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Central Bank Digital Currencies and Long-Term Advancement of Financial Stability: Lessons from Two Histories

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Abstract

The structure of the US financial system deserves modifying. 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 an 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

The digitization of currency is progressing rapidly. Banks, governments, and citizens alike have benefitted from the speed, convenience, and reliability that digital money can offer. Concurrent trends in technology such as the proliferation of mobile devices, the falling cost of providing high-speed connections, the decentralization of currency, and the development of security protocols has further accelerated the digitization of currency. Nevertheless, the 2008 financial crisis looms large in the background. Flash crashes, credit crunches, and bailouts happened faster than ever as money flowed quickly into and out of markets. Central banks in particular have focused on stemming financial market volatility, preventing damage to the real economy, and combating political pressure for bailouts to financial institutions.

On top of all that comes distributed cryptocurrency. Although the most broadly used public payment blockchain, Bitcoin, has very slow transaction speeds, some argue that it is in wide enough use that it has begun to display the characteristics of money in varying degrees. Bitcoin and other cryptocurrencies exist outside the usual government and central bank structures. They have their own monetary policies, pose AML/KYC challenges, and could reduce tax compliance. The so-called shadow

banking system promised cash-equivalent instruments and were outside the clear control of the central banks. Needless to say, this was unrealized in 2007. Even though many institutions in trouble were not classic banks within the purview of central banks, bailouts happened at lightning speed in September and October 2008, as money flowed quickly out of markets and into safe assets. This has led political pressure and actual legislation against future bailouts of financial institutions. Cryptocurrencies outside the banking system could pose a similar threat, even if today such a risk appears only faintly on the horizon.

Central banks therefore have significant concerns about even a small probability of mass adoption of cryptocurrency. These technological, financial and political developments provide an impetus for central banks to consider the implementation, over time, of *central bank digital currencies* (CBDCs). Central banks have conducted, and have underway, studies regarding the potential effects of adopting a CBDC. They are exploring design challenges. 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/or development. These include the addition of new a new monetary-policy tool (negative interest rates on CBDC deposits), disruption of payment systems (because of a lower-cost alternative), and the effects from a new zero-risk asset (banks would lose their lower cost of capital subsidy arising from deposit insurance).

Most of the literature 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 focus our analysis in three ways: assuming one particular CBDC structure, looking at a particular market, and analyzing just the lending aspects of financial stability. 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 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-implementation of a risk-free digital store of value.

Second, we use the IMF framework to examine two examples of significant, developed-nation-government withdrawal of subsidies from a market. Primarily we focus our analysis on withdrawal of corporate subsidies to lenders in the US student loan market. This is the second largest market for consumer debt in the US. 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 is very large (\$1.5 trillion outstanding credit), it has varied types of lending (government, private loans held by large and small banks, and securitizations), and there have been 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 agricultural subsidies, including to large agribusiness corporates.

Third, 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 part III and V, we quantify the effects that CBDC and subsidy removal will have on

lending both in the short and the long term. In part VI, we evaluate the impacts that a CBDC will have on financial stability.

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

CBDC research has predominantly been dedicated to exploring monetary policy effects. The international community as well as Central Banks have contributed the vast majority to this literature, and has been doing so for years (Friedman, 1965; Tobin, 1985). 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 putting forward design implications, such as keeping reserves separate from deposits. (Kumhof & Noone, 2018) (Border & Levin, 2017)

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

explores three different scenarios by which an account-based, interest-bearing CBDC could create true stable prices and help central banks achieve their inflation mandate.

Second, researchers have also explored the impact that CBDC could have on growth. For example, Bardear 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 third major set 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. This paper sets out to address some of those concerns. The primary arguments against CBDC are that they would that they could accelerate and worsen the opportunity for bank runs (Broadbent, 2016; Callesen, 2017). 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.

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 of [2009] mandated that the Deposit Insurance Fund maintain a minimum designated reserve ratio of 1.35% of estimated insured deposits. In the US 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.

The safety that deposit insurance provides for depositors also causes market distortions that affect financial stability. The World Bank summarizes this effect.

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.

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) measure the subsidy align with this risk hypothesis reducing, noting that that deposit insurance lowers bank interest rates by approximately 17 bps.

