Unintended Impact of LIBOR-SOFR Transition on Credit Markets and Economic Activity

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In this note, I discuss the impact of London Interbank Offered Rate (LIBOR) transition on credit lines, bank lending, and economic activity. I highlight the potential unintended impact of transitioning from credit sensitive reference rates to risk-free reference rates. The focus is on LIBOR transition in the U.S. where the near risk-free reference rate is the Secured Overnight Financing Rate (SOFR). It is well-known that credit market stress has macroeconomic consequences, (see Bernanke (2022) and the references therein). This note shows that LIBOR-SOFR transition might worsen these macroeconomic consequences.

First, drawing on a recent paper by Cooperman, Duffie, Luck, Wang, and Yang (2023), I discuss why the average borrowing cost on SOFR-linked credit lines could be higher than the average borrowing cost on credit lines linked to credit sensitive reference rates. The first section then highlights the fact that SOFR-linked credit line drawdown quantities could be significantly higher than LIBOR-linked drawdowns during periods of stress.

Second, I link the credit-line focused results of Cooperman et al. to the macroeconomic model implied results of Greenwald, Krainer, and Paul (2021) and show that during periods of stress or following macroeconomic shocks, while aggregate bank lending could grow, aggregate firm investment could drop. This dynamic could be intensified under large corporate SOFR-linked credit lines due to higher drawdowns. I highlight that underlying the boost in aggregate credit growth is a term loan crunch with adverse impact on small to medium-sized enterprises (SMEs). The LIBOR-SOFR transition could exacerbate the credit expansion – investment contraction dynamic and the adverse impact on SMEs during crisis episodes or following macroeconomic shocks.

In the last section, credit sensitive benchmarks are briefly discussed. This section shows that credit benchmarks that are poor proxies for average bank marginal funding spreads might increase frictions in credit markets. I will also note that the well-established economic principles and arguments in favor of developing the sustainable riskless interest rate benchmark, SOFR,

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can be similarly used to show that the economic and financial system will benefit from adopting robust and representative credit benchmarks.[2]

The Impact of LIBOR Transition on Credit Lines

Bank credit lines enable borrowers to draw credit up to a prespecified amount at any time before maturity and at predetermined pricing terms. It is well-known that credit line commitments have increased significantly since the 2007-09 global financial crisis (GFC). Acharya and Steffen (2021) estimate that banks had committed to issuing about $1.2 trillion in loans to U.S. publicly listed firms at the end of 2019.

In what follows, I will draw on a simple variation of the credit line model of Cooperman, Duffie, Luck, Wang, and Yang (2023) to highlight the effect of transitioning from credit sensitive reference rates to risk-free reference rates on credit line prices, credit line provision, and drawdown quantities during normal and crisis episodes.

Consider a bank offering a credit line of size $L \geq 0$ and fixed spread $s \geq 0$ to a borrower at time 0. Suppose that the floating reference rate on the credit line is $R \geq 0$. In analyzing the effect of LIBOR-SOFR transition, the credit line floating rate is $R = LIBOR$ when the banking sector operates under LIBOR, and it is set equal to the risk-free reference rate $R = r$ in the SOFR only environment. At time 1, the borrower chooses the quantity $q \leq L$ of cash to draw. Also, the floating rate R and the credit spread of the bank $S \geq 0$ are revealed at time 1.[3] Suppose that the borrower will not default on the credit line. And, $p \geq 0$ is the bank's conditional survival probability from time 1 to 2.[4] For simplicity, I assume that the risk-free reference rate r is a given constant.[5]

Marginal Gain in Bank Equity Value

Suppose that q is drawn at time 1. If the bank is solvent at time 2, it pays back $q(1 + r + S)$ on the funding it obtained at time 1, and it will receive $q(1 + R + s)$ on the credit line from the borrower. Following Anderson, Duffie, and Song (2019), and as shown in Cooperman et al., the marginal gain in bank equity value associated with credit line provision at time 1 can be written as

$$G = \frac{pq}{1+r}[(R + s) - (r + (1 + C)S)],$$

[2] Problems with LIBOR and its widespread manipulation in 2007-08 are well-known. Major reforms impacting the economic and financial systems often have some unintended consequences. This note focuses on identifying potential unintended effects of LIBOR-SOFR transition on the economic system.

