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The History and Economics of Safe Assets

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Abstract

Safe assets play a critical role in an(y) economy. A safe asset is an asset that is (almost always) valued at face value without expensive and prolonged analysis. By design, there is no benefit to producing (private) information about its value, and this is common knowledge. Consequently, agents need not fear adverse selection when buying or selling safe assets. Safe assets can be easily used to exchange for goods or services or for another asset. These short-term safe assets can be money or money-like. A long-term safe asset can store value over time or be used as collateral. Much of human history can be written in terms of the search for and production of safe assets. But the most prevalent, privately produced short-term safe assets, bank debts, are subject to runs, and this has important implications for macroeconomics and for monetary policy.

1. INTRODUCTION

A safe asset is an asset that can be used to transact without fear of adverse selection; that is, there are no concerns that the counterparty privately knows more about the value of the asset. Safe assets can also be used to store value through time. Historically, the quintessential safe asset was a gold coin. However, such coins were imperfect in performing the role of a safe asset. Starting roughly in the eighteenth century, certain types of debt came to serve prevalently as safe assets. Some government debt and some privately produced debt came to be used as safe assets.¹ Safe assets play a critical role in the economy and have implications for transactions and savings efficiency, financial crises, general aggregate macroeconomic activity, and monetary policy.

During the time when government-insured demand deposits were the dominant form of safe assets, little attention was paid to the subject of safe assets.² The subject, if considered at all, seemed irrelevant. However, starting in the late 1970s, the US financial system underwent a significant transformation in which the role of demand deposits declined dramatically and short-term wholesale funding became very sizeable and, thus, important. The financial crisis of 2007–2008 showed, once again, that privately produced safe assets [i.e., short-term debt like sale and repurchase agreements (repo)] are not always safe. Short-term safe debt is subject to runs, threatening systemic collapse of the financial system.

In the period leading up to the recent crisis, there was a shortage of government long-term safe debt, so agents were increasingly using privately produced long-term debt: AAA/Aaa asset-backed securities (ABS) and mortgage-backed securities (MBS). The outcome of this was that short-term privately produced debt backed by long-term privately produced debt led to the financial crisis, a devastating event in terms of human costs. Thus, more attention is now being paid to safe assets and their role in the economy. This is as it should be because almost all of human history can be written as the search for and the production of different forms of safe assets. For much of history, coins made of precious metals were thought of as safe assets (e.g., see Vilar 1969). Production of a paper currency that would be accepted at par is only a very recent arrival in history, and a credible fiat currency is even more recent. Finally, there is privately produced debt, which will be the main, but not sole, focus here.³

Safe assets, whether coins made of precious metals or some form of public or privately produced debt, are the life blood of an economy. No wonder, then, that we say that money is in circulation. Intuitively, following Holmström (2015), a safe asset is an asset taken at face value with no questions asked (NQA). NQA means that safe assets are relatively immune to the costly production of private information about their value. Dang et al. (2013) call this attribute information insensitivity. Government-issued fiat currency is a notable example of a safe asset. The sovereign debt of some countries is safe in this sense. Privately produced debt can also have this property, but not always: It cannot be riskless like, say, US government debt. In the modern era, i.e., the past 250 years, such private debt plays a special role in the economy.

The specialness of safe assets implies the existence of nonpecuniary returns (called the convenience yield), in the form of liquidity or moneyness (the money-like property of NQA) and safety; thus, the pecuniary return is lower than it otherwise would be. Currency, in whatever form, has no pecuniary return, and yet it is still held. Krishnamurthy & Vissing-Jørgensen (2012) find that

¹Throughout this review, I use the term safe asset even when the asset is privately produced debt and cannot be literally safe. Privately produced debt obviously cannot be a perfect substitute for US Treasuries. But I describe this debt as safe because the private sector has produced debt that is as close a substitute as possible.

²In the United States, deposit insurance was adopted in 1934.

³Fiat money is a safe asset except in cases of inflation. I do not include fiat money in the discussion in this review.

the yield on US Treasuries over 1926–2008 was, on average, 73 basis points lower than it otherwise would have been due to the moneyiness and safety of US Treasuries; this is the convenience yield. The existence of a convenience yield implies that US Treasuries are non-Ricardian (Barro 1979a, Gorton & Ordoñez 2013). Privately produced substitutes, such as ABS/MBS, also provide a convenience yield. This means that these forms of safe debt have a special role in the economy.

Privately produced short-term debt has the defect that it is vulnerable to runs unless there is some government support, e.g., deposit insurance. Runs occur when holders of the short-term safe debt have (rational) doubts about the value of the backing collateral (which is also debt) and want cash instead. If there is no suspension of convertibility, under which banks do not have to honor the demands for cash, then banks have to sell enormous amounts of assets, pushing prices down and causing mark-to-market losses. The resulting dislocations exacerbate the downturn with enormous costs to society, as we saw in 2007–2008.

Financial crises are an integral part of aggregate economic activity, occurring in all market economies, although countries can go for fairly long periods without a crisis. They are not rare aberrations that can be ignored. Financial crises are often preceded by credit booms, and these booms tend to occur when there is insufficient safe government debt. This has implications for monetary policy. The role of monetary policy with regard to financial stability is usually framed as a question of whether the central bank should prick asset bubbles. But that is not the right way to think of the issues. Treasuries have a convenience yield; they have a moneyiness attribute. When there are not enough Treasuries, the private sector produces substitutes, making the economy more fragile. Open market operations exchange one type of money for another—cash for Treasuries or vice versa—so the degree of financial stability is affected because open market operations alter the amount of Treasuries outstanding, which in turn affects the amount of privately produced long-term safe debt that is produced. Cash and Treasuries are not substitutes for each other. This fact was not as important when retail demand deposits were the dominant form of privately produced money, but in today’s world of wholesale short-term debt, this is a potential problem. The central bank needs to satisfy two clienteles (retail and wholesale) with demands for different kinds of money, each with different implications: one related to inflation (cash) and the other to financial stability (Treasuries).

This review proceeds as follows. Section 2 very briefly looks at earlier history and the production of coins, bills of exchange, and early sovereign debt. Examining this early history illuminates the problems with producing safe assets. It also illustrates the technological innovations that have contributed to safe asset production over time. Section 3 then details the attributes that make debt safe. Section 4 contains a description of different types of safe debt. The special qualities of safe debt imply the existence of a convenience yield, which is the subject of Section 5. The regulation of the production of privately produced safe debt is very briefly discussed in Section 6. The macroeconomic implications of safe debt are the subject of Section 7, and Section 8 looks at the implications for monetary policy. Section 9 concludes.

2. THE HISTORICAL SEARCH FOR SAFE ASSETS

Throughout history, there have been attempts to credibly produce safe assets for transacting and for storing value through time. In this section I very briefly survey this history and the voluminous literature concerning it.⁴ The main point of this section is that the production of safe assets is

⁴I want to alert the reader to the extreme brevity of this historical summary. For reasons of space and language, my summary focuses on Europe and the United States, omitting the interesting history of other parts of the world, in particular China. China was the first country to have coins (possibly at the same time as Lydia in Asia Minor). China was also the first to have

difficult. Producing information-insensitive safe assets depended on technology, legal institutions, and contract design. The early history of money production reveals the characteristics of an asset needed for efficient transactions to occur. This leads, in the next section, to a more detailed discussion of these characteristics.

2.1. Coins Made of Precious Metals

Precious metals in the form of coins played the role of safe assets throughout much of human history, unless they were heavily clipped or debased, two problems that could lead to the collapse of a coinage system (see, e.g., Lopez 1951).⁵ Coinage was desirable in times of stress and could be used to pay off debt.⁶ Coins were liquid, especially in a period when there was no credible paper money or credit instruments (see, e.g., Hoppit 1986). Coins could store value through time. Many coins, or tokens, were privately issued, for example, in eighteenth-century England (see Anderson 1970), because sovereigns underissued coins. There were also many counterfeit coins. There was also a high degree of uncertainty about the value of coins, especially of small change, and it was necessary for users to be informed about their worth, producing information by assaying and weighing the coins.

As safe assets, metallic coins were troublesome for numerous reasons. Problems included the shortage of small change and the often bewildering numbers of different units of denomination, especially around ports where foreign coins entered via foreign sailors (see Carothers 1930, Sargent & Velde 1999). There were other problems, as well, such as debasement, the reduction of the metallic content of the coins below the coin's face value (see Munro 1988, 2012; Rolnick et al. 1996; Gandal & Sussman 1997). The coin producer (government or private) at the mint knew and controlled the coin's weight and fineness, but users did not know the coin's subsequent value without producing information. Coins had to be assayed and weighed to determine their value. Money changers sometimes kept their scales moving to confuse onlookers whose good money was being exchanged for bad (Kindleberger 1991). Sometimes coins were cried up or called up, that is, the denomination of good coins was fraudulently increased and that of bad coins was cried down (see Redish 1990, Kindleberger 1991).⁷

Another problem was coin clipping, or shaving metal from the coin's circumference; there was also sweating, or shaking the coins in a bag to collect the dust that had worn off. Vallavine (1742, p. 2) claims that, "It is impossible to fix the Time when the fraudulent and pernicious Arts of Diminishing the Coin began to be first practis'd in this Kingdom; but we find so early as Edward the Confessor, and William the Conqueror, all great Sums were paid by Weight, because the current Coin had been diminish'd by clipping." Mate (1972, pp. 40–41) discusses the epidemic of coin clipping: "As a result of all these activities—coin clipping, the manufacture of

paper currency (in the thirteenth century), competitive issue of bank notes, and a government monopoly on paper currency. For more information on China, the reader is referred to, e.g., Peng (1994), Kaplan (1994), Yang (1952), and Tullock (1957), and to the general survey by Davies (2002). Classic monetary histories for Europe include those of Cipolla (1967), Vilar (1969), Spufford (1988), and Van der Wee (2013). The summary in this review is also confined to the relatively recent past, starting in the seventeenth century. The history of the prior period is also interesting and important. For examples, the reader is referred to Botticini (2000), de Roover (1942, 1953), and Postan (1928).

⁵The field of numismatics is a very specialized area of scholarship and plays little role in (current) economic history. Howgego (1995) provides one introduction. The reader is also referred to Velde (2013).

⁶Coins, of course, were not the only early form of safe assets. Before coins, commercial transactions involved jewels, jewelry, vases, statues, etc. It is not clear at what point a valuable object used in trade becomes money. For example, in early America, wampum was very important (see Herman 1956, Shell 2013). There is a huge body of literature on primitive money (see, e.g., Einzig 1948, Quiggin 1949).

⁷Hill (1922) explains the technologies successively used to make coins.

small halfpennies, and the making of imperfect new coins—men, by 1278, had little confidence in the royal currency. English merchants were worried about receiving poor money for their goods or in repayment of their loans.” In some instances, for example, from 1619 to 1623, this led to a monetary crisis and, eventually, recoinage (see Kindleberger 1991).⁸ Debasement of currency by the sovereign was yet another problem (see, e.g., Challis 1967, Gould 1970). As a result of these problems, financial crises occurred fairly frequently in Europe in the eighteenth century (see, e.g., Ashton 1959, Hoppit 1986).

Thus, coins were generally not information insensitive. Users of the coins had to assay and weigh coins because of clipping, debasement, and counterfeits (see, e.g., Munro 1988). Producing information about coins via assaying was costly because of the expertise and special tools required (see, e.g., Cramer 1741, Oddy 1983, Nightingale 1985, Gandal & Sussman 1997). Weighing coins required that the scales be fair, another problem. Eventually, the English government began certifying coins: “By stamping them, the State supplies all buyers and sellers with a piece of knowledge indispensable for all sales, the knowledge, namely, of the quality and quantity of the metal of the coin for which goods are given away” (Price 1869, p. 41).

These problems with coinage led to the creation of public banks, which were not necessarily government banks but rather embryonic central banks. From the fifteenth century on, these institutions sought to create money-like liabilities in a credible way, although they were not always successful. The money created by these banks might have been a demandable bank deposit, a bond, a time deposit, an equity-like claim, or circulating notes (see Ugolini 2011; Roberds & Velde 2016a,b). However, problems remained. For example, Checkland (1969, p. 155) points out that, “French banking as late as 1800 was still in a primitive state. Neither note-issue nor deposit banking existed; the economy relied upon a metallic currency (to the annoyance of many in war-time Britain where gold had become so scarce); the many elements of proto-banking were yet to be made explicit.” Still, even today, gold is considered a safe asset (see, e.g., Baur & McDermott 2010, Baele et al. 2014, Rickards 2016).

2.2. Bills of Exchange and Banknotes

The shortage and corruption of credible specie-based coins led to forms of privately produced circulating debt: bank notes and bills, goldsmith notes, and bills of exchange (all the forms were, however, exchangeable into coins). In the words of Davenant (1698, pp. 161–62), “And of late, when Coin grew so Corrupted . . . all great Dealings were transacted by Tallies, Bank-Bills, and Gold-Smiths Notes. . . . For Tallies and Bank-Bills did to many serve as well, and to some better than Gold and Silver.”⁹ In this subsection, I examine the early forms of debt.

