How might a central bank digital currency alter banking system operations? What is the effect of credit easing on the dynamics of bank runs? Does increased competition among banks mean a more fragile banking system, and what can be done about it? These were among the research questions addressed by economists during a recent Richmond Fed research conference.

Economists from the Richmond Fed, research universities and other institutions met in Richmond for a conference in August. Researchers presented papers on a variety of topics, including central bank digital currencies, monetary policy transmission and innovation networks.

Central Bank Digital Currency and Banks

A central bank digital currency (CBDC) differs from existing digital money such as bank deposits because it is a liability of the central bank rather than of a commercial bank. Unlike existing central bank liabilities such as bank reserves, however, a CBDC can be held by the general public, rather than just banks. A significant concern is that a CBDC might disintermediate the banking system by reducing the number of deposits into it, which could lead to reduced lending, among other effects.

Kairong Xiao of Columbia University presented research examining the potential effects of a CBDC on the banking system. His paper "Central Bank Digital Currency and Banks" was co-authored with Toni M. Whited of the University of Michigan and Yufeng Wu of the University of Illinois.

The researchers address the concern over disintermediation by first constructing a model showing that, in the absence of frictions, fewer deposits need not lead to less money available for lending, as the difference can be covered through banks' wholesale funding, or the cash they hold from banks, governments or other large entities. However, when frictions associated with such a funding mechanism are considered — specifically,
increased costs from the default risks (as wholesale funding is not insured) and interest rate risks stemming from the maturity mismatch between short-term borrowing and long-term lending — the model suggests that CBDCs can have an impact.

Through a series of counterfactuals using bank-level data, the authors find that a CBDC can, indeed, replace a large percentage of bank deposits, upwards of 30 percent if it bore interest. The effect on lending, on the other hand, is more muted, as banks would fall back on wholesale funding to cover the difference. But given the risks associated with wholesale funding, this shift can impact bank stability and costs: A one percentage point increase in the market share of a CBDC increases a bank's default probability by 1.1 percent, while unexpected increases in short-term interest rates on bank capital double in the presence of a CBDC.

**Disintermediating the Federal Funds Market**

The federal funds market is the overnight borrowing of reserves among banks and government agencies and is the primary market for monetary policy implementation. Despite its central role in the economy, the fed funds market has experienced a continuous decline in volume since its peak just before the Great Recession, dropping over 80 percent by the end of 2019. During this same period, total bank assets have ballooned by over 450 percent.

Examining the causes of this decline, Russell Wong of the Richmond Fed presented his paper "Disintermediating the Federal Funds Market (PDF)," which is co-authored with Mengbo Zhang of the University of California, Los Angeles.

The authors theorize that the observed decline in trading on the fed funds market is rooted in what they refer to as the disintermediation channel. Prior to 2008, banks that intermediated — meaning both purchased and sold fed funds on the same day — purchased more than 80 percent of fed funds. In that year, however, the number of intermediating banks fell from around 600 to only 100, and the number of intermediated trades dropped by 90 percent.

Using bank lending data, the researchers find that the decrease in both the number of intermediating banks and the volume of intermediation was driven by the introduction of unconventional monetary policy, specifically the interest rate on excess reserves (IOER). These payments incentivized banks to stop lending and maintain their reserves, which increased through quantitative easing during this period.

To identify the mechanism driving this result, the authors employ a theoretical model demonstrating that the market features too much intermediation in the absence of IOER. Such excessive trading takes place because it's costless for banks to search out counterparties to either lend or borrow. The model shows that IOER can increase the frictions associated with searching out those counterparties, including balance sheet and
regulation costs. The scholars' counterfactual analysis finds that eliminating IOER would have doubled the intermediation volume in 2018, while reducing transaction costs can quadruple the level of intermediation.

