, p_h)$ solving the first-order optimality conditions of customers and dealers, and the market clearing conditions.

The impact of a shock to aggregate transaction demand

The COVID-19 crisis created unprecedented increase in aggregate transaction demand, with a corresponding rise in trading volume. In our model, we represent this shock by an increase in N . The following Proposition characterizes the impact of this shock on the equilibrium prices and quantities of low- and high-quality transaction services.

Proposition 1. *Let $(x_l, x_h, X_l, X_h, p_l, p_h)$ be an equilibrium for a given aggregate transaction demand, N . Then, in response to a marginal increase in N :*

- $p_h - p_l$ increases and x_h decreases if $C_h(Nx_l, Nx_h) - C_l(Nx_l, Nx_h)$ is, locally, increasing in N .
- p_l increases if $C_l(Nx_l, Nx_h)$ is, locally, increasing in N .

The first bullet point characterizes the impact of the shock on the equilibrium premium, $p_h - p_l$, and quantity, x_h , of high-quality transaction services. To understand it, combine the first-order conditions of the customers and the dealers, together with the market-clearing condition:

$$u_h(1 - x_h, x_h) - u_l(1 - x_h, x_h) = p_h - p_l = C_h(N(1 - x_h), Nx_h) - C_l(N(1 - x_h), Nx_h).$$

The left-hand side defines a downward-sloping schedule for the per-customer demand of high-quality intermediation services, represented by the orange solid curve in Figure 7. The right-hand side defines an upward-sloping supply schedule, represented by the blue solid curve.¹² The intersection of the two curves determines the equilibrium given some aggregate transaction demand.

The condition stated in the first bullet point of the proposition ensures that, when there is a shock to the aggregate transaction demand, the supply schedule shifts up – in the Figure, from the blue solid to the green dashed supply curve. If the demand stays the same, the premium for high-quality transaction services increases, along the vertical red arrow. In response, of course, customers change their demand: they substitute towards low-quality transaction services. The premium decreases, along the diagonal red arrow, but remains elevated relative to its pre-shock level.

¹²Notice that both schedules are defined by differences in marginal values and marginal costs: this is because each customer has a fixed total demand of intermediation services, so a marginal increase in the demand of high-quality services induces a corresponding decrease in the demand of low-quality services.

