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Reimagining the introductory material in teaching money creation and monetary policy

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ABSTRACT

The money creation and monetary policy chapters in the leading introductory textbooks commonly present an outdated and misleading approach that is now largely irrelevant. A preferable model would help students understand that money and monetary policy are about bank and household motives, the importance of capital, and the role of credit. An updated approach would move beyond the current orthodoxy, which assumes both that the mechanical base-multiplier explains monetary policy and the quantity theory explains inflation. Monetary policy has evolved dramatically in the last 40 years. Therefore, textbook authors and teachers of introductory macroeconomics might consider some of these suggestions to help explain recent events.

KEYWORDS

Capital requirements; introductory economics; monetary policy; money creation

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In recent decades, innovations in the banking system and monetary policy have changed the financial sector's role in the real economy. Yet, during the COVID-19 pandemic and in the wake of the Great Recession, economists struggled to explain how the modern banking system and monetary policy works in practice. Central banks have struggled to restart growth through expansionary monetary policy. Short-term interest rates are historically low—even negative for some sovereign debt—and yet inflation has remained below respective targets for several years. The Federal Reserve has made attempts to clearly explain innovative changes to policy—such as interest on reserves, quantitative easing, and other liquidity programs. Yet, economists have largely spent the last ten years trying to explain these innovations to undergraduate students using the approaches of an earlier era. While many economists like Bowles and Carlin (2020) have argued that the materials being taught to undergraduates need a thorough reconstruction, there is a natural hesitancy to depart too much from what has worked in the past. This article aims to bridge the status quo and complete reconstruction by using a focus on profit-seeking and bank capital, which uses a balance sheet approach that can be applied at a modular level. Once in place, money, credit, and real-world monetary policy can be more clearly explained to undergraduates.

This approach offers connections between banking, the financial crisis, and its aftermath—and lays the groundwork for discussions on wealth, inequality, and debt. The exposition of financial markets and money might be updated to open the door for how monetary policy and regulation could be applied in a contemporary real-world context (McLeay, Radia, and Thomas [2014a, b] provide one example of this). Monetary policy remains one of the least understood economic topics in large-scale assessments (Walstad, Rebeck, and Butters 2013), and improving understanding requires a re-evaluation of how the topic is taught.

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The two approaches discussed here that require re-inspection are the basic reserve-constrained base-multiplier (B-M) (i.e., the money multiplier) and the quantity theory of money (QTM). Instructors of introductory and intermediate macroeconomics are often undermining their own credibility by trying to explain the past decade and beyond using these approaches. Unfortunately, status quo bias presents a strong roadblock to textbook authors and publishers who might be interested in transitioning. Bowles and Carlin (2020) note the "15% rule" as a barrier to how much publishers will allow new books to deviate from the standard macroeconomics textbook. Therefore, we might look to one of the standard introductory and intermediate textbook authors for guidance on how his books have changed since the crisis. Mankiw (2020b) noted that when describing the banking system, his introductory treatment has evolved since 2008 to include capital and leverage due to their prominent role in the crisis. The new coverage by Mankiw (2020a) describes these new components alongside the B-M model and QTM.

The key issue is that both B-M and QTM are teachable, testable, and deeply ingrained in not only introductory, but also in intermediate and upper-level textbooks and materials. Both topics are also included in the AP Macroeconomics and *Test for Economics Literacy* exams, meaning it is treated as fundamental to both the high school and college curricula. Our introductory materials reflect their upper-level counterparts and are often simplified so that nonspecialists can teach the material. It is important to offer new materials to guide textbook authors and instructors toward a simple real-world approach that can be later applied in upper-level coursework.

This article is also an attempt to motivate discussion regarding the usefulness of what we are teaching our high school and undergraduate students—many of whom only ever take one course in economics. I am neither advocating for a greater emphasis on unconventional monetary policy (as in Gertler 2013), nor am I trying to raise the profile of real-world examples (as in Coppock and Mateer 2018; McConnell, Brue, and Flynn 2018; Parkin 2018; and others). Rather, the article stresses the importance of teaching a more appropriate set of banking system fundamentals, with the objective being for students to understand not just the role of liquidity, but also capital, leverage, regulation, the profit motive, and interbank lending markets.

The article proceeds as follows. First, the literature on the modern banking system and undergraduate teaching materials is introduced, focusing first on what might be considered in need of revision, followed by a set of broad suggestions for reforming what is taught. This is followed by a suggested exposition, starting with an introduction to the foundations of money and debt that focuses on a role for credit in the economy. Therein I provide a discussion of wealth, income, and personal balance sheets. The exposition continues to discuss money creation with a focus on how banks create money through lending. This section includes discussions on reserve and capital requirements, as well as the role of federal funds loans. The final section of the exposition describes the difference between capital and reserve constrained banking as well as the regulatory role for the Federal Reserve's tools (instruments), targets, and goals. The final section concludes.

Problems with the B-M and QTM approaches

In leading undergraduate teaching materials, B-M and QTM often receive a great deal of emphasis. In a post-crisis world, the mechanical B-M method of money creation works to cement the idea that banks are only an intermediary with no real role in our economy and not the primary providers of credit. The B-M approach was a convenient framework for describing the financial system, but evidence shows this description only appeared to be correct (McLeay, Radia, and Thomas 2014a). This flawed treatment as an intermediary hampers the discipline's ability to explain issues like excessive risk-taking, the effect of regulation, and policies such as capital injections. The QTM framework has similarly been a convenient fallback with its own shortcomings. The QTM prediction that money growth and prices move together in lockstep over the long run is confronted with new evidence contrary to its predictions. Gertler (2013) notes there is no

QTM link between reserves and inflation. Goods price inflation and the growth of the money supply no longer are correlated to the degree they were in the past. Over the past 20 years in the United States, average annual CPI inflation was 2.1 percent, nominal GDP grew at 4.0 percent, while M1 and M2 each rose at annual rates of 6.1 percent.[1] At the start of the Fed's quantitative easing (QE) programs in 2008, it was common to hear from both economists and pundits that the Fed was courting hyperinflation. In fact, since QE began, inflation has been below the Fed's target rate of 2.0%.[2]

Pedagogically, these frameworks are typically first used to explain how the world works in theory, and then later abandoned for a narrative approach to discuss real-world examples. While it is somewhat normal for our teaching models to depart from reality to a degree, the narratives that follow are generally in defiance of the fundamental assumptions inherent in the approaches rather than nuance, which had been assumed away.

