Central Bank Digital Currencies and the Long-Term Advancement of Financial Stability

MIT Digital Currency Initiative

Abstract

The United States financial system can be restructured to reduce dependence on taxpayer subsidies by giving universal direct access to risk-free money. In the 10 years since the financial crisis, technological advancements and regulatory tools have laid the foundation for Central Bank Digital Currencies to emerge as this economic resolution. Our paper illustrates that introducing Central Bank Digital Currencies (CBDCs) can improve financial stability without degrading credit availability in the long term. We show this by focusing on the effects in a single credit market, namely, the U.S. student loan market. Our analysis showcases that by introducing CBDCs, market participants can subsequently remove two types of market subsidies that promote poor risk practices and improper pricing. These two subsidies are FDIC deposit insurance as well as risk-free deposit rent. We calculate the effect of introducing CBDCs by focusing on historical market examples when similar fundamental market shifts happened, both in the student loan market as well as in other advanced economies. Our conclusion is that CBDCs diminish credit availability within one-year, but this effect is ameliorated as financial stability improves in subsequent years. Accordingly, we recommend a roadmap for rolling out CBDCs in the least disruptive fashion.

Introduction

Maturity transformation engenders a fundamental flaw in the financial system. While a significant source of revenue for banks and based on expectations of future returns, the ability to borrow-short and lend-long inherently creates instability. Complex sets of regulations have worked to stem these risks, but as the 2008 financial crisis looms large in the background, history illustrates that this instability can also engender taxpayer funded bailouts when the mismatch hits a tipping point. When depositors fear that their funds have been deployed elsewhere and they will not be able to recoup their savings, bank-runs occur. The critical question then becomes, how can the financial system continue to provide credit to borrowers, while simultaneously providing a risk-free store of value that promotes stability? Central banks in particular have focused on this question as regulators seek to stem financial market volatility, prevent damage to the real economy, and combat political pressure for bailouts to financial institutions.

The safety and soundness considerations thus provide an impetus for central banks to consider the implementation, over time, of *central bank digital currencies* (CBDCs). BY CBDCs, we refer to universal direct access to central bank money. This differs from central bank deposits, which have largely been digitized already

and are used for large-value settlements by banks. CBDCs thus separate money and credit by providing a risk-free store of value directly to the public.

Central banks have conducted, and have underway, studies regarding the potential effects of adopting a CBDC. Most of the research to date has explored the impact that a shift to CBDC would have on creating new monetary policy implementation tools or the effect CBDC could have on payments systems. However, less research exists regarding potential CBDC effects on lending and stability that could arise from the movement of deposits to a CBDC as the ultimate safe store of value. This paper seeks to advance the discussion of those lending and stability effects.

We posit that the primary reason for introducing CBDC is to provide a risk-free store of value. A truly risk-free store of value does not practically exist in the U.S. economy. The closest risk-free store of value is deposits held at banks, which are FDIC insured. Either that or keeping all of your cash under your mattress. Rather than creating a convoluted set of intermediates that require heavy oversight. government subsidy, and a potential lender of last resort, CBCDs can provide this in a simpler, less risky fashion thus providing a public-policy good. Even still, FDIC deposit insurance is not even risk-free. As we and several authors have shown, FDIC deposit insurance might reduce risk for depositors, but it actually *increases* bank lending risks. Accordingly, our paper sets out to provide an alternative to FDIC deposit insurance that reduces financial sector risk, improves lending practices, and provides an *actual* risk-free store of value.

We focus our paper in three ways: assuming one particular CBDC structure, looking at a particular market, and analyzing just the lending aspects of financial stability. While financial stability has many components, our focus is on credit availability, lending. And preserving funding for productive enterprise in the real economy. First, we assume implementation over a long period of time of a full CBDC (not just for bank reserves), available for all retail deposits as a risk-free store of value, and accompanied by a large reduction of deposit-insurance guarantees. We assume that all lending is still done via commercial banks and that they would have to offer higher interest rates to attract deposits away from a risk-free CBDC. Introduction of CBDC does not have to mean the eradication of physical cash, just government-implement of a risk-free digital store of value.

In order to do this analysis, we use an IMF framework to examine two examples of significant, developed-nation-government withdrawal of subsidies from a market. In 2018, the IMF published a staff report collecting information, listing pros and cons of CBDC, and setting out a high-level framework around which central banks could organize CBDC policy consideration and development. These include the addition of a new monetary-policy tools such as direct transmission, increased competition amongst payment systems due to a lower-cost alternative, and the effects from a new zero-risk asset as banks would lose their lower cost of capital subsidy arising from deposit insurance.

We focus our analysis on the US student loan market and on withdrawal of corporate subsidies to lenders. Our position is that the same effects that were observed when the loan guarantees were removed will be observed when CBDCs are introduced. As deposits run out of banks and into CBDCs, this causes a similar loss in funding benefits. Just as the loan guarantee helped student lenders finance their loans, so too do deposits. CBDCs and the removal of the loan guarantee provided a new funding reality for banks. Although this is a particular market and does not exist in nations with full government funding of education, the student loan market has broad advantages as a next step of specific analysis under the IMF's CBDC analytical framework. The market has $1.5 trillion outstanding credit, has varied types of lending (government, private loans held by large and small banks, and securitizations), and has had two different subsidy removals. We therefore believe our findings can be used as a foundation for analysis and comparison of lending and financial stability effects of CBDC in many other markets and countries. We try to confirm our conclusions by examining another major corporate-subsidy withdrawal: New Zealand's elimination of subsidies to large agribusiness corporates.

We have also chosen to analyze a narrow segment of financial stability. While much of the post-crisis discussion has focused on systemic risk and interconnectedness, our focus is on lending. Our paper therefore discusses how CBDCs could improve lending-market discipline, thereby reducing the propensity for bubbles and furthering one tenet of financial stability.

The paper is organized as follows: In part I, we provide an analysis of the current literature of CBDC and design considerations, and deposit-guaranty subsidies. In part II, we survey the student loan market and illustrate why this is the best market to focus on first for illustrating the effects that CBDC will have on lending.

In parts III and IV, we quantify the effects that CBDC and subsidy removal will have on lending both in the short and the long term. In part V, we evaluate the impacts that a CBDC will have on financial stability using the IMF framework. Last, in part VI, we conclude our analysis and provide insights into areas of future research.

We conclude that a long-term introduction of CBDC (to avoid credit-shock events) could have long-term financial stability benefits. We conclude that the introduction of CBDC would subsequently pave the way for the removal of certain market subsidies. Therefore, we expect two benefits to occur: (a) improved market discipline and better price discovery and (b) the entrance and expansion of specialty lenders into the market, thereby softening the effects of reduced bank credit.

We recognize that introducing CBDCs will necessarily cause a short-term negative impact on lending, and therefore we have modeled this out. The removal of the subsidy will make bank funding more expensive, which means that banks will have to lend at higher prices, and subsequently there will be fewer takers of these higher priced loans. To quantify the size of this effect, we use historical examples of other times when subsidies to corporates were removed from markets and what the impact on growth and lending was. Our analysis of the student loan market suggests that once subsidies are removed, specialty lenders will enter the market, lending volumes will increase in the long-term, and new product innovation will increase.

Part I – Literature Review

Central Bank Digital Currencies

The concept of direct access to central bank money is not a new one (Tobin, 1985). CBDC research has predominantly been dedicated to exploring monetary policy effects. The international regulatory community as well as Central Banks have contributed the vast majority to the literature on credit versus money supply, and have been doing so for years (Friedman, 1965). While the United States Federal Reserve has been fairly quiet on the CBDC front,[1],[2] the Bank of England has outlined the balance sheet implications of CBDC as well as

[1] Lael Brainard, "Cryptocurrencies, Digital Currencies, and Distributed Ledger Technologies: What Are We Learning?", Decoding Digital Currency Conference, May 15, 2018

[2] Jerome Powell, "*Innovation, Technology, and the Payments System",* Blockchain: The Future of Finance and Capital Markets, The Yale Law School Center for the Study of Corporate Law, March 3, 2017

putting forward design implications, such as keeping reserves separate from deposits. (Kumhof & Noone, 2018) (Border & Levin, 2017) explores three different scenarios by which an account-based, interesting bearing CBDC could create true stable prices and help central banks achieve their inflation mandate.

