FEDERAL RESERVE BANK OF KANSAS CITY

ECONOMIC REVIEW

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How Did Banks and Investors Respond to the 2020 Stress Test Results?

By W. Blake Marsh

In June 2020, the Board of Governors of the Federal Reserve System took steps to preserve capital at large banks by capping dividend payments to shareholders and prohibiting common stock repurchases outright for some time. In doing so, supervisors looked to prevent behavior that could threaten large banks' survival during the COVID-19 pandemic crisis.

W. Blake Marsh investigates how the announcement of the 2020 payout restrictions influenced bank capital levels and stock prices. First, he finds that surprisingly strong income growth combined with the payout restrictions raised bank capital to near record levels. Second, although payout restrictions had only a minimal effect on stock prices for most banks, the threat of increased supervisory stringency appears to have lowered stock price returns for directly affected banks and those near the supervisory threshold. His results provide justification for supervisory restrictions during times of crisis, as restrictions may have mitigated market pressure on banks to reduce capital levels.

Long-Term Pressures and Prospects for the U.S. Cattle Industry

By Cortney Cowley

By the end of 2020, prices for most major agricultural commodities had rebounded sharply from COVID-19-related disruptions. However, cattle prices have only recently reached pre-pandemic levels. The sluggish recovery in cattle prices was reinforced by major winter storms in early 2021, which resulted in significant losses to affected producers, and a May 2021 cyberattack on meatpacker JBS S.A., which caused significant production delays. Together, these disruptions have limited the industry's ability to recover from the pandemic and, alongside changing weather and consumer preferences, could have longer-term effects on the economic outlook for cattle producers.

Cortney Cowley examines long-term pressures and prospects for the U.S. cattle sector. Going forward, U.S. cattle production faces three key pressures that may affect profitability: vulnerabilities along the supply chain; extreme weather conditions, particularly drought; and shifting demand from U.S. consumers. Although these pressures may shape cattle production in decades to come, growing international demand for U.S. beef—especially from emerging market economies—offers some prospects for industry profitability.

Do Net Interest Margins for Small and Large Banks Vary Differently with Interest Rates?

By Rajdeep Sengupta and Fei Xue

Bank net interest margins (NIMs), which denote profitability from core banking operations, have dropped sharply since 2019, renewing concerns on the viability of the traditional banking model. Any downward pressure on NIMs puts small banks at a disadvantage because a relatively greater share of small bank income comes from interest on loans. Understanding differences in small and large bank NIM behavior can shed light on the viability of different banking business models.

Rajdeep Sengupta and Fei Xue examine the relative contributions of activities that compose bank NIMs as well as their sensitivities to interest rates. They find that the recent decline in bank NIMs was largely driven by changes in interest rates rather than changes in the composition of NIM components in bank portfolios. After controlling for financial and economic conditions that also affect bank NIMs, they find that NIM contributions from loans and deposits are highly sensitive to interest rates. However, these sensitivities are not always symmetric between large and small banks and between increases and decreases in interest rates. Although lowering interest rates may be relatively disadvantageous for small banks by lowering NIMs, raising interest rates is not necessarily advantageous for them.

How Did Banks and Investors Respond to the 2020 Stress Test Results?

By W. Blake Marsh

The COVID-19 pandemic heightened investor, regulatory, and supervisory concerns about the U.S. banking system's ability to survive a downturn. Both businesses and consumers pulled back on economic activity at the start of the health crisis, leading firm revenue to decline sharply amid fears of rapidly accelerating job losses, business closures, and lower household incomes. As a result, expectations that businesses and consumers would be unable to continue servicing their debt obligations increased. Investors and bank supervisors began bracing for significant losses at banks, which could threaten the stability of the broader financial system.

Policymakers moved quickly to backstop financial markets while supervisors tried to ensure banks could withstand the anticipated loan losses. In June 2020, the Board of Governors of the Federal Reserve System took steps to preserve capital at large banks by capping dividend payments to shareholders and prohibiting common stock repurchases outright for some time. In doing so, supervisors looked to prevent banks from repeating behaviors observed during the 2007–09 global financial crisis (GFC). During that crisis, banks continued to pay dividends to shareholders while suffering sizable losses. Ultimately, those losses left many banks teetering on the edge of failure, and a federal bailout was required to keep the system afloat.

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How the dividend caps and repurchase restrictions affected banks, however, is an open question with important policy ramifications. If investors sell stocks in response to dividend caps, for example, then falling stock prices will hamper banks' ability to raise new equity funding at a time when it might be needed to offset loan losses.

In this paper, I examine how the announcement of the payout restrictions influenced bank capital levels and stock prices. I find that the restrictions helped build capital levels at large banks but may have indirectly hampered stock price returns. First, I show that surprisingly strong income growth combined with the payout restrictions drove capital to near record levels during this period. Second, I show that the payout restrictions had only a minimal effect on stock prices for most banks. Instead, the threat of increased supervisory stringency appears to have generated more persistent effects on stock prices, particularly for directly affected banks and those near the supervisory threshold. My results suggest that the post-GFC supervisory preference for payouts to be conducted primarily through repurchases, rather than dividends, provided a capital conservation channel that had only modest effects on bank stock returns.

Section I discusses why firms conduct shareholder payouts and reviews previous findings on bank payout policies. Section II reviews how the Federal Reserve limited bank payouts to investors during the pandemic. Section III shows that these restrictions helped boost bank capital, but the perception of increased supervisory stringency likely lowered stock prices.

I. Why Do Banks Pay Dividends and Repurchase Shares?

Typically, banks make payouts to investors through either dividends or common stock repurchases. Dividends are regular cash payments banks make to all shareholders of record. Common stock repurchases, on the other hand, are bank purchases of their own stock from investors. Stock repurchases should result in a capital gain for shareholders who do not tender shares in the repurchase, all else equal, because fewer available shares will increase the price of outstanding stocks. Banks typically use earned income to fund both payout types. However, payouts that exceed earned income levels will reduce capital levels. The potential for payouts to negatively affect capital levels is the key reason regulators and supervisors pay close attention to payout policies at financial institutions.[1]

In recent years, payouts by the largest U.S. banks have soared to record levels. Chart 1 shows that just prior to the pandemic, global systemically important banks (GSIBs) repurchased more than $30 billion in common stock while paying out an additional $10 billion in dividends per quarter. In many cases, annual payouts at these banks exceeded earned income levels. At the same time, smaller peer banks that also participate in the Federal Reserve's annual stress tests and Comprehensive Capital Analysis and Review (CCAR) reported steady increases in stock repurchases and some dividend growth as well.

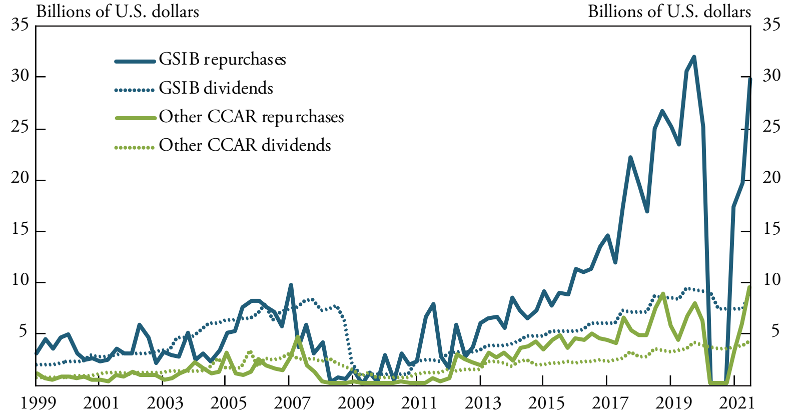
Chart 1 also shows that large U.S. banks have clearly preferred repurchases over dividends since the GFC. Prior to the GFC, dividends and repurchases were of roughly equal volumes at both GSIBs and other CCAR banks. After the recession, however, the volume of these payouts diverged: in 2019, repurchases accounted for about two-thirds of payouts at GSIBs and about one-half of total payouts at all other CCAR banks.

Relative adjustments between dividend and repurchase levels are not unusual. Banks are generally more reluctant to cut dividends than repurchases: even in normal times, stock prices generally fall in response to dividend cuts (Bessler and Nohel 1996). As a result, many banks did not cut dividends during the GFC even when they experienced sharp income reductions (Hirtle 2014; Floyd, Li, and Skinner 2015). Instead, they dramatically reduced the size of their repurchase programs. Cuts to repurchase programs are not thought to elicit the same backlash from investors, in part because they are so variable in size and frequency (Liang 2020). Thus, repurchase reductions may not spur large declines in stock prices, allowing banks to raise funds through equity issuance if needed while still conserving income during times of stress. Following the GFC, supervisors acknowledged these differences by implicitly capping dividend payments at 30 percent of total payouts, expressing a clear preference for repurchase programs over larger dividends (Kohn and Liang 2019).

Despite notions of a limited stock market reaction to repurchase cuts, shareholders may still be attuned to changes in both dividends and repurchases because they signal information about a bank's future

Chart 1

Large Bank Payout Levels, 1999–2021



Source: Board of Governors of the Federal Reserve System.

performance (Bhattacharya 1979). Bessler and Nohel (1996) argue that shareholders react negatively to dividend cuts because they convey negative information about the firm's prospects. Similarly, Vermaelen (1981, 1984) and Hirtle (2004) find that increases in the size of repurchase programs signal future profitability.

Shareholders might also care about changes to both dividends and repurchases to the extent that these payouts help discipline banks and prevent risk-taking. Firms with an excess of free cash flow might be tempted to invest poorly or spend frivolously (Jensen and Meckling 1976; Jensen 1986). Payouts provide one way to reduce the stock of excess cash and discipline bank management to invest more prudently. Repurchases are particularly important for helping banks achieve optimal capital targets (Laderman 1995; Hirtle 1998). Otherwise, banks that hold very high levels of excess capital may be inclined to risk shareholder value by "reaching for yield" to increase their return on equity.

However, lower capital holdings may not be ideal, particularly in times of stress. Banks with lower capital holdings can endure fewer loan losses before they fail. Moreover, large banks that pose systemic risk to the financial system often do not internalize the social costs of their failures. In these cases, regulatory tools such as minimum capital standards are needed to achieve higher capital levels than banks or their investors might otherwise prefer.

II. What Steps Did the Federal Reserve Take in 2020 to Limit Payouts?

Capital requirements are the primary tool for limiting bank payouts. All banks are required to hold some level of minimum capital depending on the size and riskiness of their loan portfolios.[2] Capital requirements are higher for the largest banks due to their systemic importance and the social costs that would be incurred from a large bank failure. Since the GFC, the Federal Reserve has also conducted annual supervisory stress tests (formally, the CCAR) of the largest and most systemically important banking organizations. These stress tests project capital losses at banks under a series of hypothetical macroeconomic downturns and require banks to hold enough capital to absorb these projected losses. Banks required to raise additional capital following the stress tests are subject to payout limitations.

Federal Reserve bank supervisors conducted the 2020 stress tests of large banks when the pandemic-related downturn was already underway. All banks performed well in the standard stress tests; however, supervisors also conducted an additional "sensitivity analysis" to assess banking system vulnerabilities associated with the pandemic downturn and avoid the need to recapitalize banks in the future. In the sensitivity analyses, supervisors found that under some scenarios, projected capital buffers would fall at or below minimum levels for many banks. This result, combined with a great deal of uncertainty around the projections, compelled supervisors to limit bank capital distributions to shareholders for a time as the economy recovered. These restrictions were implemented in two parts (Board of Governors of the Federal Reserve System 2020). First, supervisors suspended bank share repurchase programs indefinitely. Second, supervisors instituted dividend caps that stipulated dividends could not rise above pre-pandemic levels and could not exceed the average of a bank's prior four quarters of net income. Dividends could be paid above these limits only with approval by the Board of Governors.

These restrictions were likely surprising to investors. In March 2020, the Board of Governors adopted new rules that based large bank capital requirements in part on stress test results. These rules required banks participating in the CCAR exercise to hold a "stress capital buffer" equal to projected capital losses under a severely adverse supervisory stress scenario plus four quarters of planned common stock dividends. In addition, the rules stipulated that the stress capital buffer could not be lower than 2.5 percent of a bank's total risk-weighted assets.[3] Banks holding less than the minimum stress capital buffer would be subject to restrictions on dividends and share repurchases. These rules provided a mechanical way to incorporate the stress test results into required capital levels and removed both the soft cap on dividend payments as well as several qualitative requirements that needed supervisory approval. Given these changes to the supervisory stress test framework, judgmental interventions such as the "sensitivity assessment" and the imposition of broad payout restrictions should have been limited.

How bank shareholders responded to the payout restrictions announced during the 2020 stress tests is an open question. On the one hand, the restrictions might have conveyed bad news for investors along several dimensions. For example, investors may have interpreted an increase in required capital buffers as suggesting that bank losses would be larger or more imminent than expected. In addition, investors may have worried that increased capital buffers would incentivize banks to take on riskier but higher earning investments to justify the higher capital holdings—behavior that could put investor money at risk as bank failure probabilities rise. Finally, investors might have interpreted these restrictions as signaling more stringent supervisory oversight, which might limit future risk-taking and profitability. All these considerations would push bank stock prices down.