Second, FDIC deposit insurance reduces market discipline on bank risk taking. Calamoris 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. 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.

It is also important to acknowledge the benefits that FDIC insurance has allowed. Bartholdy presents evidence that the risk premium is on average over 40 basis points higher in countries without deposit insurance than in countries with deposit insurance. 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.

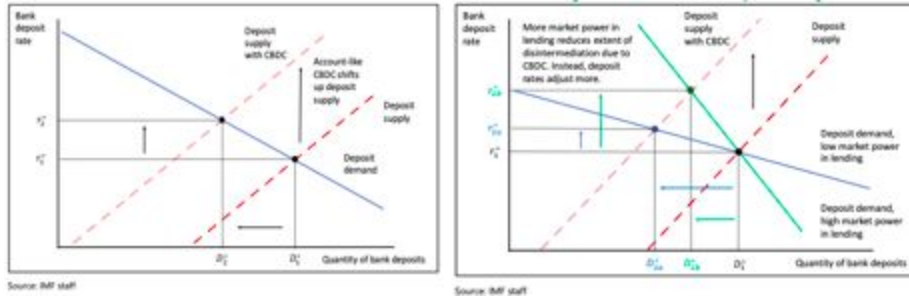
IMF CBDC Framework

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 two different scenarios: the risks of bank disintermediation in tranquil financial times and the run risk in times of systemic financial distress.

Scenario 1: Risk of Disintermediation in Tranquil Times		
Business Models	Balance Sheet Composition	Bank Risk Practices
<p>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), they can better insulate their profits by passing the deposit rate hike on to loan rates (see the chart below). Banks with little market power 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.</p>	<p>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 will likely lead to an increased cost of funding as banks turn to wholesale funding types.</p>	<p>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 for our paper.</p>

Scenario 2: Run Risk in Times of Systemic Financial Stress		
Central Bank Prudential Tools	Regulation	Bank Risk Practices
<p>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 banks struggling to meet liquidity needs.</p>	<p>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.</p>	<p>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 general economic (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.</p>



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 over a long period. We leverage the IMF framework to synthesize our analysis and highlight that the student loan market will experience greater financial stability despite a decrease in lending and removal of subsidies.

Part II – The Student Loan Market

The student loan market is the largest market for unsecured consumer debt in the United States (whereas mortgage debt is secured). Student loans outstanding grew 500% from the early 2000s to the early 2010s. The current \$1.57 billion dollars of such debt represents approximately 40% of all unsecured consumer debt. Student loans provide 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.

Over the past 20 years, the US government has removed two different, 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 will begin 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.

Background

In 1965 federal legislation provided for US government guarantees of student loans, the so-called “FFEL” program (or “FFELP”). This guaranty system came as a result of, among other things, particular internal-US-government budget accounting rules. These rules recognized government expenditures on a cash basis, rather than an accrual basis, so the cost of a student-loan guaranty did not have to be recognized until later. Various banks and other lenders originated these guaranteed loans.

The federal involvement led to the 1973 chartering of Sallie Mae, to serve as a major servicer of student loans. As a “government sponsored enterprise” 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 US Treasury, exemption from state and local taxes, and very low capital requirements (even lower than banks). Enjoying these subsidies, eventually Sallie Mae became the largest originating lender of student loans in the United States. Then from 1997 through 2004 there was a full privatization of Sallie Mae.

Sallie Mae also provides a helpful window to examine subsidy removal effects because it has always been the largest lending entity in the student loan market, by far. 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 US government undertook a complete overhaul of this system. Guarantees ended for new loans, without any phase-out. The US Department of Education became the direct lender for all new

US government funded student loans. Large US banks that had a substantial part of the US student-loan originations market completely exited the market.

Almost immediately after the US government changed from a loan-guaranty structure to direct lending in 2010, large banks exited from the student-loan origination market. US Bancorp left in 2012, and JPMorgan Chase followed in 2014. A private student-loan market has emerged. Annual origination volume hit \$18.1 billion in 2007-08, declined until 2010, and is now increasing again. Nearly 1.4 million undergraduates borrowed private loans in 2011-2012. About 15% of debt carried by seniors graduating in 2017 was in private loans. These private loans do not have government guarantees. 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. And these are amounts that originating lenders continued to hold on their own balance sheets, not securitizing them. Banks are lobbying to cap the US government loan program, so that private lending can increase.