In this vein, researchers have also explored the impact that CBDC could have on growth. For example, Barrdear and Kumhof (2016) develop a Dynamic Stochastic General Equilibrium (DSGE) model that posits introducing CBDC of 30% of GDP could boost a nation's GDP by up to 3%.

The second major field of CBDC research has examined payments systems. The primary advantages that CBDC could in this area (a) liquidity and credit gains can be achieved by reducing payment-versus-delivery times (BIS, 2018; Dyson & Hodgson, 2016); (b) resiliency improvements by creating an alternative digital payments network that reduces concentration risk (Riksbank, 2017); and (c) security and inclusivity opportunities by moving towards digital solutions, with Uruguay as an example (Licandro, 2018).

Nevertheless, CBDC also comes with concerns, to which our paper sets out to respond. The primary arguments against CBDCs are that they could accelerate and worsen the opportunity for bank runs (Broadbent, 2016; Callesen, 2017) since financial crises induce a flight to safety. Martin, Puri, and Ufier (2018) use high-frequency data to show that regulatory bad news causes a flow *out* of uninsured deposits and that regulatory bad news often does not affect insured deposits. These remain sticky, even when a bank is highly probable to fail. Basel III indicates that "less stable" retail deposits will run-off at a rate of 10% per month during a period of severe liquidity stress. Some also argue that CBDCs are not necessary at this time (Carstens, 2019), and therefore that any implementation comes with risks that are best avoided. We will address these concerns as we use historical examples to make inferences about how we can expect CBDCs to impact lending and markets.

In the following section, we will discuss the primary benefit of CBDC, which is providing a risk-free store of value. In order to evaluate the corresponding costs associated with providing this new asset class to the economy, we model out some of the expected outcomes, such as the entrance of specialty lenders into the market, an enhancement of risk practices as market distortions diminish, and an improvement in the allocation of financial resources. However, in order to explain why this change is necessary, we want to analyze the current market solution to providing a risk-free store of value for depositors: FDIC deposit insurance.

Market Distortions of Deposit Insurance

The Banking Act of 1933 established deposit insurance in the United States with the policy goal of establishing a risk-free place to store money. Currently, the FDIC provides a guaranty of all deposits up to $250,000 at member-bank institutions. The FDIC funds a guaranty insurance pool with premiums that banks and thrift institutions pay for deposit insurance coverage. In 2015, banks paid $8.8B to the deposit insurance fund, raising the total amount of the pool to $72.9B. Despite the full guaranty of qualifying deposits, the pool only contains sufficient funds for a small fraction of those deposits. The Dodd-Frank Act mandated that the Deposit Insurance Fund maintain a minimum designated reserve ratio of 1.35% of estimated insured deposits. In the U.S. where risk adjusted rates range from 0 to 27 basis points, for instance, more than 90 percent of the banks qualify for the lowest rate of zero.

However, the safety that deposit insurance provides for depositors causes certain pitfalls that affect financial stability. The World Bank summarizes this effect well:

> When deposits are insured, however, bank depositors lack incentives to monitor (Demirguc-Kunt and Huizinga 2004 and Ioannidou and Penas 2010). The lack of market discipline leads to excessive risk-taking culminating in banking crises. Demirguc-Kunt and Detragiache (2002), Demirguc-Kunt and Kane (2002) and Barth, Caprio and Levine (2004) find supportive evidence for this view.

The government's explicit backstop ensures that even if a bank engages in excessive risk-taking, the FDIC will intervene to ensure that depositors do not lose their money.

Specifically, FDIC deposit insurance causes market distortions in two ways - first, it *explicitly* lowers the risk premium charged by banks and second, it *implicitly* reduces market discipline. Since Merton (1977), the effects of these market subsidies have been well documented. Bartholdy, Boyle and Stover (1994) find that on average, the deposit risk premium in OECD countries is 25 bps lower as a result of explicit deposit insurance. Demirguc-Kunt and Huizinga's findings (2004) align with this hypothesis that the subsidy provided to banks lowers their risk premium, noting that that deposit insurance lowers bank interest rates by approximately 17 bps. Bartholdy, Boyle, and Stover (2003) conclude that the risk premium is on average over 40 basis points higher in countries without deposit insurance than in countries with deposit insurance. They conclude that the risk premium is a nonlinear function of the deposit insurance coverage, a feature which they interpret to mean

that the market recognizes that extended deposit insurance coverage makes the moral hazard problems more severe. Acharya et al (2013) find that the implicit government subsidy that deposit insurance provides results in an annual funding cost advantage of approximately 28 basis points on average over the 1990-2010 period, peaking at more than 120 basis points in 2009. While risk-free money is the goal of deposit insurance, and a critical goal at that, there exists negative repercussions for accurate risk pricing.

Second, FDIC deposit insurance reduces market discipline on bank risk taking. Calomiris and Jaremski (2016) find that in the early 20th century deposit insurance encouraged banks to increase insolvency risk. Demirguc-Kunt and Huizinga (2004) leverage cross-country differences regarding the country-specific features of deposit insurance to conclude that the existence of an explicit insurance policy lowers deposit rates, while at the same time it also reduces market discipline on bank risk taking. Thus, the mere existence of deposit insurance engenders riskier behavior. This is well documented outside of deposit insurance, as the existence of insurance, moral hazard, and principal-agent problems in many spheres tends to increase risk.

It is also important to acknowledge the benefits that FDIC insurance has allowed. This explicit guarantee provides a safe location for depositors to keep their savings, without fear that their deposits will be wiped out by exogenous forces. As a result, in the 2008 financial crisis, the US government temporarily raised the insured amount per account from $100,000 to $250,000. However, the government did not ever lower the amount, even as the financial crisis abated; the higher cap was made permanent in 2010. Twenty years before that crisis, Kennickell, Kwast, and Starr-McCluer (1996) noted that a decrease in deposit insurance from $100K to $25K per account would not be associated with a dramatic change in many non-wealthy household characteristics. Less research exists on the effects of moving deposit insurance from the $250K level back down to the previous level of $100K.

The goal of CBDCs, in turn, is to provide the same type of risk-free store of value, without the subsequent market distortions that FDIC deposit insurance causes. The obvious next question is, *how can we ensure that CBDCs do not cause market distortions that are equally unsound, if not worse?* In order to answer this question, we provide two examples. Our first example analyzes the student loan market, its historical changes, and posits that we can expect these trends to continue at an accelerated rate once CBDCs are introduced. We come to this conclusion since CBDCs remove a similar market funding measure to one that was removed in 2010. In the student loan market, the U.S. government transitioned away from subsidizing the

lending of private entities and towards instead providing much of that lending themselves. As discussed in Part II, after 2010 many of the private lenders left the industry such that the government now provides 92% of all student lending activity. This is what we want from CBDCs – transitioning away from a solution in which the private sector takes a subsidy and intermediates, and towards instead a public finance solution in which the government provides a public policy good. Just as the removal of subsidies in the student loan market improved the risk and pricing models in the industry, so too will the removal of the FDIC deposit subsidy remove a second layer from this industry and continue to improve the risk and pricing models.

Decades of poor practice has left the student loan market in crisis. Our second example models out what we expect to happen when FDIC deposit insurance is removed. We do this by looking at one of the few examples in history when a subsidy of this size, with reliable data, provided to corporates, was removed from a developed nation's industry: this occurred in 1984 to New Zealand agribusinesses. We conclude that CBDCs can improve lending practices in the student loan market and thus ameliorate financial stability.

Part II – The Student Loan Market

Background

We have chosen to analyze the student loan market with respect to CBDCs for several reasons. Most importantly, the student loan market has already experienced a removal of government subsidy and towards direct government access to services. This is the goal of CBDCs – remove government subsidies such as FDIC insurance and instead directly support a risk-free store of value. Moreover, the student loan market is the largest market for unsecured consumer debt in the United States, whereas mortgage debt market is secured. As of 2016, the U.S. government backed approximately $1.26 trillion or 92.5 percent of outstanding student loans. The remaining 7.5 percent of the higher education student loan market is made up of about $102 billion of private student loans.[3] Our paper focuses on the private student loan market.