On the other hand, investors may not have been concerned about these restrictions given that they were announced at a time of elevated uncertainty about future loan losses. Higher capital levels reduce the probability of bank failures (and, subsequently, investor losses). In addition, many large banks had already announced the cessation of repurchase programs before the new restrictions took effect, and investors had likely already priced in those announcements. Moreover, although the restrictions capped dividend growth, they allowed banks to continue making their current dividend payments so long as income levels held steady. Thus, the restrictions may have had little effect on bank stock prices.

III. How Did the 2020 Payout Restrictions Affect Banks?

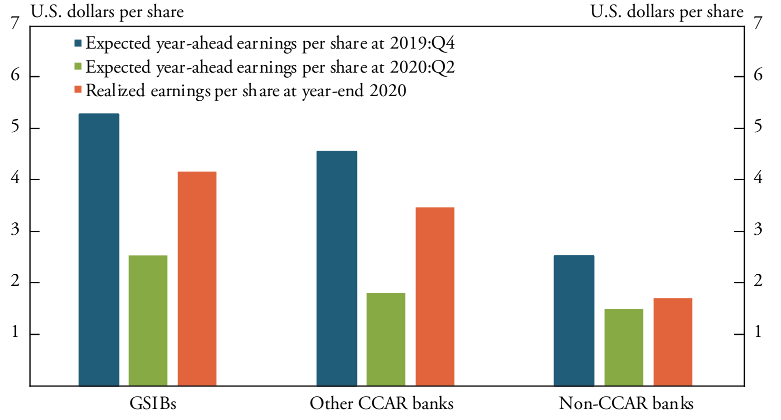
I evaluate the effect of the 2020 payout restrictions on banks in two dimensions. First, I estimate how much affected bank capital buffers increased given income levels earned in 2020 and the prevailing payout rates prior to the pandemic. Second, I estimate how bank stocks performed following the stress test announcement to gauge the response of investors to the restrictions.

Overall, payout restrictions materially increased bank capital levels. Following the payout restrictions, banks cut repurchases to zero and held dividends steady (see Chart 1).[4] At the same time, banks' reported income levels outperformed expectations. Chart 2 shows that income earned at large banks outperformed investor expectations throughout 2020. At the end of 2019, just prior to the start of the pandemic in the United States, investors expected earnings per share of more than $5 at GSIBs over the next four quarters. Earnings per share were expected to top $4 at all other CCAR banks and about $2.50 at publicly traded banks not subject to stress testing. In March 2020, expected bank earnings declined by more than half for all CCAR banks and more than 40 percent for non-stress-tested banks. However, actual earnings growth was surprisingly strong during the pandemic. Although cumulative reported earnings were below pre-pandemic expectations, realized bank income was higher than expected at the onset of the pandemic, particularly at the largest banks. Despite limited loan growth throughout the pandemic, large banks saw robust trading and investment banking activity that supported net income (Sengupta and Byrdak 2021). At the same time, expected loan losses never materialized, likely due to extraordinary policy support from fiscal and monetary agents. As a result, realized income outpaced pandemic expectations.

The combined effect of earned income and restricted payouts increased capital levels during 2020. On net, common equity Tier 1 capital ratios rose 57 basis points to 12.6 percent for GSIBs and 100 basis points to 11.1 percent for all other CCAR banks between year-end 2019 and year-end 2020. Chart 3 shows the contribution of the payout restrictions to relative capital levels at CCAR banks compared with capital levels that would have prevailed if banks had paid out income at 2019 payout ratios. For GSIBs, lower relative payouts added a full 60 basis points to capital ratios, accounting for the bulk of the net increase

Chart 2

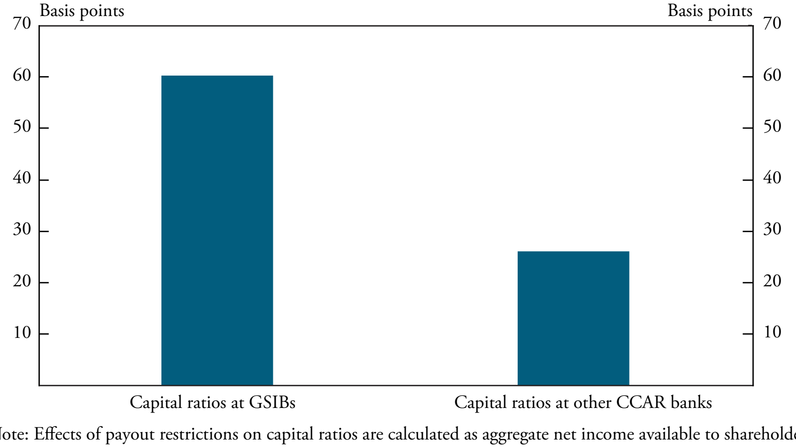
2020 Projected and Realized Bank Earnings



Notes: Blue and green bars show expected earnings per share one year ahead for 2019:Q4 and 2020:Q2, weighted by shares outstanding at the end of each respective quarter. Orange bars show aggregate earnings per share at the end of 2020.
Sources: Refinitiv Eikon/Institutional Brokers' Estimate System (IBES) and Board of Governors of the Federal Reserve System.

Chart 3

Effect of Payout Restrictions on Bank Capital Ratios



Note: Effects of payout restrictions on capital ratios are calculated as aggregate net income available to shareholders earned in 2020 times the change in the aggregate payout rate between 2020 and 2019 expressed as a fraction of risk-weighted assets at year-end 2020.
Sources: Board of Governors of the Federal Reserve System and author's calculations.

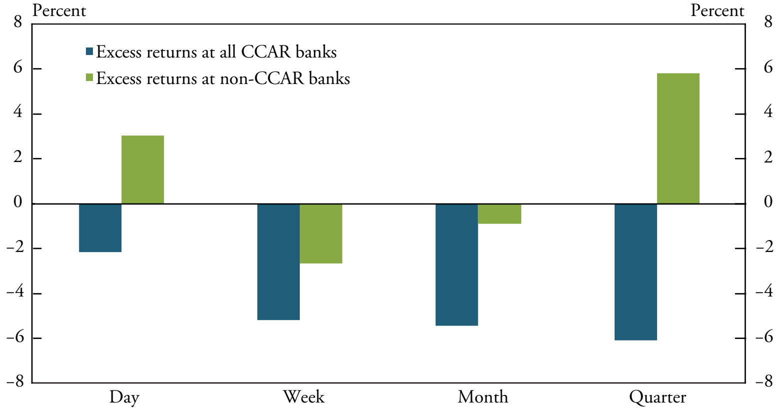
in the aggregate common equity Tier 1 capital ratio at the end of 2020. For all other CCAR banks affected by the payout restrictions, the aggregate common equity capital ratio was more than 25 basis points higher than it would have been at 2019 payout levels.

These higher capital levels made banks stronger and more resilient to future economic downturns. However, they may have had a negative effect on stock prices to the extent that shareholders reacted unfavorably to these restrictions. To assess shareholder reactions, I first use a predictive model to forecast individual stock returns based on market-wide movements in a broad stock index. I then compare the cumulative returns on stocks to these predicted returns over various windows (model details and additional analysis are available in Marsh 2022). I refer to the difference between actual and predicted cumulative returns as "excess returns"—that is, the additional return realized over the model's prediction.

Chart 4 shows the excess returns over various windows for banks subject and not subject to the Federal Reserve's stress test. Stress-tested banks had lower-than-expected returns immediately following the announcement of the CCAR results and the payout restrictions. However, banks not subject to stress testing, and therefore not subject to payout restrictions, had higher-than-expected realized returns. Over longer windows, I find that the result for stress-tested banks is persistently negative: realized returns were lower than expected at CCAR banks up to a full quarter after the announcement. Banks not subject to stress testing had mixed responses. Up to one month after the payout restriction announcement, non-stress-tested banks also had lower realized returns than predicted. However, unaffected banks outperformed stress-tested banks over longer windows, making the negative response temporary. After one quarter, banks not subject to stress testing had higher-than-predicted returns.

The predictive model alone cannot assess why investors reacted to the announcements the way they did. To understand investors' reactions, I reexamine excess returns conditional on pre-pandemic bank characteristics, expected earnings, and default probabilities. These results highlight which features investors regarded as important when pricing bank stocks. For example, investors may have rewarded banks that paid larger dividends because they would have been less affected by the payout restrictions. Similarly, investors may have punished stock

Chart 4
Bank Stock Price Reactions to Payout Restriction Announcements



Source: Author's calculations.

prices of banks with larger excess capital holdings because these stocks would continue to grow with income and incentivize banks to take on additional risk.

Table 1 reproduces the results of a regression of the standardized excess return on measures of bank size, profitability, capitalization, business model, and expected earnings from Marsh (2022). Column (1) shows that in a simple model, investors regarded bank size (measured by the natural log of assets) and the dividend rate as the most important characteristics when pricing stocks following the payout restriction announcement. Bank size is highly correlated with the imposition of the restrictions because only banks over $100 billion are subject to stress testing. Overall, a 1 percent increase in asset size is associated with about a 33 basis point reduction in excess returns over the two-day window. In addition, banks that paid larger dividends, and could therefore pay out larger shares of income via dividends, experienced larger excess returns than those that paid smaller dividends. An increase of dividends relative to capital of 1 percent is associated with about a 4 basis point increase in two-day excess returns. Larger pre-pandemic dividends were advantageous because the restrictions limited future dividend growth but did not curtail existing dividends unless income declined precipitously. The pre-pandemic size of the repurchase program did not affect

Table 1
Cross-Section Analysis of Cumulative Abnormal Returns

	Dependent variable				
Independent variables	(1)	(2)	(3)	(4)	(5)
ln(Assets)	−33.42*** (2.79)	−32.14*** (3.44)	−32.79** (3.18)	−32.63*** (3.53)	−33.15*** (3.53)
Dividend rate	3.85** (1.91)	3.71* (1.96)	1.84 (1.98)	1.81 (1.96)	2.38 (1.92)
Repurchase rate	−1.00 (0.79)	−0.79 (0.82)	−0.21 (0.79)	−0.19 (0.80)	−0.36 (0.83)
Tier 1 ratio	1.21 (1.57)	1.83 (1.85)	2.15 (1.64)	2.14 (1.64)	2.32 (1.58)
Non-interest income share		−0.37 (0.26)	−0.11 (0.28)	−0.11 (0.28)	−0.08 (0.28)
Loans to assets		−0.12 (0.29)	0.12 (0.30)	0.11 (0.28)	0.08 (0.29)
Deposit concentration			−27.43** (11.09)	−27.19** (10.99)	−30.39*** (11.17)
Repricing/maturity gap			3.52* (1.84)	3.45* (1.87)	3.64** (1.84)
2020:Q1 earnings forecast				−0.27 (1.59)	−0.01 (1.58)
Default distance					−6.70 (4.43)
Constant	569.64*** (47.21)	557.88*** (47.31)	535.38*** (65.17)	534.71*** (67.13)	550.41*** (67.41)
Observations	173	173	172	172	172
Adjusted	0.65	0.65	0.67	0.67	0.67

* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level

Notes: Dependent variable is the standardized cumulative abnormal return from a two-day window that includes the trading day following the CCAR announcement and the next day. Balance sheet and income measures are as of 2019:Q4. Earnings forecast is the median year-ahead earnings forecast from IBES as of March 31, 2020. Robust standard errors are in parentheses.
Source: Marsh (2022).

excess returns across any specification, likely because banks had already cut these repurchase programs prior to the stress test announcements.

Several factors could have driven both the dividend and bank size results, however. For example, investors may have interpreted a lower dividend rate as a sign that earnings were under pressure and rewarded banks that continued paying higher dividends. Alternatively, investors may have rewarded banks that pay higher dividends simply because those banks have greater earnings possibilities either due to business model differences or geographic diversity. The results for bank size might reflect the effect of increased stringency at larger banks, a more downbeat forecast of future performance for larger banks compared with smaller banks, or the perception that regulators were less willing to step in and assist these banks should loan losses materialize. I investigate each of these possibilities in columns (2) through (5).

Column (2) controls for differences in a bank's business model. Large, publicly traded banks conduct a wide range of lending, brokerage, and trading services for clients, all of which have a different earnings profile. As a result, banks with more numerous income sources may be able to generate higher income throughout the business cycle, enabling consistently higher dividend payments. I control for these business model differences by adding the share of loans outstanding to total assets and the amount of net revenue a bank earns from non-lending activities. The results show that even after controlling for these business model differences, dividends and bank size still significantly explain the excess returns around the stress test announcement.

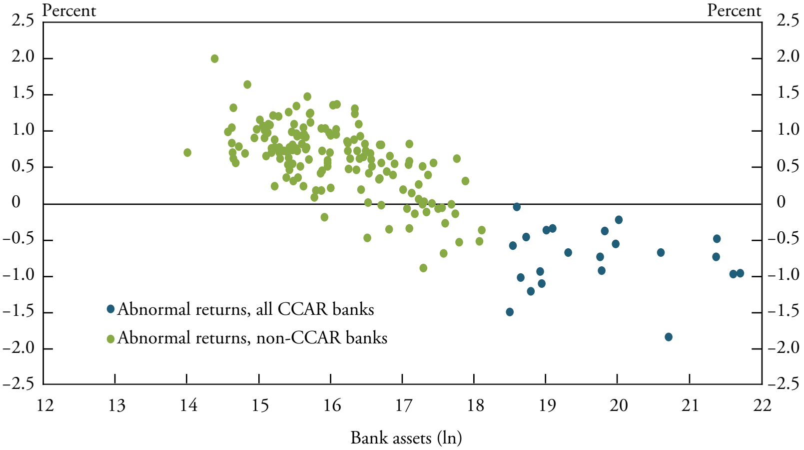
Column (3) considers additional earnings sources. Banks with a broader geographic footprint might have more consistent investment opportunities, allowing them to pay larger dividends. Similarly, banks whose assets reprice less frequently or mature later will be less sensitive to the declining interest rates observed during the pandemic, again allowing them to pay larger dividends. I control for these factors by measuring each bank's deposit concentration at the county level and the average time between the maturity of a bank's assets and of its liabilities.[5] After controlling for investment opportunities and interest rate sensitivity, the dividend result from Table 1 is smaller and no longer statistically significant. This suggests that higher dividends were simply a proxy for greater earnings and investment opportunities and are not related to the payout restriction parameters.