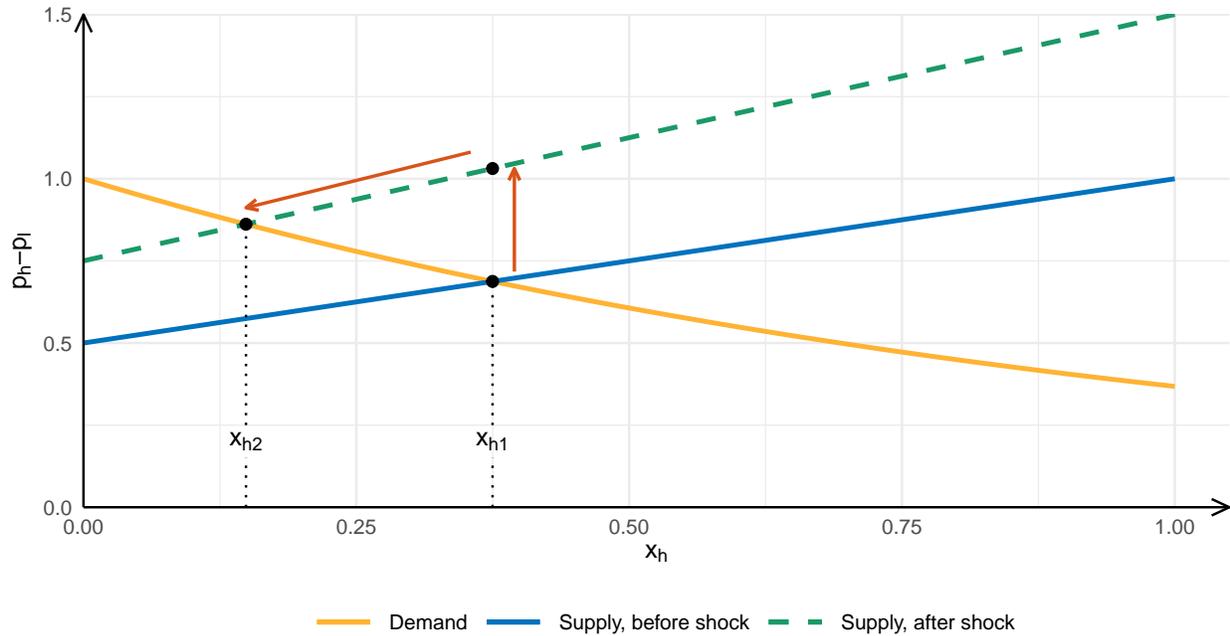


Figure 7. The determination of the price difference between high- and low-quality transaction services

The second bullet point provides a natural sufficient condition for the price of low-quality intermediation services, p_l , to go up with N . Figure 8 illustrates. The solid-blue and solid-green curves are the marginal cost for low- and high-quality transaction services. The aggregate transaction demand shock shifts the two curves up, leading to an increase in both prices.

These comparative statics can be mapped to (at least some of) our empirical observations. Drawing the analogy of $p_l \approx IRC$ and $p_h \approx CH$, we have the $p_l < p_h$ pre-crisis; that, upon impact, both p_l and p_h spiked, but the magnitude of the p_h spike was larger; and, in the new equilibrium, p_l remains only slightly elevated (if at all), while p_h remains more significantly elevated. And, of course, this coincides with an decrease in risky-principal trades.

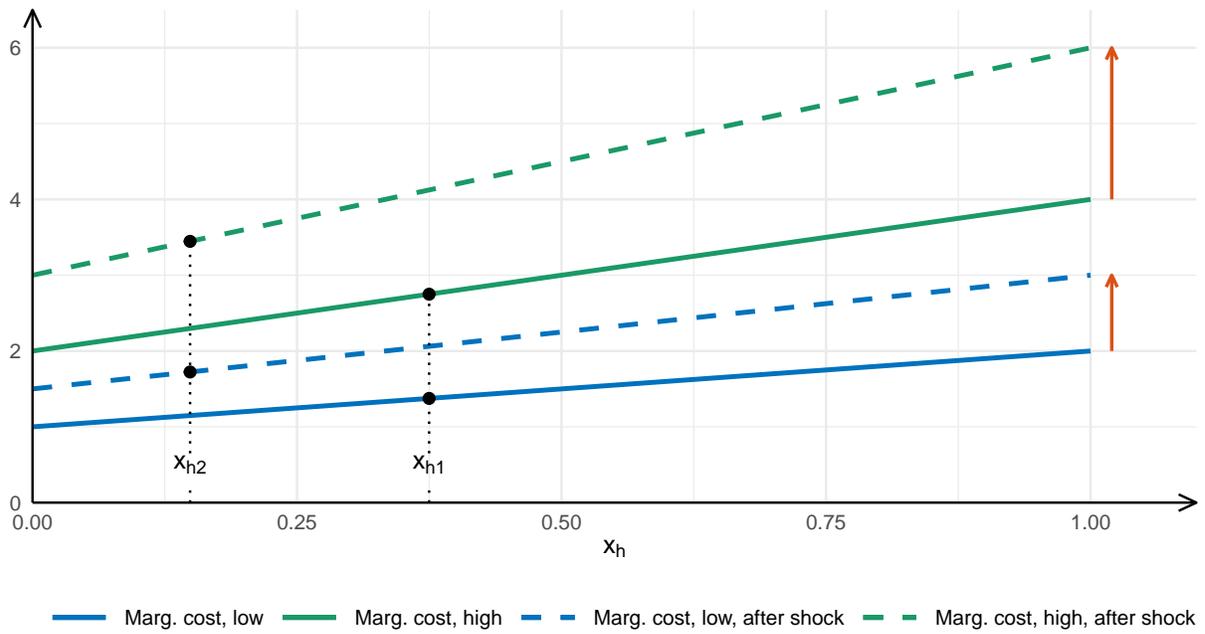


Figure 8. The determination of the price level of high- and low-quality transaction services