For centuries, starting in the Middle Ages, the bill of exchange was the main form of debt (see Usher 1914, Richards 1929, de Roover 1953). These bills could be produced in small denominations in areas where there was a shortage of coins (see Ashton 1945) or in larger denominations for trade. These latter larger bills could also circulate. Anderson (1970, p. 90) describes the transferable bill as “a decisive turning-point in the development of the English credit system.” Over time, a legal infrastructure developed to make these bills credible forms of safe debt (see Rogers

⁸The technology of milling coins was introduced in England and is attributed to Isaac Newton, who was appointed Master of the English Mint in 1699. Milling coins involves making the coins from a machine, a process that replaced the process of hammering coins into shape. Milled coins could have uniformly serrated edges, so they were less likely to be clipped, but the silver content of the milled coins was greater than that of the clipped coins, driving the milled coins out of circulation.

⁹“Tallies are records kept by cutting notches in sticks of wood, and are a survival of probably the earliest appliance of commercial nature made by man” (Spink & Son 1903, p. 5725). The reader is also referred to Lawson (1850, p. 16).

1995, Santarosa 2015). Bills of exchange were the first form of privately produced debt, and they led to the first financial crises.

A bill of exchange “was a document from a merchant (the issuer) to his agent abroad (the payer), commanding him to make payment in a different location on his behalf to a third party (the beneficiary) at a set date in the future” (Santarosa 2015, p. 691). The main point to note is that the bill could circulate. Ashton (1945, p. 25) explains how it worked:

The creditor drew a bill on the debtor; the debtor (or his agent) accepted it and returned it to the creditor, who either held it till it matured and then presented it for payment, or, if he needed ready money, discounted it with some other merchant or banker. By the eighteenth century, however, the bill had become something more than a security for payment. The drawer very often passed it on to meet obligations of his own, and those who received it, in their turn, did the same. The bill was now a substitute for money.

Figure 1 shows how a bill circulated. The issuer (creditor) ships some goods to the payer. The issuer discounts the bill and receives the face value from the first endorser. The bill can then circulate until it is presented to the payer (debtor) by the final holder for payment.

By the sixteenth century, when a bill circulated, it was common for each successive party to endorse it, assuming liability for the ultimate cash payment if the debtor were to default at maturity. Maturities were usually 2, 3, 6, or 12 months (see Ashton 1945, p. 25). That there was a high velocity is attested to by the number of endorsements (see Ashton 1945, Santarosa 2015). If there was a default, the holder of the bill could choose an endorser to collect from. This joint liability allowed medieval bills to become the major form of payment.

However, bills of exchange were not, at this point in time, equivalent to paper money because, with all of the endorsers liable for a bill’s payment, it was necessary to investigate the endorsers

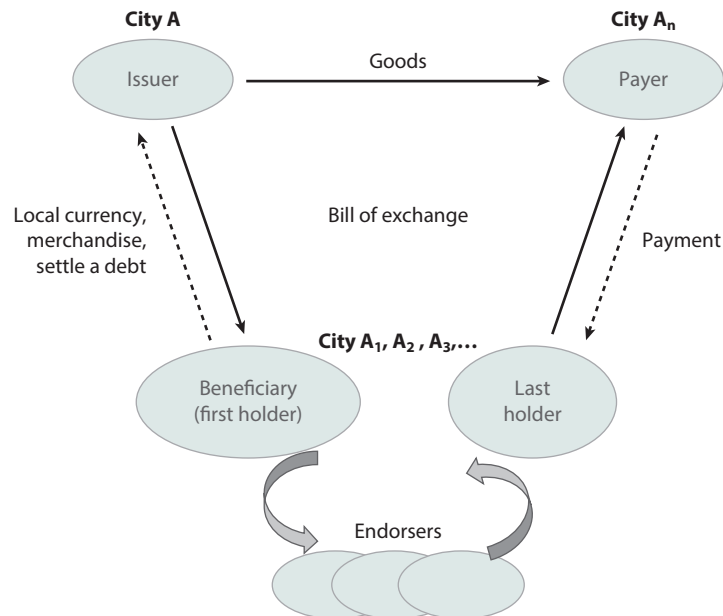


Figure 1

The circulation of bills of exchange. Figure adapted with permission from Santarosa (2015).

before accepting the bill. This restricted the bill's negotiability. The transition from endorsement to bearer instruments required the development of legal infrastructure. The term pay to bearer needed legal content that took time to develop (see Rogers 1995, Munro 2003, Geva 2011).

Bills of exchange were vulnerable to runs, as occurred, for example, in northern Europe in 1763. After the failure of a large banking house in August 1763, there were runs on merchant banks that had been financing themselves with short-term debt. Quinn & Roberds (2015) liken the start of this crisis in Amsterdam in 1763 to the Lehman failure of 2008, as it began with the failure of a large banking house. Quinn & Roberds (2015) and Schnabel & Shin (2004) point out the similarities between that crisis and the financial crisis of 2007–2008.

Circulating banknote-like claims emerged in the seventeenth century in London when goldsmiths and pawnbrokers began issuing notes, orders, and bills (see Richards 1927; Heal 1935; Quinn 1997; Temin & Voth 2006, 2013).¹⁰ Goldsmiths had safes, which were expensive.¹¹ Merchants deposited their surplus of gold coins with the gold merchants, receiving a receipt in exchange. These receipts then circulated. This was a natural beginning for bank notes, as such debt claims depended on convertibility into precious metals, which the goldsmiths stored in their safes (essentially as reserves). Goldsmith notes and bank notes are distinct from bills of exchange. According to Thornton (1807, p. 32), “[A bill circulates] in consequence chiefly of the confidence placed by each receiver of it in the last endorser, his own correspondent in trade; whereas, the circulation of a note is owing rather to the circumstance of the name of the issuer being well known as to give to it universal credit.” These were two different forms of backing the debt.

Goldsmiths also allowed their customers to draw drafts on demand (see Hilton Price 1881). However, demand deposits had their origin with merchant bankers in London in the seventeenth century (see Melton 1986). As with bills of exchange, checks were debt instruments, but unlike bills of exchange, checks were not freely transferable money substitutes. Early checks were handwritten notes directing the banker to pay a certain sum to a designated person or to the bearer. Such instruments required a legal infrastructure, and this developed in the seventeenth and eighteenth centuries. For example, the practice of endorsing a check over to a third party took some time to develop legally (see Rogers 1995).

Convertibility, or short maturity, is important to allow these debt claims to be used to monitor the issuers, i.e., to check if the backing collateral is sufficient.¹² The debt is backed by collateral that can be precious metals, in the case of goldsmiths; real property, in the case of bills of exchange; and, eventually, loans, in the case of deposits. However, the credibility of the conversion option required that the borrower have the specie when the time came to honor the debt claim. How could this be assured? This was and remains the central problem: How can the holder of short-term debt be sure that the claim can be turned into money?

In the case of bills of exchange, as discussed above, the joint liability of the endorsers to the bill meant that the backing collateral was their assets. A related contract design to assure creditors, unlimited liability, was used with Scottish banknotes prior to the Bank Charter Act of 1844, which closed entry into note issuance. Except for the three public banks, which had limited liability,¹³ Scottish banks faced unlimited liability. Although not without problems (see, e.g., Goodspeed 2016), overall, the system appears to have been a success. Although there were bank failures,

¹⁰Early checks were not widespread (see Horsefield 1952, Usher 1943).

¹¹A history of the evolution of technology in the construction of safes is provided by Price (1856).

¹²Calomiris & Kahn (1996) and Diamond & Rajan (2000) provide theoretical rationales for this convertibility option.

¹³These banks were the Bank of Scotland, the Royal Bank of Scotland, and the British Linen Company; their limited liability was granted by the Scottish Parliament (see Checkland 1975).

no losses were suffered (see Douglas 1975, p. 2). Adam Smith (1812, p. 442) reported that “the business of the country is almost entirely carried on by means of the paper of those different banking companies . . . silver very seldom appears . . . and gold still seldomer.”

Other institutions designed to maintain the integrity of circulating bank debt include monitoring systems such as the US pre-Civil-War Suffolk bank system in New England (see, e.g., Mullineaux 1987, Calomiris & Kahn 1996). Prior to the US Civil War, banks issued their own private bank notes. In Free Banking states, these notes had to be backed by state bonds, whereas in other states, the backing was bank loans. These bank notes traded at par only within a short radius of the issuing bank, and traded at fluctuating discounts further away (see Gorton 1996, 1999). The Suffolk Bank in Boston monitored the surrounding country banks by threatening to return with large amounts of their notes for redemption, ensuring that the country banks had sufficient backing for their notes.

Another mechanism for creating confidence in bank money is deposit insurance. In the United States, state-run insurance systems were set up in some states, with different designs. In New York, for example, the Safety Fund was established in 1829, but losses caused it to be ineffective (see Chaddock 1910, Calomiris 1990). Some other states followed the example of New York but ran into similar problems. After the Panic of 1907, some US states again set up insurance systems, with mixed success (see Calomiris 1989). Finally, when checks became important, private bank clearinghouses, facing counterparty risk in the clearing process, established rules and regulations for mutually monitoring member banks (see, e.g., Cannon 1910, Timberlake 1984, Gorton & Mullineaux 1987).

2.3. Government Debt

The production of safe debt by sovereigns took centuries to develop. Embryonic nation-states began borrowing in the thirteenth century, but repayment was a problem because it depended on confiscation of land, repayment in worthless currency, or gain of sufficient loot from wars. Historically, the purpose of sovereign debt was to raise funds to fight wars, which were quite common. But the institutions for ensuring repayment, much less for creating information insensitivity, took quite a while to develop. Sovereigns regularly defaulted and repudiated their debt. Indeed, prior to roughly 1770, financial crises were caused by sovereign debt; after 1770, crises often involved both public and private debt.

The development of credible safe government debt occurred in England, as described by Dickinson (1967) (see also Hamilton 1947). In a famous article, North & Weingast (1989) argue that the key change that made promises to repay English public debt credible was the rise of Parliament’s power relative to the king’s. Power-sharing institutions essentially forced the King to commit to not renege on the government debt. However, Sussman & Yafeh (2006) argue that the cost of government finance did not go down right away, but instead took time to reflect the institutional changes. Stasavage (2002) argues that the credibility of British government debt depended importantly on the distribution of the debt to elite social groups because they constituted an important partisan force (see also Stasavage 2016; for examples from France, see Velde & Weir 1992; for examples from Spain, see Conklin 1998).

Further development occurred in the nineteenth century, even before sovereign debt could be viewed as safe. Flandreau & Flores Zendejas (2009) study the period 1820–1830 and argue that governments relied on the reputations of private financial intermediaries to underwrite the debt (see also Flandreau & Zumer 2004).¹⁴

¹⁴Ratchford (1947) discusses the case of the United States.

3. PRIVATELY PRODUCED SAFE DEBT AND GOVERNMENT-ISSUED SAFE DEBT

The previous section suggests attributes that an asset must have to be safe. Historically, it has been difficult to produce safe assets. There are two ways to produce safe debt: Back the debt with the government's taxing power or use collateral. Many governments have evolved to the point where their debt and their guarantees are credible, so they can produce some safe debt. Privately produced safe debt must be backed by credible collateral. Since roughly 1750, privately produced safe assets have consisted of different types of debt, usually mortgages, as land is usually most likely to maintain its value. This section focuses on more details, identifying and discussing the attributes of public and privately produced debt that make debt safe. Because government debt is easier to understand, the main focus of the section is on privately produced debt. We first introduce some terminology. Although some of these terms have already appeared above, I include the following section for clarity.

3.1. Terminology

The terminology developed in the literature on safe assets includes the terms safety, moneyness (or money premium), liquidity premium, and convenience yield. Safety is used to describe long-term debt that will pay off at par with a very high probability. Examples include Treasury bonds (and some other government bonds) and AAA/Aaa ABS/MBS. These forms of debt hold their value over time. Moneyness and liquidity premium are usually used synonymously and refer to the NQA attribute relevant in transactions.¹⁵ This is an attribute of short-term safe debt. Examples include Treasury bills, commercial paper, and repo. Finally, the convenience yield refers to the nonpecuniary return that investors receive from holding safe debt, whether short-term or long-term. The convenience yield is the difference between the instrument's yield and the return that that bond would pay if these nonpecuniary returns did not exist but everything else was constant.

The convenience yield is not directly observed. Measures of the convenience yield take the form of a yield spread, and the research discussed below uses different spreads, usually for slightly different purposes. For example, the spread between an AAA/Aaa US corporate bond and a US Treasury of (roughly) the same maturity will be positive because corporations are riskier than the US government. If both are also valued for their safety but Treasuries are more so, then there will be a higher demand for Treasuries because Treasuries are scarce (*ceteris paribus*), so agents would bid up the price of Treasuries, lowering their yield relative to the AAA corporate. This suggests that there is a component of the spread that is due to convenience. Krishnamurthy & Vissing-Jørgensen (2012) examine this case.

3.2. Attributes of Safe Debt

Debt is a contractual promise to pay a fixed amount at maturity (or when the conversion option is exercised) and may promise interim interest payments. Some collateral, perhaps land, a portfolio of loans, a bond, etc., backs this promise. By contractual construction, debt is senior to equity, and so its value has some immunity to the arrival of information. If the debt is short term or has the convertibility option, it is not as exposed to the arrival of information over the long term. Although this is all true, it does not necessarily make debt safe.

¹⁵ However, Carlson et al. (2014) suggest that the money premium is different from a liquidity premium. They note that short-term Treasury bills have lower yields than Treasury notes and bonds with the same remaining maturity (see also Amihud & Mendelson 1991).