**Bank Runs, Fragility and Credit Easing**

Many financial crises involve bank runs, where account holders concerned with a bank's solvency rush to withdraw their deposits in anticipation that others will do the same. The accumulating withdrawals lead to a severe liquidity problem where the bank cannot meet those withdrawals. The bank thus defaults, making the run self-fulfilling. Research has shown that runs are more likely to occur in the face of weak macroeconomic fundamentals and to hit many banks simultaneously.

To better understand this loop in which fundamentals affect runs and those runs affect fundamentals — as well as to understand any implications for policy — Javier Bianchi of the Minneapolis Fed presented his working paper "Bank Runs, Fragility and Credit Easing," which was co-authored with Manuel Amador, also of the Minneapolis Fed.

The researchers develop a model of financial crises to shed light on these processes. In the model, each bank chooses its own portfolio that largely depends on dynamic asset prices. These asset prices also limit banks' commitments and shape their decisions about whether to default in the face of crises (triggered by either runs or the broader fundamentals) or to continue operating. They find that the likelihood of a run is generally low when asset prices are high, as banks will always repay. Alternatively, banks are incentivized to default when asset prices are low, increasing the potential for a run.

Credit easing — modeled as government purchases of capital — is commonly viewed as a policy tool to stop a bank-run crisis. The model further demonstrates, however, that the effectiveness of such a policy hinges on whether the crisis was driven by fundamentals or self-fulfilling runs.

Credit easing in a fundamentals-induced crisis leads to more banks defaulting rather than repaying deposits, as the attenuating increase in asset prices reduces the value of repayment by asset-buying banks. On the other hand, crises arising from self-fulfilling runs should stabilize with credit easing. Here, repaying banks are net sellers who benefit from an increase in asset prices, making default the less attractive option.

**HBANK: Monetary Policy with Heterogenous Banks**

The financial and credit crises of 2007-08 demonstrated that banks as financial intermediaries can play a significant role in the transmission of monetary policy to the real economy. The literature since that period has examined how disruptions in financial intermediation can affect economic activity. However, the significant heterogeneity across financial intermediaries and the consolidation of market power within the banking industry have largely escaped examination.
Rustam Jamilov of All Souls College, University of Oxford presented "HBANK: Monetary Policy with Heterogeneous Banks (PDF)," which aims to shed light on how bank heterogeneity and market power shape the transmission of monetary policy. The paper was coauthored by Marco Bellifemine of the London School of Economics and Tommaso Monacelli of Bocconi University.

After using bank income statement and balance sheet data to show that credit and deposit market power has become concentrated in the hands of large banks, the authors demonstrate how these institutions differ from smaller banks in response to monetary contractions. While all banks lower their credit markups and the quantity of credit available (consistent with the goal of dampening the effects of a higher interest rate on the price of loans), large banks lower those markups and quantities significantly more. Similarly, all banks raise their deposit markups (where increases in interest rates widen the spreads they charge on deposits, leading to fewer deposits and reduced lending capacity), but large banks raise them less.

To show how existing bank heterogeneity amplifies monetary shocks, the authors develop a Heterogenous Bank New Keynesian (HBANK) model. The model yields two important findings. First, it identifies intrinsic differences in banks' ability to identify profitable lending opportunities — what the researchers call permanent returns heterogeneity — as the key mechanism that strengthens the effectiveness of shocks. Larger, more profitable banks are better able to find those opportunities, and they have a higher propensity to lend as well, meaning that the large number of such banks in the U.S. banking system can have a powerful effect.

Second, the model demonstrates that credit market power drives much of the amplification due to the procyclical credit markups of large intermediary banks. Deposit market power, on the other hand, has the opposite effect, as deposit markups are countercyclical.

**Competition, Stability and Efficiency in the Banking Industry**

Is there a trade-off between competition and stability in the banking industry? Competition can increase efficiency in the market, but it can also reduce stability as it erodes profits, lowers bank valuations and encourages riskier investments. Though not universally accepted, this "competition-fragility" viewpoint suggests policymakers must make decisions about the appropriate degree of competition and tools to manage the potentially adverse consequences that can result from competition.