[3] Following Cooperman et al., one can think of S as the bank credit spread for unsecured wholesale funding maturing at time 2.

[4] For simplicity, it is assumed that the bank will not default before time 2.

[5] At time 1, the borrower chooses q that maximizes the net benefit of receiving the cash, and at time 0, it chooses L that achieves the maximum expected net benefit. The bank maximizes the market values of its equity at time 0 while competing with other banks of same credit quality for credit line provision.

where $C \geq 0$ is some constant capital ratio associated with the equity capital requirement Cq for the drawn quantity q. Competing with other banks of the same credit quality, the bank maximizes the initial market value of its equity.

This implies that at time 0, *the bank prices the credit line in a way to make its shareholders break even on marginal new credit lines*. That is, the bank chooses the fixed spread s that gives $E[G] = 0$.[6]

Costly Credit Lines and Higher Drawdowns in the SOFR Only Environment

Setting $E[G] = 0$ results in $s = E[pq(r + (1 + C)S - R]/E[pq]$. In a SOFR only environment, we have $R = r$, so the fixed spread becomes $s_r = E[pq(1 + C)S]/E[pq]$. The average corporate credit line borrowing cost in the SOFR only environment is $r + s_r$.

Now, suppose that a credit sensitive reference rate exists that can be viewed as a good approximation for average bank credit spreads. The credit line floating rate under the credit sensitive environment is $R = r + S$. Then, the fixed spread associated with the *representative credit sensitive reference rate* becomes $s_{r+S} = E[pqCS]/E[pq]$. This results in an average credit line borrowing cost of $E[r + S] + s_{r+S}$. The average borrowing cost differential can now be written as,[7]

$$(r + s_r) - (E[r + S] + s_{r+S}) = \frac{1}{E[pq]} cov(pq, S).$$

If we further assume that the bank remains solvent by the end of time 2, the credit line cost differential can be represented more intuitively, $\frac{1}{E[q]} cov(q, S)$. That is, when credit lines are priced based on a risk-free reference rate, the average borrowing costs increases when the covariance between the drawdown quantity and bank credit spread is positive $cov(q, S) > 0$. Drawdowns often occur during crisis episodes when bank credit spreads widen. For instance, it is well-known that during both the GFC and the Covid recession, drawdown quantities increased notably while bank credit spreads widened. This implies that in the SOFR only environment, we can anticipate that $cov(q, S) > 0$ will hold.

Using several data sources and granular bank-firm loan datasets from 2005 to 2021, Cooperman et al. approximate average bank credit spreads by the difference between LIBOR and overnight index swap (OIS) rates and calibrate their model after setting

$S = LIBOR - OIS$ over the 2005-2021 period that captures both the GFC and the Covid recession. Some of their main results are highlighted in Figure 1 below.

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[6] Note that $pq(1 + C)S$ on the right of the formula for G is the debt-overhang cost to bank shareholders of funding q at the wholesale spread S. When the credit line is contracted at time 0, the bank prices this expected debt-overhang cost into the terms of the line.

[7] As mentioned earlier, the risk-free rate r is assumed to be constant in this note.

The left panel shows the equilibrium interest rate paid per unit of credit drawn under LIBOR and SOFR credit lines. It indicates that, on average, SOFR credit lines are more costly than LIBOR credit lines. That is, $cov(q, S) > 0$. The right panel shows the aggregate amount of line commitments and drawdowns. Note that during crisis periods when LIBOR-OIS is at high levels, SOFR-linked credit line borrowers draw more credit than LIBOR-linked borrowers. This difference in drawdowns became significant during the GFC. During normal times, however, borrowers draw less credit on average on SOFR-linked lines.