The ability to create money out of thin air might be the most important lesson from the B-M approach and is fundamental to any discussion where credit creation is thought to be an important driver behind real economic activity (Bernanke, Gertler, and Gilchrist 1999). The Fed does intervene in the market for funds, and the stories of open-market operations like increasing bond purchases to raise reserves are workable. However, in reverse, we expect the Fed to sell bonds, contracting the supply of money, and thus raising interest rates. In the 2008 report on open market operations, the Fed admits that, in practice, they do not do this. They note, "[t]he outright sale of U.S. Treasury securities that commenced on March 7 [2008] were the first sales in nearly two decades" (Federal Reserve Bank of New York and Markets Group [FRBNY] 2009, 13). Furthermore, during the Fed's three rate increase cycles since 1990, the monetary base did not significantly shrink but instead grew throughout each tightening period.[3] It would appear some reconciliation is in order.

Reviewing the economic literature and textbook treatments

Recent research has shown that a more complete understanding of how the Fed influences the real economy should be based on bank balance sheet strength and risk perception (Disyatat 2011). Currently, this is not how banking is taught, and macroeconomists have helped perpetuate several general misconceptions. For one, in most general equilibrium macro models, the financial system had become much of an afterthought, with the central bank having only power to impact the economy through changes in interest rates (Woodford 2000). With the addition of financial frictions to general equilibrium models, there was an improvement in explaining negative shocks and responses to them (Bernanke, Gertler, and Gilchrist 1999). Unfortunately, when these more advanced models are explained in their most basic terms to undergraduate students or the general public, the common explanations often run counter to the more fundamental models they were first taught.

Most of the leading textbooks devote substantial space to describing the role of reserve requirements and the B-M model. Thirteen introductory textbooks were reviewed in preparing this article: Acemoglu, Laibson, and List (2018); Colander (2020); Coppock and Mateer (2018); The CORE Team (2017); Cowen and Tabarrok (2017); Frank et al. (2019); Greenlaw and Shapiro (2017); Hubbard and O'Brien (2017); Krugman and Wells (2018); Mankiw (2020a); McConnell, Brue, and Flynn (2018); Parkin (2018); and, Stevenson and Wolfers (2020). Ten of these books include—in varying detail—a description of the B-M approach, while only Acemoglu, Laibson, and List (2018), The CORE Team (2017), and Stevenson and Wolfers (2020) do not.[4] All of these books, with the exceptions of The CORE Team (2017), McConnell, Brue, and Flynn (2018), and Stevenson and Wolfers (2020), discuss QTM in some capacity.[5]

The most outstanding treatments here include Acemoglu, Laibson, and List (2018), who introduce banking via a profit-driven approach, addressing issues of capital and risk. Later, money is

developed via QTM, and they eliminate the B-M model in favor of a reserve-demand/reserve-supply model. Stevenson and Wolfers (2020) eliminate both B-M and QTM and explain money creation using a narrative approach. Finally, The CORE Team (2017)—supported by Bowles and Carlin (2020)—provides the most unique approach. They first describe the reason for lending and borrowing as the result of consumption smoothing, with an approach that uses indifference curves and budget constraints to optimize intertemporally. The CORE Team (2017) later describes money creation using balance sheets but eschews the B-M approach.

Many of these books address some shortcomings of the B-M approach via leakage, and the difference between required and desired reserve ratios is portrayed as fundamental to incorporate household and bank behavior (Thornton, Ekelund, and DeLorme 1991; Gamble 1991).[6] Today—in the real world—reserve requirements, or the distinction between desired and excess reserves is by and large unimportant. With the advent of sweeps accounts, reserves had already become less restrictive than in the past (Bennett and Peristiani 2002). Deposit management by banks had made it such that banks determined their own level of deposits to a degree, and thus could create their own reserves. Long before the financial crisis, banks ceased to be reserve-constrained by being able to tap into overnight interbank loan markets. In the United States, the Fed admittedly did not "buy and sell bonds" as it was generally believed. Instead, the Fed generally worked through the repo market, temporarily buying and selling assets with future commitments to reverse those transactions. Reserves are endogenously created to meet bank demand. Few of these changes are detailed in the textbooks reviewed. While the main goal is not to include topics like repos in an introductory exposition, the treatment suggested here provides a framework for these discussions.

It does not appear that the use of the B-M approach is simply to motivate the process of multiple deposit creation. A common approach to teaching B-M at the introductory level stresses the importance of how the Fed influences the economy through monetary aggregates (M1 and M2), which *then* impacts interest rates. This outcome is often explained as the result of the Fed using open-market operations to increase reserves and, therefore, expansion of the money supply. Reference to 2008 is usually treated as a special case, where much of the simplified approach is replaced with a narrative.

Intermediate textbooks present a similar approach. Mankiw (2019) describes monetary policy as "the government's control over the money supply." Later, this exposition develops money creation via the B-M approach, and subsequently adds a discussion on capital, leverage, and leakage. The subsequent discussion on monetary policy starts by discussing changes in the monetary base, which students would presumably link back to the earlier B-M approach. Mankiw notes the failure of the B-M model to predict massive growth in the money supply by explaining that the money multiplier is kept low because interest paid on reserves encourages banks to hold more excess reserves. Blanchard (2017) opens his book with stories about the financial crisis, failing banks, bad balance sheets, and mortgage origination, but never returns to describe another bank balance sheet. The subsequent explanation of money uses a "money-demand/money-supply" framework, explaining central bank money increases or decreases with open-market operations. Thus, financial intermediaries and exogenous money play a central role, with banks and money creation receiving only a minimal role in the economy.[7]

Interest on reserves (IOR) was first implemented in the United States in 2008, but other countries like Canada and the United Kingdom had been using this tool for some time. The countries using IOR before 2008 typically have no reserve requirement, and generally leave most liquidity decisions up to the banks themselves. A few introductory textbooks provide some detail on the role of interest paid on reserves since the crisis, but it is typical that more space is spent on reserve requirements and discount rates. Interest on reserves generally appears as an afterthought, as opposed to a substantive part of the B-M framework. Yet, our current models imply that IOR is the primary backstop preventing runaway inflation. A more suitable exposition might

incorporate interest on reserves as a more important functional role in the profit-seeking financial system. When the financial system has ample excess reserves, even with an IOR policy in place, bankers can still seek out lending opportunities that offer a higher return. They might be restricted, however, by a lack of interested borrowers at the rates being offered, or if banks are otherwise uncomfortable making loans to prospective borrowers at market-bearing rates. Capital, capital requirements, and credit constraints offer crucial insights into why banks might not be lending—or people might not be borrowing.