There are different notions of safe. Diamond & Dybvig (1983) define bank debt as a form of insurance allowing agents to smooth consumption. The payoff on real investments in the economy is longer than the potential consumption desires of agents. In other words, agents might want to consume before the payoffs from the real economy have been realized. Diamond & Dybvig (1983) posit that this maturity mismatch is an inherent feature of an economy and that this is what creates a problem for the agents. Banks issue debt with the feature that agents can withdraw early if they have an unanticipated desire to consume (a need for liquidity). Agents with no such need wait for the real investment to pay off. Agents face the risk of wanting to consume early. If they invested on their own, rather than depositing in a bank, they might have to liquidate the real investment early at a loss. If the possibility of needing to consume early is high enough, no real investment would take place, and agents would simply store their endowments. Bank debt insures against the risk of early consumption needs; the risk is shared between those agents who turn out to have early consumption needs and those without such needs. The debt is safe in the sense that it can perform this function. However, Diamond & Dybvig (1983) show that such debt is vulnerable to runs, requiring deposit insurance to make it safe and to reliably smooth consumption.

Holmström & Tirole (1997, 1998, 2011) think of liquidity as being pledgeable cash flows, i.e., assets with cash flows that are readily verifiable. Pledgeability is at the root of all debt instruments because debt instruments are claims on cash and cash streams. Pledgeability is essentially a legal concept, and the legal infrastructure supporting it must be developed. This is the basis of securitization, for example, where contractual cash flows of underlying loans are the basis for ABS/MBS. Assets with cash flows that are pledgeable provide insurance against possible bad events in which agents need liquid instruments. In the work of Holmström & Tirole (1998, p. 2), safety refers to “instruments (market and nonmarket) that can be used to transfer wealth across periods.” In their setting, firms cannot pledge the entire value of the firm because of a moral hazard problem. Consequently, if the firm faces a liquidity shock in the future, requiring more funds, then without new funds, it would be forced to terminate the project even though this termination is suboptimal. Firms want to hedge against such a shock. In this setting, liquidity means insuring against the forced liquidation of the project in the face of a shock by holding reserves or marketable securities or by arranging a credit line. If each firm hedges, then when some firms face a shock and others do not, the fortunate firms hold liquidity that cannot be used, which is an inefficiency. A bank can resolve this problem: It can hold the liquidity and distribute it to firms in need if they face a shock, for example, via credit lines. But in the presence of an aggregate shock, this solution breaks down. This creates a role for the government to create liquidity with government bonds.

In the work of both Diamond & Dybvig (1983) and Holmström & Tirole (1997, 2011), the problem is that a demand for liquidity may be realized, which could force inefficient liquidation of real investments unless there is a way to insure against this. A financial instrument is safe if it holds its value intertemporally. In both cases, the instrument allows an agent (household or firm) to insure against an adverse shock. The debt discussed by Diamond & Dybvig (1983) most resembles demand deposits, and the debt discussed by Holmström & Tirole (1998) most resembles a marketable security asset or a line of credit with a bank; in either case, the debt needs to hold its value. In these two cases, the main friction is not transactions per se; that is, agents are not confronting each other in a market and exchanging safe debt for goods and services.

Safe debt such as is produced by banks can also be used without fear of being taken advantage of by privately informed agents in transactions. This is the argument of Gorton & Pennacchi (1990). By tranching cash flows, information is also tranced, (potentially) leaving one part, the debt, information insensitive and the remainder, the equity, information sensitive. Consequently, the debt is designed to be immune to adverse selection. Gorton & Pennacchi (1990) argue that, as banks exist to produce debt, their output is debt.

In the work of Gorton & Pennacchi (1990), the debt produced by banks is riskless. The form of the contract, the debt, is assumed, and the focus is on designing an institution, namely the bank. The bank attracts privately informed agents from the stock market to be bank equity holders such that the bank's debt is immune to adverse selection when uninformed agents use it to trade. Gorton & Pennacchi (1990) equate liquidity with being able to transact without fear of adverse selection, that is, without worrying about the presence of privately informed traders. Bank debt is created for this purpose. This debt must be such that there is no question about its value (Holmström's NQA property) so that it can be used efficiently for trade (Holmström 2015).

Gorton & Pennacchi (1990) characterize bank debt as riskless, and the asset side of the bank balance sheet does not play much of a role. More generally, the question of how banks produce safe debt remains open. What are the inputs? How are they chosen? These issues are addressed by Dang et al. (2016), who argue that, in order for bank debt to have the NQA property, the bank must be opaque. That is, information about the bank's assets must be kept secret, and the assets must be selected so that expert outsiders do not have an incentive to produce private information, but rather to just accept the money NQA. This can be accomplished if the bank makes loans that are costly for outsiders to learn about, such as consumer loans and loans to small businesses. Large firms go to capital markets.

3.3. Information-Insensitive Debt

The NQA property is one necessary characteristic of short-term safe debt. Such debt is accepted in trade without extensive and costly verification of its value. As discussed above, producing this NQA property requires sufficiently credible backing. Another characteristic of safe debt is the ability of the asset to store value through time. The first characteristic is associated with short-term debt (as shorter maturities reduce risk), whereas the second characteristic is associated with long-term debt. However, long-term debt is used as collateral for short-term debt.

Why is the contractual form debt? This question is addressed by Dang et al. (2013) and Holmström (2009, 2015). Dang et al. (2013) study a contract design problem in which there are three agents and three dates. Omitting the details, there are two transactions. First, agent B finances agent A's project; this security must be designed. Then, in the next period, agent B wants to trade with agent C using the security he got from agent A as collateral. Before trade with agent C, there is a public signal. Agent C can produce private information about agent B's collateral (conditional on the public signal) at a cost. Agent B wants to obtain a known and fixed amount after trading with agent C (his demand for liquidity); obtaining this amount drives the outcomes, i.e., agent B's utility is to be maximized. In trading with agent C, agent B wants to avoid adverse selection, which occurs if agent C produces information. How can this possible adverse selection be avoided?

Dang et al. (2013) show that the optimal contract that agent B can offer agent C is debt. One explanation for why debt is optimal is shown in **Figure 2**. The figure shows the contractual payoffs to the debt holder as a function of the backing collateral. At maturity, the value of the backing collateral determines whether the payoff is the face value (the flat line amount) or whether it is to the left of the kink, where the borrower defaults and the debt holder receives exactly the value of the collateral. At dates prior to maturity, agents have beliefs about the value of the backing collateral. If the collateral value is believed to be sufficiently far to the right, the debt is information insensitive. There is no point in producing costly information about the exact value of the collateral. If the value is believed to be close to the kink, perhaps to the left of the kink (but prior to maturity), then its value depends exactly on what the collateral is worth, and it may pay to produce private information to find out this exact value.

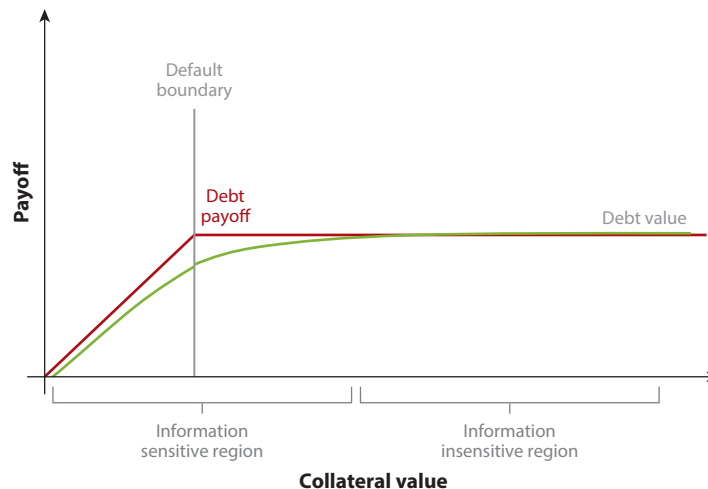


Figure 2

The contractual payoff to a debt holder as a function of the backing collateral. Figure adapted with permission from Holmström (2015).

The implication of this is that debt is designed to keep the collateral value (the state of the world) secret. As discussed above, this can be done by increasing the collateral value with joint liability, monitoring, etc. Another way to keep the debt information insensitive is to increase the cost of producing the information. The collateral value will never be known if the debt pays off its face value.¹⁶

Privately produced safe debt is risky, unlike credible government debt. Credit risk refers to the possibility that debt may not be safe. Privately produced information-insensitive debt is risky in this sense. Long-term privately produced safe debt, i.e., ABS/MBS, refers to the AAA tranches. The transition from information-insensitive to information-sensitive debt corresponds to a downgrade to a rating below AAA. Indeed, ratings are best viewed as indicating distance to the kink in **Figure 2**; that is, ratings indicate the distance to information sensitivity.

3.4. Collateral

Dang et al.'s (2013) main result, however, is that the optimal contract that agent B offers agent A is also debt. Agent B knows that the contract he designs for the transaction with agent A will, next period, be the collateral for the contract he offers agent C. Dang et al. (2013) show that debt on debt is the optimal contract. The conclusion is that, if a particular bond is almost always information insensitive, then using that bond as collateral for another debt contract makes the second debt contract even more information insensitive. A repo contract is a clear example of this because the lender obtains a short-term debt contract and also receives a high-grade US Treasury of AAA/Aaa as collateral.

Debt on debt means that the collateral for the short-term debt used to transact (be it bank notes, demand deposits, sale and repurchase agreements, commercial paper, etc.) will also be debt.¹⁷ So, short-term safe debt means that long-term safe debt is needed for collateral. For example, in

¹⁶This is the same as the model of Townsend (1979), although that setting does not involve trade.

¹⁷In the case of insured demand deposits, the collateral is the taxing power of the government.

free banking states in the United States before the Civil War, privately issued bank notes were required (by state law) to back those notes with state bonds, which were not riskless (see Rolnick & Weber 1983, 1984). Demand deposits are backed by portfolios of loans and are overcollateralized to the extent that the bank has equity. National Bank notes, issued by banks in the United States during the period 1863–1914, were required to be backed by US Treasury bonds. A repo contract is backed by a specific bond that the lender takes as collateral. Asset-backed commercial paper (ABCP) was backed by ABS/MBS, which themselves were backed by bank loans.

3.5. Financial Crises

Short-term bank debt is vulnerable to runs, and financial crises are bank runs. Diamond & Dybvig (1983) were the first to point this out. In the model of Diamond & Dybvig (1983), the run is disconnected from fundamentals, but Goldstein & Puzner (2005) show that, in a model like that of Diamond & Dybvig (1983), depositors run when sufficiently bad news about the bank's backing assets arrives. These models, like that of Gorton & Pennacchi (1990), assume the existence of debt.

Dang et al.'s (2013) explanation for the existence of debt implies a concept of a financial crisis that is inherent in debt, although debt is the optimal contract. A financial crisis is an event in which safe debt with the NQA attribute becomes suspicious; questions are asked. Holders of short-term bank debt suspect the backing loans and run on the bank. Holders of repo suspect the collateral offered and refuse to roll their debt. Gorton (1988) studies financial panics during the US National Banking Era (1863–1914) and shows that a panic occurs when a leading economic indicator unexpectedly exceeds a threshold. Every panic during the National Banking Era was an event in which the threshold was exceeded, and there was never an event in which the threshold was exceeded without there being a panic. A financial crisis corresponds to short-term switching from information-insensitive to information-sensitive debt (see also Gorton & Metrick 2012a,b).

Figure 3 portrays a suggestive example of the switch from information-insensitive to information-sensitive debt at the start of the crisis in the eurozone. Sovereign bonds that were

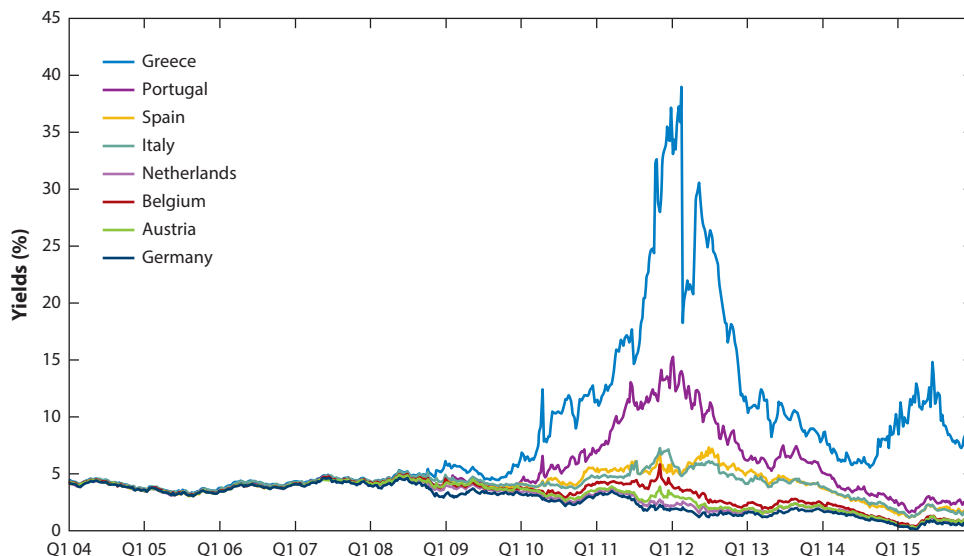


Figure 3

Bond yields of selected sovereigns of the euro area. Figure adapted from <http://investing.com>.

perceived to be safe, i.e., information insensitive, became information sensitive, meaning that information was produced such that the degree of safeness was differentiated across different sovereign debt.