Student loans outstanding grew 500% from the early 2003 to the early 2013. The current $1.57 trillion dollars of such debt represents approximately 40% of all unsecured consumer debt. Student loans provide

[3] Office of the Inspector General, U.S. Department of Treasury, "SAFETY AND SOUNDNESS: Financial Institutions' Private Student Lending Activities", OIG-17-008, November 14, 2016

approximately 24% of all funds used to pay for tuition and other costs of university undergraduate and graduate students in the United States. As described below, the market structure has changed over time, formerly including massive government guarantees of debt, a major privatization of a key government-sponsored enterprise in the sector, direct-lending by a government program, and now significant attempts by banks and specialty lenders to make entirely private loans. Lastly, the level of student debt has started crippling the U.S. economy. As delinquency rates rise, homeownership for Americans aged 24-32 has fallen, income mobility is declining as higher education becomes increasingly out of reach with rising costs, and policy solutions seem challenging to manage amidst complex bankruptcy claims.[4]

Over the past 20 years, the U.S. government has removed two major subsidies from this lending market. As the government removed subsidies to lenders, two new market structures emerged. First, many existing lenders exited and specialty lenders entered the market; and second, one major player emerged to dominate the private lending market. This section begins by providing context for the student loan market so that readers can evaluate how changes to this market mirror changes that can be expected by introducing CBDCs.

In 1965 federal legislation provided for U.S. government guarantees of all student loans. The Federal Family Education Loan "FFEL" program (or "FFELP") was a system in which all private loans made by banks were subsidized by the government and also guaranteed against default. This created a classic "principal-agent" problem in which the agent (the student loan servicers) had little incentive to act in the best interests of the principal (the federal government) while student loan servicers similarly did not have much incentive to prevent borrowers from defaulting.[5]

The federal involvement in the student loan market led to the 1973 chartering of Sallie Mae to serve as a major servicer of student loans. As a "government sponsored enterprise" (GSE), Sallie Mae was widely assumed to have an implicit government guarantee. Prior to 1997, Sallie Mae also enjoyed a $1B special line of credit from the U.S. Treasury, exemption from state and local taxes, and very low capital requirements (even

[4] William Dudley, "Opening Remarks at the Economic Press Briefing on Household Borrowing, Student Debt Trends and Homeownership", Federal Reserve Bank of New York, April 3, 2017

[5] Susan Dynarski, "An Economist's Perspective on Student Loans in the United States", Economic Studies Working Papers at Brookings, September 2014

lower than banks). Enjoying both the government guarantee benefit as well as the benefits associated with being a GSE, Sallie Mae became the largest originating lender of student loans in the United States. However, from 1997 through 2004, Sallie Mae underwent full privatization as the government decided to wind down its government guarantee program. Sallie Mae now accounts for 50% of the lending in the private student loan market.

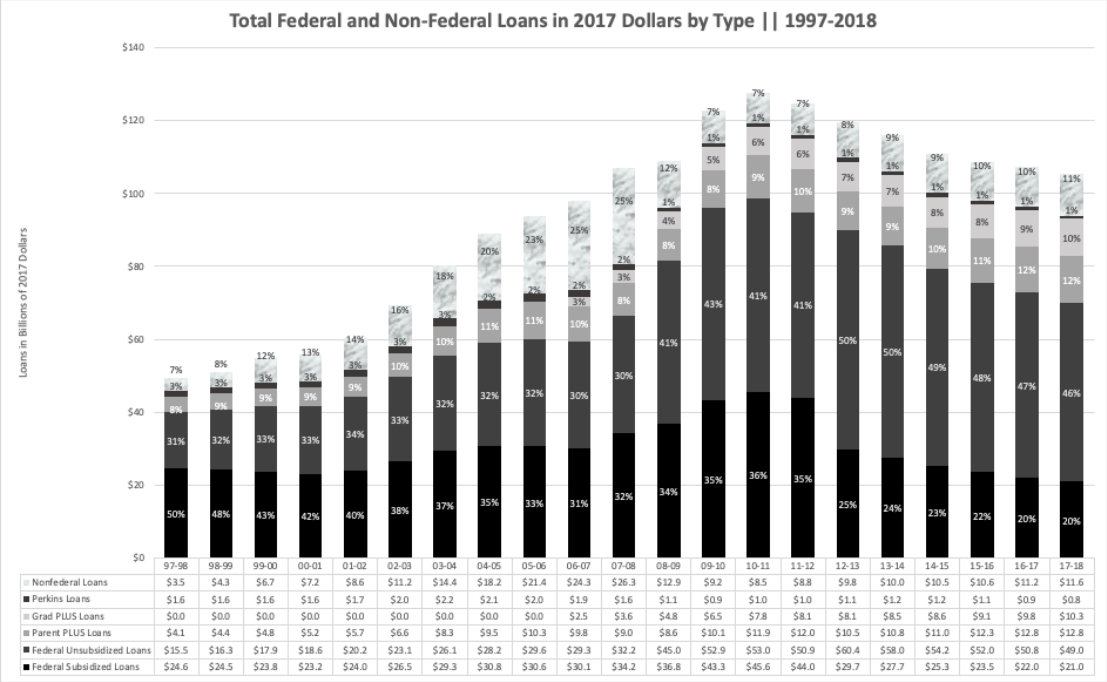
Sallie Mae provides a helpful window to examine subsidy removal effects because it has always been the largest lending entity in the private student loan market. This market concentration allows us to examine, on a case-study basis, how removal of subsidies have affected the student loan market.

Current Market Composition

In 2010, the U.S. government undertook a complete overhaul of its guarantee system such that guarantees ended for new loans, without any phase-out. After 2010, the U.S. Department of Education became the direct lender for all new U.S. government funded student loans. Large U.S. banks that had a substantial part of the U.S. student-loan originations market completely exited the market as the guarantees against default were eliminated.[6] Almost immediately after the U.S. government changed from a loan-guaranty structure to direct lending in 2010, large banks exited from the student-loan origination market. U.S. Bancorp left in 2012, and J.P. Morgan Chase followed in 2014.[7]

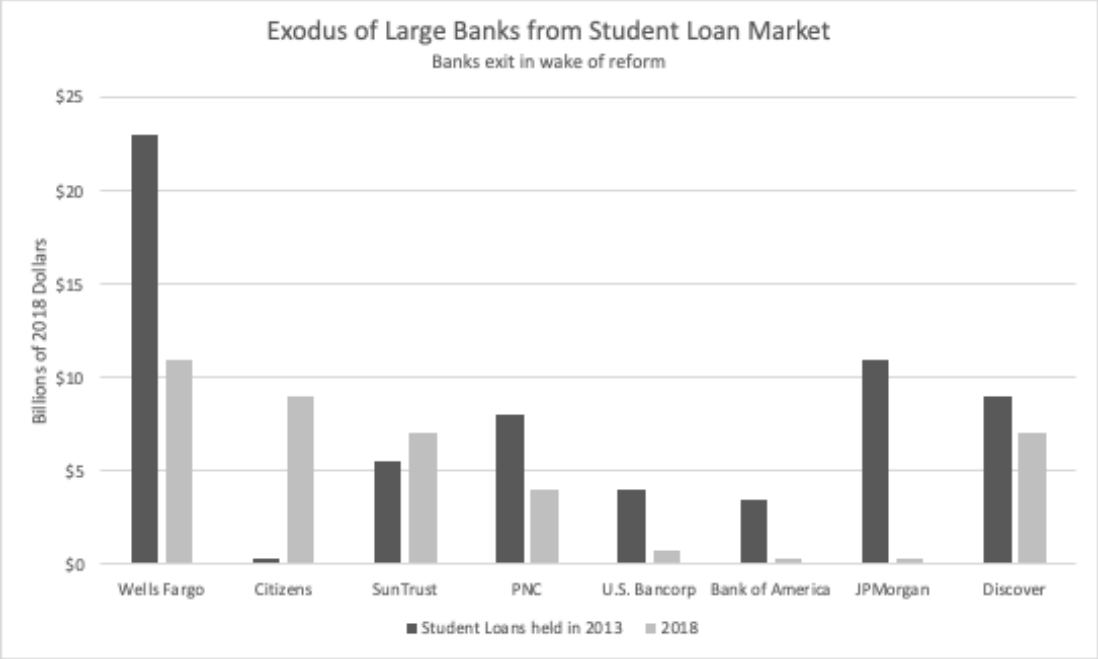
[6] The College Board, "Trends in Higher Education: Total Federal and Non-Federal Loans over Time" accessed from https://bit.ly/2I6Jz0M on May 28, 2019