Next, column (4) controls for the possibility that larger banks simply had a larger decline in forecast earnings between the first and second quarters of 2020 (as shown in Chart 2). This difference could explain why large banks had larger declines in stock returns. However, after controlling for the level of expected earnings in 2020:Q1, I find that the coefficient on bank size remains similarly sized and statistically significant.

Finally, column (5) considers whether investors interpreted the greater supervisory stringency as a sign that the probability of large

Chart 5

Bank Size and Cumulative Abnormal Returns after 2020 Stress Test Results



Sources: The Center for Research in Security Prices (Wharton Research Data Services), Board of Governors of the Federal Reserve System, and authors' calculations.[6]

bank failures had increased or that the possibility of bank bailouts in the event of excessive losses was lower. I control for this possibility by including each bank's distance to default and find essentially no change in the bank size coefficient.

The results in Table 1 demonstrate that bank stock prices appear to be relatively insensitive to the payout restrictions that were announced as part of the 2020 stress test results. The parameters most affected by the restrictions, namely the dividend and repurchase rate, do not significantly explain stock returns during very short trading windows following the announcement of payout restrictions. Instead, stock prices performed more poorly following the announcement as bank size increased. Indeed, Chart 5 shows a strong negative relationship between bank size and abnormal returns in the days following the announcement of the stress test results and restrictions. After ruling out several possibilities that might explain this relationship, including increased failure probabilities and lower expected earnings, I conclude that the stress test results suggested an increase in supervisory stringency that was likely to be more severe for larger banks.

Conclusion

The COVID-19 pandemic increased the possibility that large, systemically important banks would suffer substantial losses that threatened their survival. In response, bank supervisors conducted additional stress-testing exercises and imposed restrictions on dividend payments and stock repurchases to preserve bank capital.

I investigate how supervisory actions affected bank capital and how investors responded to the actions. I find that supervisory actions were effective at raising capital levels because they limited the share of income paid out to investors and occurred at a time when bank income was stronger than expected. Overall, the restrictions were effective at raising capital while preserving banks' ability to continue to pay dividends—a key post-crisis supervisory goal.

However, I also find that the imposition of these restrictions implied to investors that large banks would face greater supervisory stringency in the future. As a result, stock price returns were lower than expected among stress-tested banks. Even among unaffected banks, abnormal stock returns declined as bank size increased, suggesting to investors that banks closest to the supervisory threshold were also likely to face increased supervisory stringency.

Nonetheless, my results provide a justification for the use of judgmental assessments by supervisors, particularly during times of crisis. Although the results indicate that increased supervisory stringency was costly to banks during this time, the restrictions were successful at materially raising bank capital levels. Increased supervisory stringency was likely warranted given the very high levels of uncertainty that prevailed at the time. The stock price results illustrate the importance of robust and flexible supervisory regimes that can be used to counter market pressure on banks to reduce capital levels.

Endnotes

[1]Allen and Michaely (2003) provide an extensive review of research on payout policy, including the choice of payout tool, measurement issues, and theory around the importance of payouts to shareholders and management.

[2]Individual capital requirements are too numerous to explore here. However, the key capital requirements are the leverage ratio, which determines capital based on bank size without regard to the riskiness of the portfolio, and risk-based capital requirements, which are determined based on the potential for the loan portfolio to generate losses during stress.

[3]Risk-weighted assets are the total amount of assets held by a bank adjusted for their riskiness. Under risk-based capital regimes, less risky assets such as Treasury securities have lower capital requirements than riskier assets such as business loans. Minimum risk-based capital requirements are expressed as a percentage of these risk-weighted assets.

[4]Only one CCAR-participating bank was required to cut dividends based on income levels under the payout restrictions.

[5]Deposit concentration is based on a Herfindahl-Hirschman Index calculated from deposits booked at local branches by county. Branch-level data are reported on the Summary of Deposits.

[6]I used Wharton Research Data Services (WRDS) in preparing the chart. This service and the data available thereon constitute valuable intellectual property and trade secrets of WRDS and/or its third-party suppliers.

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Long-Term Pressures and Prospects for the U.S. Cattle Industry

By Cortney Cowley

Cattle prices in 2021 have been recovering slowly from several disruptions—including a pandemic, two ice storms, and a cybersecurity attack—which have already had significant effects on profit margins for cattle producers. Although prices for all major agricultural commodities fell dramatically in the first half of 2020 due to COVID-19-related disruptions, most commodities rebounded sharply in the fourth quarter of 2020 and remained strong through most of 2021. However, despite a similarly sized fall, prices producers receive for cattle have only recently surpassed pre-pandemic levels. The sluggish recovery in cattle prices was reinforced by major winter storms in early 2021, which resulted in significant losses to affected producers, and a May 2021 cyberattack on meatpacker JBS S.A., which caused significant production delays. Together, these disruptions have limited the industry's ability to recover from the pandemic and, alongside changing weather and consumer preferences, could have longer-term effects on the economic outlook for cattle producers moving forward.

In this article, I examine long-term pressures and prospects for the U.S. cattle sector. Going forward, U.S. cattle production faces three key pressures that may affect profitability: vulnerabilities along the supply chain; extreme weather conditions, particularly drought; and shifting demand from U.S. consumers. First, although cattle operations had

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been transforming prior to 2020 to produce more beef with fewer inputs, both the pandemic and the May 2021 cyberattack revealed that increasingly efficient, "just-in-time" beef production is highly vulnerable to supply chain shocks. Second, the intensity and frequency of extreme drought, which threatens herds and increases production costs, has only increased in recent decades and can be expected to continue posing risks to cattle production. Third, in addition to pandemic-related shifts in demand, demand for beef in the United States more broadly is under increasing pressure from other traditional meats and plant-based protein sources, especially as consumer prices for retail beef have experienced much larger increases in the pandemic aftermath than other food and meat categories. Although these pressures may shape cattle production in decades to come, growing international demand for U.S. beef—especially from emerging market economies—offers some prospects for the industry.

Section I provides an overview of cattle production and describes how supply chain transformations prior to and during the COVID-19 pandemic could continue to affect producer profitability in the longer term. Section II illustrates how severe weather events have affected cattle herd migration and producer profitability in the past and how increasing weather variability could affect the industry moving forward. Section III discusses trends in beef consumption relative to other protein sources, both in the United States and abroad.

I. Overview of the Cattle Industry, Supply Chain Evolution, and Recent Disruptions

The supply chain for beef is inherently more vulnerable to some disruptions than supply chains for other commodities due to how cattle must be raised and slaughtered. Moreover, the cattle industry has undergone changes in the past few decades that may extend the effects of short-term shocks into the longer term.

The beef supply chain begins with cattle production on cow-calf farm and ranch operations. After calves are raised to a weight of around 500 pounds and weaned, they are sold either directly to feedlots or to stockers or "backgrounders" who graze them on grass or wheat pasture to add another 300 pounds. "Feeder cattle," or steers (male) and heifers (female), are finished on feed grains, legumes, silage, and distillers' grains or other byproducts, depending on the area and availability.[1] Once mature, cattle are sold to beef packing plants to be processed and packaged into primal cuts of meat. Processing plants add value by creating products that consumers can easily access, such as steak, ground beef, and frozen meals. Beef products are sold from the processor to the retailer at a wholesale price, then purchased by the consumer at retail. A single cow and its meat could be sold as many as six times before it finally reaches the consumer.

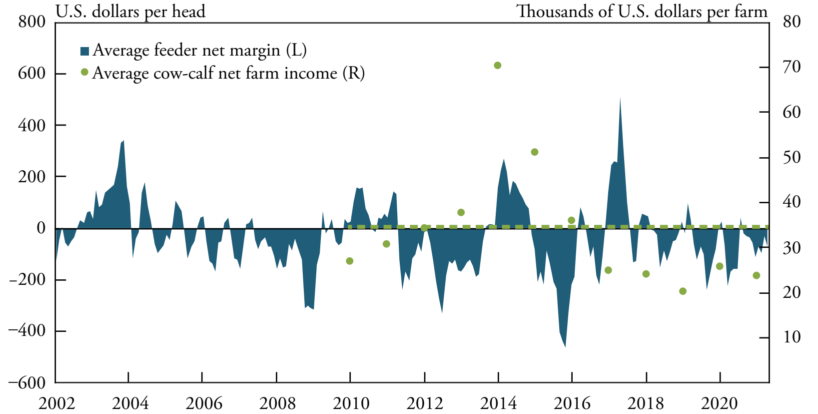
Net margins and farm incomes for U.S. cattle producers tend to be narrow. Chart 1 shows that since peaking in 2014, net income for the average cow-calf producer in the United States (in green) has declined notably and is projected to be $23,700 in 2021, 32 percent lower than the previous 10-year average of approximately $35,000. In addition, net margins for cattle feeders are calculated by subtracting the costs of finishing a steer from the price received from the packer when the steer is mature. Since January 2002, the national average for profit margins at feedlots (in blue) has been negative a majority of the time.

One reason for narrower profit margins in the cattle industry is that production costs are relatively high compared with other commodities. The primary costs associated with cow-calf operations are breeding livestock, land, rent, fuel, and hay. Although calves are an output for cow-calf operations, they are an input cost for stockers and cattle feeders (feedlots). Along with the prices cattle feeders pay for calves, corn accounts for about 50 percent of feed costs, and feed expenses can comprise 60–80 percent of total variable costs associated with finishing a mature animal. Higher feed costs track with higher total finishing costs, which often means tighter margins (assuming the price of cattle is constant over the short run).

On the revenue side of profit margins, the prices cattle producers receive are highly correlated with supply—that is, the number of cattle produced in the United States. Chart 2 shows that over time, the relationship between feeder cattle inventories and prices has been linear and inverse, meaning an increase in inventories is typically correlated with a decline in prices. Since 1995, a 1 percent increase in inventories of feeder cattle in January has led, on average, to a 0.82 percent decline in annual prices for feeder cattle the following year. Over time, as supply chains have become more efficient, the relationship between supplies and prices for cattle has become increasingly important to monitor.

Chart 1

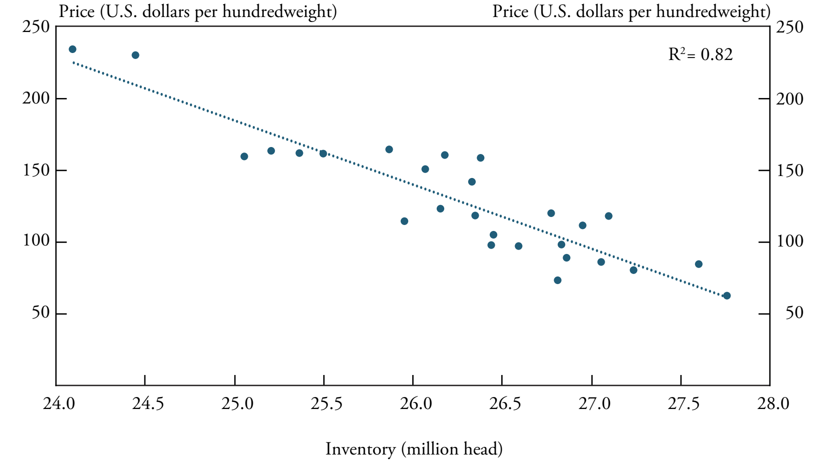
Average Profitability in the U.S. Cattle Sector



Note: Green dashed line shows average income from 2010 to 2020.
Sources: U.S. Department of Agriculture (USDA) and Iowa State University.

Chart 2

Feeder Cattle Prices and Inventories, 1995–2021



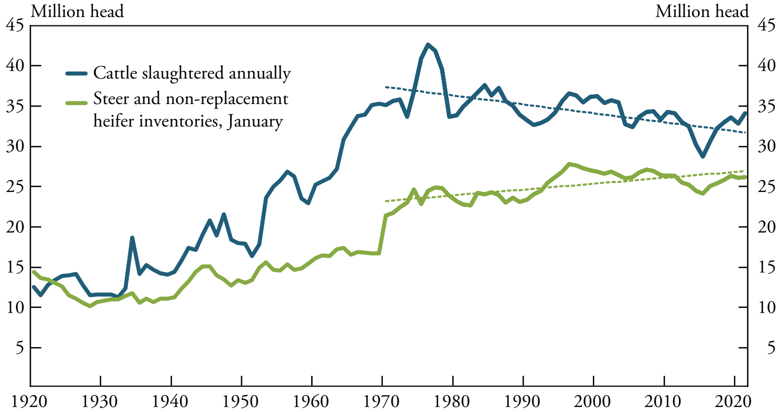
Sources: USDA and Iowa State University.