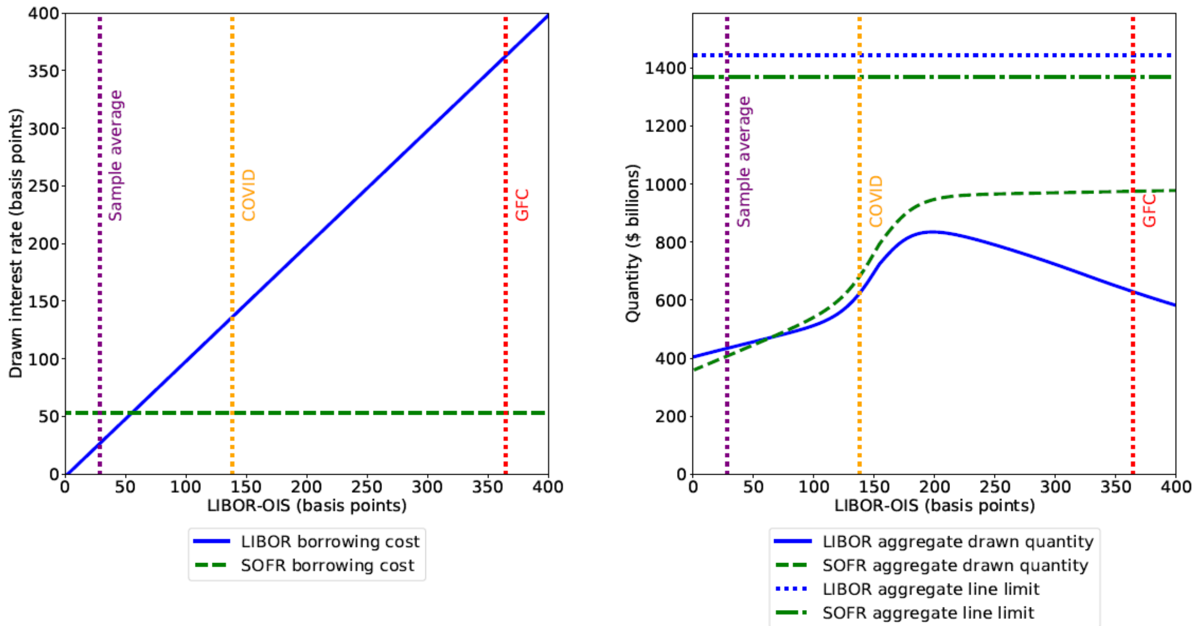

Figure 1: The Impact of LIBOR-SOFR transition on credit line pricing, credit line provision, and drawdowns Source: Cooperman et al. (2023). The horizontal dashed-dotted lines in the right figure indicate the sizes of the credit lines. Vertical purple, orange, and red dotted lines are shown at the sample average of LIBOR-OIS (28 basis points), at the level of LIBOR-OIS reached in the COVID shock of March 2020 (140 basis points), and at the level of LIBOR-OIS reached during the GFC (360 basis points).

This "normal-time" equilibrium result can be understood by noting that the SOFR-line fixed spread s_r is larger than the credit sensitive fixed spread s_{r+S}.[8] So, SOFR-line borrowers with higher drawdowns during crisis periods and higher fixed spreads draw less credit during normal times when LIBOR-OIS is near its sample average. The right panel also indicates that in going from LIBOR-linked credit lines to SOFR-linked lines, there will be a reduction in credit line provision but not significantly -- by around 3.3% in aggregate line size L.

[8] Recall that from the model implied fixed spreads, $s_r = E[pq(1 + C)S]/E[pq]$; $s_{r+S} = E[pqCS]/E[pq]$, and so $s_r > s_{r+S}$.