[7] Brandon Kochkodin, "Here's How the Student Loan Landscape has Changed since 2013", Bloomberg News, December 6, 2018



	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18
Nonfederal Loans	$3.5	$4.3	$6.7	$7.2	$8.6	$11.2	$14.4	$18.2	$21.4	$24.3	$26.3	$12.9	$9.2	$8.5	$8.8	$9.8	$10.0	$10.5	$10.6	$11.2	$11.6
Perkins Loans	$1.6	$1.6	$1.6	$1.6	$1.7	$2.0	$2.2	$2.1	$2.0	$1.9	$1.6	$1.1	$0.9	$1.0	$1.0	$1.1	$1.2	$1.2	$1.1	$0.9	$0.8
Grad PLUS Loans	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$2.5	$3.6	$4.8	$6.5	$7.8	$8.1	$8.1	$8.5	$8.6	$9.1	$9.8	$10.3
Parent PLUS Loans	$4.1	$4.4	$4.8	$5.2	$5.7	$6.6	$8.3	$9.5	$10.3	$9.8	$9.0	$8.6	$10.1	$11.9	$12.0	$10.5	$10.8	$11.0	$12.3	$12.8	$12.8
Federal Unsubsidized Loans	$15.5	$16.3	$17.9	$18.6	$20.2	$23.1	$26.1	$28.2	$29.6	$29.3	$32.2	$45.0	$52.9	$53.0	$50.9	$60.4	$58.0	$54.2	$52.0	$50.8	$49.0
Federal Subsidized Loans	$24.6	$24.5	$23.8	$23.2	$24.0	$26.5	$29.3	$30.8	$30.6	$30.1	$34.2	$36.8	$43.3	$45.6	$44.0	$29.7	$27.7	$25.3	$23.5	$22.0	$21.0

Source: The College Board



Source: Bloomberg

This private-loan portion of the market consists primarily of specialty finance companies and smaller banks. Even in the face of direct government lending, private student loans total $115 billion in outstanding amount; about 8% of the overall market. These are amounts that originating lenders continued to hold of their own balance sheets, not securitizing them. Banks are lobbying to cap the US government loan

program, so that private lending can increase. Accordingly, 92% of student lending is now provided by the U.S. government.

Our position is that the same effects that were observed when the loan guarantees were removed will be observed when CBDCs are introduced. As deposits run out of banks and into CBDCs, this causes a similar loss in funding benefits. Just as the loan guarantee helped student lenders finance their loans, so too do deposits. CBDCs and the removal of the loan guarantee provided a new funding reality for banks. In the following section, we explain what this new reality looked like following the removal in 2010, and in turn what we can expect this to look like in the future.

Part III - Improved Lending Over Time

The Persistence of Lenders

Central Bank Digital Currencies will alter the student loan market by decreasing the amount of deposits held at lenders, though given similar changes that this market has already experienced, we expect lenders to persist. The student loan market has a unique benefit that no other market of this size has: one single company is responsible for 50% of the loan market. Sallie Mae thus provides an important dataset and insight into this market functioning, risk practices, and lending.

Most importantly, Sallie Mae provides a clear example of two benefits that occur when government guarantees are removed: specialty lenders enter, and market funding persists. In our analysis of financial stability, we want to ensure that credit is still available and that financial institutions in the market are exhibiting safe and sound practices. Markets often consider companies associated with governments to have an implicit guarantee against failure -- that the government will bailout creditors and stockholders in the case of company failure. This is an indirect subsidy, because such companies can take excessive risks by exporting the risks onto the government.

Two U.S. government agencies analyzed the effect of the subsidy to Sallie Mae and the following impact of its removal. In 1985, before the privatization and before privatization considerations were even on the table, a Congressional Budget Office study concluded that Sallie Mae benefited from a subsidy of 30 bps. This GSE subsidy, which several studies have similarly modeled for too-big-to-fail banks, indicates that Sallie Mae, and in turn a huge percentage of the student loan market, was experiencing pricing benefits that were market

distortive. A U.S. Treasury Department study after completion of the privatization in 2004 concluded: "Congress provided the wind-down period to allow time for the safe and sound transfer of Sallie Mae operations and assets and to give the private company time to develop alternative financing sources to fund these transfers." The removal of Sallie Mae's government sponsored enterprise implicit subsidy, and its U.S. Treasury credit facility, required Sallie Mae to reset the liability side of its balance sheet and subsequently its cost of funding.

However, after 2004 Sallie Mae became fully privatized and thus was no longer able to enjoy these market funding benefits, shedding light on how we can expect CBDCs to similarly change the market. Just as Sallie Mae had to find new funding schemes beyond government guarantees and GSE benefits, so too will CBDCs continue to alter the student loan market funding schemes, and by extension, all other lending markets.

First, Sallie Mae was able to secure new funding sources. For example, in 2002 during the privatization process, Sallie Mae was able to issue private debt for the first time. At that same time, Sallie Mae was able to undertake its first market-rate securitization of non-guaranteed student loans. In addition, Sallie Mae sought a banking license so that it could use deposit funding. The government rejected that application. Sallie Mae nevertheless continued to grow. It was able to obtain, for the first time, $4 billion of bond capital at its parent company. Sallie Mae now accounts for 50% of the private student lending market. In conclusion, despite Sallie Mae losing its subsidy and becoming a publicly traded private company, the firm still wanted to operate, but now with market rate funding. The well-conceived medium-term transition of Sallie Mae away from its implicit bail-out subsidy could have lessons for CBDC implementation removal of the implicit deposit-guaranty subsidy. In the following section, we will explore what happened to the other 50% of the market that is not accounted for by Sallie Mae.

Specialty Lenders Enter and Improve Market Functioning

As deposits move to CBDCs, FDIC insurance diminishes, and the subsidy to large banks abates, we expected specialized lenders to enter the student loan market and thus improve credit risk standards. Specialty lenders differ from traditional banks in that they target narrower customer segments and leverage industry

expertise in this one specific field. The Federal Reserve examined whether specialized lenders make superior credit decisions. That study concluded that due to specialization, such lenders have superior lending expertise (Kimball, 1997). In today's lending market where specialty lenders compete with subsidized-cost-of-capital banks, specialty lenders use that knowledge and experience advantage because they must make loans in the riskier part of the market (Carey, Post & Sharpe 1996).

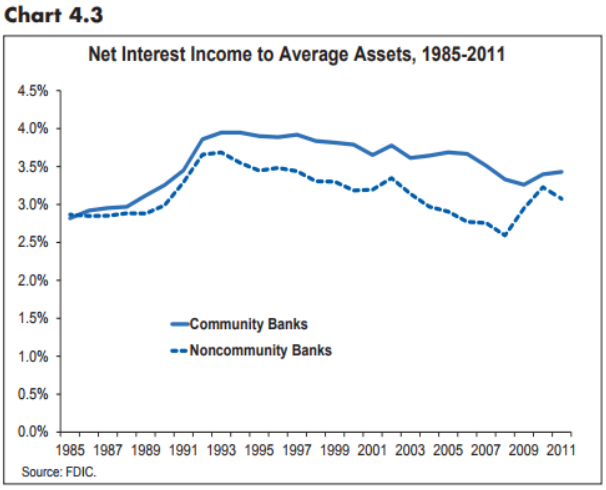
The student loan market's evolution before and after the 2010 guaranty removal illustrate this fact. Before 2010, the quality of issued loans would not impact banks' balance sheets because of the government guaranty. With the removal of the guaranty, credit analysis became crucial within the student loan market while securitization became less attractive since loans were no longer guaranteed. Thus, a bank with a choice to leave a lesser-subsidized market would do so. Banks that were focused more on consumer lending, like Wells Fargo, remained in the market, as well as specialty lenders since they were able to leverage their comparative advantage. Community banks also entered the student loan market, and often sourced underwriting and servicing practices to specialty lenders and student-loan-knowledgeable service providers.