Greater efficiency in the supply chain means that meatpackers have been able to produce higher quantities of meat with fewer cows. Efficiency in the industry has resulted from a few key developments. First, on the farm, selective breeding and technologies such as artificial insemination and embryo transfer have made higher quality genetics available to all producers, helping the industry produce more beef per cow. Despite a decline in the total number of cattle slaughtered, both the pounds of beef produced per head and the total amount of beef produced in the United States have increased. In fact, the number of pounds of beef produced per cow slaughtered nearly doubled over the last 45 years; in 2021, the total quantity of beef produced is projected to be a record 12.6 million metric tons. Second, the U.S. meatpacking industry started consolidating rapidly in the 1970s and 1980s (MacDonald and others 2000). Beef production and processing is expensive and capital-intensive, which has driven the industry toward economies of scale and fewer, larger firms that are able to operate and produce beef with lower marginal costs. Today, more than 70 percent of beef in the United States is processed at only 3 percent of U.S. meat processing plants (12 plants in 2019). The third development that has contributed to greater efficiency in the cattle and beef supply chain is the industry's transition to "just-in-time" inventory management, where cattle are shipped to packing plants and slaughtered just as soon as they reach maturity. Just-in-time inventory management attempts to match demand and supply and reduce excess capacity.

A more efficient supply chain will likely have longer-term effects on profitability for cattle producers. By concentrating cattle slaughter geographically, the costs of shipping cattle to processors increases with the distance from the farm to the plant, and processors may be able to mark down cattle prices because they have access to larger numbers of animals over a greater geographic area. Moreover, greater efficiency at slaughter has reduced demand for cattle even as supplies of steers and heifers have increased. Chart 3 shows the total number of cattle slaughtered at commercial meatpacking plants each year (in blue) and inventories for steers and non-replacement heifers, or heifers not kept on the farm to reproduce (in green). Earlier in the twentieth century, both inventories and slaughter numbers increased. In fact, from 1950 to 1970, the pace of increase in slaughter capacity seemed to outpace growth in steer and heifer inventories. However, since 1970, total slaughter capacity for cattle in the United States has declined. Overall, the number of cattle slaughtered each year declined from a peak of 43 million in the 1970s to around 30 million in recent years while inventories of steers and non-replacement heifers have increased slightly. In fact, due in large part to disruptions in 2020, monthly cattle-on-feed reports from February to

Chart 3

Transition to a More Efficient Supply Chain



Notes: Cattle slaughtered for 2021 projected based on number of animals slaughtered year-to-date in September 2021. Blue and green dotted lines show trends from 1970 to 2020.
Sources: USDA and Iowa State University.

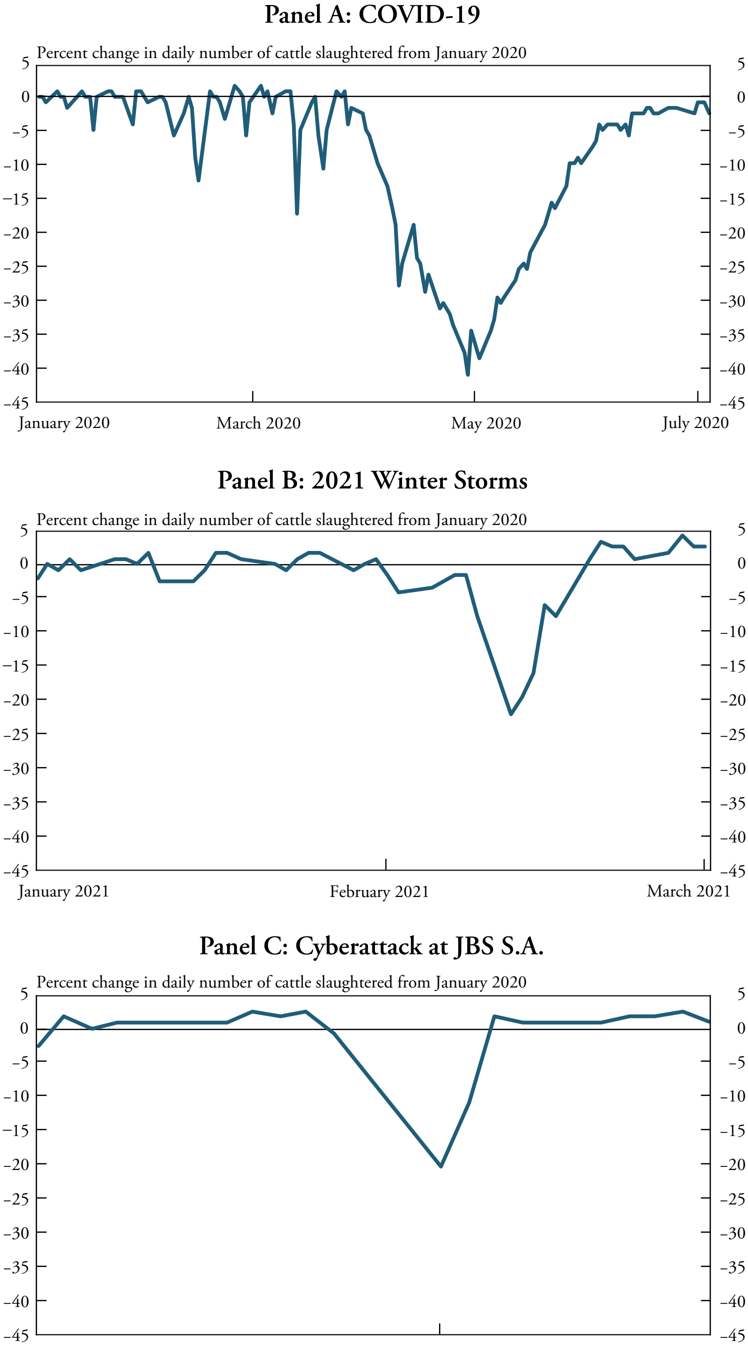
June 2021 showed fed cattle inventories (of which steers and heifers make up a large majority) to be the second highest since 1996.

The transition to a more consolidated and efficient supply chain may have made both producers and consumers more vulnerable to shocks. First, when an increasing share of beef production is concentrated among fewer plants, any one plant shutdown becomes more disruptive to the supply chain. Second, when less excess slaughter capacity is available in the system, backlogs take longer to work through and can put downward pressure on cattle prices for a longer period.

Indeed, starting in March 2020, a series of disruptions led to processing backlogs and surplus cattle on farms. First, COVID-19 outbreaks at meatpacking and processing plants across the country forced plants to shut down or slow operations. Amid shuttered plant operations, the number of cattle slaughtered declined by as much as 40 percent in May 2020 (Chart 4, Panel A). Reduced demand due to the pandemic-related plant shutdowns created backlogs in the beef supply chain and led to surplus cattle on farms—the cumulative oversupply of cattle in the supply chain may have been up to 500,000 head (Cowley 2020). Together, these supply shocks put substantial downward pressure on live cattle prices and producer profitability.

Chart 4

Disruptions in U.S. Beef Production, 2020–21



Sources: USDA and author's calculations.

As the cattle industry was addressing pandemic-induced backlogs, two other shocks further disrupted beef supply chains. In February 2021, extreme winter weather across the United States affected a large share of the beef cattle herd. Snow and ice storms were so severe in some areas that packing plants were forced to shut down or reduce operations. Winter storms Uri and Viola reduced slaughter capacity and beef production by as much as 22 percent in the following two weeks (Chart 4, Panel B). And on May 30, 2021, one of the largest meatpackers in the country, JBS S.A., suffered a cyberattack that stalled its beef and pork packing plants. Total U.S. beef production was 20 percent lower on June 1 and 11 percent lower on June 2 compared with levels at the beginning of the year (Chart 4, Panel C). Although the cyberattack was short-lived—and the timing just before the Memorial Day holiday likely limited its effects—the size of the decline in total U.S. beef production shows just how concentrated meat production has become.

The trend toward consolidation is not unique to beef producers, of course, and the pandemic and weather-related shocks weighed on all livestock producers. However, supply disruptions can be disproportionately challenging for beef producers due to slower production cycles, less support from exports, and higher recent inventories for cattle on feed. Indeed, due in part to both continued disruptions and difficulty unwinding backlogs, cattle prices remained below pre-pandemic levels for most of 2020 and 2021. In August 2021, prices for mature cattle reached pre-pandemic levels, remaining flat through September even as prices for other commodities were 20 to 40 percent higher than pre-pandemic levels. Cattle prices moved above pre-pandemic levels in October and November 2021, but the increase has not yet been as large as upward price movements for other commodities.

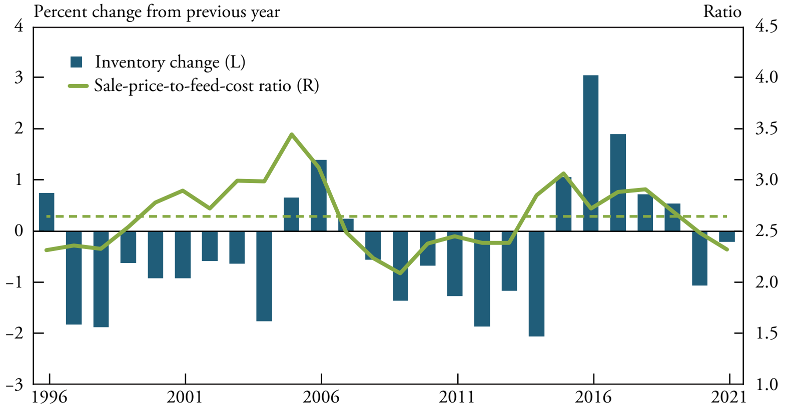
Compared with other species of livestock, the biology of cattle production makes backlogs more difficult to work through. It takes about three years from the time a cow is bred for her offspring to be marketed for slaughter, and a cow has only one calf per year. Comparatively, a sow can have about 25 piglets per year, and a hen can lay up to 250 eggs per year. Sows and hens have much shorter life cycles as well, allowing hog and poultry producers to ramp up or reduce production more quickly in response to price movements in the market and disruptions in the supply chain. Because cattle are produced on longer production cycles, shocks and backlogs in the supply chain can take longer to work through and have more lasting effects on prices.

In addition to slower production cycles, the cattle industry is also less dependent on exports than are other commodities. Over the past decade, the United States has exported only about 10 percent of beef produced compared with 15 percent of corn, 25 percent of pork, 47 percent of soybeans, and 50 percent of wheat, on average. Although exports were likely not a drag on prices for beef, they did not provide the level of support experienced by markets for other commodities.

Cattle prices also have been slow to recover because cattle markets typically move in longer-term cycles. As producer profitability increases, cattle herds expand, increasing overall U.S. inventories. When profitability declines, producers begin to liquidate, and U.S. cattle inventories decline. Chart 5 shows my estimate of producer profitability using a sale-price-to-feed-cost ratio, where sale price is the average for live cattle, and feed costs are the average total costs of feeding a 1,500-pound steer to maturity. The average ratio of 2.6 means that, on average, the price producers receive for a finished animal is roughly 2.6 times larger than the associated feed costs. Since 1996, U.S. cattle inventories have never expanded in the year following a below-average price-to-feed-cost ratio. Although inventories have declined in five of the last 24 years following above-average profitability in the cattle sector, these years typically correspond to general economic recessions. The remaining 19 years show a notable positive correlation between U.S. cattle inventory changes and producer profitability in the previous year. In other words, cattle inventories typically increase the year after producer profitability increases (an increase in the sale-price-to-feed-cost ratio) and decrease the year after producer profitability declines.

However, cattle inventory movements in 2020–21 appear to have bucked this trend, which could add longer-term pressures to profit margins. In 2020, the price-to-cost ratio fell below average levels, but total cattle inventories in 2021 have thus far declined at a slower pace than in 2020 and at a slower pace than expected based on previous trends. Based on the historical trend, I estimate the change in total cattle inventories in 2021 using the 2020 price-to-feed cost ratio. In 2020, the ratio was 2.3, which would have led to a 1.25 percent decline, on average, in herd inventories going into 2021. As of January 2021,

Chart 5
U.S. Cattle Inventories and Price-to-Cost Ratios



Notes: Cattle inventories are total cattle inventories in the United States, including cows, calves, bulls, steers, heifers, and cattle on feed. Dashed green line shows the average sale-price-to-feed-cost ratio from 1996 to 2021.
Sources: USDA and author's calculations.

however, inventories had only declined 0.2 percent from January 2020, indicating that half a million more cattle were on U.S. farms coming into 2021 than would have been expected based on 2020 producer profitability. Currently, cattle inventories would need to decline a bit more in 2021 for the industry to see improvement in profitability and prices in future years. Higher-than-expected inventories may have kept prices for cattle below pre-pandemic levels for a longer period.

Cattle inventories may have declined by less than expected in 2021 for at least two reasons. First, as discussed, supply chain disruptions in 2020 and 2021 reduced demand at packing plants and left many farmers and feedlots with limited options for moving and selling cattle. In addition, tight labor markets and the efficient, "just-in-time" nature of the beef supply chain means packing plants have had limited ability to ramp up production to work through backlogs more quickly. Therefore, producers were having difficulty finding placements for finished cattle and culled cows.

Second, government payments provided substantial support to farm finances in 2020, reducing producers' incentives to cull herds. Government programs typically focus on support for crop producers, but in 2020, livestock producers received the largest share of the $16 billion in funds provided by the Coronavirus Food Assistance Program

(CFAP). Support from the government may have helped producers maintain herd sizes at higher levels than current market conditions would normally support, thereby limiting herd liquidation and depopulation. Although these payments have supported farm finances in the short term, the higher supply of cattle could keep prices lower than they would have been over the next few years.