Most of the textbooks noted here have downplayed the role played by capital and the importance of the profit motive in creating credit, focusing instead on the B-M approach.[8] Gertler (2013) targets educators in his description of the importance of the "credit channel" in monetary policy and describes the irrelevance of the money multiplier or quantity theory of money. Gertler instead suggests we refocus our attention on the importance of credit and inside money. Carpenter and Demiralp (2012) note that the credit channel itself often relies on a narrow bank-lending channel, like that discussed by Kashyap and Stein (2000). Carpenter and Demiralp (2012) show further that there is no discernible link between reserves to money supply and, finally, to bank lending. Thus, bank lending is demand-driven, implying an important role for household needs, moods on risk, and balance sheet strength (Disyatat 2011).

Effective financial regulation has struggled to keep pace with innovation, facing difficulties in the years following the financial crisis (Tarullo 2019). Tarullo repeatedly notes the important role played by capital requirements, hardly even mentioning liquidity requirements or reserves. While liquidity measures were important in the height of the credit crisis, the residual effect of the Great Recession has been a long-term change to the treatment of capital. The federal funds market has changed since the crisis, with different actors and instruments in use (Craig and Millington 2017; Wolla 2019).

While textbooks are notoriously slow to change, the Federal Reserve might be expected to offer some clarity in their educational materials. Some recent research reflects a more modern approach (Wolla 2019), while other new materials continue to echo the typical textbook explanations given over the past several decades (FRBSL n.d.[a], [b]). The idea that monetary policy is conducted by changing the quantity of reserves rests on the notion that banks are reserve-constrained. This then links to the popular misconception that banks "lend out deposits" or "lend out reserves" when we know this is not the case (McLeay, Radia, and Thomas 2014a).

Combining the typical B-M and QTM approaches leads many students to believe that banks are a passive intermediary serving little purpose other than to multiply reserves at the Fed's request. Reality defies this belief, as the financial sector made up 20 percent of the entire stock market capitalization in mid-2019 and has averaged 26.5 percent of all domestic profits since 2009.[9]

Changes to the typical exposition of money creation

Outlined below are changes in the typical exposition of money creation in monetary policy that would provide students with a more accurate framework for understanding the banking system. In addition to outlining these changes, I provide a sample exposition of introductory material that incorporates these changes.

Deposit creation without money multiplier

The stories told in textbooks about central bank influence often rely on the money multiplier (B-M) model, which mainly only exists in a world where banks are strictly reserve-constrained. In a reserve-constrained setting, banks would like to increase loans (and therefore deposits) at any moment to a perfectly elastic demand for credit curve, but their limited reserves are stopping

them. The reality is that this has not been true for several decades in the United States or other developed economies. It is relevant in countries like China and Turkey who routinely use reserve requirements as a monetary policy tool. However, it would be more appropriate to teach these special cases outside of introductory courses.

The definition of money and the explanation of its creation is expanded here to emphasize the importance of inside money (i.e., bank money), and the ability given to lenders to create money and manage their monetary base in a world without reserve constraints. Gray (2011) notes that in 2010, nine countries out of 121 reported having no reserve requirements—Australia, Canada, Denmark, Hong Kong, Mexico, New Zealand, Norway, Sweden, Timor-Leste, and the United Kingdom. Today in the United States, banks maintain reserves for several reasons other than meeting statutory requirements. De-emphasizing the B-M model will allow instructors to spend time explaining the important roles for liquidity and capital.

Bring a focus on capital

Many leading introductory textbooks describe money creation using balance sheets. However, of the 13 textbooks reviewed here, only seven used any form of capital in their balance sheets (Acemoglu, Laibson, and List 2018; Coppock and Mateer 2018; The CORE Team 2017; Greenlaw and Shapiro 2017; Hubbard and O'Brien 2017; Mankiw 2020a; McConnell, Brue, and Flynn 2018). Others exclude any discussion of capital (Cowen and Tabarrok 2017; Krugman and Wells 2018; Frank et al. 2019), while a few do not use balance sheets for describing money creation (Colander 2020; Parkin 2018; Stevenson and Wolfers 2020). The Basel banking accords place a much higher value on capital regulations versus liquidity—which comes not just as reserves but other highly liquid assets. The B-M process is unimportant as banks and other financial institutions are seeking to create profits to pay out to shareholders or accumulate capital. Without a model of banking grounded in capital and the profit motive, leverage and most banking regulation make little sense to students. Students are rarely given the opportunity to examine how one of the most salient aspects of the 2007–8 financial crisis—widespread foreclosures and falling property values—affected both personal and bank balance sheets.

Drop or move quantity theory of money

Too often, students are taught the B-M approach such that the Fed controls outside money (M0), and, therefore, inside money creation (M2). Perhaps they are taught that there is some leakage through currency or excess reserve holdings, but that these factors are generally stable and, therefore, the B-M approach is rather mechanical. This then typically leads to a QTM discussion of the long-run impact of the quantity of money (usually M2) on the price level. Thus, we might expect students to believe if the Fed buys a $1,000 bond, it creates $10,000 new dollars through the B-M process, and we should therefore see prices rise by a corresponding amount.

Empirically, some of this may hold to a degree in the long run (McCallum and Nelson 2010). However, the connection between the Fed's short-run actions and money creation is less than clear (Thornton 2014). The deeper underlying assumption most textbooks are trying to work around is that monetary policy is solely a short-run matter related to interest rates, with no long-term effects. The quick transition to the long run relies on a tight connection between monetary aggregates and inflation. In fact, the evidence on this is often mixed. Gertler and Hofmann (2018) show a weak link between money creation and inflation, and, in low inflation countries, De Grauwe and Polan (2005) show nearly no relationship between monetary aggregates and inflation. De Grauwe and Polan directly address their approach in comparison to earlier work by Dwyer and Hafer (1999), who do not differentiate between high- and low-inflation countries when they show M2 is proportionally related to changes in the price level over the medium term.

Furthermore, if the Fed is not exogenously controlling M2, then there is a flaw in connecting mechanical price growth to the mechanical B-M approach. The literature has become fragmented on the role of monetary aggregates in price and output growth, and it might be reasonable to want students to understand that there is a disconnect between what the Fed does to change interest rates and how money growth, credit creation, and prices react in both the near term and long term. Given the way the short run and long run are connected in our existing textbooks, it is typical for students to misunderstand and misuse the concept of money neutrality. With students confused about the length of time it takes to reach the long term, the current pedagogical approach may inadvertently downplay the importance of banks in credit creation in the short term.

After this exposition—B-M to QTM—students are right to ask about the role of quantitative easing. It is confusing to tell students that the central bank spurs lending by adding reserves and that this should result in accelerating inflation, when direct experience since 2008 tells everyone otherwise. This is not to say that the quantity theory should not be taught at any point, but that it might be better suited to sections of the course related to the long term or kept in intermediate books, which universally include the approach.