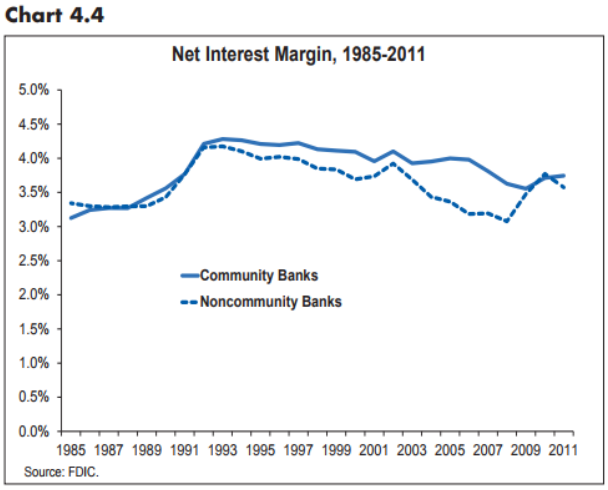
Other forms of consumer and small business finance have also seen a shift from bank lending to specialty lenders with market costs of capital. For example, specialized consumer lending increased 200% from 2014 to 2016. This lending encompasses both consumer lending (71% as of 2018) and small-business lending (21% of the specialty lending market). This demonstrates that specialty lenders can step in to fund productive enterprise at the ground-floor level of small business loans. Such growth has happened over a medium-term period, in the 8-10 years since the 2008 financial crisis. There is no reason to think that specialty lenders could not similarly step in during a long adjustment period of CBDC implementation.

That said, it may be difficult to quantify the benefit of specialty lenders in a space. Nevertheless, we sought to obtain a quantitative estimate by comparing Wells Fargo's balance sheet, the only remaining big bank in this sector, against that of community banks, who have the practical ability to deploy significant capital into this market on a specialized basis because the economics of outsourcing work for them.

High level data suggests that specialized student loan issuers would perform better. The net interest margin of Wells Fargo is 2.6-2.8%. This may have been lower due to a one-time charge in connection with certain large government fines, but in any event the net interest margin of the five largest US bank was 3.1%. The top 10 community banks participating in the student loan market have an average net interest margin of

3.3%. More generally, a 2012 FDIC study concluded that "historically, community banks have been more successful than larger banks in generating net interest income. Over the entire study period, the ratio of net interest income to total assets has been higher at community banks in all but one year.





Part IV - Removal of Subsidies to New Zealand Agribusiness

Leveraging History for a Comparable Example

In order to confirm our observations and conclusions, we examined another historical case study involving the removal of a large corporate subsidy in a developed nation. But first, it is important to note the differences between subsidies and guarantees. While the World Trade Organization allows for a liberal interpretation of a subsidy as "Any government program that benefits private companies," there are several relatively distinct types. For example, there are direct subsidies and that generate *implicit* subsidies. For implicit subsidies, "Costs are lowered because part of the return demanded by funders is to cover credit risk, which is virtually eliminated if there is a government guarantee, reducing the interest rate needed to lure investors. The subsidy must be calculated by estimating the difference in interest rate between what the bank pays in real life and what it might have to pay without the guarantee." This difference is important because it makes guarantees difficult to measure. Direct subsidies often have a specific monetary value that they confer, whereas guarantees are implicit and alter risk pricing. In the end, a subsidy of either type provides economic value to firms that distort markets, but one is easier to measure and make some quantitative assessments as well.

We sought to find an instance of a removed direct subsidy, with a robust dataset and data for both the subsidized market and that post-removal market. This last requirement was particularly hard because most corporate subsidies in the modern era are introduced and are never removed. We did not want to use the removal of corporate tax incentives, preferring the closer example of a direct subsidy, if it could be found.

These requirements for another analogy to potential CBDC subsidy removal pointed us in one direction: the 1984 removal of agricultural subsidies in New Zealand. In the 1970s and early 1980s, the New Zealand government provided direct income support to agribusiness corporations. If agricultural commodity price fell below the target price, public funds paid large corporations as a supplement to their market revenue. In 1983, 75% of the subsidies to New Zealand pastoral agriculture came in the form of this income support. With such high subsidy levels, there was both an explicit guarantee of income, an implicit guarantee against failure of large farming enterprises. In 1984 New Zealand's budget deficit was 9% of GDP, with nearly 40% of that budget deficit coming from agricultural subsidies.[32] Ultimately, a political impetus for fiscal responsibility led New Zealand to remove the subsidies.

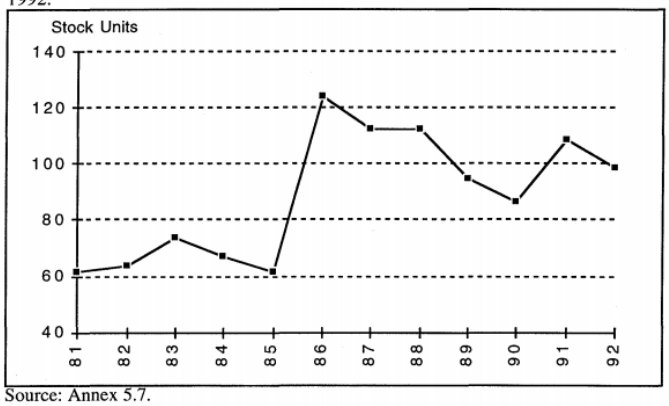
FDIC deposit insurance is a subsidy that causes both explicit and implicit benefits to private lenders, whereas New Zealand farm subsidies provided both explicit and implicit benefits to private enterprise. Because a full retail CBDC would remove a guaranty subsidy, these two examples allow a qualitative but harder-to-measure comparison of indirect subsidies and a more concrete measurement of direct subsidy removal. The New Zealand Meat and Wool Boards' Economic Service, Sheep and Beef Farm Survey and the New Zealand Department of Statistics have data for the 5 years before subsidy removal and most the 10 years after subsidy removal.

Three Benefits of Removing Subsidies in New Zealand

Over the long term, New Zealand saw three benefits when subsidies were removed: (1) better allocation of resources both within firms and across the industry; (2) growth of product innovation; and (3) diversification within companies of farm product portfolios.

1. Improved Resource Allocation - After removal of subsidies, productivity remained relatively flat but the allocation of resources dramatically improved. Specifically, fertilizer usage per unit of livestock became far more efficient. Fertilizer amount used per sheep (the second largest export product of New Zealand) halved in the five years after subsidy removal, indicating improved efficiency as the stock of sheet remained stable. This was a major positive effect because fertilizer accounted for 75% of farmers' expenditures in 1983, the year before the subsidy removal. There was a very short-term dip in 1985 following the removal of the subsidy, but then a period of sustained growth leveling at ~100 stock units per ton of fertilizer, approximately a 40% increase in efficiency.

Figure 5.11. Stock Units per Tonne of Fertiliser Used on Sheep Farms, New Zealand, 1981-1992.



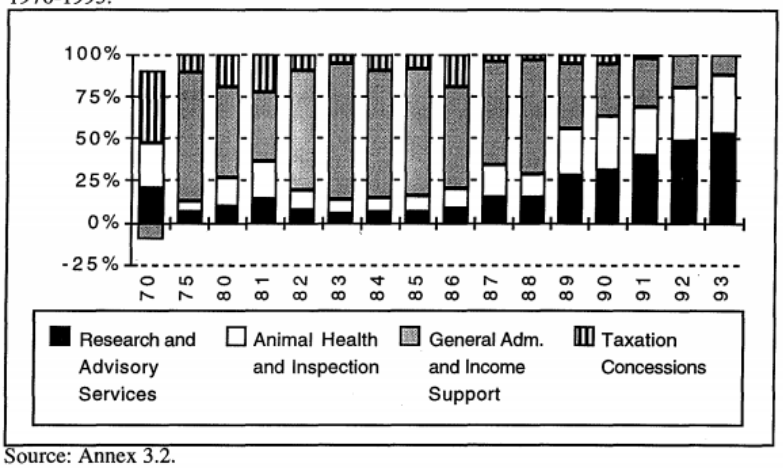
Source: Annex 5.7.

The New Zealand government was also able to redirect some pure subsidy funds into forward-looking development in the agriculture industry. Rather than providing millions in subsidies, the New Zealand government redirected funds towards research and development (R&D) in the agricultural sector.