Producers are likely to feel the effects of the pandemic and concurrent shocks for several years. Disruptions and reduced capacity at meatpacking plants caused a surplus of animals on farms, which put downward pressure on prices and revenues. In addition, these disruptions could have longer-term effects due to previous trends of greater consolidation and efficiency in the industry. In fact, current long-term projections for livestock revenues, of which cattle make up a large share, remain below pre-pandemic levels (FAPRI 2020). Livestock revenues for 2020 came in 7 percent below levels forecast prior to the pandemic. In 2021, forecasters revised their 10-year projections for farm revenue down 3 percent relative to projections made in February 2020. With production costs expected to increase, producer profit margins may tighten even further over the next decade.

II. Drought and the Cattle Industry Moving Forward

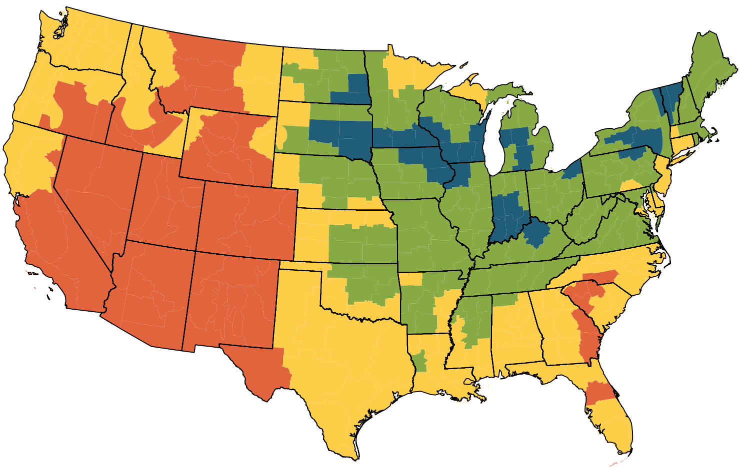
In addition to supply chain difficulties, increasingly severe and variable weather conditions could have greater effects on cattle production and producer profitability in the future. Although several forms of severe weather—including ice storms, hurricanes, and floods—can disrupt supply chains and create financial difficulties for local cattle producers, drought is likely to put the most widespread pressure on the cattle industry in the coming decades. Panel A of Map 1 shows that drought has occurred with greater intensity and frequency since 2000 than throughout the twentieth century, particularly in the West and Southeast. In the Southwest, drought has been more severe than in previous decades, with hotter temperatures alongside lower precipitation for a longer period. West of the Rocky Mountains, 16 of the last 20 years have been in some level of drought, and 11 of the top 20 driest years on record have occurred since 2000.

Drought has historically influenced herd management decisions and cattle inventories. Since the 1970s, U.S. cattle inventories have

Map 1

Drought Intensity and Herd Migration in the United States

Panel A: Drought Intensity

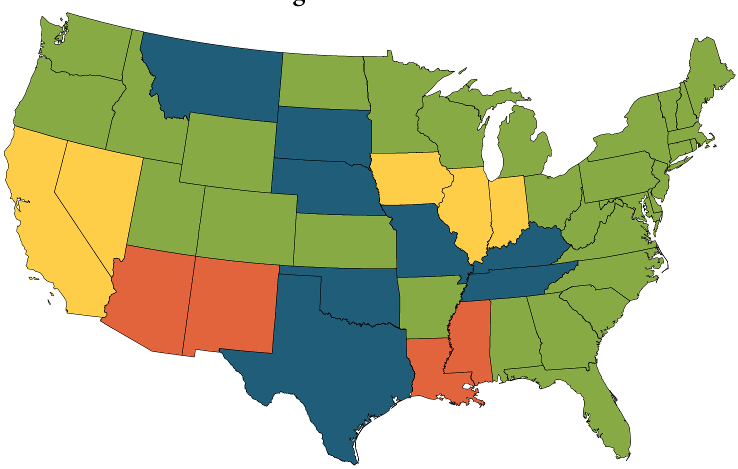


Drought since 2000 compared with twentieth century

More severe drought | Drier

More drought | Less dry

Panel B: Change in Beef Cow Inventories



Number of cows since 2000 compared with twentieth century

Loss of 100,000 to 201,000 | Gain of 1 to 400,000

Loss of 0 to 99,999 | Gain of 400,001 to 720,000

Sources: National Oceanic and Atmospheric Administration, USDA, and author's calculations.

declined in each year where at least 20 percent of the country was in severe-to-exceptional drought.[2] In 2011, for example, a drought began to spread across the contiguous United States; by early 2012, all lower 48 states were in some level of drought or abnormally dry, and more than one-third of the country was in severe-to-exceptional drought. The drought was especially severe in the Southern Plains, where a majority of the U.S. cattle herd is located, and by June 2012, U.S. cattle inventories had declined to the lowest levels in 60 years.

In addition, drought has had a significant effect on where cattle inventories are concentrated around the country. Panel B of Map 1 shows that in the last two decades, beef cow numbers have declined notably in the Southwest but increased in other states, particularly Missouri, Nebraska, and Oklahoma, which accounted for a large share of the overall increase in beef cow inventories. Although many factors could influence cattle production across states and regions—such as policy, culture, industry composition, and land quality and availability—drought has been notably less prevalent in most of the states that have experienced increased beef cow numbers. More recently, severe-to-exceptional drought has spread through much of the western and northern United States, and as of the beginning of 2021, cattle inventories had declined in states where 50 percent or more of the land area had been in severe-to-exceptional drought at the end of 2020.

Drought can affect producer profitability by putting downward pressure on revenues and upward pressure on costs. Farm revenues are determined by the price and quantity of cattle sold. Because drought can contribute to losses of pasture and forage, producers may be forced to sell a larger share of their herd in a drought year than planned. If conditions are so severe that producers must sell breeding stock, then drought-induced liquidation may also reduce potential future revenues.

Severe weather can put upward pressure on production costs as well. Abnormally dry or wet conditions limit grass and forage production. When grazing is not sufficient to meet the dietary needs of cattle, cow-calf producers must supplement with hay and other feed. Hay and pasture maintenance costs can account for 30 to 75 percent of total production costs on cow-calf operations and tend to increase in years of extreme weather events. Since 1975, hay prices have increased in all years with some level of drought, while wet years tend to put downward pressure on hay prices unless they are extreme enough to limit hay production or reduce hay quality. In drought years, less hay is produced in areas experiencing drier-than-normal conditions, which reduces feed supply. At the same time, demand for hay may increase in dry areas, and producers may have to purchase hay from sources farther away, thereby driving up transportation costs.

Because drought can affect both farm revenues and costs, it can also have a notable effect on farm finances and agricultural credit conditions. In fact, since 1980, the total economic losses from 28 drought events have totaled $262 billion, and the 2012 drought in the Southern Plains was the third most costly natural disaster on record for the United States (Smith and Matthews 2015). In the first quarter of 2021, agricultural lenders who respond to the Tenth District Survey of Agricultural Credit Conditions were asked to assess the overall change in the financial condition of borrowers that rely on crops as inputs (such as cattle, hog, poultry, and dairy producers) relative to one year ago.[3] Respondents indicated that the financial conditions of farm borrowers had improved at a majority of banks across the region, but less so for livestock producers and producers affected by drought. Improvement was notably slower in Oklahoma and the Mountain States (Colorado, New Mexico, and Wyoming), where drought was more severe and widespread. Overall agricultural credit conditions were also weaker in areas experiencing more widespread and severe drought (Cowley and Kreitman 2021). For example, although farm income and farm loan repayment rates grew in almost all states in the first quarter of 2021 relative to 2020, incomes and repayment rates grew at a much slower pace in the Mountain States and Oklahoma. Although loan demand grew at a faster pace in areas affected by drought, ranchland values were expected to grow more slowly in dry areas.

In the decades to come, drought is likely to worsen in intensity and frequency in some areas, which would put additional pressure on profit margins, particularly in areas where water is already scarce. According to the National Climate Assessment, rising temperatures, extreme heat, drought, wildfire on rangelands, and heavy downpours are expected to increasingly disrupt agricultural productivity in the United States. Projected increases in extreme heat conditions are expected to lead to further heat stress for livestock, changes in water and forage availability, and disease and pest outbreaks, which can result in large economic losses for producers (NCA 2017).

III. Evolving Domestic and International Demand for Beef

In addition to supply chain shocks and extreme weather, a third concern for the U.S. beef industry over the last two decades has been growing consumer preferences for chicken and pork and increasing demand for alternative meat and protein sources. Although domestic demand for beef may be shifting, international demand—especially in emerging economies—offers prospects for U.S. beef producers.

In recent decades, production and consumption of beef have not kept pace with other animal proteins. Chart 6 shows that throughout the 1970s and 1980s, beef was "what's for dinner"—to quote an early 1990s ad campaign—and in the United States, more beef was produced than pork or chicken. However, by 2000, production and consumption of pork and chicken caught up to beef and have since been on steeper increasing trajectories, while U.S. beef production and consumption have been relatively flat.

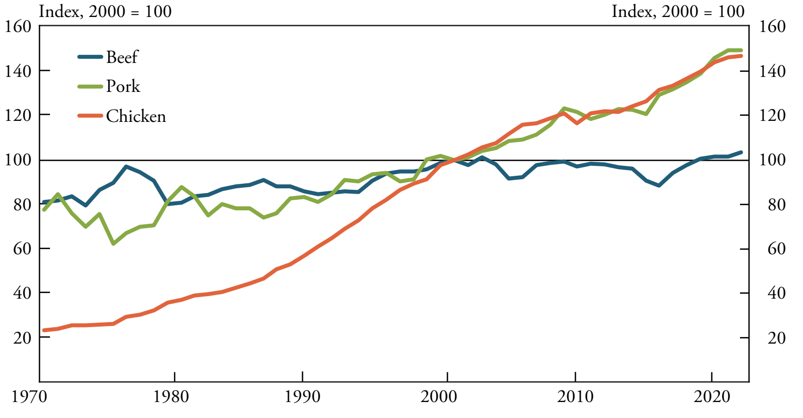
Public perceptions of climate change and its relationship with meat production, alongside consumer preferences for other protein products and beliefs about animal welfare and nutrition, could also pose some downside risks to domestic demand for beef and cattle producer profitability. For example, in 2019, the United Nation's Intergovernmental Panel on Climate Change urged people to eat less meat and more plant-based foods to improve health and reduce carbon dioxide emissions by up to 15 percent (IPCC 2019). More recently, a popular cooking website banned new beef recipes over concerns about climate change (Taylor and Morales 2021). In 2021, a popular New York City restaurant announced that it would no longer serve meat or seafood, becoming one of the most high-profile restaurants to switch to a plant-based menu out of environmental concerns (Anderson and Gross 2021).

Amid concerns about health, animal welfare, and the environmental effects of meat production, the popularity of plant-based meat products has risen, though these products still account for a very small share of the protein market. Consumers purchase traditional beef in the marketplace about three times more often than plant-based protein alternatives (Tonsor, Lusk, and Schroeder 2021). Although the market share for alternative protein sources is currently small, higher demand for plant-based meat could contribute to lower aggregate demand for

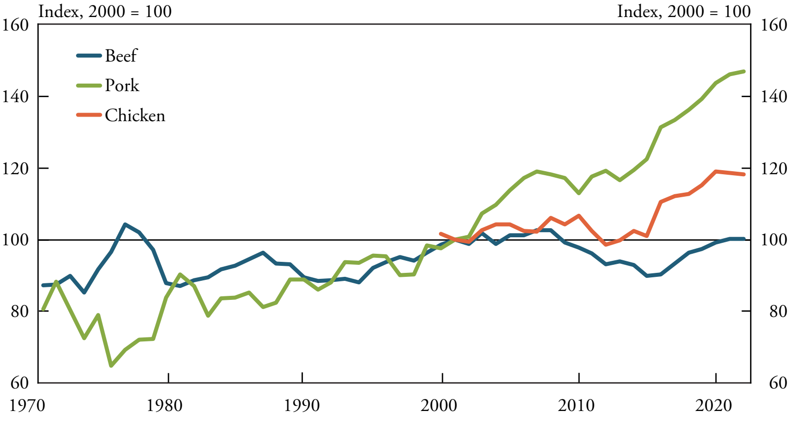
Chart 6

U.S. Meat Consumption and Production

Panel A: U.S. Meat Production



Panel B: U.S. Meat Consumption



Note: Data for chicken consumption are unavailable prior to 1999.
Source: USDA.

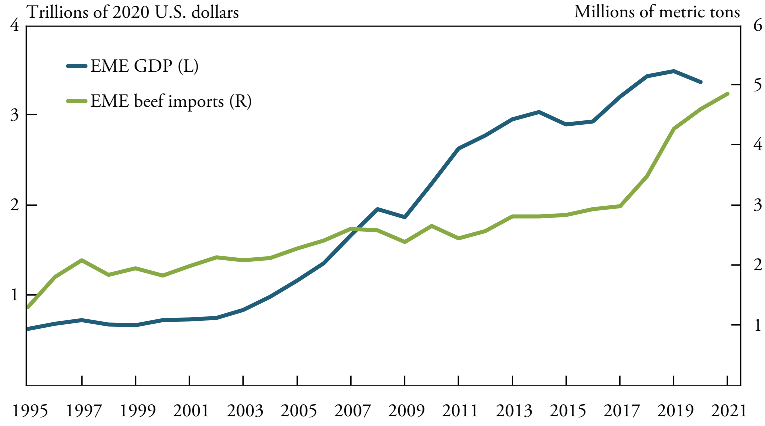
beef and thereby reduce demand for cattle upstream. If demand for cattle declines, the only way to increase profits for cattle operations would be to reduce the cattle supply. According to a recent working paper by Lusk and others (2021), a 10 percent increase in demand for plant-based meat would reduce U.S. cattle production by approximately 0.15 percent, resulting in a $300 million decline in economic welfare for U.S. cattle producers.