A proposed exposition

In the proposed exposition below, money is introduced as it often is in other textbooks. However, the major difference is in the emphasis on credit and measuring wealth. This is used to motivate the subsequent discussion on stock versus flow variables, and the difference between nominal and real. Discussing the notion of intertemporal exchange of real activity provides a basis for discussing the role of interest rates here that would be discussed in an earlier section. It is also presumed that the Federal Reserve as an institution has been established at an earlier point. Additional sections for consideration outside of this exposition would be to add a discussion on M0, M1, and M2 for the United States and discuss the way the framework built here fits into a post-crisis world, including quantitative easing and the elevated role played by IOR.

With minor changes, one could incorporate blocks 1, 2, and 3 (including 3a and 3 b) as a free-standing module on money creation.[10] In the exposition here, I have used detailed balance sheets and T-accounts to display both the stock and flow for consistency. For brevity, the T-accounts are kept to a minimum after their introduction. The inclusion of both might seem cumbersome at first but does provide a convenient platform to discuss the main differences between income and wealth, and the process of credit and money creation.

The mechanics of monetary policy are introduced in block 4, where an interbank loan is used to exemplify the movement of reserves in the banking system. Should the author or instructor want to skip this detail, block 4a—with slight modifications—is enough to introduce monetary policy. Block 5 is the closest that we come to recreating the B-M approach by explaining when constraints to capital and liquidity become binding. This block could be cut by those wishing to avoid concerns about constraints or adding too many balance sheets. Keeping this block, however, helps explain both lender of last resort responsibilities and the role of the FDIC in resolving failing banks. Without the detail of transactions and write-downs, block 6 gives a free-standing example of capital and liquidity constraints. Block 6 is best to include as an explanation of why ample reserves might not be associated with runaway money creation or inflation. When seeking to avoid teaching QTM, students might naturally question what is preventing runaway inflation when reserves are ample. If excluding blocks 4 and 5, it is possible to explain modern banking in some detail with only block 6. Block 7 is a summary of the instruments, targets, and goals of monetary policy, and block 8 is an aside on sweeps programs, which have fundamentally changed the calculation of required reserves. While it is recommended that block 7 be included here, block

8 is entirely optional. Thus, at a minimum, it is suggested to include blocks 1, 2, 3, and 6. A more complete exposition would entail adding one or more of the optional sections.

Money, debt, & credit (block 1)

The suggested exposition begins by introducing students to money as an abstract social and political concept. As a social construct, money functions as it does—facilitating exchange, measuring value, and storing value—because people agree that it exists. As a political construct, states authorize their money for the payment of taxes and require it to be accepted in payment for debts. In this sense, nations can be considered as the protectors of the debts between occupants of politically delineated boundaries. Presenting the traditional functions of money—alongside a standard of deferred payment—sets the stage for a discussion of the relationship between money creation and household debt. It is worth noting that the standard of deferred payment reflects the fact that debts are created whenever there is a delay in completing a transaction. It is also suggested that instructors relay the difference between the stock and flow concepts of wealth, income, credit, deficit, and debt.

In discussing debt, it is useful to note that debts do not need to be denominated in terms of official state-issued currency. Students can then envision the real nature of debt by thinking about how they might owe a friend a favor or other obligation. Debt is often vilified, when the true concern might be that a person or entity has taken on too much debt. It might be more effective to encourage students to think of debts as symbolizing promises of future real activity. When a person or entity takes on more future real obligations than they can deliver, it is common that both the debtor and creditor renegotiate the terms of repayment.[11] Yet, in most circumstances, debts are repaid. In this way, debt represents the social and community ties that take place over time.

Wealth and balance sheets (block 2)

As is typical in many textbooks using balance sheets, a suggested exposition would include a balance sheet and T-account for an individual before showing the same concepts for banks or businesses. Here, the ideas of assets, liabilities, and net worth can be introduced. Providing a discussion of liquidity in balance sheets is common in existing textbooks, and important to later discussions of bank insolvency and illiquidity. A household balance sheet that has a negative net worth value is suggested to help facilitate discussion on the differences between rich and poor, high v. low income, consumption v. savings, inequality, and the technical meaning of bankruptcy.

The household might be in a negative net worth scenario because they are borrowing money to get an education, investing in their own human capital. Discussing the intertemporal exchange taking place helps students understand that their human capital investment is expected to pay for itself through additional future earnings. This arrangement—borrowing money to go to school—is usually a good deal for both the borrower and the lender. It is only when real promises are unfulfillable that borrowers face bankruptcy.

Banks and money creation (block 3)

Banks can be described using balance sheets and T-accounts in much the same way as we described household finances. Banks are different, though, in that they are profit-seeking institutions, looking to make money for their investors (i.e., more specifically their equity holders or shareholders). The discussion of stock versus flow concepts also applies here to bank revenue from borrower interest payments, asset appreciation, dividend payments, and changes to net equity. Students can benefit from the following realistic example involving amortization. A person

Table 1. Jupiter bank-initial balance sheet.

Assets		Liabilities + Net Worth	
Cash	$50,000		
		Capital	$50,000
Total	$50,000		

Table 2. Jupiter bank: T-account after initial deposit.

Assets		Liabilities + Net Worth	
Cash	+$1,050		
		Deposits	+$1,050
Total	+$1,050	Total	+$1,050

Table 3. Jupiter bank: balance sheet after initial deposit.

Assets		Liabilities + Net Worth	
Cash	$51,050	Deposits	$1,050
		Capital	$50,000
Total	$51,050	Total	$51,050

who owes $3,000 to a bank for a loan, with an 11% annual interest rate, repaid over four years, would have to make regular monthly payments of $77.50. At first, the principal repayment is $50, and the remaining $27.50 is interest.[12] Over the course of the loan, this person pays $3,722, which is $722 in interest, on top of the $3,000 of principal. At no point do they make a big $3,000 payment, but instead make many smaller monthly payments.

A sample exposition continues here to emphasize the profit and risk-taking motives of banks. Banks, just like other businesses, start with capital (i.e., equity or net worth). The example begins with a group of investors who are opening Jupiter Bank. The owners want to pool financial resources to incorporate as a bank and make a profit. Let's imagine a group of 50 investors who each contribute a $1,000 cash investment for a total of $50,000, as in table 1.

As investors, we might think that stored cash is not going to generate much of a return. We would be right. If prices rise over time due to inflation, the investors' money buys fewer real goods each year. Investors want their assets to grow over time so that they have greater wealth and can buy more real goods. Thus, the bank owners decide to hire managers who will take some calculated risks on their behalf. In order to operate as a bank, depositors are needed, and loans would be made. To attract business, the newly founded bank might offer higher interest rates on their deposits than other banks. Let's suppose they offer a 1% annual return on deposits, along with a host of other benefits like debit cards, and online banking.