This provides an interesting precedent for a CBDC subsidy removal. In this area, a concern of central banks is to what extent a CBDC's effect on lending could reduce the growth of productive enterprise. The New Zealand example demonstrates that there can be a redeployment of subsidy resources to a different type of long-term growth enhancing program, such as R&D. Similarly, removal of a government subsidy to banks could allow a redeployment away from the financial sector into R&D for productive, nonfinancial portions of the economy. In New Zealand's case, the misallocation of resources due to the subsidy was a drag on the real-economy by propping up firms. Japanese "zombie companies" in the country's Lost Decade(s) provide a salient

example as well. In the chart below, we can see the sustained growth in R&D investments at the same time as the costs associated with income support (i.e. the agro-subsidy) is reduced.

Figure 3.4. Breakdown of Total Assistance to Pastoral Agriculture by Category, New Zealand, 1970-1993.

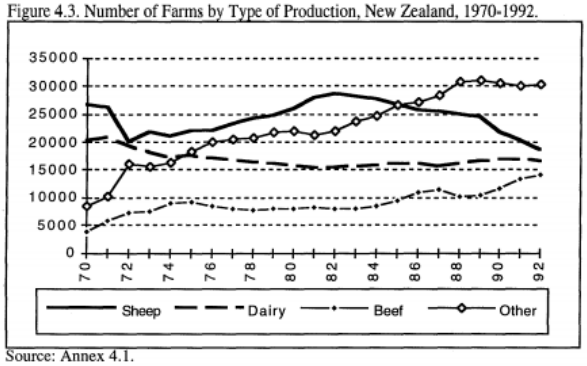


Source: Annex 3.2.

2. New Product Innovation - In 1983, New Zealand dairy farms produced 35 different commodities from milk, but by 2017, these companies were producing over 2,200 different dairy products. While this 63x new product innovation is coupled with a larger global industry trend towards development of new products, the pace of New Zealand's innovation is exceptional. This growth occurred even while much of the farming industry in the developed world received significant subsidies and accommodative policies as many farming countries retrenched and rolled out protectionist policies. The period after subsidy removal saw New Zealand agribusiness able to compete because of innovation and efficiency gains.

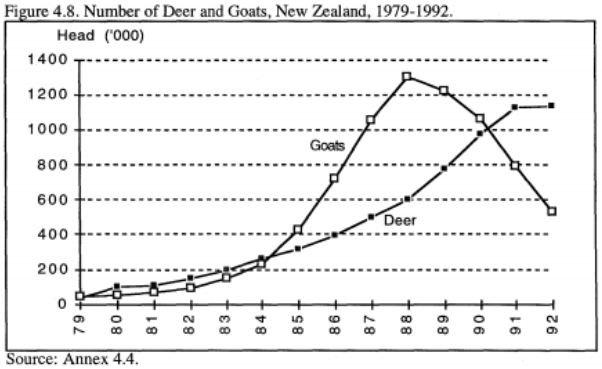
3. Portfolio Diversification - As beef and sheep prices fell after subsidies were removed, farmers diversified land use to include deer and goat farming. Sheep was one of the most highly subsidized sectors and without government support, this product was no longer profitable for farmers and therefore this sector saw a production decline. Sheep and beef land-use dropped 16% from 1984 to 1994 to make room for deer and goat farming. The subsidies encouraged farming corporates to concentrate their business models to maximize the benefits that the subsidies provided. However, once the subsidies were removed, the farmers had to reconsider their asset allocations not only to meet true market demands, but also to hedge against portfolio risk.

Figure 4.3. Number of Farms by Type of Production, New Zealand, 1970-1992.



Source: Annex 4.1.

Figure 4.8. Number of Deer and Goats, New Zealand, 1979-1992.



Source: Annex 4.4.

The conclusion that we can draw here is that while total agricultural output did not markedly increase or decrease for the period, the *diversification* for different products changed significantly.

Benefits of Removing Subsidies in New Zealand Agribusiness:

Tying back to the U.S. Student Loan Market

While we recognize that the connection is not without its differences, there are three conclusions that we draw that highlight what policymakers might come to expect when removing FDIC deposit insurance.

First, resources will be more properly allocated. In the context of financial markets, this means new market entrants. As government support to incumbents falls away, higher priced loans will draw new players. Given the historical events when the loan guarantee was removed from the student loan market, our analysis indicates that specialized lenders specifically are expected to enter the market. This trend aligns well with productivity gains. Specialized lenders will be able to allocate resources in a more nuanced and efficient manner, thereby restructuring the funding channels in the economy.

Second, portfolio diversification will increase as banks need to consider different product offerings. Formerly cheap and risk-free loans for banks will start to diminish from their balance sheets. As such, banks will need to acquire other safe assets to continue to hedge their positions. Student loans are particularly interesting in this respect since students cannot declare bankruptcy and in turn the credit risk is even more nuanced. Therefore, we can expect bank balance sheets to change as the degree of risk that they are now taking on shifts further out. In turn, Treasuries might see an uptick as well.

Third, new product innovations will come to market. The New Zealand government at the time did not know that so many new dairy products or different types of fertilizer utilization were possible. As such, it is beyond the scope of this paper to posit what new product innovations in the student loan market will look like. What we can observe is that in the student loan market and the New Zealand agriculture market, businesses did adapt to having market-rate costs and non-subsidized revenues.

Nevertheless, it remains entirely possible that as new risk practices engender new prices, certain students may be priced out of the industry. The removal of the 2010 loan guarantee did change the industry in the short-term as major firms exited, the longer-term gains have been better risk practices. A fundamentally new market structure that focuses on risk, diversification, and innovation over the long-term rather than the short-term will portend benefits to the consumer as well.

Part V - IMF CBDC Framework

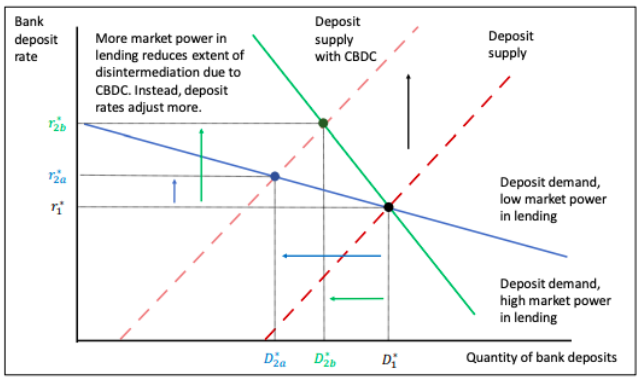
The IMF's 2018 paper *Casting Light on Central Bank Digital Currencies* sets out a framework for evaluating the question "Would CBDCs undermine financial stability and banking intermediation?" The IMF was expressly not trying to resolve questions, but instead set a foundation for various countries to consider CBDC issues. The IMF's analysis divides the risks into two different scenarios: the risks of bank disintermediation in tranquil financial times and the run risk in times of systemic financial distress. Within these two scenarios, we provide answers to the three questions raised by the IMF for analyzing financial stability.

Our conclusions from the IMF framework indicates five major factors that policymakers will need to stay aware of. First, banks that rely more on retail deposits will face bigger risks as CBDCs come to market. Second, banks may actually begin to hold safer assets as regulatory requirements mandate that as deposits leave, they will need to substitute new assets onto their balance sheets instead. Regulators have spent years building the Liquidity Coverage Ratio and the High Quality Liquid Asset ratios, which provide a detailed ranking of the safest assets banks may need. Third, digital money may in fact provide a new policy tool for central banks as they can more easily port money during times of stress, whereas physical cash is much more difficult to move. Fourth, regulation will need to remain nimble, particularly during the first crisis following the introduction of CBDCs. Fifth, bank risk practices will likely improve.