References

- Amihud, Yakov, and Haim Mendelson, 1986, Asset pricing and the bid-ask spread, *Journal of Financial Economics* 17, 223–249.
- An, Yu, 2019, Competing with inventory in dealership markets, Working paper, Johns Hopkins.
- An, Yu, and Zeyu Zheng, 2018, Conflicted immediacy provision, Working paper, Johns Hopkins.
- Baer, Justin, 2020, The Day Coronavirus Nearly Broke the Financial Markets, *The Wall Street Journal*, <https://www.wsj.com/articles/the-day-coronavirus-nearly-broke-the-financial-markets-11589982288>.
- Bernanke, Ben, and Janet Yellen, 2020, The Federal Reserve must reduce long-term damage from coronavirus, *The Financial Times*, <https://www.ft.com/content/01f267a2-686c-11ea-a3c9-1fe6fedcca75>.
- Chappatta, Brian, 2020, Treasury Liquidity Dries Up. Fed Makes It Rain, *Bloomberg News*, <https://www.bloomberg.com/opinion/articles/2020-03-12/treasury-liquidity-dries-up-fed-makes-it-rain>.
- Cheng, Jeffrey, David Wessel, and Josh Younger, 2020, How did COVID-19 disrupt the market for U.S. treasury debt?, *The Hutchins Center, Brookings*, <https://www.brookings.edu/blog/up-front/2020/05/01/how-did-covid-19-disrupt-the-market-for-u-s-treasury-debt/>.
- Choi, Jaewon, and Yesol Huh, 2018, Customer liquidity provision: Implications for corporate bond transaction costs, Working paper, UIUC and Federal Reserve Board.
- Demsetz, Harold, 1968, The cost of transacting, *The Quarterly Journal of Economics* 82, 33–53.
- Dick-Nielsen, Jens, 2014, How to clean enhanced TRACE data, Working paper, CBS.
- Ebsim, Mahdi, Miguel Faria-e Castro, and Julian Kozlowski, 2020, *Corporate Bond Spreads and the Effects of Unconventional Monetary Policy during the Pandemic*, Federal Reserve Bank of Saint Louis.
- Feldhütter, Peter, 2012, The same bond at different prices: Identifying search frictions and selling pressures, *Review of Financial Studies* 25, 1155–1206.
- Haddad, Valentin, Alan Moreira, and Tyler Muir, 2020, When selling becomes viral: Disruptions in debt markets in the covid-19 crisis and the Fed’s response, Working paper UCLA and Rochester.
- He, Zhiguo, and Konstantin Milbradt, 2014, Endogenous liquidity and defaultable bonds, *Econometrica* 82, 1443–1508.
- He, Zhiguo, and Wei Xiong, 2012, Rollover risk and credit risk, *Journal of Finance* 67, 391–429.
- Idzelis, Christine, 2020, The Corporate Bond Market Is ‘Basically Broken,’ Bank of America Says, *Institutional Investor*, <https://www.institutionalinvestor.com/article/b1ktrscdcnn5zt/The-Corporate-Bond-Market-Is-Basically-Broken-Bank-of-America-Says>.
- Scaggs, Alexandra, 2020, Bond Funds Just Had Another Week of Record-Setting Investor Withdrawals, *Barron’s*, <https://www.barrons.com/articles/bond-funds-record-setting-outflows-51585262192>.
- Weill, Pierre-Olivier, 2007, Leaning against the wind, *Review of Economic Studies* 74, 1329–1354.