Despite longer-term pressures on domestic demand for beef, prospects for international demand are bright, particularly as economies become more prosperous. The United States went from exporting about 16,000 metric tons of beef per year in the 1960s to exporting almost 1.34 million metric tons of beef in 2020. The U.S. beef industry is on pace to export more in 2021, as March and May set new monthly records for beef exports. The recent surge in beef exports is broad based (USMEF 2021). Although China has contributed substantially to growing U.S. beef exports, several other countries have as well, especially those considered emerging market economies (EMEs).[4]

The outlook for EMEs' demand for beef has improved in recent years and could continue to grow in the decades following the pandemic. Chart 7 shows that from 1995 to 2017, beef imports to EMEs grew at a steady pace of about 4 percent per year. Starting in 2018, however, beef imports to EMEs grew 15 percent per year on average alongside strong GDP growth. Moreover, despite EMEs accounting for only 36 percent of the world's nominal GDP in 2021, EMEs' share of total world imports of beef has grown from 28 percent in 1995 to 51 percent in 2021.

Higher international demand for beef could offset any potential declines in U.S. demand related to shifting consumer preferences. After the industry works through backlogs created by short-term supply shocks, stronger demand will also help support prices for cattle. In the longer term, growing global demand for beef could encourage some expansion of slaughter capacity in the United States. Under current conditions of tight labor markets and more efficient supply chains, the United States might not be able to produce enough beef to meet a dramatic increase in international demand. But if global demand for beef continues to grow at a strong, steady pace, U.S. ranchers and

Chart 7
GDP and Beef Imports in EMEs



Note: EMEs include the following countries, in alphabetical order: Argentina, Brazil, Chile, China, Colombia, Egypt, Hungary, India, Indonesia, Iran, Malaysia, Mexico, the Philippines, Poland, Russia, Saudi Arabia, South Africa, Thailand, Turkey, and the United Arab Emirates.
Sources: USDA and International Monetary Fund (accessed through Haver Analytics).

meatpackers may invest further in expanding slaughter capacity and beef production.

Conclusion

Recent shocks related to the pandemic, weather, and a cyberattack led to a decline in demand for cattle at processing plants and a weak price environment for cattle producers, who were not able to adjust herd sizes quickly enough to increase profitability. Without adjusting the supply of cattle, short-term disruptions could result in a longer period of low profitability for cattle producers. Farm financial conditions in the cattle industry could continue to be challenging if government support is withdrawn or if slaughter capacity remains limited.

In years ahead, the cattle industry faces several pressures that could threaten profitability, but there are opportunities for growth as well. The pandemic and other disruptions revealed vulnerabilities in the cattle and beef supply chain that, if not addressed, could continue to result in larger and longer-lasting downside risks for cattle producers when shocks occur. But these disruptions have also increased consumer interest in locally sourced beef and may have spurred new ways to improve resilience, information transmission, and automation in the industry, which could benefit producers in coming decades. More variable weather conditions and intense drought also present downside risks for cattle prices and producer profits, with some areas of the country facing more strain than others. However, farmers and cattle producers have long adopted new technologies and sustainable practices on their operations, which could offset some of the effects of more variable weather moving forward. And even if plant-based and lab-raised proteins and traditional meats besides beef gain market share in the United States, international markets for beef could replace any displaced domestic demand. In 2021, U.S. beef exports have set new records in almost every month. As countries recover from the pandemic and incomes increase around the world, global demand for traditional meat will likely increase, supporting U.S. cattle producers.

Endnotes

[1]Steers and heifers make up almost 80 percent of total annual cattle slaughter in the United States, with cows, bulls, and calves comprising the remaining 20 percent.

[2]The U.S. Drought Monitor classifies drought conditions into five categories: abnormally dry, moderate drought, severe drought, extreme drought, and exceptional drought. When an area is in severe-to-exceptional drought, it may experience widespread crop losses, water shortages and restrictions, and decreased reservoir levels. In addition, areas in severe drought for eight consecutive weeks, or in extreme or exceptional drought for any period, may be considered experiencing a natural disaster and thus eligible for federal disaster assistance.

[3]Tenth District states include Colorado, Kansas, Nebraska, Oklahoma, Wyoming, northern New Mexico, and western Missouri.

[4]According to the International Monetary Fund, EMEs have lower incomes than "advanced" economies but have "sustained strong growth and stability that can produce higher-value-added goods and are more like advanced economies not only when it comes to income, but also in participation in global trade and financial market integration" (Duttagupta and Pazarbasioglu 2021, p. 7).

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Do Net Interest Margins for Small and Large Banks Vary Differently with Interest Rates?

By Rajdeep Sengupta and Fei Xue

Bank net interest margins (NIMs) have declined since 2019, renewing concerns about the viability of traditional banking in a low-interest-rate environment. NIMs denote a bank's profitability from its core banking operations—the difference between interest income from loans, securities, and other assets and interest expenses from deposit and non-deposit funding. In practice, bank NIMs have changed with the stance of monetary policy—reductions in the effective federal funds rate have coincided with declining bank NIMs.

However, declining NIMs may pose a greater challenge for small banks than large banks. Small community banks rely more heavily on the traditional banking model and generate most of their income from interest on loans, while large banks typically have more sources of noninterest income. Understanding differences in small and large bank NIMs (as well as the forces driving them) may shed light on the effects of the recent decline. Typically, small banks provide financing to small businesses that have fewer options for external financing. Lower profits and increased distress at small banks could constrain credit to their customers, adversely affecting local economic outcomes.

In this article, we examine the relative contributions of activities that compose bank NIMs as well as their sensitivities to interest rates. We find that the recent decline in bank NIMs was largely driven by

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changes in interest rates rather than changes in their composition in bank portfolios. In particular, we find that interest income from loans and interest expenses on deposits are sensitive to changes in interest rates. However, the sensitivities are not always symmetric between large and small banks and between increases and decreases in interest rates. For example, increases in interest rates have a relatively stronger association with loan contributions to NIMs at large banks. Therefore, while lowering interest rates may be relatively disadvantageous for small banks by lowering NIMs, raising interest rates is not necessarily advantageous for them. Our results suggest that increases in loan incomes at small banks have had a relatively weaker association with increases in interest rates since 2015.

Section I describes the behavior of large and small bank NIMs since the global financial crisis (GFC) of 2008. Section II examines how changes in the composition of bank activities and their yields have changed NIMs over short and long horizons. Section III shows that interest sensitivities of contributions to bank NIMs vary with bank size and the stance of monetary policy.

I. Bank NIMs since the Global Financial Crisis of 2008

A decline in NIMs may undermine the viability of the traditional banking model, in which banks primarily take deposits and make loans, with greater consequences for small banks.[1] Small banks rely more on the traditional approach to banking: they focus on building relationships with borrowers and typically lend to small businesses, whose ability to repay is arguably harder to assess due to a lack of history or experience. In contrast, large banks rely more on a transaction-based business model and typically lend to large businesses, which are more transparent and have access to alternative sources of financing in capital markets. Moreover, large banks have increasingly supplemented their interest earnings with noninterest income, which includes fees, service charges, and revenues from trading and investment banking activities (Haubrich and Young 2019). Whereas interest income accounts for roughly 40 to 50 percent of large banks' operating income (the sum of net interest and noninterest income), it accounts for roughly 60 to 70 percent of small bank operating income. Naturally, large banks are less reliant on NIMs.

As Chart 1 shows, small banks typically record higher NIMs than large banks. This difference can be generally attributed to differences in their business models. Small banks tend to pay more on their expenses from liabilities because they lack the benefits of scale economies and "too big to fail" subsidies in funding markets that accrue to large banks (Jacewitz and Pogach 2016).[2] At the same time, small banks may be able to charge substantially higher rates on their loans because they build relationships with borrowers who arguably have fewer outside options for financing than clients of large banks.

Chart 1 also shows that large and small bank NIMs diverged after the GFC. In the five years following the GFC, large bank NIMs (blue line) fell by 70 basis points, whereas small bank NIMs (green line) declined by only 20 basis points (Covas, Rezende, and Vojtech 2015).[3] Three factors may explain this divergence. First, interest expenses declined relatively more at small banks during this period than at large banks. Large banks had already lowered their interest expenses prior to the GFC, leaving them with little room for further downward adjustment in deposit rates. Second, large banks experienced a greater decline in interest income from loans relative to securities and other assets. Third, GFC bank failures were limited almost exclusively to small banks; accordingly, their smaller decline in NIMs after the crisis may reflect a survivorship bias.

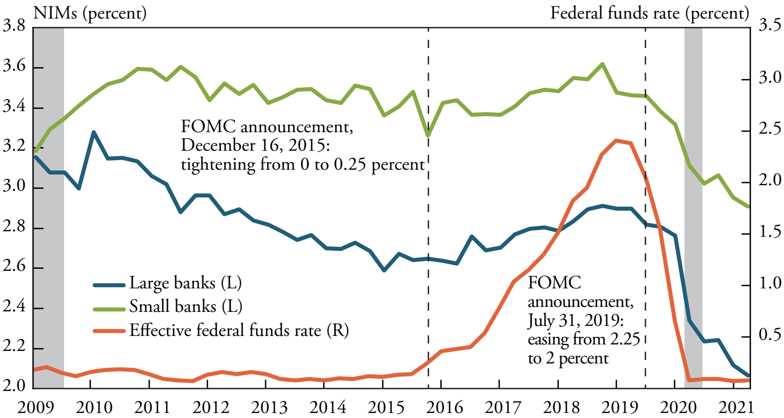
Barring the period from 2016 to mid-2019 during which monetary policy tightened, NIMs have gradually declined with interest rates since the GFC. This decline is part of a much broader historical trend of declining bank NIMs attributed to declining long-term interest rates (term premiums) since the early 1990s (Di Lucido, Kovner, and Zeller 2017).

More recently, however, the decline in NIMs has been both sharper and relatively comparable across large and small banks. Since 2019:Q2, large bank NIMs have declined by around 70 basis points, while small bank NIMs have declined by roughly 55 basis points. This decline in NIMs has coincided with the easing of monetary policy that started in August 2019. The further easing of monetary policy since the onset of the pandemic in early 2020 was accompanied by an even steeper decline in NIMs.[4]

Although the gap between small and large bank NIMs widened after the GFC, the difference in levels has remained nearly unchanged

Chart 1

NIMs at Small and Large Banks, 2009:Q1 to 2021:Q2



Note: Gray areas represent National Bureau of Economic Research (NBER)-defined recessions.
Sources: Board of Governors of the Federal Reserve System, NBER, and authors' calculations.

in recent years. This recent pattern would suggest that factors that affect NIMs, such as interest rates, do so in the same way for large and small banks. However, as prior research has shown, NIMs and interest rates do not always move in tandem (Ennis, Fessenden, and Walter 2016). Moreover, considering the widening of large and small bank NIMs after the GFC, NIMs and interest rates do not necessarily move in the same way for large and small banks either. Investigating the interest sensitivities of NIM components may shed light on differences in large and small bank NIMs over the credit cycle—the expansion and contraction of credit over time.

II. Changes in the Contributions of NIM Components over Short and Long Horizons

Bank NIMs comprise five components that tend to vary with interest rates. The three asset-side components—loans, securities, and other interest-bearing assets—generate income for the bank. The two liability-side components—expenses from interest-bearing deposit and non-deposit liabilities—reduce that income. Changes in contributions from these five components together yield the overall changes in NIMs. In general, the asset-side components generate positive contributions when interest rates rise, whereas the liability-side components generate a negative contribution. The converse is true when interest rates decline.

A change in the contribution from any one of these components can be further decomposed into changes in the yield of that component and changes in the share of that component in banks' portfolios. For example, the total contribution from loans comprises changes in loan yields (changes in returns on loans) and changes in the loan share of earning assets (changes in the volume of loans in the banks' asset portfolio). Accordingly, we account for changes in both yields and shares of each NIM component when assessing potential differences in the relative contributions of NIM components across small and large banks.