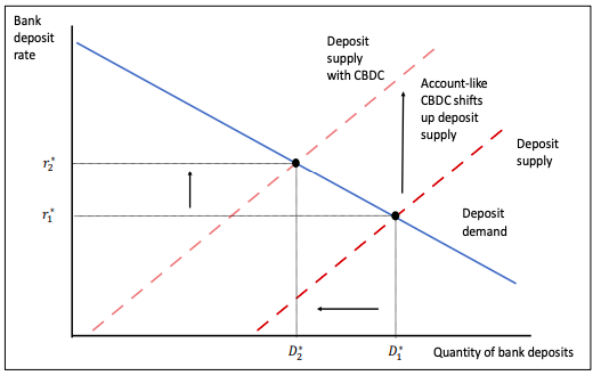
Scenario 1: Risk of Disintermediation in Tranquil Times		
Business Models	**Balance Sheet Composition**	**Bank Risk Practices**
Banks that rely more on retail deposits than wholesale deposits will face the biggest risks. These banks will have to offer higher rates to attract deposits. This increase may get passed onto lenders in the form of higher interest rate loans. When banks have more market power in lending (also reflected in the steepness of the demand curve for deposits - see below), they can better insulate their profits by passing the deposit rate hikes onto loan rates.. Banks with little market power may adjust more aggressively in quantity, exhibiting a larger contraction in deposit and loan volume. This indicates that regional banks, which tend to have more market power, may be able to pass on more of these hikes.	Banks will actually have to hold safer assets to correct for the loss of deposits. Retail depositors are more stable sources of funding than wholesale depositors (see Huang and Ratnovski 2011; Gertler, Kiyotaki, and Prestipino 2016) so as retail deposits leave, banks will have to hold more liquid assets to meet regulatory requirements. This may lead to an increased cost of funding as banks turn to wholesale funding.	While the IMF notes that introducing CBDCs might impact market discipline and risk practices, they note that this might be because of movements between insured and uninsured deposit accounts at banks. Our scenario does not allow for insured accounts at banks and therefore this part of the framework is not relevant.

Scenario 2: Run Risk in Times of Systemic Financial Stress		
Central Bank Prudential Tools	**Regulation**	**Bank Risk Practices**
Central banks have provided liquidity assistance to banks in almost 96 percent of the 151 crisis episodes studied by Laeven and Valencia (2018). While Central Banks will not be allowed to loan out retail deposits, this new form of transacting via digital/mobile may be important in geographically remote areas where it is harder to provide physical cash. After 9/11, the Fed struggled to provide cash to NYC and had to use boats to get cash to	The IMF notes explicitly that FDIC deposit insurance may limit flight from banks to CBDCs. Our position is that, if the risk is priced appropriately, depositors will either keep the money at the bank to continue to earn interest on it, or they will bring it to the central bank as a safe store of assets. There does not need to be a question of which is safer, insured institutions or the central bank. While the first crisis after introducing CBDCs may continue certain idiosyncrasies, sticky deposits will likely prevail.	We readily acknowledge that a flight to safety will exist, but we contend that in a systemic risk this effect will be muted. First, if a banking crisis coincides with a more prototypical currency or sovereign crisis, money may be withdrawn from all local assets, including CBDC. Second, even short of a general crisis, CBDC is unlikely to matter much if very safe and liquid alternatives already exist, such as Treasury-only mutual funds.

banks struggling to meet liquidity needs.		



Source: IMF staff



Source: IMF staff

Part VI - Conclusions

Assumed CBDC Structure

Our analysis assumes a particular CBDC implementation model – full retail implementation in which individual and business customers can take any current bank deposits, without cap, and place them instead in a deposit account directly at the central bank. Because this would be the primary type of risk-free demand asset, we assume a reduction of FDIC deposit insurance significant enough that we can ignore any remaining effects of that subsidy. We also assume a gradual implementation of CBDC over an extended period of time, likely in congruence with the FDIC deposit insurance removal. In the following section, we apply our analysis to the student loan market and illustrate that this sector will experience greater financial stability despite a decrease in lending and removal of subsidies.

Our proposal is to remove FDIC deposit insurance in a stepwise fashion from its $250,000 threshold down to zero over the course of 5 years after the implementation of CBDCs. This timeline is based off of BIS

best-practices and the timeline taken for full implementation of the Basel III Common Equity Tier 1 ratio. Every year an additional 20% will be removed from the deposit insurance until 100% of the subsidy has been eliminated. Kennickell, Kwast, and Starr-McCluer (1996) note that a decrease in deposit insurance from $100K to $25K would not be associated with a dramatic change in many non-wealth household characteristics. The change to $250K is a relatively recent development, therefore less research exists on the effects of moving deposit insurance from the $250K level back down to the previous level of $100K.

Synthesis and Future Work

The IMF 2018 Report raised issues of reduction of lending, counterbalanced against improved credit quality, as potential effects that central banks might consider when evaluating CBDCs. We conclude that the introduction of CBDC, in the long term, could improve financial stability by improving lending practices in a certain market segment. We specifically look at the likely substantial reduction of deposit insurance as a subsidy, because a retail CBDC will provide the zero-risk safe-haven for capital. We find that after the removal of similar implicit subsidies from the U.S. student loan market, lenders dependent on the market stayed. There could be several channels driving this improvement: market funding requiring better credit decisions and promoting specialty lenders that further improve credit quality.

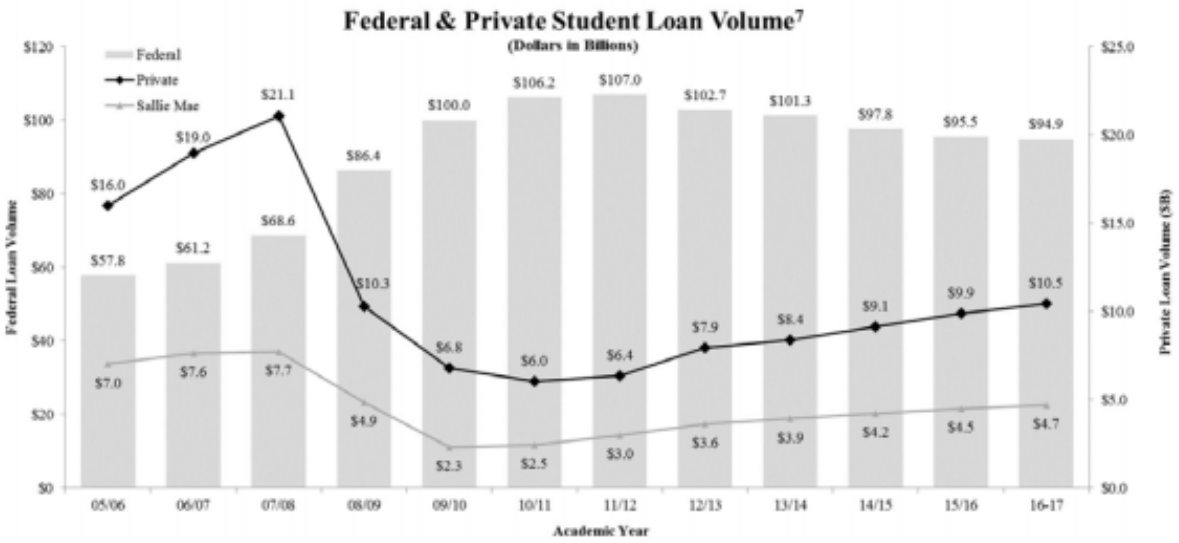
As for market improvements arising from CBDC and removal of bank-deposit-guaranty subsidies, at least development of the same types of lending as exist in the student loan market are possibilities: maturity-matched securitization, longer-term student loans made with funds obtained from offering market-rate deposits of varying maturities and not just demand deposits, and specialty lenders that could be financed with other intermediate-term capital.

There is one final comparison between our two historical examples that could benefit central bank consideration of CBDC policy issues. Both the New Zealand subsidy removal and the US 2010 subsidy removal occurred in one action, creating short term effects (including declines in production and credit availability). In the U.S. case, the government had to step in as a direct lender. In contrast, the organized, multi-year privatization of Sallie Mae can provide an example of planning for and implementation of subsidy removal that was smooth, ahead of schedule and did not see the same kind of short-term effects. These differences could provide guidance around CBDC implementation that is beyond the subject of this paper.

It is the authors' hope that these historical examples of subsidy withdrawal can provide illustrative analogies to frame and spur additional research and analysis. Each central bank has to consider its own specific banking funding and lending system. There may be country-specific examples of subsidy removals inside or outside the banking sector that can be leveraged for policymaking discussions. We think that the U.S. student loan market has a broad range of lenders, and therefore the method of analysis might provide a foundation for country-specific CBDC implementations that reduce financial market subsidies. Similarly, the New Zealand experience adds another perspective of major-business subsidy removal in a developed country.

The financial crisis of 2008-09 caused many regulatory, economic, and social changes to the financial system. Nevertheless, fractures still exist that pose risks to financial stability. As the global economy becomes increasingly interconnected and as taxpayers continue to stand at risk of funding bailouts for large banks, CBDCs emerge as a solution to promoting long-term financial stability.