Part III - Removal of Subsidies to New Zealand Agribusiness

Leveraging History for a Comparable Example

We wanted to confirm our observations and conclusions with another example of removal of a large corporate subsidy in developed nations. Before going too far into this second example, it is important to note the differences between subsidies and guarantees. While the WTO allows for a liberal interpretation of a subsidy as “Any government program that benefits private companies,” there are several relatively distinct types. There are direct subsidies and guarantees that generate *implicit* subsidies. For implicit subsidies, “[c]osts 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.

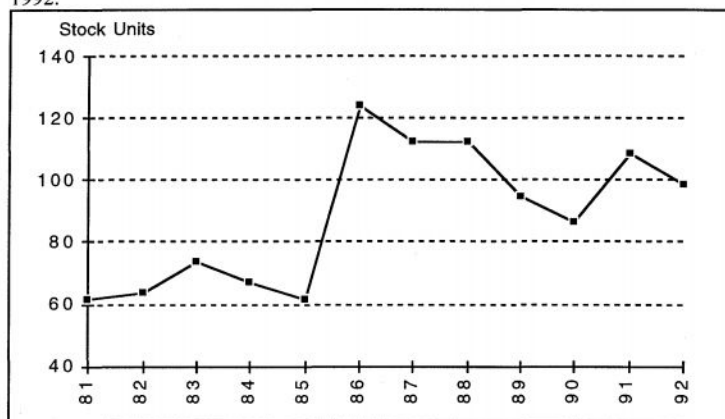
Thus FDIC deposit insurance is a subsidy that causes both explicit and implicit benefits to private lenders, whereas New Zealand farm subsidies provided both explicit and implicit benefits to private enterprise. Because a full retail CBDC would remove a guaranty subsidy, these two examples allow a qualitative 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. For example, fertilizer amount used per sheep (the second largest export product of New Zealand) more than doubled in the five years after subsidy removal. 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.



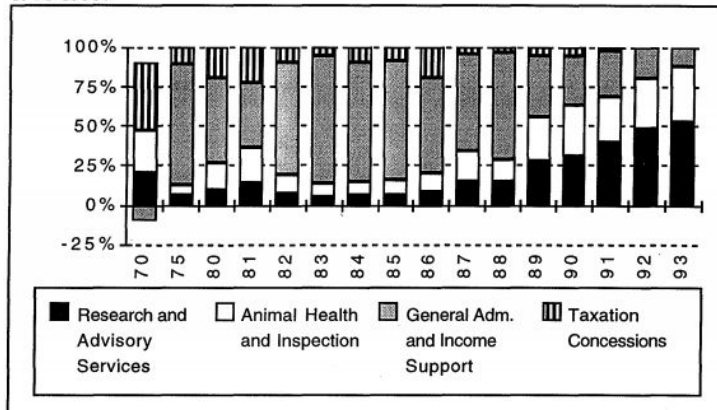
Source: Annex 5.7.

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 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 (R&D). Similarly, removal of a government subsidy to banks could allow a redeployment away from the financial sector into R&G for productive, nonfinancial portions of the economy.

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

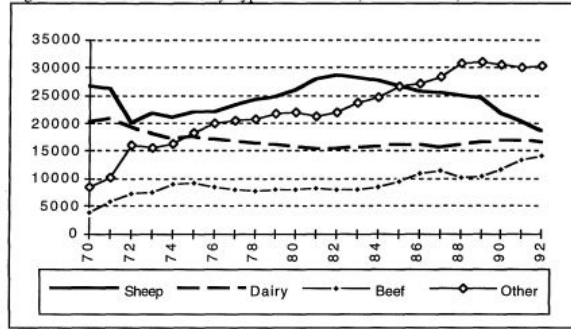


Source: Annex 3.2.

2. New Product Innovation - In 1983, New Zealand dairy farms produced 35 different commodities from milk. By 2017, this was over 2,200 different products. 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 heavily subsidizes and benefited from protectionist policies. The period after subsidy removal saw New Zealand agribusiness able to compete because of innovation and efficiency gains.