Bank Lending and Economic Activity in Periods of Stress

Greenwald, Krainer, and Paul (2021) document that credit lines have become the dominant form of bank lending in the U.S. Analyzing datasets that contain bank-firm loans in the U.S. over the period 2012-2020, they find that the volume of undrawn credit line balances was more than 40 percent larger than total term loans and used credit line balances between 2012 and 2019, (see their Table 3.1 and Figure 3.1).

Greenwald et al. (GKP) also show that the top 10 percent of firms, in terms of firm size distribution, account for more than 71 percent of the total unused credit available, (Figure 3.2 in GKP). Ordering firms by size, the threshold for the top 10 percent of the firm size distribution is $582 million in total assets. GKP's empirical study has notable implications for SMEs, (Figure 3.2 and 3.3): First, compared to large corporates, SMEs have lower credit line balances and rely more on term loans. In part, because large drawdowns often occur in periods of distress, banks prefer to allocate more credit through credit lines to old, public, large, more stable, less leveraged, and more profitable firms.[9] Second, SMEs utilize more of their committed credit during normal times and so have lower undrawn credit balances. This implies that SMEs often do not have sufficient credit line capacity following adverse shocks.

Term Loan Crunch and Dampened Economic Activity

Figure 2 shows significant increase in commercial and industrial (C&I) bank lending following the Covid-19 outbreak. This rise in bank credit provision is almost entirely due to existing credit line drawdowns as also documented by Acharya and Steffen (2020). The largest 10 percent of the firms drew most of the existing credit during the pandemic. Note that other forms of credit (consumer and real estate loans) do not increase or do not increase considerably during the outbreak of the pandemic.

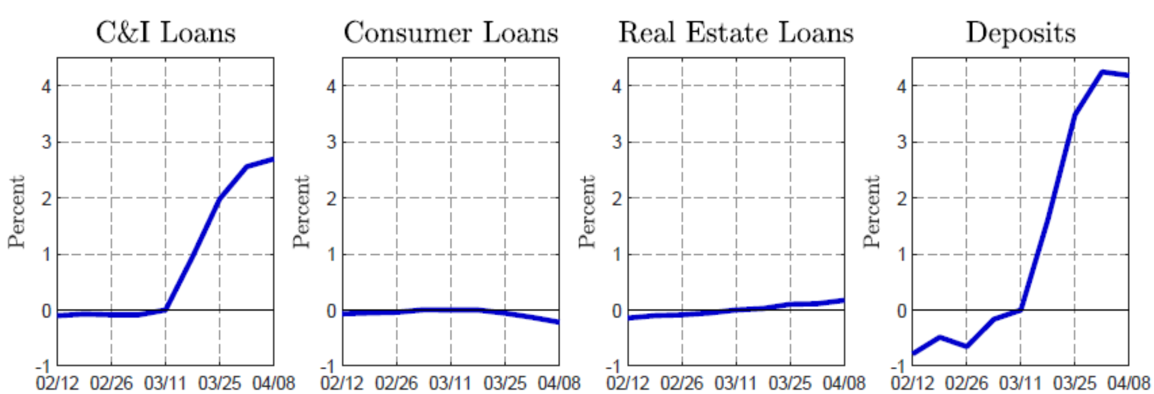

Figure 2: The Impact of Covid-19 on Bank Balance Sheets. Source: Greenwald et al. (2021).
Changes in credit relative to total assets on 03/11/2020 around the start of COVID-19 in the U.S. The series are based on the H.8 releases for U.S. commercial banks from the Board of Governors of the Federal Reserve.

[9] This is consistent with well-known agency problems on bank lending, e.g., lenders' concern about moral hazard.

Cooperman et al. estimate that during the Covid recession, $1 of corporate drawdowns led to 89 cents increase in corporate deposits. Despite large deposit inflows during the pandemic outbreak, banks that face large drawdowns contract the provision of term loans. GKP estimate a term lending cut of around 10-30 cents for a $1 credit line drawdown. This crowding-out effect highlights the adverse impact of macroeconomic shocks on the supply of term loans to SMEs. The term loan crunch occurred in 2020 while aggregate bank deposits increased by more than C&I loans over the period (Figure 2). That is, despite the availability of funding, banks reduced the supply of term loans to SMEs. This bank behavior could be explained in part by noting that undrawn credit lines have lower regulatory risk-based capital requirements compared to used credit lines. Drawdowns tie up regulatory capital and put pressure on bank balance sheets in distress times.