Dean Corbae of the University of Wisconsin, Madison presented "Competition, Stability and Efficiency in the Banking Industry (PDF)," a paper coauthored with Ross Levine of the University of California, Berkeley to help further understand the trade-offs between competition and stability.
Building off earlier theoretical work, Corbae and Ross introduce a model of the banking industry that:

- Allows for banks to enter and exit the market based on expected profits
- Incorporates leverage requirements and monetary policy
- Introduces the possibility of frictions between bank owners and managers

The model's results confirm the existence of a trade-off: More competition increases market efficiency as well as bank instability.

The model also produces several important implications. First, policies that improve bank governance and tighten leverage requirements can bring stability to the banking system with varying effects on efficiency:

- Eliminating agency conflicts between owners and managers results in increased efficiency and greater stability.
- Tightening leverage (or capital) requirements reduces efficiency but enhances stability.
- Governance and leverage requirements interact, which allows coordinated policies to enhance efficiency and stability.

These governance requirements include measures aimed at altering the incentives of bank executives so that they focus more on a bank's long-run value, rather than short-term objectives such as surging stock prices to trigger larger executive bonuses.

The other key implication stemming from the model is that competition intensifies the impact of monetary policy on bank lending. In competitive markets, small interest spreads and profit margins force banks to respond more aggressively to contractionary monetary policy, increasing their willingness to take risks and decreasing short-term lending.

**The Reserve Supply Channel of Unconventional Monetary Policy**

In response to the 2007-08 financial crisis and the COVID-19 pandemic, the Fed purchased trillions of dollars of assets as part of its quantitative easing (QE) program. As a result, the quantity of reserves held by banks increased from less than $0.05 trillion in 2006 to $3.3 trillion in 2021.

Such an increase in the supply of reserves could either increase or decrease bank lending:

- Increasing the supply of reserves could encourage bank lending when reserves are a scarce liquid asset whose meager supply constrains lending.
- In contrast, increasing the supply of reserves could inhibit bank lending when scarce bank equity or regulatory constraints make it costly for banks to expand.
Yiming Ma of the Columbia Business School presented research that attempts to measure the impact of increased reserves on bank lending. Her paper "The Reserve Supply Channel of Unconventional Monetary Policy (PDF)" was co-authored by William Diamond of the University of Pennsylvania's Wharton School of Business and Zhengyang Jiang of Northwestern University's Kellogg School of Management.

Estimating a structural model of the market for bank deposits and loans, the researchers attempt to answer two key questions:

- How elastic are the demand curves for bank loans and deposits?
- How do increased reserve holdings change a bank's cost of supplying loans and deposits?

To estimate the elasticity of bank loans, the researchers examine data following natural disasters, when banks tend to focus their lending on the affected areas and lessen the supply of loans to counties unaffected by the disaster. Thus, the unaffected areas suffer negative supply shocks, which facilitate the identification of loan demand elasticities. The researchers find that the demand for bank loans is quite sensitive to changes in interest rates.

To capture the loan supply effects of increased reserves, the researchers estimate how a bank's costs of providing loans depends on the overall composition of its balance sheet. Their estimates imply that increasing a bank's reserve holdings increases its loan costs.

The researchers conclude that requiring banks to hold the trillions in reserves created by QE caused a significant reduction in bank lending to firms. They argue that reducing the regulatory constraints banks face when holding reserves could avoid this crowding-out effect.

### Innovation Networks and R&D Allocation

Economists have long studied the relationship between economic policy and innovation. Usually, the focus of the discussion has been on the aggregate amount of research and development (R&D) investment and the costs associated with either underinvestment or overinvestment. But do economic policies affect the allocation of R&D resources across economic sectors or technological fields?