An initial deposit of $1,050 is made, which is a liability to Jupiter as the bank now owes money to its depositor. The changes are reflected in a T-account (table 2) and the new balance sheet (table 3).

Reserves (block 3a)

At this point, we introduce the concept of a reserve requirement, breaking the cash holdings of our fictional bank into required reserves and excess reserves. In this regard, it is important to take care to note that "vault cash" is called just "reserves" in banking terminology, and that it is functionally equivalent to electronic money. Introducing both regulators here is important for the purpose of reflecting upon later, as both the Federal Reserve (Fed) and Federal Deposit Insurance Corporation (FDIC) are relevant. Another key point that is often missed in existing expositions is that reserve requirements apply only to deposits—and not savings or other accounts.

Table 4. Jupiter bank: reclassifying assets from table 3.

Assets		Liabilities + Net Worth	
Required reserves	$105	Deposits	$1,050
Excess reserves	$50,945	Capital	$50,000
Total	$51,050	Total	$51,050

Table 5. Jupiter bank: balance sheet after security purchase.

Assets		Liabilities + Net Worth	
Required reserves	$105	Deposits	$1,050
Excess reserves	$30,945		
Securities	$20,000	Capital	$50,000
Total	$51,050	Total	$51,050

Furthermore, in the U.S. system, banks must maintain a percentage of deposits—on average—over a two-week maintenance period.

Next, it is suggested to discuss how both required and excess reserves are the primary source of liquidity in the banking system. When banks need to meet withdrawals or move money around to other banks, they do it with reserves. The Fed acts as a "bank for banks," helping transfer money between banks, while also being able to create reserves out of thin air using a computer keystroke. As is shown below, reserves move with transactions, and banks will often borrow them from each other for various reasons. The reserve requirement for this exposition is set at 10 percent. With this reserve requirement, the balance sheet can be rewritten, as in table 4. Beginning in October 2008, U.S. banks have been paid interest on their reserve balances. In early 2020, the interest rate on reserves (IOR) was set at 1.6% annually.[13] So, with this interest earned on reserves, Jupiter Bank is currently getting a positive monthly cash flow simply from offering deposit services to its customers and storing reserve balances. Note that if the Fed were to increase this interest rate, banks would likely increase the interest rate they are charging customers who borrow money.

At this point in the exposition, Jupiter Bank's managers decide to purchase some U.S. government bonds (i.e., Treasuries). While the return on U.S. Treasuries is usually relatively low—around 2% in early 2020—it is typically higher than cash or the IOR rate. This presents a good opportunity to discuss the role played by risk and collateral in our profit-seeking venture. It can also be noted that there is a very liquid market for Treasuries, and it is easy to turn them into cash quickly. In table 5, we show that Jupiter takes $20,000 of its cash (i.e., reserves) and uses it to buy government bonds.

Starting from table 5, Jupiter's managers make loans. The important point to take away from this portion of the exposition is that the interest and fees on the loans made will allow them to pay interest to depositors, finance their operations, and create a profit for shareholders. In this exposition, I assume a potential business owner wants to borrow $20,000 at an interest rate of 8%, meaning she would pay about $1,600 in interest in the first year. When the bank makes this loan, the bank deposits the funds into an account for her at Jupiter Bank so that she can use the money later, paying her the same 1% rate of return on her deposits. Jupiter creates this loan, and this transaction is reflected in table 6, with a new balance sheet in table 7. Students can notice here that the process involves reserves turning into a loan, then deposits, and finally back into reserves.

Jupiter's new balance sheet in table 7 has increased by $20,000 on both sides, just as the T-account described. This emphasis on stock and flow helps students see that banks are able to make money and loans out of thin air. The loan is an asset to the bank, and while there is a risk that it will not be repaid, the bankers can be seen as willing to take this risk in order to make a profit. It may be helpful to note here that the bank's earning a profit relies upon the borrower

Table 6. Jupiter bank: T-account due to new loan and deposit.

Assets		Liabilities + Net Worth	
Excess reserves	−$20,000		
Loan	+$20,000		
		Deposits	+$20,000
Required reserves	+$2,000		
Excess reserves	+$18,000		
Total	+$20,000	Total	+$20,000

Table 7. Jupiter bank: balance sheet after new loan & deposit.

Assets		Liabilities + Net Worth	
Required reserves	$2,105	Deposits	$21,050
Excess reserves	$28,945		
Securities	$20,000		
Loans	$20,000	Capital	$50,000
Total	$71,050	Total	$71,050

fulfilling her end of the deal, doing the real work in the future necessary to repay the loan and interest.

A typical exposition takes this process and repeats it until reaching the point that all reserves are required, lending is maximized, and the base-multiplier is described. Instead, we focus on the role played by reserves as a necessity in the transfer of money from one party to another. A typical exercise here could be to describe how our business takes a portion of their new deposits and uses them to purchase materials to support their own operations. Here we can see how money moves out of her deposit account, and a corresponding amount of reserves must go with it.

Capital requirements and lending (block 3b)

With an understanding of money creation and the profit motive in place, an exposition might then address the role of capital requirements, the capital ratio, and the role for leverage. Addressing solvency and liquidity—and their respective regulators—can help students separate the concepts. While capital ratios are complicated in practice, for illustrative purposes, we set the capital requirement at 10% of loans. In table 7, the total amount of loans is $20,000, and 10% of this would be $2,000. The bank, with $50,000 in capital, is well above the $2,000 requirement. We might note that Jupiter's managers are free to make more loans if they wish. This can be tied back to reserve requirements as well, with $30,050 in reserves for $20,050 in deposits, $28,045 in excess of the legal requirement.

In our example, we suppose that a new round of $30,000 in lending takes place. From table 7, we note that the bank does not have enough in excess reserves (because $28,045 < $30,000), and making the loan would leave them with only a portion of the reserves they are required to have. However, because our customer redeposits the money at Jupiter—shown in the T-account in table 8—there is no shortfall in required reserves. We can point out that, in this situation, the total amount of reserves between tables 7 and 9 is unchanged. It is only the portion that is considered to be required that has changed. This portion of the exposition explains that reserves are closer to an accounting trick rather than a pile of physical paper. This lends itself to a better explanation of the purpose and action behind federal funds loans or the repo market.

Federal funds loans (block 4)

Picking up from our previous balance sheet, we presume our customer spends their borrowed money to finance their business. After the money is transferred out of Jupiter, we see reserves

Table 8. Jupiter bank: T-account due to new loan and redeposit.

Assets		Liabilities + Net Worth	
Excess reserves	−$30,000		
Loan	+$30,000		
		Deposits	+$30,000
Required reserves	+$3,000		
Excess reserves	+$27,000		
Total	+$30,000	Total	+$30,000

Table 9. Jupiter bank: balance sheet after new loan & redeposit.