Using firm financial data, it has been documented that the term loan crunch led to a reduction in the total debt of SMEs. The reduction in total debt in turn resulted in lower investment (capital expenditures). In short, facing high credit line drawdowns by large firms following the outbreak of Covid-19, banks contracted term loan provision to SMEs, and this resulted in a reduction in their total debt and investment.

LIBOR-SOFR Transition Implications

Focusing on credit line pricing and provision, the partial-equilibrium analysis of Cooperman et al. quantifies larger corporate drawdowns during the GFC and Covid recession under SOFR-linked credit lines (Figure 1). Drawing on the empirical study of Greenwald et al, we could infer broad macroeconomic implications of LIBOR-SOFR transition:

In making the transition to the risk-free reference regime, higher credit line drawdowns in distress times might exacerbate the term loan crunch with adverse impact on SMEs. This could in turn intensify the reduction in investments by SMEs. In aggregate, despite higher credit expansion, the fall in investment could be worsened.

I will now briefly discuss some of the quantitative general-equilibrium implications of the structural model of GKP for LIBOR-SOFR transition.[10] The model captures two types of firms, unconstrained and constrained firms. The first category represents large corporates (firms in the top 10% of the size distribution) and the second category represents SMEs that have higher leverage. Unconstrained firms borrow via credit lines, and constrained firms borrow using term loans. Unconstrained firms use debt margin for both investing and dividend payments. Constrained firms use debt margin entirely to fund new investments.

[10] The theoretical macroeconomic model of Greenwald et al aims to capture their empirical analysis and findings over 2012-2020. The objective of their study is not analyzing the effect of LIBOR transition. While the financial structure of their macroeconomic model needs to be modified for a formal and detailed analysis of the effect of LIBOR transition, I use some of their results and show how/why they can be leveraged to obtain insights on the impact of LIBOR-SOFR transition on the bank lending channel and real activity.

The modeling and calibration of credit lines resemble SOFR-linked credit lines more than LIBOR-linked lines. More specifically, the floating rate is set equal to the risk-free rate, and the fixed spread on credit lines (equation 6.10 in GKP) is set equal to 250 basis points. This implies that the credit line model could be more representative of a SOFR-linked line. Consequently, having a SOFR like regime in mind, I will now highlight some of the model implied results.

The left panel in Figure 3 shows the model implied impact of a Covid-19 type shock on borrowing and investments by unconstrained firms. The middle panel focuses on constrained firms and shows the impulse response to the adverse shock. The right panel shows aggregate results. Unconstrained firms increase their borrowing through credit lines by around 10% percent on impact and by 20% in the 10^{th} quarter (10Q) following the shock. Their investment, however, declines by more than .12% due to their low marginal propensities to invest. They instead tend to use the credit more to soften the adverse impact of the shock on dividend payouts. The large increase in lending to unconstrained firms puts pressure on bank balance sheets, so they cut the supply of term loans to constrained firms by more than 5% in the 20Q following the shock. Constrained firms in turn reduce investments by more than 3% after 20Q. The right panel approximates the aggregate macroeconomic implications of the adverse shock on bank lending and investment. Aggregate bank lending increases by a maximum of more than 7%. This is almost entirely due to unconstrained firms borrowing through credit lines. Despite the overall credit expansion, aggregate capital falls by more than .5% in the 20Q following the shock. It is likely that the above-mentioned quantitative results will be magnified if the model captures credit line provision more accurately and could better differentiate SOFR linked lines from LIBOR lines. For instance, under SOFR-linked lines, the current calibration of the model would probably lead to underestimating large corporate drawdowns. Otherwise, the results of Figure 3 could have been amplified.