When this switch from information-insensitive to information-sensitive debt occurs, what is the response? How can confidence be restored? In other words, how does the economy get back to information-insensitive debt? Notably, the answer is not to make debt more information sensitive by revealing the state of individual banks' backing collateral. Quite the opposite is true. In the pre-Federal Reserve National Banking Era, private bank clearinghouses first cut off information, instructing member banks to stop publishing weekly balance sheet information in newspapers, which members were otherwise required to do. The clearinghouse then issued a new security—the clearinghouse loan certificate—which could be used in clearing and later handed out to the public as a cash substitute. The loan certificates were the legal obligations of the joint clearinghouse membership, thus binding all the members into a single large bank. Basically, the clearinghouse combined all the collateral (the bank loan portfolios) into a single portfolio to attempt to convince depositors that the banking system was solvent (see Gorton & Tallman 2015).¹⁸

Central banks have the ability to alter the backing collateral quality via the discount window or emergency lending facilities. With these mechanisms, banks can borrow cash or Treasuries in exchange for bonds and loans. Notably, this is kept secret, as in the recent financial crisis. That is, the identities of the borrowing banks are not revealed. The problem in a crisis is that all the bank debt has lost the NQA attribute. It is counterproductive to attempt to recover this on a bank-by-bank basis, revealing the weak banks in the process. The banking system will unravel serially. With anonymous emergency lending facilities, the quality of the collateral in the economy shifts toward government collateral and away from privately produced collateral. This is similar to the clearinghouse response to a crisis in the sense that the response is to improve the quality of the backing collateral in the entire economy (see Gorton & Ordoñez 2016b).

Understanding the logic of the response to financial crises, which has developed over the past 250 years, is instructive for understanding what kind of event constitutes a crisis.

4. TYPES OF SAFE DEBT

Safe debt can be sovereign debt (although, obviously, not all sovereigns can produce safe debt) or privately produced debt,¹⁹ and it can be short term or long term. Gorton & Metrick (2010) outline two ways to create safe debt. First, debt that is credibly backed by the government, i.e., either government bonds or guaranteed debt like demand deposits, can be safe. Second, privately produced safe debt can never be as safe as the first category, but short-term privately produced safe debt can be produced by choice of the backing collateral. Over time, safe debt has taken different contractual forms depending on the demand from different clienteles and on contracting (i.e., legal) technology (see Geva 2011).²⁰ Privately produced safe debt has taken the form of goldsmith notes, bills of exchange, bank notes, demand deposits, certificates of deposit, commercial paper, and sale and repurchase agreements, to name a few. But aside from financial histories, there is

¹⁸In this period, the New York City Clearinghouse Association solvency was essentially equivalent to the solvency of the entire system.

¹⁹Due to space limitations, I omit discussion of a small but interesting body of literature that looks at bubbles as safe assets. The reader is referred to, e.g., Caballero & Krishnamurthy (2006), Gourinchas & Jeanne (2012), Farhi & Tirole (2012), and Martin & Ventura (2015).

²⁰Garbade (2012), for example, examines the evolution of the US Treasury market, exploring the problems and solutions that developed as this market evolved.

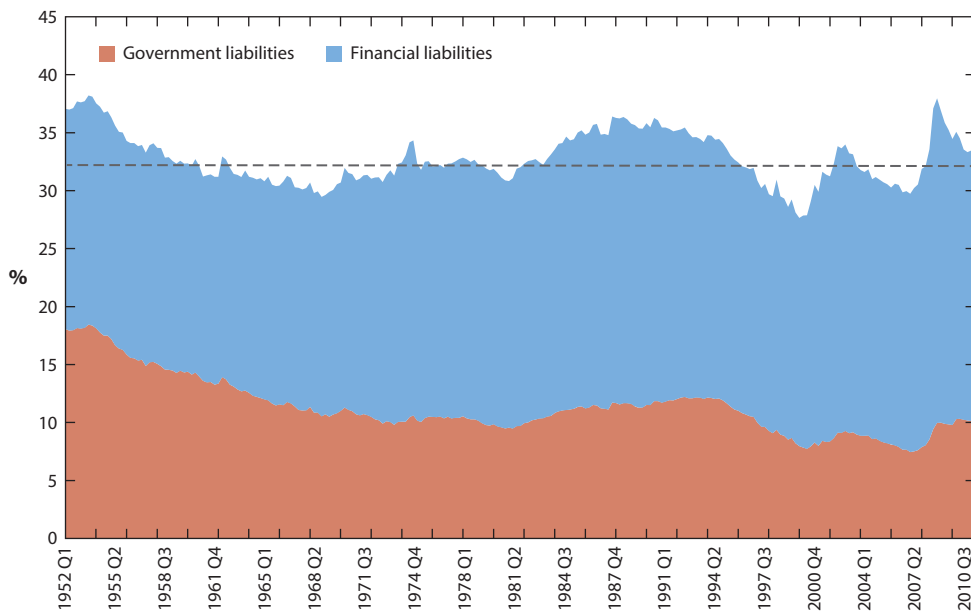


Figure 4

The safe debt share. Figure adapted with permission from Gorton et al. (2012).

little work (and little data) on the relative size of the components of safe debt and how they change through time.

4.1. Overview

At the aggregate level, Schularick & Taylor (2012) construct a data set on money and the banking sector of 14 major economies since 1870. They show that the ratio of broad money aggregates, M2 or M3, to GDP was relatively stable until World War II, after which it rose sharply. They label the postwar period the second financial era because of this growth.²¹ It is not clear, though, whether the composition of the bank liabilities changed over the period they study.

For the United States, more can be said about the components of safe debt. **Figure 4** shows privately produced safe debt and US Treasury debt outstanding (in the hands of the public) as a percentage of total assets in the United States over the period 1952–2010. This figure, based on Federal Reserve Flow of Funds data, includes both long-term and short-term debt. The major components of safe debt include bank deposits, money market mutual fund shares, commercial paper, federal funds, repo agreements, short-term interbank loans, US Treasuries, agency debt, municipal bonds, private-label securitized AAA debt, and high-grade financial-sector AAA corporate debt. Long-term debt, which includes the last five categories in the preceding list, is often used as collateral in repo transactions and ABCP market or to safely store value through time.

With respect to the data in **Figure 4**, Gorton et al. (2012) make two points. First, it is notable that, over the almost 60-year period included in **Figure 4**, the fraction of total safe liabilities to

²¹Jordà et al. (2011) examine disaggregated data for 17 advanced economies since 1870. Their main finding is that there has been a sharp rise in mortgage lending during the twentieth century, when banks' balance sheets doubled in size. However, it is not clear what bank liabilities financed this increase.

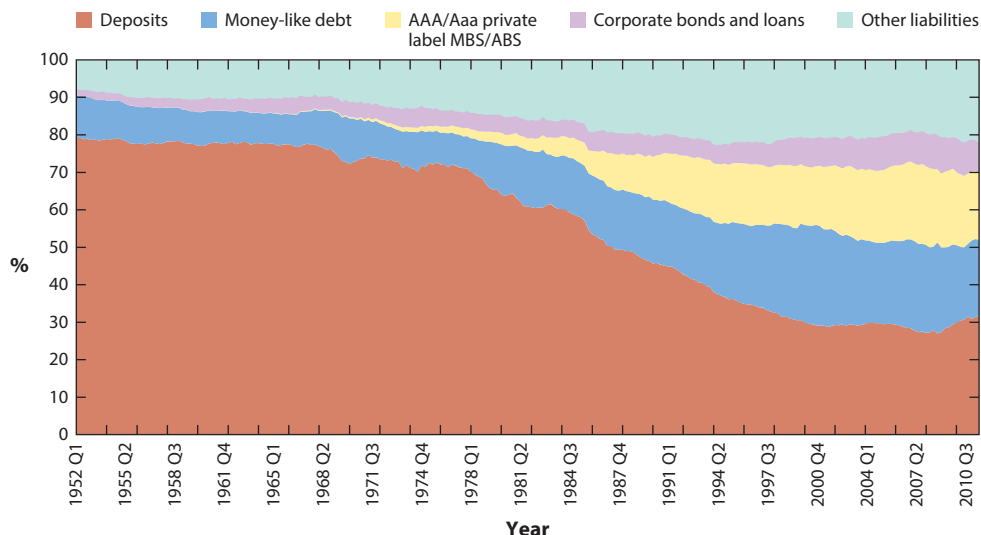


Figure 5

The components of privately produced safe debt. Figure adapted with permission from Gorton et al. (2012). Abbreviations: ABS, asset-backed securities; MBS, mortgage-backed securities.

total assets in the economy is persistent at approximately 32%, suggesting a stable relationship between safe debt and total assets. Second, the privately produced safe debt component has always been substantial.

Figure 5 shows the composition of the privately produced safe debt in the United States as a percentage of total privately produced safe debt in the United States since 1952. The figure shows a very significant transformation of the US financial system starting roughly in the mid-1970s. Demand deposits were the dominant form of safe debt for approximately the first 25–30 years, starting at nearly 80% of the total and remaining high at 70% in the late 1970s. But then, demand deposits began a steep decline as the financial architecture changed with the rise of money market mutual funds and money market instruments (e.g., repo and commercial paper) and with securitization. This transformation reflects the changing demands for different types of safe debt, as demands from the wholesale market grew enormously relative to the retail market. The change corresponds to the rise of the shadow banking system. The figure suggests that this is a permanent change, which has important implications for macroeconomics and monetary policy, discussed in Section 8.

In the period before the financial crisis of 2007–2008, there was a buildup of safe debt in the form of ABS/MBS (see Bertaut et al. 2011). Securitization collapsed during the financial crisis, so this source of safe debt has been significantly diminished. Bertaut et al. (2014) examine the supply and demand of safe debt since the financial crisis. They have a number of interesting findings. First, they show that, postcrisis, the (high-grade) foreign financial sector has produced and supplied safe debt to meet US demand for safe assets. A large portion of this debt is in the form of foreign financial wholesale certificates of deposit. In particular, high-grade dollar-denominated debt from Austria and Canada is now 40% of the US foreign portfolio of high-grade dollar-denominated bonds, whereas precrisis this share was 8%. They also find “a strong negative correlation between the foreign share of the U.S. financial bond portfolio and measures of U.S. safe assets availability; providing evidence on the importance of foreign-issued financial sector debt as a substitute when U.S. issued ‘safe’ assets are scarce” (Bertaut et al. 2014, abstract).

Other countries similarly display a relatively constant ratio of safe assets to GDP. Gourinchas & Jeanne (2012) calculate safe asset shares for Japan, England, Germany, and France. The share of safe assets to each country's GDP is quite stable and comparable to that of the United States. After 2002, there is a rise in safe assets, with most of the increase (with the exception of Japan) coming from within the financial system. Most of the increase in demand for safe debt came from foreign financial institutions and foreign official agencies. Holdings of US safe assets (currency, Treasuries, and municipal debt) by the rest of the world went up significantly.

4.2. Sovereign Debt

Holmström & Tirole (1998) provide a rationale for the non-neutrality of government debt. In their setting, firms are constrained by the fact that not all their income is pledgeable; only pledgeable income can serve as collateral. In each state of the world there is a limited amount of aggregate collateral (pledgeable cash flows). Firms face uncertain liquidity needs that cannot be met when there is aggregate uncertainty. This provides a role for safe government debt.²² Caballero & Farhi (2014a,b) also provide a rationale for government debt, as discussed in Section 8.²³

Today, the sovereign debt of some countries is safe and is used globally as a mechanism for storing value.²⁴ Modern government debt issuance amounts and outstanding amounts are determined by fiscal considerations, rather than being based on the demand for safe debt (see Barro 1979b, 1981). As shown in **Figure 4**, there has never been enough US Treasury debt, motivating the private sector to produce substitutes. The shortage of safe government debt is discussed below, as is the foreign demand for US government debt.

In the past 40 years or so, there has been enormous demand from foreigners for US Treasury debt (see **Figure 6**). In the words of Bernanke et al. (2011, p. 8), “[A] large share of the highly rated securities issued by U.S. residents from 2003 to 2007 was sold to foreigners—55%. This share was even higher than in the 1998–2002 period—22%—even though total net issuance of apparently safe assets rose from \$3.1 trillion in the first period to \$4.5 trillion in the second [period]. (The net issuance of private label AAA-rated asset-backed securities outstanding, including MBS, rose from \$0.7 trillion in the first period to \$2 trillion in the second.)” And in the words of Maggiori (2013, p. 2), “U.S. residents’ holdings of foreign assets were focused on riskier assets, such as equity and foreign direct investment (FDI), which together accounted for 56% of total U.S. assets. By contrast, foreign residents’ holdings of U.S. assets were concentrated in safe assets such as debt, which accounted for 69% of total liabilities.”

The foreign demand for safe assets is motivated by a desire to store value. Gourinchas et al. (2014, abstract) “document that the U.S. provides insurance to the rest of the world, especially in times of global stress.” This has been referred to as the global savings glut and is the subject of a large body of literature (see, for example, Caballero 2006; Bernanke 2005, 2007; Caballero & Krishnamurthy 2009; Gourinchas et al. 2014; Bernanke et al. 2011; Bertaut et al. 2011; Gourinchas & Jeanne 2012).

Foreign demand for US safe government debt and US agency debt has contributed to a domestic US shortage of safe assets. For example, prior to the crisis of 2007–2008, the Bank for

²²There is also an earlier body of literature that is relevant here, e.g., Diamond (1965). Woodford (1990) shows the value of government debt in a neoclassical economy where agents are liquidity constrained.