Assets		Liabilities + Net Worth	
Required reserves	$5,005	Deposits	$50,050
Excess reserves	$25,045		
Securities	$20,000		
Loans	$50,000	Capital	$50,000
Total	$100,050		

Table 10. Jupiter bank: balance sheet after $30,000 in borrowed money is spent.

Assets		Liabilities + Net Worth	
Required reserves	$2,005	Deposits	$20,050
Excess reserves	−$1,955		
Securities	$20,000		
Loans	$50,000	Capital	$50,000
Total	$70,050	Total	$70,050

Table 11. Jupiter bank: T-account due to interbank loan.

Assets		Liabilities + Net Worth	
		Interbank loan	+$1,955
Excess reserves	+$1,955		
Total	+$1,955	Total	+$1,955

Table 12. Jupiter bank: balance sheet after interbank loan.

Assets		Liabilities + Net Worth	
Required reserves	$2,005	Deposits	$20,050
Excess reserves	$0	Interbank loan	$1,955
Securities	$20,000		
Loans	$50,000	Capital	$50,000
Total	$72,005	Total	$72,005

and deposits fall by a corresponding amount. At this point in the exposition, the bank is no longer meeting its reserve requirements, and excess reserves are negative, indicating a shortfall in reserves (table 10). In this case, it can be viewed as total reserves being $50, with a shortfall of reserves of $1,955. Here, we can introduce the normally functioning overnight market, either by federal funds or repo transactions. Because borrowed funds incur a cost, we assume they borrow the smallest amount needed (table 11). This interbank loan shows up as a liability to Jupiter in its new balance sheet (table 12). It is worth noting here that it typically costs banks more to borrow funds from other banks when compared to deposits. In early 2020, the federal funds rate was around 1.6%, in comparison to the 1% return on deposits assumed here. We can note here that the federal funds rate market loans are not collateralized in comparison to either the repo market or discount loans, where firms must post assets like government securities as collateral to borrow money at similar rates. Furthermore, a key feature of the interbank loan market is that banks do not have to hold reserves against these funds. Thus, it is a way banks can meet their requirements without having to maintain additional reserves.

Table 13. Jupiter bank: balance sheet after open market sale of securities.

Assets		Liabilities + Net Worth	
Required reserves	$2,005	Deposits	$20,050
Excess reserves	$10,000	Interbank loan	$1,955
Securities	$10,000		
Loans	$50,000	Capital	$50,000
Total	$72,005	Total	$72,005

(Block 4a)

As long as there are excess reserves somewhere in the system—and other banks believe the borrowing bank is likely to repay—banks have access to necessary funds to increase lending and deposits. At this point, we introduce the Federal Open Market Committee (FOMC), open-market purchase/sale, repo transactions, and the target federal funds rate. If overnight borrowing costs rise and there is a shortfall in reserves with many banks trying to borrow—the Fed can inject liquidity into the system by creating reserves out of thin air to temporarily purchase assets like Treasuries from a bank or the general public. We assume here that the Fed buys $10,000 of bonds directly from Jupiter—even if this is an unlikely real-world scenario in normal times (table 13).[14]

In this scenario, the Fed is fulfilling its role as the lender of last resort and ultimate source of liquidity to the system. If the system is illiquid—as is often the case during crises—then the creation of credit for borrowers might slow down more than anticipated. The role of credit in our economy is emphasized with this exposition, describing how it helps finance firm operations and helps smooth consumption by households.

Binding constraints and bankruptcy (block 5)

In lieu of the B-M model, this exposition suggests approaching money creation by first addressing binding constraints of capital and liquidity. Starting from table 13, we can observe that Jupiter can make more loans and still meet both its capital and reserve requirements. An explanation that parallels with the B-M story would be that with $50,000 in capital, they can make up to $500,000 in loans with a 10% capital requirement. Also, with $12,005 in reserves, they would be able to support up to $120,050 in deposits. This might seem to align more with the B-M model, but with access to the overnight market for reserves, our bank could increase lending to a much greater degree and borrow the reserves necessary to meet any requirement. It is worth reiterating that the goal of the bank is to make a profit and holding on to reserves only earns the interest on reserves rate of 1.6% paid by the Fed. We can then use an example of Jupiter's managers targeting a level of $150,000 in loans to customers who redeposit their money back into the bank (table 14).

To reach the target level of loans of $150,000, Jupiter would have had to make $100,000 in additional loans, or 10 times the excess reserves in table 13. With these additional loans, we can show the bank has exactly 10 percent of its deposits held as reserves, and well over $15,000 in capital required. Thus, the bank is meeting both liquidity and capital requirements.

At this point in the exposition, we can address the role of down payments, collateral, and issues of foreclosure and firm bankruptcy. For example, using a write-down of $10,000, we can show that banks will reduce their capital a corresponding amount (table 15).

In our balance sheet in table 16, Jupiter's loans and capital decline together. The bank still owes its depositors their money back, and their reserves are not available to reflect losses. The owners of the bank suffer these losses, and the bank's overall balance sheet shrinks.

Taking this a step further, we now assume that Jupiter has made a lot of bad loans, so many in fact that they lose another $45,000 in value (table 17). The new balance sheet would show a

Table 14. Jupiter bank: balance sheet after increasing loan portfolio.

Assets		Liabilities + Net Worth	
Required reserves	$12,005	Deposits	$120,050
Excess reserves	$0	Interbank loan	$1,955
Securities	$10,000		
Loans	$150,000	Capital	$50,000
Total	$172,005	Total	$172,005

Table 15. Jupiter bank: T-account due to $10,000 write-down on loan portfolio.

Assets		Liabilities + Net Worth	
Loans	−$10,000	Capital	−$10,000
Total	−$10,000	Total	−$10,000

Table 16. Jupiter bank: balance sheet after $10,000 write-down on loan portfolio.

Assets		Liabilities + Net Worth	
Required reserves	$12,005	Deposits	$120,050
Excess reserves	$0	Interbank loan	$1,955
Securities	$10,000		
Loans	$140,000	Capital	$40,000
Total	$162,005	Total	$162,005

Table 17. Jupiter bank: balance sheet after $45,000 write-down on loan portfolio.

Assets		Liabilities + Net Worth	
Required reserves	$12,005	Deposits	$120,050
Excess reserves	$0	Interbank loan	$1,955
Securities	$10,000		
Loans	$95,000	Capital	−$5,000
Total	$117,005	Total	$117,005

negative value for net worth in table 17. At this point, we can discuss insolvency, moral hazard, and the role played by the FDIC. A point addressed in this exposition is that the FDIC usually tries to intervene well before the bank is insolvent and helps arrange for another bank to buy the failing one. Another bank might want to buy access to Jupiter's depositors, their remaining loan portfolio, or the physical locations and employees.