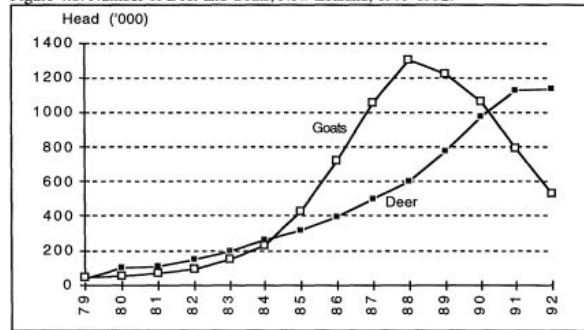
3. Portfolio Diversification - As beef and sheep prices fell heavily after subsidies were removed, farmers diversified land use to include deer and goat farming. Sheep was one of the most highly subsidized sectors and without government support, this product was no longer profitable for farmers and therefore 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.

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.

There are two important considerations to make: first, it is beyond the scope of this paper to determine the benefits to consumers. While a reduction in sheep might not align with consumer tastes, it is a generally accepted market principle that more diversification is better than not. With that said, the sheep sector in New Zealand has made a significant rebound and exports have been setting records in recent years. Second, it is important to note that the production trends in the lead-up to the subsidy removal. Farms may have realized that the subsidies would not last forever and therefore began to change their practices in the years leading up to 1984. As such, we can also come to expect some of this gamesmanship during the 5-years in which the FDIC deposit insurance is rolled back.

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

Part IV - Financial Stability and the Removal of Subsidies

Benefits of Removing Subsidies in the Student Loan Market:

The Persistence of Lenders, Despite Higher Funding Costs

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 while putting the risks onto the government. There are two well-known examples in the US housing market: Fannie Mae and Freddie Mac. There was substantial analysis at the time of the effect that the Sallie Mae subsidy had on lending activity. Those studies concluded that a lender prices to its borrowers "at market cost" (given that competitors have market-rate funding), taking the benefit of any subsidy to itself. This indicates that the amount of lending certainly did not decrease upon removal of the subsidy, just the market-rate funding of the lender. Thus one of the benefits of privatization of a government-sponsored company is the removal of that implicit government subsidy. This is what occurred with Sallie Mae in its 1997-2004 privatization.

Two US government subsidies investigated the size of the Sallie Mae subsidy and effect of removal. In 1985, before the privatization, a Congressional Budget Office study (i.e. before consideration of privatization began) concluded that Sallie Mae benefited from a subsidy of 30 bps. A US Treasury Department study after completion of the privatization concluded: "Congress provided the wind-down period to allow time for the safe and sound transfer of SLMA 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 US Treasury credit facility, required Sallie Mae to reset the liability side of its balance sheet; i.e. its cost of funding.

For example, in 2002 (during the privatization process), the Sallie Mae holding company 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 short, the lender losing its subsidy (Sallie Mae) 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.

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 lending market.

Subsequently, Sallie Mae does now fund itself primarily with deposits. It has an FDIC-insured banking subsidiary so that it can benefit from the FDIC-insurance subsidy. However, Sallie Mae's deposits are not typically small, demand, retail consumer deposits. Instead they are brokered deposits and certificates of deposits. This indicates that Sallie Mae is having to pay interest rates on deposits that are at least somewhat closer to a non-subsidized market. Moreover, Sallie Mae has been able to attract capital with longer maturities. Approximately 50% of its deposits have a maturity of one year or more, rather than demand deposits and short-term certificates of deposit. It also has even longer-term capital in the form of \$4 billion of on-balance-sheet securitization obligations.

We also note that Sallie Mae still engages in maturity transformation. Even its "deposit" funding is heavily weighted toward interest-bearing, non-demand instruments. Over 54% of Sallie Mae's total deposits are brokered deposits, indicating that the customers/funders are sophisticated, and able to demand market rates by evaluating Sallie Mae credit risk if the company was not subsidized.

Despite these increases in funding costs, Sallie Mae has made the strategic decision to focus on student loan lending. It began as a loan servicer, because both lender and servicer, and now has spun off its servicing business. This suggests two potential effects on subsidy removal in a lending market, as would happen with a retail CBDC. First, market participants may initially specialize, focussing on particular business lines so that expertise can counterbalance a higher financing cost structure. Second, lenders are in the business of lending, and they do not close up shop with higher financing costs. The largest US banks did leave the student loan market upon loss of the loan-guaranty subsidy. But they had other businesses in which they could deploy their capital, in an improving economy after 2010. For

CBDs, the Sallie Mae example could be the most salient. When a market-wide subsidy for all lending was removed, the lender who depended most heavily on that subsidy did not shut down.