²³These rationales are for safe government debt. The reader is also referred to, e.g., Woodford (1990), who implicitly assumes that government debt is safe.

²⁴He et al. (2015) provide a model of the sovereign debt as a reserve asset (as opposed to a reserve currency, in which one country's bond plays the role of safe debt).

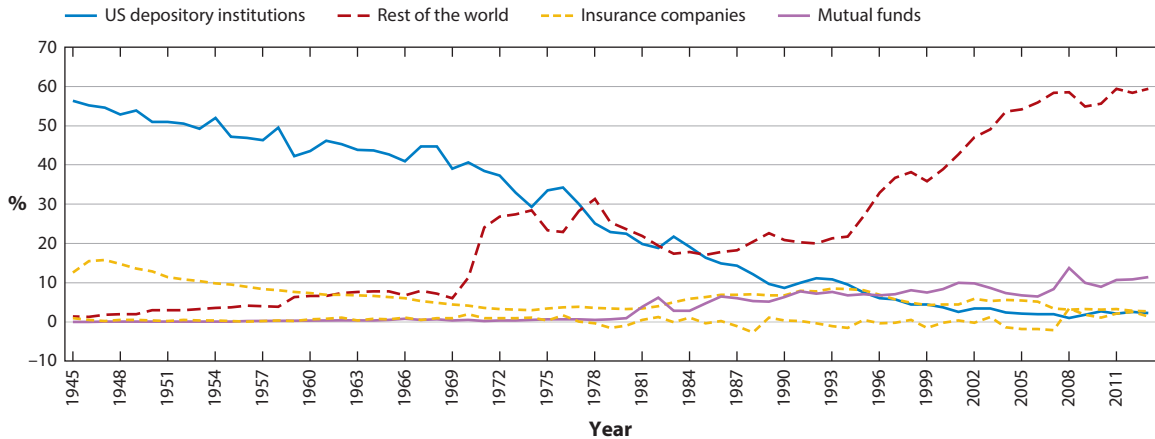


Figure 6

Holders of US Treasuries (percent of total outstanding). Figure adapted with permission from Board of Governors of the Federal Reserve System Flow of Funds data.

International Settlements (Bank Int. Settl. 2001, p. 2) noted, “The increase in collateralized transactions has occurred while the supply of collateral with inherently low credit and liquidity risk has not kept pace. Securities markets continue to grow, but many major government bond markets are expanding only slowly or even contracting.” Gorton & Muir (2015) provide some direct evidence of this shortage.

4.3. The Supply of Privately Produced Safe Debt Via Securitization

When there is a shortage of public safe debt, the private sector responds by producing substitutes. When shortages developed in the past 30 years due to the economic transformation from a retail-based banking system to wholesale-based system, two things happened: Commercial banks became much less profitable, and there was a need for privately produced (mobile) safe debt. The conjunction of these two forces led to securitization. Stein (2012b), Gennaioli et al. (2013), Gorton & Metrick (2012b), and others argue that one of the main purposes of securitization is to produce safe assets.

Securitization is the private production of safe debt. It takes bank loans as inputs and produces bonds (asset-backed securities) as outputs. Bank loans are mostly immobile; they cannot be traded or used for collateral. They sit on the banks’ balance sheets. But when used to produce ABS/MBS, the resulting bonds, backed by these same loans, become mobile: That is, they can be traded, used as collateral, rehypothecated, and held to store value. Securitization has been driven by a shortage of long-term safe debt. The AAA/Aaa tranches of ABS/MBS are viewed as safe debt and have a convenience yield. Xie (2012) finds that, on average, 86.3% of an ABS/MBS deal is rated AAA. Gorton & Metrick (2013) provide a survey of the literature on securitization (see also Gorton & Souleles 2006). This section is only a brief summary.

As in **Figure 5**, over the period 1975–2010, when demand deposits declined and other forms of privately produced safe debt grew, it became necessary to produce safe debt to back money market instruments. This is particularly true because of the foreign demand for US Treasuries and agency bonds (see **Figure 6**).

Securitization has several characteristics that make the AAA/Aaa tranches ideal as privately produced long-term safe debt. First, it is complicated. Very few financial intermediaries or institutional investors can conduct a loan-by-loan simulation of the performance of an ABS/MBS. This was certainly the case prior to the crisis of 2007–2008, although it is less so now. In other words, if we wanted to conduct a Monte Carlo analysis of an ABS/MBS, then we would have to know the riskiness of different characteristics of the borrowers, recovery rates, etc., and the details of the internal workings of the ABS/MBS would have to be specified. Safe debt can be produced when the cost of private information production is prohibitive. This is the case with ABS/MBS. Another important characteristic of ABS/MBS is that the equity tranche is not traded, but rather is held by the sponsor of the securitization, so there is no information leakage. Note that, when an ABS/MBS bond is used as collateral to back repo or ABCP, the structure is debt on debt on debt, which, by the above logic, makes the privately produced short-term debt very information insensitive. An ABS/MBS is a bond backed by a portfolio of loans.

In Section 5, we see some evidence of the convenience yield on AAA/Aaa ABS/MBS, which means that these bonds are issued at a lower coupon than they otherwise would be if they could not be used as a safe store of value. If banks' cost of funding is lowered because of the convenience yield, then banks would not want to lose access to this market. Because of this, there should be implicit recourse to the banks (see Gorton & Souleles 2006) if the special purpose vehicles that issued their ABS/MBS deals got into trouble. In fact, that is what we observed during the financial crisis. Large banks essentially bailed out their large credit card receivable master trusts by having these trusts issue junior debt to them, adding to the buffer that ABS holders would have. For example, Bank of America purchased \$8.5 billion of junior debt from one of its trusts in the first quarter of 2009 (see Scholtes & Guerrero 2009). In the same spirit, Albertazzi et al. (2015) study 1 million prime mortgages, some securitized and some not securitized. "The main finding is that, for given observable characteristics, securitized mortgages have a lower default probability than nonsecuritized ones. We show that this finding is consistent with banks caring about their reputation for not selling lemons" (Albertazzi et al. 2015, p. 33).²⁵ In contrast, Elul (2015) finds that privately securitized mortgages performed worse than nonsecuritized mortgages.

5. THE CONVENIENCE YIELD

The characteristics of moneyness and safety mean that investors receive some return on safe debt that is nonpecuniary. Safe debt should display a convenience yield, and economists have recently focused on measuring this yield. Examining whether there is a convenience yield empirically is important for verifying that the attributes of safe debt are valued in nonpecuniary ways and that safe debt is special in this sense.

5.1. Measuring the Convenience Yield and Its Components

Figure 7 (Krishnamurthy & Vissing-Jørgensen 2012) shows the yield spread between AAA/Aaa-rated US corporate bonds and Treasuries (on the y axis) and the ratio of US government bonds outstanding to US GDP (on the x axis). The figure shows that, when Treasuries are relatively scarce, the convenience yield rises, i.e., there is a higher relative demand for Treasuries, pushing the price up and the yield down. In other words, Treasuries offer more liquidity and greater safety

²⁵ However, securitization of subprime mortgages seems to have been accompanied by a decline in lending standards.

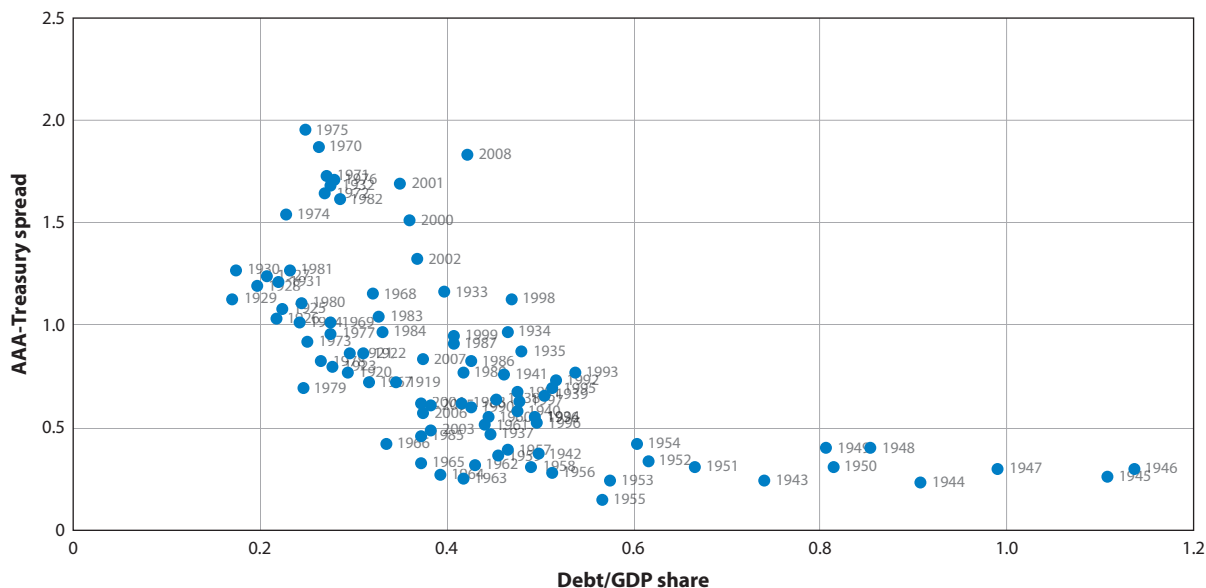


Figure 7

Corporate bond spread and government debt. Figure adapted with permission from Krishnamurthy & Vissing-Jørgensen (2012).

than do AAA/Aaa-rated corporate bonds. The basic conclusion of **Figure 6** is econometrically confirmed for a variety of spreads by Krishnamurthy & Vissing-Jørgensen (2012). They also examine the Baa corporate bond to Treasury spread. Based on these regressions, they calculate that the convenience yield, on average, was 73 basis points. They also look at short-term spreads, such as the spread between the highest-rated 3-month commercial paper and 3-month Treasury bills, and find similar effects.

The Krishnamurthy & Vissing-Jørgensen (2012) regressions take the following form. They confirm that increases in the supply of Treasuries (to GDP) reduce both short-term and long-term spreads by looking at both long-term spreads and short-term spreads in regressions where the main right-hand side variable is the log of (the market value of) outstanding US Treasuries to GDP. The magnitudes of the responses of the long-term spreads (AAA to Treasuries and BBB to Treasuries) and the short-term spreads (the highest-rated commercial paper to Treasury Bills and a lower-rated commercial paper yield to T-Bills) are basically the same.

The Krishnamurthy & Vissing-Jørgensen (2012) regression results are consistent with there being two kinds of convenience: Treasury bills provide short-term safety (moneyness) and Treasury bonds provide long-term safety (certainty of final repayment). Krishnamurthy & Vissing-Jørgensen (2012) distinguish between liquidity and safety and ask whether these different characteristics are priced. They do this by looking at the spreads on different assets with different liquidity but similar safety characteristics. For example, they look at the spread between Baa and AAA/Aaa corporate bonds; Baa bonds have more default risk than AAA/Aaa bonds but are similarly illiquid. So this spread, for example, would capture the long-term safety attribute and not the liquidity attribute.

Greenwood et al. (2015) also argue that short-term government debt is more like money than long-term government debt because it provides greater short-term safety (due to the short maturity). Greenwood et al. (2015) show this by calculating the difference between actual Treasury

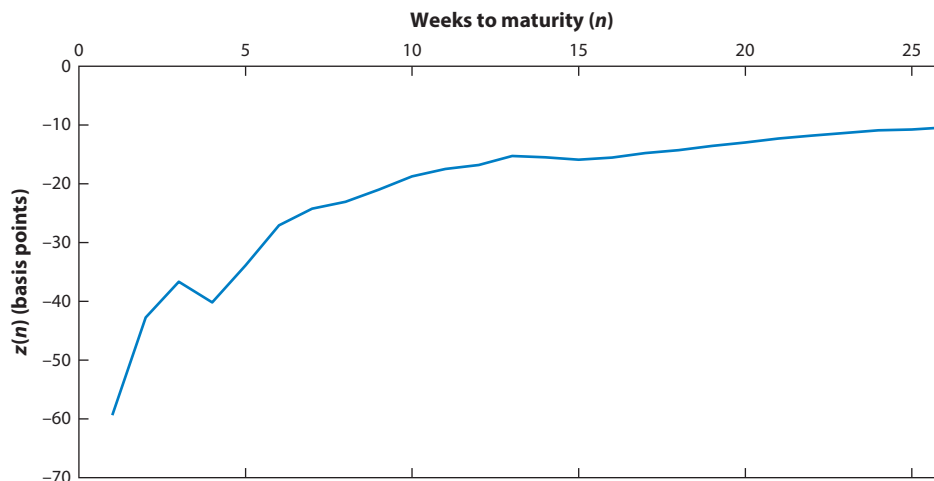


Figure 8

Average premium (actual Treasury bill yield minus fitted yield) by week to maturity, 1983–2009. Figure adapted with permission from Greenwood et al. (2015).

bill yields and fitted Treasury yields. **Figure 8** shows the average spread over the period 1983–2009 between actual Treasury bill yields (on-the-run Treasury bills with maturities from 1 to 26 weeks) and fitted yields [based on a flexible extrapolation of the Treasury yield curve using the method of Gurkaynak et al. (2007)]. The figure shows large differences; for example, for the 1-week bill, the difference is approximately 60 basis points. The authors interpret this as a premium for moneyness and show how the premium varies with the mix of T-bills and longer-term government debt. Relatedly, Greenwood & Vayanos (2014) find that yields on short-term Treasuries decrease relative to long-term Treasuries when the supply of short-term bills decreases. Amihud & Mendelson (1991) and Duffee (1998) have also noted that the yields on Treasury bills are low relative to those on longer-term US Treasuries.