Appendix



Source: https://www.salliemae.com/assets/investors/shareholder/annual-reports/SLM_Corp_2017_Form_10-K_2.23.18.pdf

Bibliography

Kenneth Rogoff, "The Curse of Cash", Princeton University Press, 2016

Robert C. Merton, "An Analytic Derivation of the Cost of Deposit Insurance and Loan Guarantees: An Application of Modern Option Pricing Theory", Journal of Banking Finance, Volume 1; Issue 1; June 1977

Milton Friedman, "A Program for Monetary Stability", Readings in Financial Institutions, Houghton Mifflin, 1965

Michael Kumhof and Clare Noone, "Central bank digital currencies — Design Principles and Balance Sheet Implications", Staff Working Paper No. 725, Bank of England, May 2018

John Barrdear and Michael Kumhof, "The Macroeconomics of Central Bank Issued Digital Currencies", Staff Working Paper No. 605, Bank of England, July 2016

BIS, "Central Bank Digital Currencies", Committee on Payments and Market Infrastructures, March 2018

Sveriges Riksbank, "The Riksbank's e-Krona Project", Report No. 1, September 2017

Gerardo Licandro, "Uruguayan e-Peso on the Context of Financial Inclusion", Banco Central del Uruguay, November 16, 2018

Speech by Ben Broadbent at the London School of Economics, London, 2 March 2016.

Speech by Governor Per Callesen at CBS' 100 Year Celebration, "Can Banking Be Sustainable in the Future? A Perspective from Denmark's Nationalbank", Denmark Nationalbank, October 30, 2017

Speech by August Carsten at the Central Bank of Ireland, Whitaker Lecture, Dublin, 22 March 2019.

American Bankers' Association, "Who Pays for Deposit Insurance?", Available at: https://www.aba.com/Tools/Economic/Documents/WhoPaysDepositInsurance.pdf

Asli Demirguc-Kunt and Harry Huizinga, "Market Discipline and Deposit Insurance", Journal of Monetary Economics, April 2003

Kennickell, A. B., M. L. Kwast, and M. Starr-McCluer, "Households' Deposit Insurance Coverage: Evidence and Analysis of Potential Reforms," Journal of Money, Credit and Banking, 1996

Demirguc-Kunt & Edward J. Kane, "Deposit Insurance Around the Globe: Where Does It Work?", Journal of Economic Perspectives, American Economic Association, vol. 16(2), Spring 2002

Deniz Anginer, Demirguc-Kunt, and Min Zhu, "How Does Deposit Insurance Affect Bank Risk? Evidence from the Recent Crisis", World Bank, August 2013

Demirguc-Kunt, Baybars Karacaovali, and Luc Laeven, "Deposit Insurance Around the World: A Comprehensive Database", World Bank, April 2005

Jan Bartholdy, Glenn Boyle, and Roger Stover, "Deposit Insurance, Bank Regulation and Interest Rates: Some International Evidence", November 1994, Available at SSRN: https://ssrn.com/abstract=5802

Jan Bartholdy, Glenn Boyle, and Roger Stover, "Deposit Insurance and the Risk Premium in Bank Deposit Rates", Journal of Banking and Finance, Volume 27; Issue 4, April 2003

Patricia McCoy, "The Moral Hazard Implications of Deposit Insurance: Theory and Evidence", Seminar on Current Developments in Monetary and Financial Law, February 2007, available at: https://www.imf.org/external/np/seminars/eng/2006/mfl/pam.pdf

Stefan Jacewitz and Jonathan Pogach, "Deposit Rate Advantages at the Largest Banks", FDIC Center for Financial Research Working Paper 2014-02, February 2014

Daniel-M. Gouin, Noella Jean, and John R. Fairweather, "New Zealand Agricultural Policy Reform and Impacts on the Farm Sector: Detailed Historical Analysis Addressing the Issue of the Specificity of the Farm Sector", Agribusiness & Economics Research Unit, Lincoln University, Canterbury Research Report No. 230, December 1994

World Trade Organization, "Subsidies, Trade, and the WTO: Defining Subsidies", WTO, World Trade Report 2006, available at: https://www.wto.org/english/res_e/booksp_e/anrep_e/wtr06-2b_e.pdf

Douglas J. Elliott, "Implicit Subsidies for Very Large Banks: A Primer", Economic Studies at Brookings, The Brookings Institute, July 29, 2014

Josh Siegel, "What Happened When New Zealand Got Rid of Government Subsidies for Farmers" The Daily Signal, September 22, 2016

Deloitte, "Global Dairy Sector - Trends and Opportunities", January 2017, available at: https://bit.ly/2yWVA3K

Tommaso Mancini Griffoli, MariaSoledad Martinez Peria, Itai Agur, Anil Ari, John Kiff, Adina Popescu, Celine Rochon, "Casting Light on Central Bank Digital Currencies", IMF Staff Discussion Notes No. 18/08, November 12, 2018

Oz Shy, Rune Stenbacka, and Vladimir Yankov, "Limited Deposit Insurance Coverage and Bank Competition", Finance and Economics Discussion Series Divisions of Research & Statistics and Monetary Affairs Federal Reserve Board, Washington, D.C., August 6, 2014

Viral V. Acharya, Deniz Anginer, and A. Joseph Warburton, "The End of Market Discipline? Investor Expectations of Implicit State Guarantees", March 2013. Available at SSRN: http://ssrn.com/abstract=1961656

Michael D. Bordo and Andrew T. Levin, "Central Bank Digital Currency and the Future of Monetary Policy", National Bureau of Economic Research, August 2017

Gary S. Corner & Andrew P. Meyer, "Trends in Community Banks' Net Interest Margins", Central Banker, Federal Reserve Bank of St. Louis, 2013

Chris Hunt, "Banking Crises in New Zealand - and Historical Perspectives", Reserve Bank of New Zealand: Bulletin, Vol.72, No.4, December 2009

Sumedh Rao, "Examples of Successful Fuel Subsidy Removal", 2011

Charles W. Calomiris & Matthew Jaremski, "Deposit Insurance: Theories and Facts", Annual Review of Financial Economics. 8. 97-120, May 2016

Evan Sparks, "Why Bankers Should Care About Student Debt", ABA Banking Journal, May 1st, 2017, available at https://bankingjournal.aba.com/2017/05/why-bankers-should-care-about-student-debt/

U.S. Department of Education, Federal Student Aid, *FY 2017 Annual Report*

Andrew Woodman, "Note: The Student Loan Bubble: How the Mortgage Crisis Can Inform the Bankruptcy Courts", 6 Alb. Gov't L. Rev. 179, 2013

Ambrose, Brent W. and Cordell, Larry and Ma, Shuwei, The Impact of Student Loan Debt on Small Business Formation (July 2015). FRB of Philadelphia Working Paper No. 15-26. Available at SSRN: https://ssrn.com/abstract=2633951 or http://dx.doi.org/10.2139/ssrn.2633951

Gene Amromin and Janice Eberly, "Education Financing and Student Lending", Annual Review of Financial Economics 8:1, 289-315 2016

Stephanie Cellini,, Rajeev Darolia, and Lesley Turner. "Where Do Students Go When For-profit Colleges Lose Financial Aid?" Federal Reserve Bank of Philadelphia Working Paper 17-12, 2017

Satyajit Chatterjee and Felicia Ionescu, "Insuring Student Loans Against the Financial Risk of Failing to Complete College," Federal Reserve Bank of Philadelphia Working Paper 12-15, 2012.

Rajeev Darolia, "An Experiment on Information Use in College Student Loan Decisions," Federal Reserve Bank of Philadelphia Working Paper 16-18, 2016.

Hylands, Thomas. Student Loan Trends in the Third Federal Reserve District, CDS&E Cascade Focus, Federal Reserve Bank of Philadelphia, April 2014.

Wenli Li, "The Economics of Student Loan Borrowing and Repayment," Federal Reserve Bank of Philadelphia Business Review, 3Q 2013.

Susanne Soederberg, "Student Loans, Debtfare and the Commodification of Debt: The Politics of Securitization and the Displacement of Risk", Critical Sociology, August 2014

Morgan Stanley Investment Report, Kenneth Michlitsch, "An Introduction to Alternative Lending" DATE