Benefits of Removing Subsidies in the Student Loan Market:

Specialty Lenders Improve Credit Quality

A second potential benefit of subsidy removal is improvement of credit quality because credit risk must then be market priced based on market-rate funding costs. Well prior to the 2008 financing crisis, The Federal Reserve examined whether specialty 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 deposit guaranty. The rationale of big banks being in the student loan market was mainly to accumulate as many loans as they could issue, and then securitize them. 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 focussed more on consumer lending, like Wells Fargo, remained in the market, as well as specialized lenders. Community banks have also entered the student loan market, with the underwriting and servicing often outsourced to specialty student-loan-knowledgeable service providers. This of course makes these community banks *de facto* specialized lenders in this space.

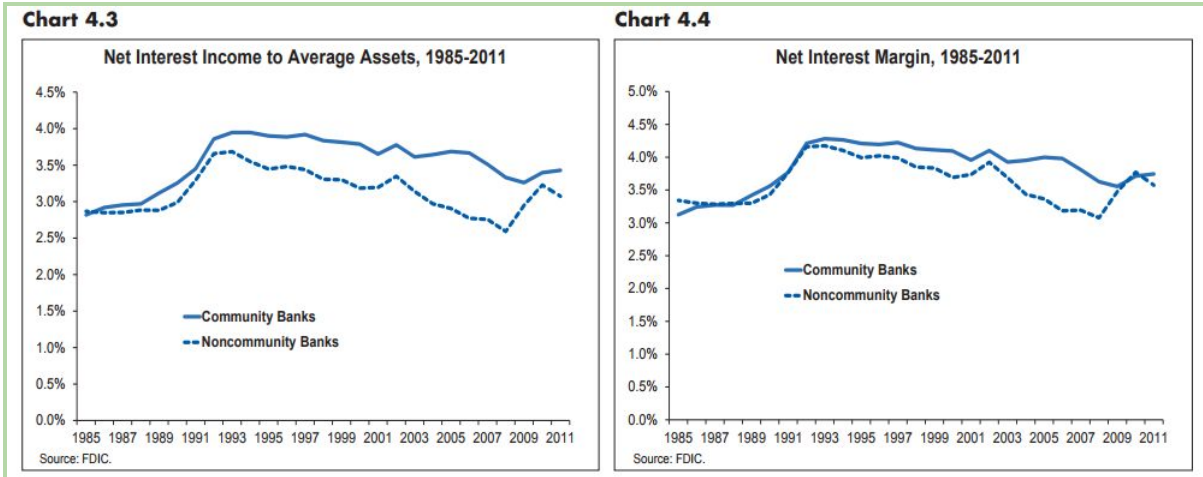
There is significant confirmation of this on a qualitative basis. As described above, student-loan-lending and servicing businesses in the market, such as the Sallie Mae spinout of Navient.

Navient has itself now sought to enter the student-loan origination business. Thus the number of speciality lenders has begun to increase.

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 speciality lending market). This demonstrates that speciality lenders can step in to fund productive enterprise at the ground-floor level of small business loans. That 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 speciality 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 speciality lenders in a space. Nevertheless, we sought to obtain a quantitative estimate by compare 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 loans 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 5 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.



As a measure of superior credit quality we can look to delinquency rates. Wells Fargo's 90-days-plus student-loan delinquency rate is approximately 10%, compared to 7.8% for the top 10 community banks engaged participating in the student-loan market. The specialized servicer Navient has a delinquency rate of 7.1%. Improved credit quality is a significant factor in maintaining stability of lending institutions.

Benefits of Removing Subsidies in New Zealand Agribusiness:

Confirmation by Example

While we recognize that the connection is not without its differences, we 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, 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.

Part V - Conclusions

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. 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 US 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 speciality lenders that further improve credit quality. Having loans move to specialty lenders, and away from systemically important banks, improves the diversification in the sector, much like New Zealand saw in agribusiness after its corporate subsidy removal.

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 US 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 US 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.

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