Carlson et al. (2014) look at an interesting experiment to distinguish the convenience components on short-term and long-term Treasuries. They examine the 1-month holding period return relative to the overnight rate as well as Treasury bills with n weeks to maturity in excess of the 1-week rate. The pattern shows that this spread increases sharply but at a decreasing rate. In other words, the longer the maturity, the lower is the convenience yield.

Krishnamurthy (2002) examines the yield spread difference between on-the-run and off-the-run Treasuries. This can be used to derive another estimate of the convenience yield. Krishnamurthy & Vissing-Jørgensen (2015) calculate this to be 144 basis points (on an annual basis).

What about securitization? Do AAA ABS/MBS have a convenience yield? This is a harder problem. Nadauld & Weisbach (2012) study collateralized loan obligations (CLOs), which securitize corporate loans. Their main finding is based on comparing two very similar loans, one securitized and one not securitized. They compare loans that were more likely to be securitized (because of their attributes) with similar but not likely to be securitized loans. Loans that could be securitized cost 17 basis points less to the borrower. One can interpret this result as indicating that there was a strong demand for AAA debt, and one way to produce this debt was by securitizing BB-rated loans (because this can create a large amount of AAA debt). The 17 basis points can be viewed as the convenience yield.

5.2. The Convenience Yield and the Private Sector Response to Changes in Outstanding Treasuries

As shown in **Figure 4**, since the 1950s, there has never been enough US government Treasuries to use as safe debt, so the private sector has consistently produced the bulk of this debt (at least in the United States). One important issue concerns how the composition of safe debt changes between public debt and privately produced debt over time. The result in the literature is that the private sector produces more safe debt when there is a lack of government debt, as indicated by a rise in the convenience yield.

In the Krishnamurthy & Vissing-Jørgensen (2015) model, a decrease in government securities causes an increase in the convenience yield, which induces financial intermediaries to borrow with short-term or demandable debt and then use the proceeds to invest in illiquid loans. Financial intermediaries respond to changes in the convenience yield: If the convenience yield increases because there is a shortage of Treasuries, the private financial intermediaries create more safe debt, and vice versa. Also, Holmström & Tirole (1998, 2011) show a connection between the supply of liquid securities supplied by the government and the amount of privately produced safe debt. Holmström & Tirole (2011) argue that, when there is a shortage of government bonds, a liquidity premium arises, causing the private sector to produce substitutes.

Empirically, Gorton et al. (2012) show that government debt and privately produced safe assets in the United States are strongly negatively correlated. Krishnamurthy & Vissing-Jørgensen (2012) also document this negative relationship between the supply of privately produced safe assets (by the US financial sector) and the supply of US government debt. Krishnamurthy & Vissing-Jørgensen (2012) show that the outstanding amount of US Treasuries to GDP have large impacts on a variety of yield spreads corresponding to measures of liquidity and safety. Krishnamurthy & Vissing-Jørgensen (2015) then show that a shortage of Treasuries causes an increase in measures of the convenience yield, leading to an increase in short-term debt issued by the private sector. Consistent with the crowding out private debt/crowding in view of government debt, Greenwood et al. (2015) show that changes in government debt maturity choices affect private-sector debt maturity choices (see also Carlson et al. 2014).

Studies of the private sector issuance of safe debt confirm that issuance responds to widening of the convenience yield spread. Xie (2012) analyzes all private-label ABS/MBS issued from 1978 to 2010, amounting to 20,000 deals, 300,000 tranches, and \$11 trillion in issuance. Using daily data, Xie (2012) finds that more ABS/MBS are issued when the expected convenience yield is high. This phenomenon does not happen in other markets for privately produced debt, like corporate bond markets. Sunderam (2015) looks at the issuance of ABCP at the weekly frequency. He finds, among other things, that issuance of ABCP also responds to a shortage of T-bills, as evidenced by the convenience yield.

5.3. Implications for Asset Pricing

In standard asset pricing theory, asset prices are based on the expectation of the product of the asset's payoff with the consumer's intertemporal marginal rate of substitution. The existence of a convenience yield is not consistent with standard asset pricing models. Intuitively, safe debt has a lower beta than would otherwise be the case.

Holmström & Tirole (2001), in an article entitled "LAPM: a liquidity-based asset pricing model," present an asset pricing model with a demand for liquidity and articulate the implications of taking this demand for liquidity into account in pricing assets. In their setting, risk-neutral firms "are willing to pay a premium on assets that help them in states of liquidity shortage. This is a form of risk aversion, but unlike in models based on consumer risk aversion, return variation within

states that experience no liquidity shortage is inconsequential for prices” (Holmström & Tirole 2001, p. 1862). The agency friction in the model is the inability of firms to pledge all of their future cash flows to outsiders, limiting their long-term financing and raising the possibility of the realization of a future state in which the firm needs more financing. The pledgeability constraint implies that collateralizable assets are in short supply and that the assets that are available command a premium. This shortage affects real investment. The extent to which this matters depends on future states of the world in which firms may need to invest more. As long as no liquidity demand state of the world is realized, the model satisfies the usual Euler equations, and asset prices follow a martingale. Although asset prices in the model are driven solely by the agency problem, the model is still quite rich and suggestive.

Another approach concerns the role of financial intermediaries in producing safe debt. Because it is financial intermediaries that respond to a changing convenience yield, their ability to respond would also seem relevant for asset prices. The amount of collateralizable assets that are privately produced depends on intermediaries’ ability to perform this function. Rather than firms being unable to pledge future cash flows, it may be that banks experience frictions. For example, if there is a binding capital constraint, leverage constraint, or liquidity constraint, then banks might not be able to respond to a change in the convenience yield. Asset pricing models that, for these reasons, view financial intermediaries as the center of asset pricing include those of He & Krishnamurthy (2012), Adrian et al. (2014), Brunnermeier & Sannikov (2014), and Moreira & Savov (2017).

6. THE REGULATION OF THE PRIVATE PRODUCTION OF SAFE DEBT

Banks are universally regulated because they are opaque to produce short-term debt, which is vulnerable to runs (see Dang et al. 2016). The negative externalities from bank runs are the rationale for bank regulation. Bank regulation is aimed at making banks’ short-term debt into safe assets. Deposit insurance is a straightforward example of this. Another potential problem is destructive competition, i.e., too much short-term debt creation with free entry into banking. This would create systemic fragility (see Alhadeff 1962; Shleifer & Vishny 2010; Stein 2012a,b).

One important form of bank regulation has been formal or informal entry restrictions. Entry into banking is restricted by the requirement that banks be chartered; banks must then satisfy a multitude of capital and reserve requirements, as well as restrictions on activities.²⁶ Because of the huge scope of this topic, I restrict attention to a very brief discussion of entry restrictions via charter requirements, mostly in the United States.

Originally, entry into banking was limited to a single bank because this bank would, essentially, be the government’s bank. The Bank of England was incorporated, i.e., given a charter, in 1694. Its charter was renewed in 1697 and then again in 1708, when it was granted a monopoly until 1826, when an Act was passed to permit the formation of joint stock banks with unlimited liability 65 miles or more from London and with no branches in the city of London (see Broz & Grossman 2004). A similar approach was taken in the United States. In the early United States, banks needed to obtain a state charter to operate. This required an act of state legislation. The first bank in North America, called the Bank of North America, was incorporated by the Continental Congress in 1771 and obtained a charter from Pennsylvania in 1782. The Bank of Massachusetts and the Bank of New York were established in 1784. By 1840, there were 772 banks, all formed by obtaining

²⁶There are many issues involved in bank regulation, and there is a large body of literature on the topic. I only scratch the surface in this review to note that the private production of safe debt has historically been regulated. For more information, the reader is referred to Macey et al. (2001), Grossman (2010, chapter 6), Calomiris & Haber (2014), and Gorton (2010, chapter 5).

charters via separate acts of legislation (see Hammond 1934). Later, the First Bank of the United States was organized in 1791, and the Second Bank of the United States was organized in 1817. These were both large, monopolistic banks.

In the pre-Civil War United States, state legislatures eventually granted more charters. Weber (2006) finds that 2,291 banks were in business in the United States between March 24, 1782 and December 31, 1860. The charter granting process was widely seen as corrupt (see Bodenhorn 2006). This led to free banking in some states, where, subject to some restrictions on note issuance, no legislation granting a charter was needed to enter banking. However, according to Ng (1988), there was not much entry. Gorton (1996) argues that there was no excessive competition in the sense that bank notes were mispriced. Later, in the National Banking Era, both state and national banks were required to obtain charters and submit to various regulations.

Limiting entry only makes sense if other firms are not allowed to act like banks. Other firms were restrained from entering the business of banking. A restraining act is legislation that prohibits nonbanks from issuing short-term debt. For example, in New York, the first restraining act (Act to Restrain Unincorporated Banking Associations) was passed in 1804 with the objective of guaranteeing “to banks a monopoly of the rights and privileges granted them, which had been encroached upon or infringed by private associations” (McMaster 1915, p. 571). (see, e.g., *N.Y. Fireman’s Insurance Co. v. Ely* 1825). Prior to this act, the right of banking was a common-law right, which could be exercised by individuals and nonchartered institutions. Once the law was passed, entering banking depended on having a charter (see Cleaveland 1857, Symons 1983).

Regulated banks may also receive subsidies to the extent that entry is limited and deposit insurance is underpriced, and there may be ceilings on interest rates paid on bank liabilities. The entry restrictions create monopoly rents for banks, the value of which is referred to as a bank’s charter value.²⁷ Importantly, because charter value is an intangible asset that is lost if the bank fails, it creates an incentive for bank owners to avoid risk that would jeopardize their charter (see Marcus 1984). In this way, charter value helps align the banks’ private propensities for risk taking with the social goal of producing safe short-term debt. Saunders & Wilson (2001) argue that charter value is very sensitive to aggregate economic activity. During contractions, charter value can rapidly decline.

During the transformation shown in **Figure 5**, banks faced competition from nonbanks (e.g., money market mutual funds, junk bonds) and deregulation (e.g., of interest rate ceilings and branching restrictions). US commercial banks became less profitable when money market mutual funds were able to successfully compete with banks because banks faced interest rate ceilings (Regulation Q of the Class-Steagall Act of 1933, which limited the interest banks could pay on demand deposits). Junk bonds also competed successfully with bank loans. This caused bank charter values to decline, which, in turn, caused banks to increase risk and reduce capital (see Gorton & Rosen 1995). This is documented by Keeley (1990), who notes an increase in risk taking and a decline in capital levels. Banks became less profitable (see Berger et al. 1995). It is not an accident that the shadow banking system developed coincidentally with the disappearance of charter value. As shown in **Figure 5**, this development was fairly long in the making, but it was not hidden; it was there for all to see.²⁸

²⁷Informally, large banks are members of a club with the central bank, and the club restricts entry (as in the case of the Canadian banking system). The club is the source of the entry restrictions.

²⁸For example, Pozdena (1986, p. 1) discusses “the causes of rapid growth in securitization” almost 25 years ago. He writes: “Securitization is . . . one manifestation of how financial innovation—driven by technological and other changes—is moving some parts of financing activity away from financial intermediaries” (Pozdena 1986, p. 1).

7. THE MACROECONOMIC IMPLICATIONS OF PRIVATELY PRODUCED SAFE DEBT

Financial crises are not rare (see, e.g., Kindleberger 2006, Cassis 2011, Laevan & Valencia 2012). They have occurred in all market economies throughout history: in economies with a central bank and in economies with no central bank, in economies with various forms of short-term debt, in developed economies and in less developed economies, and in the past and currently. The recent financial crisis of 2007–2008 made clear that financial crises are not events of only esoteric historic interest. In the seventeenth century and before, financial crises were typically related to sovereign debt. Since then, a financial crisis has been caused by runs on privately produced short-term debt such that the financial system is effectively insolvent (because the banks' debt contracts cannot be honored). Such a crisis is a first-order macroeconomic event. Financial crises occur when debt that was viewed as safe unexpectedly comes to be viewed as suspect upon the arrival of new information. Thus, there is an intimate connection among safe debt, aggregate economic activity, and crises.

7.1. Credit Booms and Aggregate Economic Activity

Credit booms typically, although not always, precede financial crises. This is an important stylized fact to be taken into account in any model of aggregate economic activity that includes financial crises.

Jordà et al. (2011, p. 1) study 14 developed countries over almost 140 years, from 1870 to 2008, and conclude that “credit growth emerges as the single best predictor of financial stability.” Laevan & Valencia (2012) study 42 systemic crises in 37 countries over the period 1970–2007 and reach the same conclusion. Gorton & Ordoñez (2016a,b) study 34 countries over 50 years. They find that credit booms are not rare. Over 50 years, the average country spends 27 years in a boom, and, on average, 12 of those years were spent in a boom that ended in a crisis (see also Desmirguc-Kant & Detragiache 1998, Mendoza & Terrones 2008). Many more papers show essentially the same finding.