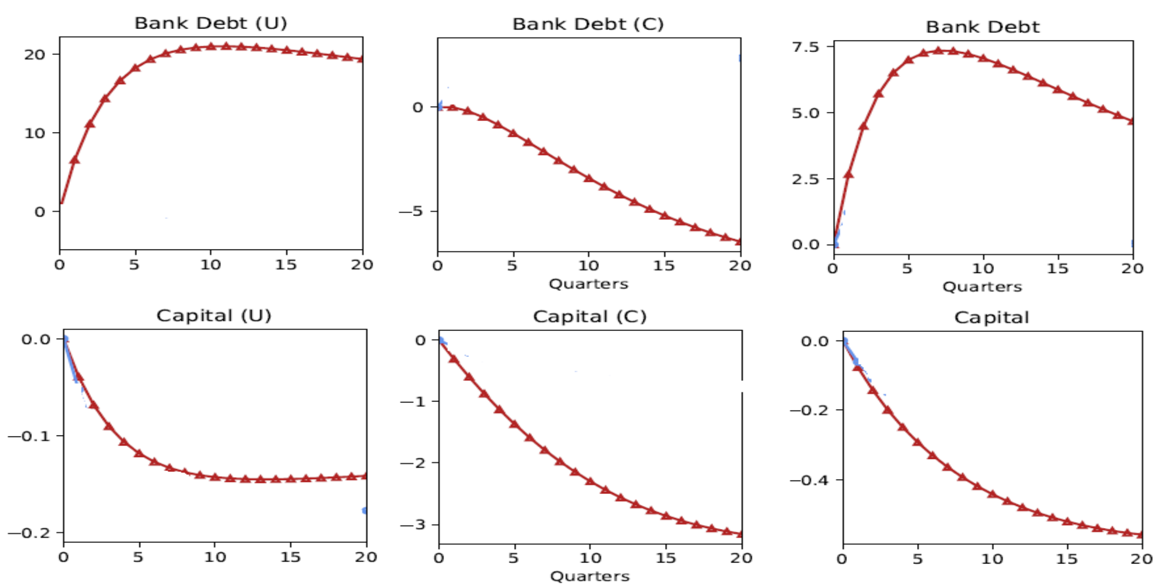

Figure 3: Model Implied Response of the Economy to a Covid-19 Like Shock. Source: Greenwald et al. (2021).
This figure plots the model impulse response to a Covid-19 type productivity shock.

I conclude by noting that similar macro-financial dynamics could play out following contractionary monetary policy shocks, (Gertler and Gilchrist (1993)). That is, the (counterintuitive) rise in bank lending following contractionary monetary policy shocks appears to be entirely due to large corporate credit line drawdowns which could result in a notable contraction in the supply of term loans as shown by Greenwald et al. Given the current inflationary environment, this macro-financial dynamic might be magnified under the SOFR only environment. This could have adverse implications for the process of monetary policy transmission.

Representative Credit Benchmarks

Large banks have responded to market and regulatory pressures to increase stable funding by significantly changing their funding structures since the GFC. Underlying the decline in many banks share of wholesale funding has been a cutback in the use of short-term funding and a contraction in interbank liabilities, (see Ghamami (2021) and the references therein). LIBOR, which is meant to estimate short-term wholesale unsecured funding, is not the perfect representative of average bank funding costs and so bank credit spreads anymore.