Capital v. reserve constrained banking (block 6)

Regulation of both capital and liquidity plays an important role in banking. Starting with another fictional bank—Callisto Bank—we discuss the role of regulation. This provides an opportunity to discuss capital ratios and leverage. In table 18, Callisto Bank has a debt-to-equity ratio of 14-to-1. The leverage ratio provides insight into the regulatory environment and risk-taking because it represents the amount of borrowed money relative to their own capital. Callisto's capital ratio is an 8-to-1 ratio, or 12.5% of loans held as capital.[15] Using the 10% requirement from earlier, this bank is meeting its capital requirement. With $200,000 in deposits and $30,000 in total reserves, the bank is also well above its reserve requirement with a 15% ratio.

As an alternative to the B-M approach—which reflects on only one requirement—we examine competing regulatory standards. This raises the question as to how much lending this bank could do and still meet both statutory requirements. With existing reserves, the bank could support deposits of up to $300,000 (table 19).[16] This level of lending would imply the bank is holding loans that place it at more risk than regulators would prefer. Callisto's capital ratio at this point is only 6.8%, below its 10% requirement of $22,000. Thus, Callisto is capital-constrained, but not liquidity constrained. If Callisto wanted to increase lending while still meeting their capital

Table 18. Callisto bank: balance sheet.

Assets		Liabilities + Net Worth	
Required reserves	$20,000	Deposits	$200,000
Excess reserves	$10,000	Interbank loan	$10,000
Securities	$75,000		
Loans	$120,000	Capital	$15,000
Total	$225,000	Total	$225,000

Table 19. Callisto bank: balance sheet with proposed loan expansion based on reserve requirement.

Assets		Liabilities + Net Worth	
Required reserves	$30,000	Deposits	$300,000
Excess reserves	$0	Interbank loan	$10,000
Securities	$75,000		
Loans	$220,000	Capital	$15,000
Total	$325,000	Total	$325,000

Table 20. Callisto bank: balance sheet with proposed loan expansion based on capital requirement.

Assets		Liabilities + Net Worth	
Required reserves	$23,000	Deposits	$230,000
Excess reserves	$7,000	Interbank loan	$10,000
Securities	$75,000		
Loans	$150,000	Capital	$15,000
Total	$255,000	Total	$255,000

requirement, they could increase lending from $120,000 in table 20 to $150,000. Thus, while Callisto might be able to borrow more reserves on the overnight market, their level of capital constrains their lending. This is highly relevant to teaching a coherent explanation of the financial crisis in the late 2000s or the Fed's response to the COVID-19 pandemic.

Table 20 is more representative of the modern system, where banking operations are more constrained by access to capital and capital requirements than by reserve or liquidity requirements. After the 2008 financial crisis, the Federal Reserve increased reserves in the system by nearly $4 trillion. This increase spurred fears of an overwhelming increase in lending, but those predictions failed to understand that banks were already constrained by capital requirements and a lack of demand for new lending. Following the housing crisis that started in 2006, bank capital had been decimated. Banks were not necessarily eager to make new loans just because they were given the reserves to do so. Instead, they faced much tighter oversight of their capital, while many banks were facing a crisis of solvency. The Fed can do only so much when banks face solvency issues because that is left to the FDIC, which does not typically help recapitalize banks. Banks were left to raise capital on their own and were under pressure to find investors who would be willing to give banks money in exchange for ownership stakes in what were now undercapitalized banks. In 2008, the Troubled Asset Relief Program (TARP) authorized the government purchase of an ownership stake in financial institutions that were deemed systemically important. These institutions were effectively nationalized as the government took a large controlling stake in the banks. The government did not overwhelmingly restrict the banking operations of these institutions, although TARP did come with some additional oversight responsibility.

Federal Reserve tools/instruments, targets, and goals (block 7)

In this section of the exposition, we present and make a distinction between the Federal Reserve's tools (or instruments), targets, and goals. With the preceding exposition, the ability for certain tools to be used in certain situations can be made clearer. Open market operations, interest on reserves, reserve requirements, and discount lending has already been addressed. Balance sheet

Table 21. Callisto bank: balance sheet with savings accounts.

Assets		Liabilities + Net Worth	
Required reserves	$20,000	Deposits	$200,000
Excess reserves	$0	Savings	$10,000
Securities	$75,000		
Loans	$130,000	Capital	$15,000
Total	$225,000		$225,000

Table 22. Callisto bank: T-account due to sweeps.

Assets		Liabilities + Net Worth	
		Deposits	−$50,000
		Savings	+$50,000
Required Reserves	−$5,000		
Excess Reserves	+$5,000		
Total	$0	Total	$0

Table 23. Callisto bank: balance sheet after sweeps.

Assets		Liabilities + Net Worth	
Required reserves	$15,000	Deposits	$150,000
Excess reserves	$5,000	Savings	$60,000
Securities	$75,000		
Loans	$130,000	Capital	$15,000
Total	$225,000	Total	$225,000

operations, which are arguably different than pure open-market operations, can be addressed in this framework. Because the central bank is attempting to influence interest rates other than the federal funds rate, we can see how extraordinary action influences both banks and firms through changes in their incentives. Separating tools from targets can show how intermediate objectives might influence economic activity like consumption or investment. While the Fed had historically targeted the money supply, they currently focus more of their efforts on the federal funds rate target and manipulating other interest rates. Finally, this exposition provides a path to discuss the difference in tools, targets, and goals. Meeting the goals of full employment and stable prices is rather detached from the typical story of open-market operations increasing reserves, lending, and prices. Until the COVID-19 crisis, the Fed had not ever attempted to directly increase lending. Their recent actions fit the story presented here, though, as lending must increase—or stop rapidly declining—to prevent further departure from their goals.

An aside on sweeps (block 8)

As a final piece to this exposition, there is one other regulatory complication that has made the U.S. banking system less reserve-constrained and more subject to capital constraints. Take the example of Callisto Bank again, which now instead of having interbank loans has savings deposits from its customers in the amount of $10,000. This bank could make loans under its capital requirement (up to $150,000 as seen in table 21), but they do not have any reserves to make the—for example, $5,000—loan they would like to. What the bank can do is reclassify some of its deposits as savings. They do this because savings accounts are not subject to reserve requirements.[17]

The changes to the balance sheet must lead to an increase in excess reserves of $5,000, which we can get by switching $50,000 out of their deposits and into savings as in tables 22 and 23. The size of the balance sheet does not change in these steps—and total reserves do not change—only how their money is categorized changes. After this recategorization, the bank is free to make more loans and increase the size of its balance sheet.