Ernest Liu of Princeton University presented research that addresses this important yet understudied question. His paper "Innovation Networks and R&D Allocation (PDF)" was co-authored by Song Ma of Yale University.

The key novelty of their theoretical approach is to introduce a network perspective to model the propagation of innovation across an economy. The network perspective captures the notion that one sector's innovation activities require researchers and scientists to build
on prior discoveries and knowledge, often from outside their own fields or sectors — a key feature in the innovation process.

The researchers begin by modeling a closed economy without international knowledge spillovers. They explicitly solve for the optimal path of cross-sector R&D resource allocation. It turns out that the solution is intuitive: It accounts for the direct effect of R&D on sectoral output and the indirect network effects on other sectors through R&D spillovers, discounting benefits that occur far into the future. The optimal R&D allocation is affected by the society's discount rate. A society valuing long-term growth should allocate more resources toward sectors with fundamental technologies that are upstream in the innovation network, such as semiconductors. By contrast, a society with a shorter-term horizon should allocate more R&D resources toward sectors that are downstream in the innovation process.

The authors then extend their model to an open economy with international knowledge spillovers. Their analysis highlights the incentive for countries to "free ride" on fundamental technologies: Holding the total level of R&D constant, an economy more reliant on foreign knowledge spillovers has less incentive to direct resources toward fundamental innovation in upstream sectors.

The researchers empirically validate the key mechanism behind their theory — namely, that a sector's innovation activities benefit from past innovation in upstream sectors linked through the innovation network. They present evidence that a sector's patent production increases in response to increased patent output in upstream sectors.

**Dealer Intermediation Costs and Customer Counterparty Choice**

In the aftermath of the 2007-08 financial crisis, several governments enacted regulations to help protect their economies from future financial crises. The U.S., for instance, enacted the Dodd-Frank Wall Street Reform and Consumer Protection Act in 2010. To some extent, the Dodd-Frank Act and similar regulations in other countries accomplished their goal. This was highlighted by the global financial sector's resilience during the economic fluctuations caused by the pandemic. However, a major focus of academics and policymakers has been to assess how such regulations affect the financial sector in normal times.

Bruno Sultanum of the Richmond Fed presented research that examines the longer-term effects of post-crisis bank regulations. His work in progress "Dealer Intermediation Costs and Customer Counterparty Choice" was co-authored by Lucas Dyskant of Yale University and Andre Silva of the Nova School of Business and Economics.

The researchers review two empirical findings about corporate bond markets. The first one is that traditional measures of market liquidity have improved on average after the financial crisis. This finding appears to suggest that new financial regulations have had only a minor
impact on financial market liquidity. However, they also show that the cost of illiquidity — measured by the impact of illiquidity on the yield spreads of corporate bonds — also increased. In other words, while markets seem to be more liquid, the cost of illiquidity has increased.

They argue that these two findings can be rationalized by a model that allows for customer counterparty choice. In their model, when dealers’ cost of intermediating trades increases, dealers increase their bid-ask spread. However, investors seek liquidity from other investors, increasing the number of customer-to-customer trades and decreasing the number of dealer-to-customer trades. Customer-to-customer trades are cheaper, but it takes longer to find another customer to trade with than it does to find a dealer. This result implies that the average bid-ask spread in the market — a traditional measure of illiquidity — can decrease when new regulations increase dealers' costs of intermediating trades.

John Mullin and Matthew Wells are senior economics writers in the Research Department of the Federal Reserve Bank of Richmond.

To cite this Economic Brief, please use the following format: Mullin, John; and Wells, Matthew. (August 2022) "Intermediation and Bank Liquidity: A Conference Recap." Federal Reserve Bank of Richmond Economic Brief, No. 22-34.

This article may be photocopied or reprinted in its entirety. Please credit the authors, source, and the Federal Reserve Bank of Richmond and include the italicized statement below.

Views expressed in this article are those of the authors and not necessarily those of the Federal Reserve Bank of Richmond or the Federal Reserve System.