Gorton & Ordoñez (2014; 2016a,b) link credit booms to crises. In their setting, short-term debt consists of collateralized loans from households to firms, abstracting from intermediation. Gorton & Ordoñez (2014) find that the driving issue is whether lenders should produce costly information about the quality of the collateral offered. Collateral is needed because the output of firms is not verifiable. Lenders can produce costly information about the collateral value prior to lending—information-sensitive debt. Or, lenders can forego the cost of information production and lend based on their prior information about the collateral quality—information-insensitive debt. Agents do not find it optimal to produce information all the time. Think, for example, of the repo market, where trillions of dollars of repo are rolled each morning. The lenders do not stop and do due diligence on the collateral that is offered.

What happens over time to agents' beliefs about the collateral quality if no information is produced? Gorton & Ordoñez (2014) assume that collateral is subject to idiosyncratic shocks changing its quality, but such that the overall amount of good and bad collateral in the economy does not change. Agents know there are idiosyncratic shocks but do not know the outcome of each shock. This has the effect that, over time, all the collateral comes to appear as collateral of average quality. If the average quality is high enough, more and more firms will get loans, causing a credit boom. Eventually, a small negative shock turning some good collateral into bad collateral will cause agents to produce information, and there will be a collapse of lending, output, and consumption. The effect of a shock, however, depends on how long the credit boom has been going on because that determines how many firms will be cut off from loans. The key points are,

first, that credit booms and financial crises are interrelated and, second, that the explanation of a crisis need not rely on a large shock hitting the economy.

Gorton & Ordoñez (2016a,b) go further and link credit booms to technological change. They first empirically define a credit boom, eschewing the standard methodology of Hodrick-Prescott filtering, which hardwires how much of a change in a series is allocated to the trend and how much to the remainder. With an agnostic definition of a boom, i.e., that 3 consecutive years of at least 5% average credit growth is the start of a boom that then continues until there are 2 consecutive years of nonpositive credit growth, they find, as mentioned above, that booms are not rare and that the average boom is 10 years in length. However, they show that not all booms end in a financial crisis. Some do (bad booms) and some do not (good booms). Empirically (looking at 34 countries over 50 years), they show that both types of booms start with a positive shock to total factor productivity (TFP) and labor productivity (LP), but that TFP and LP growth die off rather fast for bad booms but not for good booms. They then present a model in which there is a technological innovation. Over time, as the credit boom develops via the Gorton & Ordoñez (2014) mechanism (although in this review both borrowers and lenders can produce information, which is critical for the results), the average quality of firms' projects declines over time until such date as lenders want to produce information, leading to a crash.

In the Gorton & Ordoñez (2016a,b) setting, a new technology arrives, on average, a decade prior to the financial crisis. No contemporaneous negative shock is needed, as in much of current macroeconomics. Further, trend growth and macroeconomic activity, in particular financial crises, cannot be separated as they are separated in the standard paradigm of business cycles of deviations from trend.

Moreira & Savov (2017) build a dynamic macro model of shadow banking in which banks transform risky assets into securities that are safe in normal times but that become illiquid when there is an uncertainty spike. Investors require liquid securities to be able to trade quickly in large amounts. Intermediaries can tranche loans to create a safe security to meet investors' demands for liquidity. The senior tranche is always safe, but the middle tranche is not always safe; in particular, it becomes illiquid if there is a large shock. The residual equity tranche is never safe. The middle tranche is labeled shadow money.

There are two types of capital in the model. One type has high but risky cash flows, whereas the other type has low but safe cash flows. The mix of capital in the economy is endogenous and depends on the prices of the two types of capital. In a boom, the price of the risky capital rises and results in more investment in that type of capital. This reverses in a crash. Uncertainty changes over time. There is a time-varying probability of a crash. But, more importantly, what drives the model is that agents learn about the probability over time based on the occurrence or nonoccurrence of crashes. Agents' beliefs about the likelihood of a crash determine their decisions. If there has not been a crash in a while, then perceived uncertainty is low and there is a boom in the creation of liquidity by banks. This liquidity creation by banks leads to a lower cost of capital for firms, more investment, and more economic growth. But, over time, riskier investments are made, more shadow money is produced, and fragility builds up. When there is a crash, uncertainty is high thereafter. It then drifts down, making crashes less likely.

When fragility builds up because the last crisis was some time ago, even a small shock can bring the economy down. Agents do not want shadow money, and there is flight to safe assets. But this forces banks to delever to try to meet this demand. This has knock-on effects for discount rates (which go up) and asset prices (which go down). In the end, there is a deep recession.

As in the Gorton & Ordoñez (2016a,b) setting, the credit boom results in an increase in investment and output, but when the crisis comes, it is worse to the extent that the credit boom has been going on. In the settings of both Gorton & Ordoñez (2016a,b) and Moreira & Savov

(2017), there is an externality from the money produced during the boom, i.e., the quality of the collateral is declining. This provides a rationale for government intervention.

7.2. Safe Asset Shortages and the Global Savings Glut

Consistent with the trends noted in **Figures 5** and **6**, Gourinchas & Rey (2007) show that the United States went from a larger creditor position in the early 1950s to a larger debtor position in the early 2000s. The approximate turning point is 1988 (see Gourinchas & Rey 2007, figure 1.1).²⁹ Bernanke (2005), among others, notes the existence of the global savings glut, that is, the fact that the net foreign asset position of the United States is negative and large: US gross liabilities exceed gross assets—a persistent current account deficit. Caballero & Farhi (2014a) note, “The unmistakable signature of the growing shortage of safe assets at any given (safe) real interest rate is the secular downward trend in equilibrium real interest rates for more than two decades.” And Caballero (2006, p. 1) notes that the “world has a shortage of financial assets” and argues that this point could explain the global savings glut, low real interest rates, and low inflation.

Bernanke (2005) asked, “Why is the United States, with the world’s largest economy, borrowing heavily on international capital markets—rather than lending, as would seem more natural?” One answer is that, since the late 1980s, the United States was essentially selling insurance to the rest of the world by selling US Treasury and Agency debt. Caballero et al. (2008) point out that countries differ in their ability to produce safe financial assets for storing value. In particular, pledgeable income in the rest of the world is limited due to development-related frictions. The rest of the world has few reliable safe local assets to store value, and, so, there is a demand for foreign assets, leading to a current account deficit for the developed country and a decline in the world interest rate.

The development of the global savings glut also involved changes in the composition of the US portfolio. Gourinchas & Rey (2007, p. 21) describe the changes: “U.S. assets have shifted more and more out of long-term bank loans towards FDI [foreign direct investment] and, since the 1990s, towards FDI and equity. At the same time, its liabilities have remained dominated by bank loans, trade credit and debt, i.e., low yield safe assets. Hence the U.S. balance sheet resembles increasingly one of a venture capitalist with high return risky investments on the asset side.” This change has been interpreted as being consistent with the United States essentially selling insurance to the rest of the world in the form of safe debt (US Treasuries and agency bonds). Gourinchas & Rey (2007), Caballero et al. (2008), Caballero & Krishnamurthy (2009), and Maggiori (2013) provide models of this. In general, these models provide a rationale for why the United States has a greater ability to handle financial risks.

The picture of the global savings glut is further complicated by another aspect. Although the main focus of the savings glut literature has been on the net position, the gross flows have increased enormously. Johnson (2009) and Obstfeld (2012), among others, have drawn attention to the gross flows. The net flows hide the enormity of the gross flows. Furthermore, in the words of Obstfeld (2012, p. 9), “For the rich industrial countries, much of the expansion of gross external asset and liability stocks has necessarily taken the form of debt instruments.” In fact, there were sizeable two-way debt flows, particularly between the United States and the United Kingdom and between the United States and the euro area. In particular, European banks bought sizeable amounts of AAA/Aaa ABS/MBS and financed it with dollar-denominated commercial paper, sold in the United States. These would net out but hide the large gross flows. These flows are discussed in detail by Bernanke et al. (2011) and Bertaut et al. (2011).

²⁹Gourinchas et al. (2014) update the results of Gourinchas & Rey (2007).

The shortage of safe assets has continued. For example, the IMF *Global Financial Stability Report* (IMF 2012, p. 81) notes that “the shrinking set of assets perceived as safe, now limited to mostly high-quality sovereign debt, coupled with growing demand, can have negative implications for global financial stability.” Gorton & Muir (2015) also provide evidence on the shortage. Bertaut et al. (2014) show that, postcrisis, US investors are buying a larger share of foreign-issued financial debt, mostly issued by Australian and Canadian financial intermediaries. We know that a shortage of safe debt is associated with an increase in financial fragility.

8. SAFE DEBT: IMPLICATIONS FOR MONETARY POLICY

The current dominant postcrisis view of monetary policy continues to be that monetary policy should not be concerned with financial stability, credit booms, or macroprudential issues but should instead focus exclusively on inflation.³⁰ The proponents of this view believe that the central bank should not use interest rates to prick asset bubbles. This viewpoint is sometimes presented as a practical problem: Booms cannot be realistically identified, particularly for individual asset classes. Macroprudential issues, in this view, are best left to bank regulators and specially tasked groups, such as the Financial Stability Board, and individual countries’ macroprudential bodies, such as the Financial Stability Oversight Council in the United States. This conventional view seems not to have recognized the fundamental transformation of the economy portrayed in **Figure 5** or the inherent features of the recent financial crisis. Some recent literature on monetary policy provides a new view incorporating the important features of the current financial system and financial crisis to argue that monetary policy should not be focused solely on inflation.

There are some key differences in the starting points between the new view and the conventional view. First, the new view recognizes that the financial system has changed fundamentally and permanently. The banking system has metamorphosed from a system based on insured demand deposits to one based on the demands of a different clientele, wholesale investors. In this world, a scarcity of safe debt has important implications. Secondly, there is a convenience yield on Treasuries that cannot be perfectly replicated by private substitutes. This is important in a system that is much less reliant on insured demand deposits and more reliant on uninsured wholesale deposits. Finally, financial crises occur when holders of short-term debt have doubts about the privately produced collateral backing their debt. To the extent that this collateral is privately produced, the risks of financial crisis are higher, as discussed above. (Not all of the literature discussed below incorporates all three differences.)

8.1. Monetary Policy and Safe Debt

Several studies discuss monetary policy in the context of issues of safe debt.³¹ Stein (2012a,b) focuses on the creation of too much safe debt when there are externalities. Other studies consider monetary policy in the context of a shortage of safe debt or in the context of central bank policy to address the quality of safe debt to mitigate financial fragility.

³⁰Recent articulations of this view are provided by Bernanke (2015) and Svensson (2015). Williams (2015) provides further references.

³¹There are many other studies that have introduced a transactions or moneyiness role for government bonds and examined monetary policy in that context. However, these studies do not consider the context of a shortage of safe debt and do not include the endogenous production of privately produced debt substitutes. In general, these other studies address a range of other monetary policy issues not discussed in this review (e.g., Bansal & Coleman 1996, Canzoneri & Diba 2005, Belongia & Ireland 2006, Benk et al. 2010). An older body of literature assumes that there are some transactions services from government bonds (e.g., Patinkin 1965).

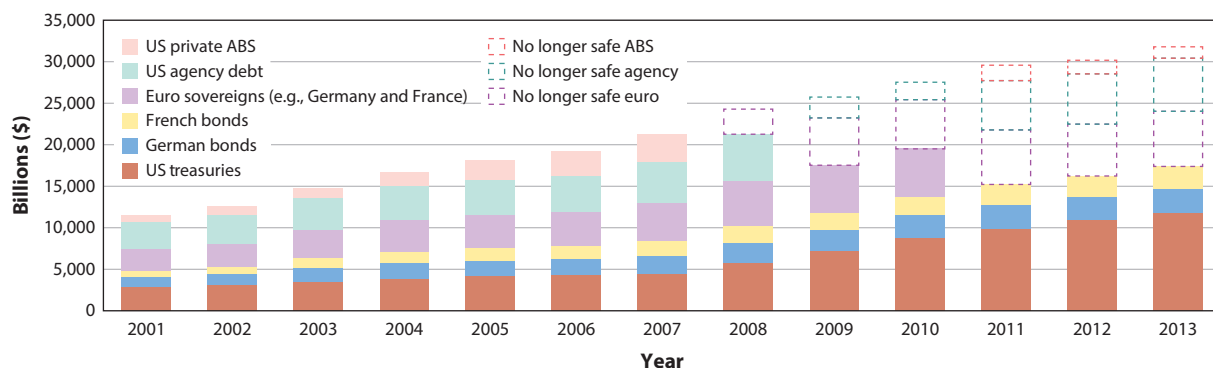


Figure 9

Safe assets: world. Figure adapted with permission from Adalfatto & Williamson (2015) and based on FRB/Eurostat/ECB/Haver. Abbreviation: ABS, asset-backed securities.

Stein (2012a,b) examines a world in which unregulated production of private money—short-term uninsured debt—has an externality.³² Such bank money is special, which is modeled by including it in the utility function (as a reduced form). Too much short-term debt increases the fragility of the financial system, but this is not taken into account by the private money issuers. If there is a financial crisis, the money-issuing banks have to sell assets at fire sale prices. Fire sale prices affect other agents via a collateral constraint. Stein (2012a,b) then asks how this problem could be addressed. Suppose the regulator is imperfectly informed about the banks' investment opportunities. For this case, Stein (2012a,b), examines a cap-and-trade system under which the regulator issues permits that allow banks to produce a specific amount of money. Of course, the regulator does not know how many permits to issue, but, assuming they know the other parameters of the model (i.e., how the world works in general), by adjusting the quantity, the regulator can hit the market-clearing price consistent with the model.