NIM components and the 2019:Q2–2021:Q2 decline in bank NIMs

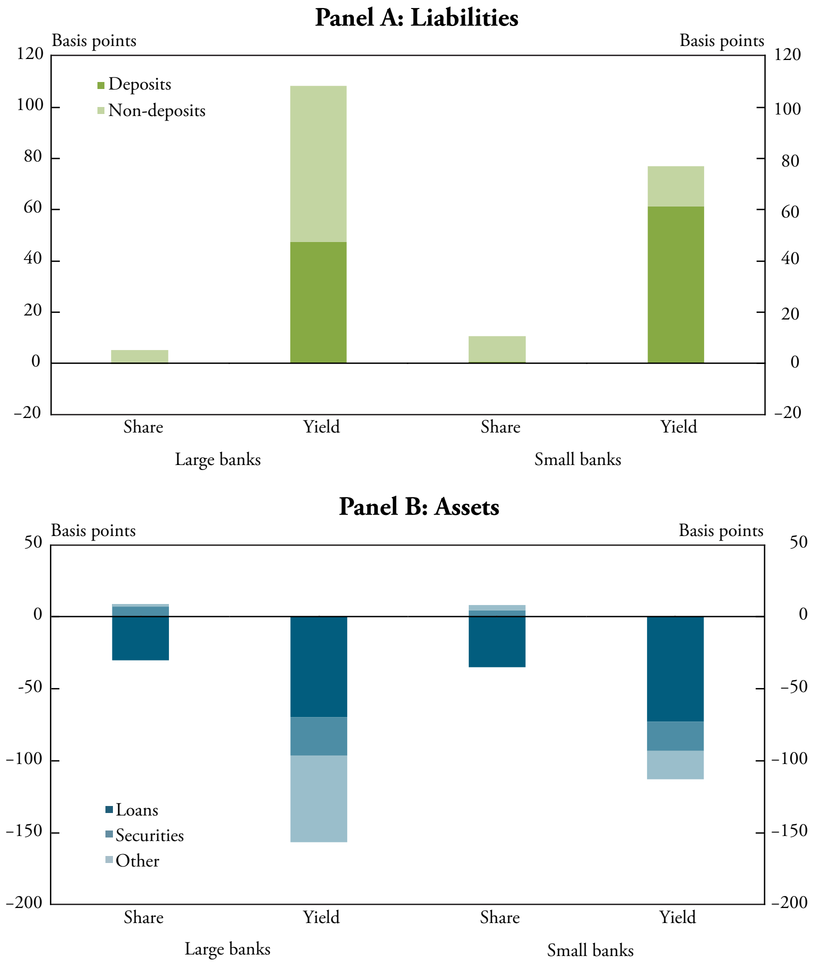
As a first step, we decompose the recent decline in NIMs since 2019:Q2 into changes in the yields and shares of both liabilities and assets. Together, Panels A and B of Chart 2 indicate that the bulk of changes in contributions to NIMs in the past two years have been driven by changes in the yields of both asset-side and liability-side components. Changes in the portfolio composition of assets and liabilities have been relatively small.

Panel A of Chart 2 shows that reduced expenses from interest-bearing deposit and non-deposit liabilities have contributed positively to NIMs at both small and large banks over the past two years. In comparison, the contribution from changes in portfolio composition have been minimal and can be attributed mostly to a marginal increase in non-deposit financing.[5] Deposits make up a relatively larger share of total liabilities in small banks (about 70–80 percent compared with 50–60 percent for large banks) and consequently contributed relatively more to changes in yields at small banks. Moreover, small banks tend to gain relatively more from reduced expenses from deposits when interest rates are cut (Covas, Rezende, and Vojtech 2015). In contrast, non-deposits make up a relatively larger share of total liabilities in large banks and consequently a relatively larger share of contributions from changes in yields.

Panel B of Chart 2 shows that reduced interest income from loans, securities, and other interest-bearing assets contributed negatively to NIMs at both large and small banks over the past two years, more than offsetting the positive contribution from reduced expenses.[6] The negative contribution from changes in yields from loans and securities (dark blue and medium blue bars, respectively) has been comparable

Chart 2

NIM Contributions from Changes in Yields and Shares, 2019:Q2 to 2021:Q2



Sources: Board of Governors of the Federal Reserve System and authors' calculations.

across large and small banks. However, the negative contribution from changes in other interest-bearing assets (light blue bars)—which include leases, trading assets, repurchase agreements, and interest-bearing balances due from other depository institutions—is much greater at large banks than small banks. Other interest-bearing assets make up a relatively larger share of interest-earning assets in large banks and consequently a relatively larger share of contributions from changes in yields.

Importantly, changes in the share of loans in bank portfolios have also contributed negatively to NIMs in the last two years. The dark blue bars in Panel B show that declining loan shares at both small and large banks made a significant negative contribution to NIMs. This result stands in contrast with the marginally positive contribution of changes in loan shares to NIMs following the GFC (Covas, Rezende, and Vojtech 2015). The decline in loan shares over the past two years has been driven in part by the decline in loan demand due to government stimulus and transfers during the pandemic.[7] Still, the lack of significant increases in bank lending when interest rates drop to low levels has led recent research to question the efficacy of the bank lending channel at low rates (Borio and Gambacorta 2017).

Together, Panels A and B of Chart 2 suggest that despite a sizeable contribution from declining loan shares, most of the decline in bank NIMs over the past two years can be attributed to reduced yields from loans, securities, and other interest-bearing assets. Because changes in interest rates are among the most significant drivers of changes in yields, we next examine how contributions from NIM components vary with changes in interest rates.

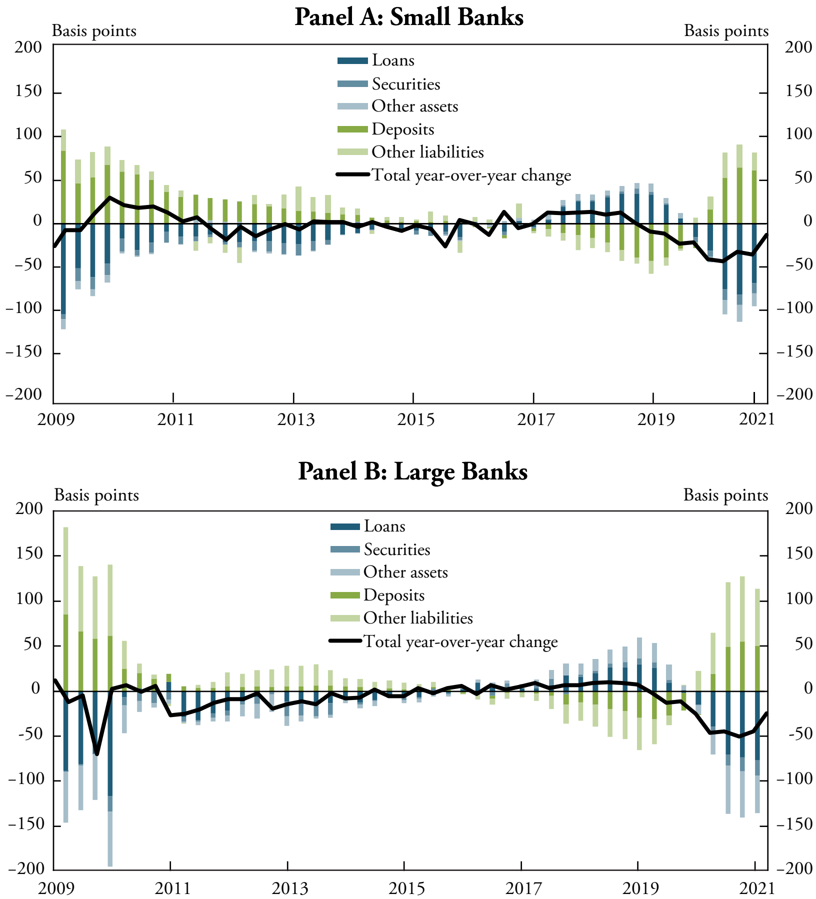
Changing NIM contributions over the post-GFC credit cycle

Understanding how contributions to NIMs change through different phases of the credit cycle is likely to become increasingly important as the economy improves and monetary policy begins to normalize. To assess how the contribution of different NIM components changes with both increases and decreases in interest rates, we extend our period of analysis to 2009:Q1–2021:Q2. We use this post-crisis period because the conduct of monetary policy and the operating environment for banks have changed significantly since the GFC.[8]

NIM components vary based on whether the monetary policy stance is restrictive or accommodative. For example, interest rate cuts during the GFC not only reduced interest expenses from both deposit and non-deposit liabilities but also reduced interest income from assets. Panels A and B of Chart 3 show that after these cuts, liability-side components at both large and small banks contributed positively to bank NIMs, while asset-side components contributed negatively—the same pattern exhibited during the recent decline in NIMs since mid-2019.

Chart 3

Changes in Contributions of NIM Components, 2009:Q1 to 2021:Q2



Sources: Board of Governors of the Federal Reserve System and authors' calculations.

When monetary policy became more restrictive after 2015, this pattern reversed: interest expenses increased (contributing negatively to NIMs) as did interest income (contributing positively to NIMs). Because rate cuts were drastic at the onset of the GFC and the COVID-19 pandemic, the changes in NIM contributions have been consequently greater at the beginning and end of the period shown in Chart 3 than in the middle.

Changes in NIM contributions at smaller banks tend to be smaller in magnitude than those at large banks. Comparing Panels A and B of Chart 3 shows that changes in NIM contributions at small banks come mostly from loans and deposits, which comprise a relatively larger portion of their balance sheet. In contrast, changes in NIM contributions at large banks tend to be larger and come from other interest-bearing assets and non-deposit liabilities. The heterogeneity in the pattern of small and large bank NIM contributions reflects the relative share of each component in the bank's balance sheet.

Despite these differences, NIM contributions from small and large banks have varied similarly with changes in interest rates, albeit with different magnitudes. In other words, differences in the contributions of NIM components across large and small banks can be traced largely to the magnitude of these components' response to changes in rates. In the next section, we measure the responsiveness of these contributions using statistical methods. In doing so, we account for changes in macroeconomic and financial conditions that can also influence NIM contributions.

III. How Do NIM Contributions Vary with Interest Rates?

Although both interest income and interest expenses exhibit a positive relationship with interest rates, this relationship is not necessarily symmetric. For example, an increase in the effective federal funds rate might generate a greater increase in interest income from loans than in interest expenses on deposits, thereby raising NIMs. In fact, the pass-through from policy rates to loan rates and deposit rates often differs. Driscoll and Judson (2013) find that the pass-through from monetary policy to deposit rates tends to be sluggish in episodes of tightening. The pass-through to deposit rates may also be weaker because deposit rates lack a term premium—additional compensation investors receive for longer-maturity assets such as loans. Research has often attributed the historical decline in bank NIMs since the early 1990s to a decline in term premiums (Paul and Zhu 2020). Because NIMs constitute the margin of longer-maturity loans over shorter-term deposits, both short-term and long-term interest rates are relevant to any analysis of the interest sensitivity of NIM components.

We use interest rates on U.S. Treasury securities as our measures of short-term and long-term interest rates. The market for U.S. Treasuries is the largest and most liquid financial market in the world, and Treasuries are widely accepted as the benchmark low-risk assets against which all interest-bearing assets are priced. The plot of yields on Treasury securities of different maturities is known as the yield curve. An upward *shift* of the yield curve denotes an overall increase in interest rates regardless of maturity. An upward *slope* of the yield curve, on the other hand, denotes a positive term premium and therefore a relative increase in interest rates for longer-maturity Treasuries over shorter-maturity Treasuries. We use changes in the three-month Treasury yield to denote a shift in the yield curve and use the difference between the 10-year and the three-month Treasury yields to denote changes in the slope of the yield curve. The level and slope of the yield curve are summary measures for overall interest rates.

To determine the sensitivity of different NIM components to changes in interest rates, we estimate a linear model that controls for variations in macroeconomic and financial conditions.[9] In particular, we control for overall macroeconomic conditions using (annualized) quarterly changes in real GDP, the civilian unemployment rate, and commercial and residential house price indexes. In addition, we control for financial market conditions using quarterly growth in stock returns and a risk premium measured as the difference between the BBB bond index and the 10-year Treasury yield.

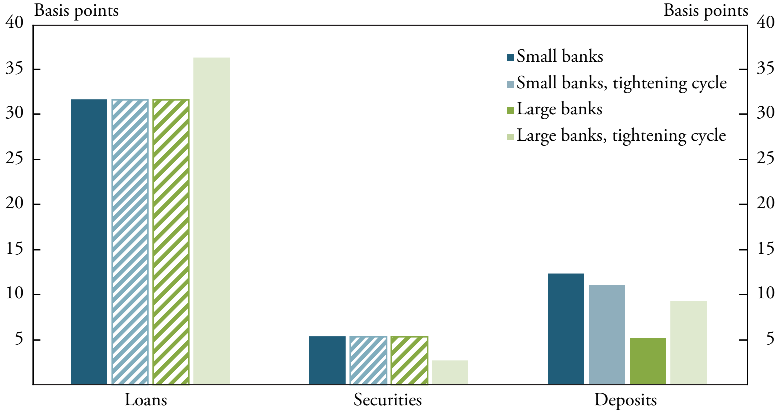
We interact explanatory variables in our model with an indicator variable for large banks and an indicator variable for the monetary policy tightening cycle. Fully interacting explanatory variables with an indicator variable for large banks allows us to determine whether the observed associations differ between large and small banks. Moreover, fully interacting explanatory variables with an indicator variable for the quarters that belong to a tightening cycle helps us determine whether the observed associations differ based on the stance of monetary policy.[10]

We find significant associations between interest rates and NIM contributions from deposits, loans, and securities. However, we find no significant association between interest rates and NIM contributions from other assets and non-deposit liabilities. These results are consistent across small banks and large banks and hold irrespective of the stance of monetary policy. Appendix Table A-1 includes the complete regression results.