Credit sensitive reference rates that are poor proxies for average bank credit spreads could increase frictions and inefficiencies in credit markets. To see this in the context of credit line pricing, recall the marginal gain in bank equity value as formulated earlier in this note. For simplicity, assume that the capital ratio is zero, $C = 0$, and that the bank will be solvent by time 2, i.e., $p = 1$. Suppose that while the "true" average credit spread of banks is S, banks use a nonrepresentative benchmark NB to price credit lines. That is, with the floating rate being $R = NB$, banks set $s_{NB} = 0$. Then, with credit line being inaccurately priced via $R = NB$ and $s_{NB} = 0$, the "true" average marginal gain in bank equity value becomes

$$E[G] = \frac{1}{1+r} E[q(NB - (r + S))] \neq 0.$$

That is, bank shareholders do not break even on marginal new credit lines. This could increase frictions and inefficiencies in credit markets. For instance, when the current average bank funding cost is lower than the nonrepresentative credit benchmark (in all states of the world), we will have $E[G] > 0$. This could imply overpriced credit lines which might in turn adversely affect bank credit intermediation and lending market liquidity and could ultimately have adverse welfare implications.

To my knowledge, the Across-the-Curve-Credit Spread Index (AXI) is the existing reliable credit benchmark that is a good proxy for average bank marginal funding spreads and could be used as a supplement to SOFR.[11]

[11] The Across-the-Curve-Credit Spread Indices were introduced and outlined by Darrell Duffie and his collaborators, Antje Berndt and Yichao Zhu in 2020. They were operationalized by SOFR Academy in partnership with Invesco in 2022.

There has not yet been consensus among policymakers and regulators on whether reliable and representative credit benchmarks are needed as supplements to SOFR. Reaching a consensus should not have been difficult as economic arguments in favor of using benchmarks are well-established, Duffie and Stein (2015). I will now briefly mention some of the arguments that are important in the context of reliable and representative credit benchmarks.

Credit benchmarks reduce asymmetric information in lending markets. Suppose that a borrower considers a bank loan linked to SOFR plus an ad hoc fixed spread. Clearly, the bank and the borrower have opposite incentives on how to measure and set the fixed spread. In the presence of a representative credit benchmark, it is more likely that the two parties agree on the term of the contract efficiently. Credit benchmarks can also reduce search costs and improve matching efficiency in lending markets. This is important because the resulting boost in credit intermediation and liquidity in credit markets could more than offset any potential reduction in banks' net interest income. This could hold even when we do not consider derivatives risk management applications that would arise following the introduction of the credit benchmark to financial markets.

From the perspective of banks, the presence of reliable and representative credit benchmarks should be particularly appealing as it could mitigate the adverse selection problem associated with hedging the risk of changes in their borrowing costs. Otherwise, it might be difficult for banks to hedge even the common component of their credit risk.

Concluding Remarks

SMEs contribute more than 50% of GDP in high-income countries, and they account for about 99% of firms and 70% of all jobs in OECD countries. Between February 2020 and April 2021, 70-80% of SMEs across 32 countries lost about 30-50% of their revenues, (McKinsey & Company (2022)). The Covid recession exposed the financial fragility of small businesses in the U.S. Bartik, Bertrand, Cullen, Glaeser, Luca, and Stanton (2020) show that the extremely limited cash available on hand of small businesses explained the massive layoffs and shutdowns following the Covid-19 crisis.

Proactive policies and regulation that help reduce frictions and increase efficiencies in credit markets during normal times could result in managing and mitigating crises more effectively. Adopting sustainable and representative credit benchmarks as supplements to SOFR belongs to this policy set. Otherwise, extraordinary and extensive government and central bank interventions and support during crisis episodes might continue to be necessary, which might have their own unintended consequences (see, e.g., Ghamami (2021) and the references therein on the joint impact of the pandemic-driven fiscal stimulus and monetary policy on inflation and financial markets).

The results of this note could also be viewed through the lens of the financial accelerator theory (see Bernanke (2022), Bernanke (2007), and the references therein). The LIBOR-SOFR transition could increase credit market frictions and result in SMEs facing more significant external finance premiums.[12] That is, financial accelerator effects might be amplified under a SOFR only environment, which could worsen macroeconomic consequences of credit market stress. Representative credit benchmarks could help counteract these consequences.

[12] The external finance premium is the total cost of a loan for a given borrower less the safe rate of interest.