Stein (2012a,b) argues that the cap-and-trade approach is almost isomorphic to a monetary policy where the central bank adjusts required reserves. When there are more reserves, banks are able to create more money. Reserves act like the permits in the cap-and-trade system. "An open market operation that increases the supply of reserves relative to T-bills is isomorphic to an increase in the regulatory limit on [money] in the . . . cap-and-trade version of the model" (Stein 2012b, p. 80). This assumes that all banks in the system are subject to reserve requirements, which assumes the regulator knows which firms are banks (see also Stein 2014a,b).

Several studies focus on the monetary policy when there is a shortage of safe debt due to a financial crisis. **Figure 9** shows the categories of debt that become unsafe over time, e.g., ABS/MBS and some European government bonds. The amount of safe debt remaining in 2013 is quite low.

Andolfatto & Williamson (2015) specify a general equilibrium model in which there are demands for both cash and government bonds to be used in transactions. Government bonds thus have a convenience yield. But cash and government bonds are not substitutes. There are two goods: Good 1 requires cash for purchases (the usual cash-in-advance constraint) and good 2 requires some cash and some bonds in fixed proportion (a cash-and-bonds-in-advance constraint). Households produce the two goods and trade the goods with other households (a household does not

³² Stein (2014) takes the view that the risks of a financial crisis cannot be completely mitigated with conventional nonmonetary tools.

have a taste for its own goods). If the two constraints do not bind, households will be indifferent about producing and selling each of the two goods.

Scarce safe debt means that the cash-and-bonds-in-advance constraint binds. In this world, a lower nominal interest rate (higher bond price) reduces consumption in the market for good 2 and increases consumption in the market for good 1. Essentially, an increase in the bond price is an increase in the relative price of consumption of good 2 from the household's point of view. But reducing the demand for good 2 reduces aggregate output and welfare. In this context, Andolfatto & Williamson (2015) analyze a number of monetary policies.

Their main results show that the world is different when government debt has a convenience yield, especially with respect to monetary policy. Andolfatto & Williamson (2015) do not really focus on the optimal monetary policy in their environment. Instead, they focus on what the results would be if the central bank followed a Taylor rule. The reason for this is that they are interested in explaining why there need not be deflation at the zero lower bound if the central bank does not understand the correct model. A Taylor-rule central banker, misunderstanding how the world works when there is a shortage of government debt, would, for example, persistently undershoot the target inflation rate. In addition, there is a persistently low real interest rate. Ennis (2015), discussing the results of Andolfatto & Williamson (2015), argues that the way they model the interaction between fiscal and monetary policy is very important for their results.

There was a shortage of safe assets prior to the financial crisis of 2007–2008, but, at the onset of the crisis, this shortage took on even larger dimensions, with implications for monetary policy. Caballero & Farhi (2014a, p. 111) argue that the shortage of safe assets constitutes a “structural drag on the economy, undermining financial stability and straining monetary policy contractions.” Caballero & Farhi (2014a,b) study the implications of a safe asset shortage following the crisis onset (see also Landau 2014).

They study an economy with two types of agents: risk neutral agents (Neutrals) and agents who are infinitely risk averse (Knightians). Assets come from Lucas trees, which have risky dividends. However, trees can be tranced into risky assets and safe assets. In equilibrium, Knightians hold the safe assets and Neutrals hold the risky assets. In the crisis, there was a sudden demand for safe assets but, simultaneously, a sudden reduction in safe assets. During the financial crisis, government-sponsored enterprise debt and AAA subprime MBS were no longer considered safe. The usual equilibrating mechanism for the market in safe assets would be a reduction in the real interest rate and accommodation by central banks via lowering of nominal rates. Caballero & Farhi (2014a,b) show that, when a shortage of safe assets pushes the economy up against the zero lower bound, the usual mechanisms for equilibration and policy effectiveness weaken or do not work at all. They describe this situation as a safety trap.

Figure 10 shows this situation. Initially, the economy is at point E with a positive interest rate. In the figure, there is a leftward shift in the supply of safe assets. This shift is the financial crisis. However, if there is some friction of the type normally included in New Keynesian models, then this adjustment requires a decrease in nominal interest rates. This decrease cannot happen if the economy hits the zero lower bound, as shown in the figure. The only equilibrium requires a reduction in the real interest rate—to zero in the figure. Agents have to reduce their consumption or investment, depressing aggregate demand. The only way to get out of the safety trap and to increase output is to reduce the demand for or increase the supply of safe assets. In a postcrisis economy, the private sector cannot produce safe assets. The economy eventually gets to point E'. At point E', the interest rate hits the zero lower bound and there is excess demand for safe assets. “It is our conjecture that the shortage of safe assets will remain a structural drag, pushing down real interest rates, putting pressure on the financial system, and straining monetary policy during contractions” (Caballero & Farhi 2014a, p. 120).

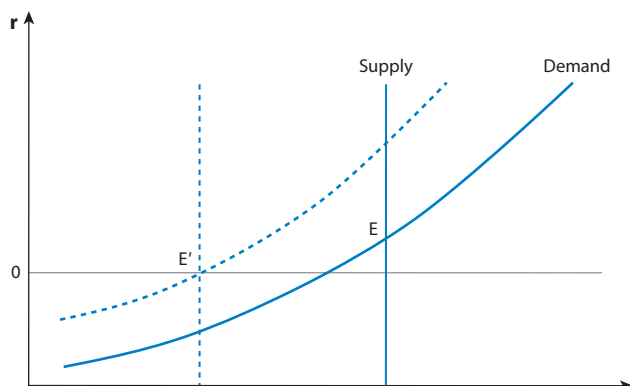


Figure 10

Supply and demand for safe debt as a function of the real interest rate. The initial equilibrium is point E. An exogenous reduction in safe debt hits the zero lower bound. Equilibrium E' is such that there is an excess demand for safe debt. Figure adapted with permission from Caballero & Farhi (2014a).

Benigno & Nisticò (2017) study a setting where there are multiple assets with different liquidity properties, modeled essentially as exogenous haircuts. Households only find out about the haircut at the time that they try to use the asset to purchase goods. Benigno & Nisticò (2017) are interested in what happens when an exogenous liquidity shock worsens the quality of some of the assets for use in exchange. The shocked assets—e.g., bonds—suffer a fall in price and a rise in yield because there is a shortage of safe assets. The shortage of safe assets means that the demand for consumption goes down. There are no nominal rigidities, so the price level falls. (If there are nominal rigidities, there would be a recession.) How should the central bank respond? The answer is, “To keep . . . prices on their target, the excess demand for liquidity should be filled by assets with a high degree of acceptance in exchange for goods” (Benigno & Nisticò 2017, p. 11). When there are financial intermediaries that produce the safe asset (at a cost), the shock to their deposits raises deposit rates. This in turn leads to higher lending rates. But there is still a shortage of safe assets. Again, an important role of the central bank is to supply safe assets.

The three studies discussed above focus on monetary policy when there is a shortage of safe debt due to an (unmodeled) crisis. What about the prevention of crises? Gorton & He (2016) study optimal monetary policy when collateral plays a real role in the economy. Their starting point is the situation in **Figure 5**, in which the financial sector has permanently changed into a system designed to meet the demands of the wholesale market for safe debt. Wholesale safe short-term debt requires collateral as backing. This collateral can be Treasuries or privately produced safe debt. In this new world, the quality mix of collateral in the economy is very important. Too low an amount of outstanding Treasuries results in an increase in privately produced collateral and a credit boom, and this situation increases financial fragility. In the previous retail-based market, this was not a concern because the dominant form of safe debt, demand deposits, was insured. In the retail-based system, it was still the case that there was a convenience yield on Treasuries, but this is much more important in the wholesale system. This leads to the fundamental observation that, in the wholesale system, the central bank's open market operations exchange one form of money for another: Treasuries for cash. The fundamental real-world friction at the root of the

Gorton & He (2016) model is that cash cannot be securitized, which makes cash and Treasuries distinct and not substitutes for each other.³³

Gorton & He's (2016) setting is an infinite-horizon game between the central bank and many small households and firms. Households face a cash-in-advance constraint, and firms need collateral for production; collateral enters the production function, a reduced form for a consolidated financial and real sector. The model displays the trade-off that open market operations trade one kind of money for another: cash for Treasuries. The amount of cash in the economy affects inflation, and the amount of Treasuries in the economy affects the quality of collateral. In this model, MBS are endogenously produced (there is a demand for housing by households) depending on the amount of Treasuries outstanding. If there are not enough Treasuries, the private sector produces MBS—a credit boom.

However, if the ratio of MBS to Treasuries rises, the likelihood of a financial crisis increases. The central bank, in this model, understands this and maximizes the utility of the representative agent plus a term that depends negatively on the ratio of MBS to Treasuries. Although the central bank's objective function could be modeled as a Ramsey problem, adding the extra term shows clearly the linkages in the economy. In this model, the central bank sometimes acts to tighten and reduce economic activity to avoid a higher likelihood of a financial crisis. A recession is triggered to reduce the likelihood of a crisis. Sometimes, the opposite can occur.

8.2. Current Federal Policies

It is too early to evaluate recent Federal Reserve policies from the point of view of the subject of safe debt. The effects of the Federal Reserve's large scale asset purchases (LSAP) are "likely not net zero in terms of its effects on the overall amount of safe debt and liquid assets available for private investors" (Krishnamurthy & Vissing-Jørgensen 2015, p. 579). LSAP contribute to a shortage of safe assets but may still have the beneficial effects claimed for them. The LSAP replaced the assets purchased with cash, held by banks as reserves that bear interest from the Federal Reserve. However, the overnight reverse repo operations (ON RRP) allow for some of the safe assets on the Federal Reserve's balance sheet to re-enter the economy. Frost et al. (2015, p. 1) state that "an ON RRP facility could have repercussions for financial stability. These might include beneficial effects arising from the increased availability of safe, short-term assets to investors." This effect is limited, though, because the repo contract is limited to overnight, so the best that can happen is that money market mutual funds can access the safe debt.

What are the effects these limitations? Replacing assets purchased with interest-bearing reserves creates the problem that Gorton & He (2016) raise, namely that interest-bearing reserves cannot be securitized, so they do not replace the assets purchased under the LSAP. The Fed's ON RRP provides a limited mechanism to receive safe debt (collateral) in exchange for cash, but only for money market mutual funds. But the agreement is only overnight, and the operational structure of the ON RRP restricts rehypothecation of bonds received for cash under the ON RRP system such that the collateral cannot circulate in the financial system; for example, the collateral cannot be used to post to central clearing parties or in the bilateral derivatives market. These are important topics for future research.

³³That is, cash cannot be securitized under the current institutional arrangements. If bonds could be issued against cash segregated into a single account at the Federal Reserve and earned interest on this cash as reserves, then cash could be securitized. This is not currently the case. Garratt et al. (2015) discuss segregated balance accounts but not securitization.

9. CONCLUSION

In this review, I have briefly touched on many topics, most of which deserve much more research.

The main point I have made is that safe assets play a critical and fundamental role in any economy and yet are associated with financial crises when the safety attribute of short-term debt comes into question. There are two ways to produce safe debt: A government may have credible taxing power to back its debt and its guarantees, and privately produced safe debt may have credible backing using privately produced collateral. But neither method is ironclad, and when they fail, i.e., when the NQA attribute is gone, it leads to a financial crisis or a sovereign debt crisis, or both. Financial crises occur in all market economies because the production of safe debt is inherently difficult, as history has shown (over and over again).

The technological and legal infrastructure and institutions for producing safe assets had to develop and continue to change over time; the forms of safe assets have changed through human history. But the essential role of safe assets is a constant. There has always been a demand for safe assets, and a lack of safe assets constrains transactions and consumption smoothing. Sovereign debt is not always safe and can lead to sovereign debt crises. When there is a shortage of publicly produced safe assets, the private sector produces substitutes. This becomes a source of systemic fragility when the safe assets are debt.

The financial crisis of 2007–2008 dramatically revealed the importance of safe debt. The crisis demonstrated that the economy has evolved, changing from a system based on insured demand deposits to one based on the demands of a different clientele, wholesale investors. New forms of privately produced safe debt have emerged to meet the demands of wholesale investors, a continuation of the evolution of safe assets through human history.

Because the banking system appears to have permanently changed from a system based on insured demand deposits to one that is based on the demands of wholesale investors, attention has shifted to issues concerning safe debt. New legislation and regulation have not solved the problem of the vulnerability of this wholesale system to runs. Given this, there appear to be important implications.

First, there are implications for macroeconomics, which has historically not been concerned with the financial sector or financial crises, i.e., with the implications of the systemic vulnerability of safe debt and the mix between public debt and privately produced safe debt. The period from 1934 (when deposit insurance was implemented) to 2007 was a unique period in US history. The financial crisis of 2007–2008 suggests that the United States may have reverted to the earlier history. A macroeconomics that does not address, explain, and incorporate credit booms and financial crises will not be of much use.

The second set of implications is for monetary policy because open market operations exchange one type of money for another: cash for Treasuries. When the financial system is significantly dominated by institutions desiring wholesale safe debt, the mix of the different kinds of money (cash and Treasuries) has implications for financial stability. There can be no returning to normal because the financial system has permanently changed.

Third, for bank regulators, if Treasuries are a product sold around the world, then the US investors will have to rely on privately produced safe assets, creating fragility. This is not just a matter of trying to make banks safe because, depending on those regulations, a new shadow banking system can develop.

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