Chart 4 shows that changes in interest rates have the strongest positive association with changes in NIM contributions from loans and a relatively weaker positive association with deposits and securities. Specifically, a 1 percentage point change in the three-month Treasury yield is associated with a 32 basis point change in NIM contributions from loans

Chart 4

Association with a 1 Percentage Point Change in the Three-Month Treasury Yield



Notes: Solid bars indicate associations are statistically significant at the 5 percent level. Hashed bars indicate no statistically significant change (at the 10 percent level) from the baseline estimate. "Tightening cycle" indicates quarters in which the Federal Reserve increased the target federal funds rate or left the target federal funds rate unchanged following an increase in previous quarters.
Sources: Board of Governors of the Federal Reserve System and authors' calculations.

at small banks (dark blue bar) compared with a 12 and 5 basis point change in the NIM contributions from deposits and securities, respectively.[11] The association for loans is stronger because most bank loans are variable-rate loans that are indexed to benchmark rates (Kumbhat, Palomino, and Perez-Orive 2017). Monetary policy drives benchmark rates, yielding a higher pass-through to loan yields and loan contributions.[12]

However, the estimated associations do not always change with bank size or with the stance of monetary policy. For example, at small banks, the association between interest rates and NIM contributions from loans and securities does not significantly change during a tightening cycle (comparing the dark blue and hashed light blue bars in Chart 4). Put differently, the positive contributions to small bank NIMs from loans and securities when rates are rising are of similar magnitude to the negative contributions from loans and securities when rates are falling. In addition, when policy is accommodative and rates are falling, the association between interest rates and NIM contributions from loans and securities does not significantly change with bank size (comparing the dark blue and hashed dark green bars). In other words, large and small banks see a similar decrease in NIM contributions from loans and securities when rates are declining.

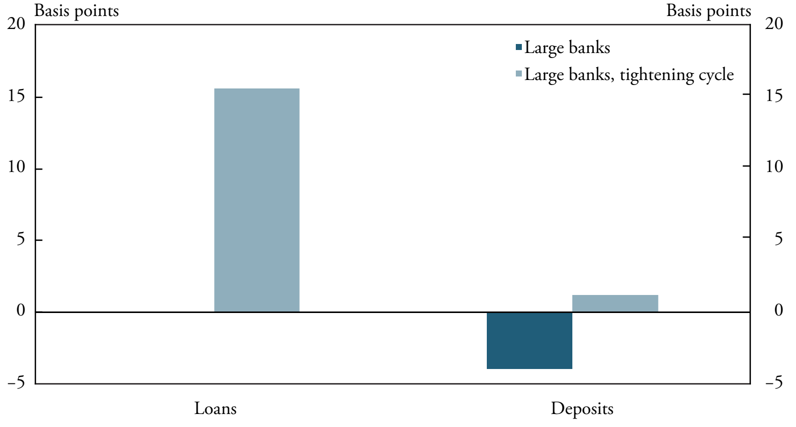
In contrast, during a tightening cycle, when interest rates are *increasing*, the associations between interest rates and NIM contributions from loans and securities differ by bank size. The solid light green bars in Cha*f*rt 4 show that the association at large banks is relatively stronger and more substantial for loans but weaker and negligible for securities.

The stronger association between rising rates and higher loan income at large banks could be the result of increasing loan shares, increasing yields, or both. First, contrary to conventional wisdom, raising rates in an ultra-low-rate environment may actually boost lending, raising the loan share of earning assets. Indeed, this article has already demonstrated that the recent decline in interest rates shrank bank loan portfolios (see Panel B of Chart 2). Rising interest rates increase banks' interest income from lending, thereby increasing their willingness to lend (Borio and Gambacorta 2017). Our results would suggest that this incentive is relatively stronger at large banks given their access to alternative sources of income. Second, increasing yields on large bank loans can be attributed to differences in the types of loans (that is, more leveraged loans at large banks) and loan contract terms between small and large banks. Because the stronger association between rising rates and higher loan income at large banks is relative to small banks, it could also be attributed to a lower degree of pass-through on loan rates for small-bank customers who may be unwilling or unable to withstand a higher interest burden. Another important factor is the increased concentration of loans at large banks in the syndicated loan market—the largest market for bank loans—allowing them to charge higher spreads on comparable loans (Lian 2018). By contrast, small banks possess relatively less market power in the loan markets in which they operate. Therefore, differences in market power could also account for the relatively higher loan incomes at large banks following rate increases.

The association between interest rates and NIM contributions from deposits changes with bank size and the stance of policy. Because deposits are an expense item, they generate a positive contribution to NIMs when interest rates decline and a negative contribution when interest rates increase. However, the magnitude of these contributions differs between small and large banks. When monetary policy is accommodative, reduced expenses from lower deposit rates are higher at small banks than at large banks (comparing the solid dark blue bar

Chart 5

Association with a 1 Percentage Point Increase in the Slope of the Yield Curve



Notes: All associations shown in the chart are statistically significant at the 5 percent level. "Tightening cycle" indicates quarters in which the Federal Reserve increased the target federal funds rate or left the target federal funds rate unchanged following an increase in previous quarters.
Sources: Board of Governors of the Federal Reserve System and authors' calculations.

with the solid dark green bar in Chart 4). This result is unsurprising, as large banks pay less on deposits than small banks and accordingly can reduce expenses to a lesser extent than small banks when the Federal Reserve cuts rates. Thus, small banks gain relatively more from reduced interest expenses when the stance of policy is accommodative. During a tightening cycle, however, the estimated associations between interest rates and deposit contributions are comparable (comparing the solid light blue bar with the solid light green bar in Chart 4).[13] Despite large banks' funding advantage, increased expenses on deposits from rising rates at large banks are comparable to those at small banks. Yet, as mentioned above, rising rates did increase NIM contributions from loans at large banks to a significantly greater degree than at small banks. With a comparable increase in expenses and a relatively greater increase in incomes, a tightening cycle does appear to favor large banks.

Our analysis yields significant associations between the slope of the yield curve and NIM contributions from deposits and loans, but only for large banks.[14] Chart 5 shows that though the association with deposits is marginal, the association with loans is substantial. During a tightening cycle, a steepening of the yield curve can significantly increase loan incomes at large banks. Bank loans typically have maturities over longer horizons. Although some loans are indexed to shorter-term benchmarks, the loan spread is known to increase with the steepening of the yield curve.[15] This result also implies that yield curve inversion during a tightening cycle would substantially reduce income from loans at large banks.

Conclusion

The sharp drop in bank NIMs since 2019 has once again focused attention on the viability of the traditional banking model. Understanding the implications of this decline, however, requires an understanding of how the components of NIMs have changed, both in bank portfolios and in their sensitivity to interest rates. We analyze changes in five components that drive NIMs at small and large banks over the post-GFC period. We find that the recent decline in bank NIMs since mid-2019 was largely driven by changes in yields on these components rather than changes in their composition in bank portfolios. In particular, we find that changes in yields on loans and deposits drove changes in NIMs at small banks while changes in yields of other assets and non-deposit liabilities drove changes in NIMs at large banks. This pattern has largely held since the GFC, though small banks have seen a relatively greater decline in NIMs in recent years.

We conduct a statistical analysis of the sensitivities of NIM contributions to changes in interest rates over the post-GFC period. After controlling for financial and economic conditions that also affect bank NIMs, we find significant associations between interest rates and NIM contributions from deposits and loans at both large and small banks. Despite their funding advantage, increased expenses on deposits from rising rates at large banks are comparable to those at small banks. However, rising rates did increase the NIM contribution from loans at large banks to a significantly greater degree than at small banks. Moreover, this contribution increases further with a steepening of the yield curve. With a comparable increase in expenses and a relatively greater increase in incomes, the statistical analysis suggests that a tightening cycle of monetary policy has favored large banks relatively more over the post-GFC period.

Our results highlight that while lowering rates is relatively disadvantageous for small banks because of the accompanying decline in NIMs, raising rates is not necessarily advantageous for them. Although recent experience would suggest that a tightening cycle may mitigate the disadvantage from low NIMs faced by small banks, it would also help large banks in terms of relatively higher loan incomes. More research is needed to determine the source of large banks' advantage in loan incomes during tightening cycles. Differences in loan types and contractual terms between small and large banks could yield this advantage, as could relatively higher market power in setting loan rates.

Appendix

Regression Results

Table A-1

Interest Rate Sensitivities of NIM Components

	Dependent variable				
	Assets			Liabilities	
Independent variables	Loans	Securities	Other assets	Deposits	Non-deposits
Level (short-term rate)	0.316**	0.053*	0.035	0.123**	0.090
	(0.020)	(0.006)	(0.039)	(0.004)	(0.157)
Level * Large bank	−0.031	0.015	0.018	−0.071**	0.114
	(0.007)	(0.004)	(0.014)	(0.002)	(0.056)
Level * Tighten	0.028	−0.086	0.002	−0.012**	0.030
	(0.018)	(0.058)	(0.030)	(0.000)	(0.060)
Level * Large bank * Tighten	0.050**	−0.026**	0.025	0.053**	−0.031
	(0.001)	(0.002)	(0.011)	(0.002)	(0.028)
Slope	0.133	0.070	−0.010	0.025	0.036
	(0.063)	(0.023)	(0.010)	(0.004)	(0.016)
Slope * Large bank	−0.042	−0.014	0.014	−0.040**	0.036
	(0.007)	(0.005)	(0.006)	(0.002)	(0.006)
Slope * Tighten	−0.117	−0.092	0.016	−0.040	−0.001
	(0.032)	(0.072)	(0.028)	(0.007)	(0.006)
Slope * Large bank * Tighten	0.156**	−0.019	−0.037	0.052**	−0.005
	(0.011)	(0.008)	(0.012)	(0.002)	(0.024)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	98	98	98	98	98
R^2	0.996	0.975	0.993	0.996	0.974

* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level

Notes: Robust standard errors are in parentheses. We use changes in the three-month Treasury yield to denote a shift in the level of the yield curve and use the difference between the 10-year and the three-month Treasury yields to denote changes in the slope of the yield curve. “Large bank” is an indicator variable for the group of banks with $50 billion of assets in end-of-year 2009 U.S. dollars. “Tighten” is an indicator variable for observations that belong to a quarter during the tightening cycle from 2015:Q4 to 2019:Q2.

Endnotes

[1]We use a $50 billion threshold in end-of-year 2009 U.S. dollars to distinguish between large and small banks. We use public data from regulatory filings of domestic banking organizations. Our primary data source is Form Y-9C, which collects basic financial data from domestic bank holding companies (BHCs). We refer to banks, banking organizations, and BHCs interchangeably.

[2]In addition to scale economies, large banks have benefitted from increased concentration and market power in some markets, as well as any implicit too-big-to-fail subsidy.

[3]Covas, Rezende, and Vojtech (2015) present the trends for small and large bank NIMs prior to the GFC.

[4]Research has pointed to the fact that the already severe decline in NIMs could have been worse without the extraordinary policy interventions undertaken during the pandemic. Marsh and Sharma (2021) find that the Paycheck Protection Program (PPP) supported margins of participating banks. More broadly, Beck, Carletti, and Bruno (2021) argue that these interventions created a virtuous circle that reduced risk premiums for all economic agents, including large banks. We abstract from examining the effects of such extraordinary measures except for their effect on interest rates.

[5]This may come as a surprise to readers who are aware of the record increases in bank deposits since the March 2020 turmoil in financial markets. However, most of the increase in deposits is attributed to noninterest-bearing deposits and therefore not included in NIMs. In addition, banks have significantly reduced expenses on any increases in interest-bearing deposits.

[6]In part, the reduced income has been attributed to low rates on PPP loans (Marsh and Sharma 2021).

[7]Although loan shares have decreased, bank lending increased sharply at the onset of the pandemic and then slowed significantly. Much of the increase in lending comes from participation in the PPP. However, non-PPP bank lending has declined since 2019 (Ennis and Jarque 2021).

[8]The expansion of the Federal Reserve's balance sheet has substantially increased the reserves currently held at banks, whereas changes in liquidity and capital regulation following the GFC have changed banks' operating environment.

[9]We follow the regression specification in Claessens, Coleman, and Donnelly (2018) and Altavilla, Boucinha, and Peydró (2018). Specifically, we regress quarterly contributions to NIMs on a lagged dependent variable and the level and slope of the yield curve. We use year fixed effects and control for quarterly changes in macroeconomic and financial conditions. Alternative specifications yield qualitatively similar results.

[10]We classify a quarter as belonging to a tightening cycle if the Federal Reserve increased the target federal funds rate in that quarter or left the target

federal funds rate unchanged following an increase in previous quarters. Using this definition, we determine that the only tightening cycle in our period of analysis lasted from 2015:Q4 to 2019:Q2.

[11]Because loans and securities are income items, a 1 percentage point increase in the three-month Treasury yield is associated with a 32 basis point increase in the NIM contribution from loans and a 5 basis point increase in the NIM contribution from securities. However, deposits are expense items, and therefore, a 1 percentage point increase in the three-month Treasury yield is associated with a 12 basis point decrease in the NIM contribution from deposits.

[12]Most bank loans are indexed to some benchmark rates. Borrowers submitting loan applications typically get quotes of the contractual benchmark rate plus some number of basis points. Until recently, most banks used as their benchmark the London Interbank Offer Rate (LIBOR), which is highly correlated with Treasury yields of similar maturity. However, with the LIBOR set to expire by the end of 2021, banks are currently using alternative benchmarks.

[13]The estimated associations show that changes in contributions from deposits are only 2 basis points lower than those for small banks.

[14]We cannot make any useful comparison with small banks as our results suggest no statistically significant associations between the slope of the yield curve and NIM contributions for small banks.

[15]The median maturity on large bank syndicated loans is 48 months. And while most loans have been indexed to a three-month LIBOR rate, the spread on the loan would likely increase with the term premium.

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