Banks sweep deposits into non-reserve-requiring savings accounts for the purpose of reducing their need to hold reserves, so that the bank can purchase assets that offer depositors a higher rate of return. In the years after this was made possible in the early 1980s, bank reserves fell to approximately seven percent of total deposits prior to the financial crisis in 2008. Prior to 2008, there were only about $45 billion in reserves in the entire banking system, with about $30 billion being vault cash. This meant there were only about $15 billion in reserve balances with the Fed and $2 billion in excess reserves. These reserves supported checkable deposits of approximately $600 billion in 2008.

Conclusion

The main takeaway from this article and sample exposition is that the banking system is more likely to make loans based on a borrower's ability to repay their debt, and not simply because they have low-return reserves held as an asset. Potential borrowers, some of whom were hurt in the financial crisis or its aftermath, might also be hesitant to take out loans. If banks are less interested in giving loans, and borrowers are not as interested in taking out loans, then we would expect to see loan creation slow down. No amount of reserves will help undercapitalized banks issue new loans.

This begs the question of how many students have been taught that runaway inflation is "right around the corner," based on the Fed's quantitative easing programs. The only thing they might hear that is preventing this was the Fed paying 0.25% on reserves. It is at least partially true that IOR helps constrain the central bank's target overnight rate, but it is not yet clear how effective the IOR is at constraining lending.

In some ways, textbook authors have made small transformations to how economics is taught at the undergraduate level. The one place where, shockingly, this has not seemed to penetrate is in our introductory model of banking and money. Textbooks still speak of the money creation process as if the broader supply of money were exogenously determined by the central bank. However, rarely does one see a discussion of the role of bank capital or the importance of credit, debt, and inside money. The primary importance is still seemingly based on reserves and how central bank operations control the supply of outside money. Here, I build a modern description of the banking system that can be used to discuss the central bank's existing tools and the relevance of capital. To the point, the money creation process is still relevant, but the profit motive—seen nearly everywhere else in economics—could play a larger role.

To help students understand money creation and the role of central bankers and regulatory authorities, it might help to shift from the story that commercial banks are simply financial intermediaries lending out unused cash. A more realistic story of banks accounts for their profit-seeking nature and the ability to create money out of thin air. Newly-created money is then used to finance risky ventures, where the transaction takes place intertemporally, and there is always the possibility that the borrower fails to repay. This type of model can help our students improve their understanding of the relationship between financial markets and real variables.

Notes

1. Over the past 10 years, M1 and M2 grew at average annual rates of 8.6% and 6.2%, while inflation measured 1.7% per year and nominal GDP grew at 4.0%.
2. In June 2009, Arthur Laffer predicted that due to quantitative easing, "we can expect rapidly rising prices and much, much higher interest rates over the next four or five years." https://www.wsj.com/articles/SB124458888993599879.
3. If looking at only reserve balances at the central bank, this amount generally declined from around $30 billion in 1990 to under $10 billion in 2008. Looking at the 18-year period from 1990 to August 2008, the one-month change in the monetary base is hardly predictive of the one-month change in the effective

federal funds rate, with a negative correlation of −0.11. If looking only at monthly changes in the more restrictive "reserve balances held at the central bank," this correlation falls to −0.05. (Author's calculations.)

4. Online resources are increasingly available to help students learn introductory materials on this topic. For example, Cowen and Tabarrok (2017) provide a 7-minute video explaining the money multiplier process at https://youtu.be/93_Va7I7Lgg. This video has over 150k views. Several other available videos online describe the same approach with slight variations. For example, the widely referenced Khan Academy has one video with over 325k views at https://youtu.be/F7r7l1VG-Tw, and a second with 26k views at https://youtu.be/gd8B-zrMSYk. YouTube also hosts materials by less well-known economists discussing the same approach. Jacob Clifford has approximately 540k views at https://youtu.be/JG5c8nhR3LE, and Jason Welker has had over 140k views https://youtu.be/Ov2Sd-QRi_g. All download measures are current as of February 2020.
5. McConnell, Brue, and Flynn (2018) treat QTM as an explicit part of an explanation of monetarism in a separate section.
6. Leakages are the combination of increases to public cash holdings and excess reserves.
7. Jones (2018) introduces money via QTM in a long-run model, and later uses money-demand and money-supply like Blanchard (2017) to develop an IS-MP model of the economy. Abel, Bernanke, and Croushore (2020) first explain money as exogenous in their IS-LM exposition. Later in the text, money is created via a more detailed B-M approach, where tools like interest on reserves can be used to reduce the money multiplier. In Mishkin's (2019) textbook on money, credit, and banking, he develops an even more detailed B-M approach than Abel, Bernanke, and Croushore, starting with the simplest model and breaking it down. The final sentences of the chapter explain the role interest on reserves might have played in the decline of the multiplier.
8. Acemoglu, Laibson, and List (2018) describe the credit market before banking, but still focus on the process of intermediation for banks as reliant upon savings decisions made by households. They also stick to a form of QTM that strictly adheres to a stable velocity of money in the long run.
9. Total market capitalization was estimated using the Wilshire 5000 index for all financial firms (https://wilshire.com/Portals/0/analytics/indexes/characteristics/wilshire-5000-characteristics.pdf) and profit ratios are available from the BEA's Table 6.16D of the NIPA tables.
10. A full student-focused exposition of this material is available on request or on demand at https://aneveu.com/econ200-book.
11. Social and political norms can help arbitrate the renegotiation under certain circumstances such as death. Suppose a person owes their bank $1,000, but passes away suddenly. The bank might try to recoup their losses by taking over ownership of the person's house or car.
12. The $3,000 is the principal on the loan, the 5% represents the interest rate, and the four years represents the term to maturity. The $77.50 figure is found by using an amortization calculator like those found at https://www.amortization-calc.com/loan-calculator/.
13. The Fed pays banks interest on reserves with money created out of thin air.
14. Notice that the Fed is effectively using newly created money to bid up the price of bonds that are for sale on the open market. This would lead to an increase in the price and a decline in the interest rate. In our example here, this is what the Fed is trying to accomplish. When interest rates are rising away from the Fed's target federal funds rate, they inject liquidity to ease the upward pressure. If interest rates are falling below their target, their goal is to extract liquidity, lowering prices and raising interest rates.
15. We are assuming here that the debt issued by the bank takes only the form of loans, and equity only comes in the form of capital.
16. Note again, we are assuming all loans created are immediately held as deposits.
17. Technically, sweeps are not savings accounts, but this simplification is made to make it clear that deposits are still relatively liquid.

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