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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. That is, 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 easily be used to exchange for goods or services or to exchange for another asset. These short-term safe assets are money or money-like. A long-term safe asset can store value over time or be used as collateral. 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 debt, are subject to runs and this has important implications for macroeconomics and for monetary policy.

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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. And, safe assets can also be used to store value through time. Historically, the quintessential safe asset was a gold coin. Such coins were imperfect in performing the role of a safe asset. Starting roughly in the 18th century certain types of debt came to prevalently serve as safe assets. Some government debt and some privately-produced debt came to be used as safe assets.[1] Safe assets perform a critical role in the economy and have implications for transactions and savings efficiency, financial crises, aggregate macroeconomic activity generally, 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. The subject, even if visible at all, seemed irrelevant. In a sense, safe assets did not show themselves to be important. But, starting in the late 1970s the U.S. financial system underwent a significant transformation in which the role of demand deposits declined dramatically and short-term wholesale funding became very sizeable and hence important. The financial crisis of 2007-2008 showed, once again, that privately-produced safe assets (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.

And, 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 and mortgage-backed securities (ABS/MBS). The outcome of this – short-term privately-produced debt backed by long-term privately-produced debt -- was the financial crisis, a devastating event in terms of human costs. So, now more attention is 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)). Producing 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.[2]

Safe assets, whether coins made of precious metals or some forms of public or privately-produced debt, are the life blood of an economy. No wonder 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, Gorton and Holmström (2015) 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

[1] Throughout the paper I will say "safe asset" even when the asset is privately-produced debt and cannot literally be "safe". Privately-produced debt obviously cannot be a perfect substitute for U.S. Treasuries. But, I will say it is "safe" meaning that the private sector has produced debt that is as close as possible a substitute.

[2] Fiat money is a safe asset except for inflation. I do not include fiat money in the discussion here.

this sense. Privately-produced debt can also have this property, but not always because it cannot be riskless like, say, U.S. government debt. In the modern era, say the last 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 and safety, and so 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 and Vissing-Jørgensen (2012) find that the yield on U.S. Treasuries over 1926-2008 was, on average, 73 basis points *lower* than it otherwise would have been, due to the "moneyness" and safety of U.S. Treasury securities; this is the convenience yield. The existence of a convenience yield implies that U.S. Treasuries are non-Ricardian (Barro (1979a) and Gorton and Ordoñez (2013)). And, privately-produced substitutes, ABS/MBS, also provide a convenience yield. The implication is that these forms of safe debt have a special role in the economy.

Privately-produced short-term debt has the defect that it is always 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). They 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, though countries can go for fairly long periods without a crisis. They are not 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 an issue of whether or not 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 moneyness 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. This was not so 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 on money, each kind of money with different implications: one related to inflation, cash, and the other related to financial stability, Treasuries.

The paper 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 contributed to safe asset production over time. Section 3 then details the attributes that makes debt safe. Section 5 describes different types of safe debt. The special qualities of safe debt imply the existence of a convenience yield,

which is the subject of Section 6. The regulation of the production of privately-produced safe debt is very briefly discussed in Section 7. The macroeconomic implications of safe debt are the subject of Section 8 and Section 9 looks at the implications for monetary policy. Section 10 is a conclusion.

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, very briefly survey this history and voluminous literature.[3] The main point is that the production of safe assets is 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.

A. Coins Made of Precious Metals

Precious metals in the form of coins played the role of safe assets through most of human history, unless heavily clipped or debased, two problems that could lead to the collapse of a coinage system.[4] Coinage was desirable in times of stress and could be used to pay off debt.[5] 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 under-issued coins. There were also many counterfeit coins. But, 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. There were numerous problems. One problem was the shortage of small change and often bewildering numbers of different units of denomination, especially around ports where foreign coins entered via foreign sailors. See Sargent and Velde (1999) and Carothers (1930). But, there were other problems such as debasement, the reduction of the metallic content of the coins below the coin's face value (see Munro (1988, 2012), Rolnick, Velde and Weber (1996) and Gandal and Sussman (1997)). The coin producer (government or private) at the mint knew and controlled the

[3] I want to alert the reader to the extreme brevity of this historical summary. For reasons of space and language, my brief summary focuses on Europe and the U.S., 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 paper currency (in the 13th century), competitive issue of bank notes, and a government monopoly on paper currency. On China see, e.g., Peng (1994), Kaplan (1994), Yang (1952) and Tullock (1957), and generally a survey by Davies (2002). Classic monetary histories for Europe include Cipolla (1967) and Vilar (1969). The summary is also confined to the relatively recent past, starting in the 17th century. The history of the prior period is also interesting and important. Examples include Botticini (2000), de Roover (1942, 1999) and Postan (1928).

[4] The field of numismatics is a very specialized area of scholarship and plays little role in (current) economic history. One introduction is Howgego (1995). Also, see Velde (2013).

[5] Coins, of course, were not the only early form of safe assets. Before coins commercial transactions involved jewels, jewelry, vases, statutes etc. So, it is not clear when a valuable object used in trade becomes "money." Also, for example, in early America wampum was very important. See Herman (1956) and Shell (2013). There is a huge literature on primitive money; see, e.g., Einzig (1948) and Quiggin (1949).

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) and Kindleberger (1991)).[6]

Another problem was coin clipping, shaving metal from the coin's circumference; there was also "sweating," shaking the coins in a bag to collect the dust that had worn off. Vallavine (1741): "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" (p. 2). Mate (1972) discusses the epidemic of coin clipping; "As a result of all these activities—coin clipping, the manufacture of 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" (p. 40-41). In some instances, this led to a monetary crisis and eventually recoinage, for example, the crisis from 1619 to 1623 (see Kindleberger (1991)).[7] Indeed, financial crises occurred fairly frequently in Europe in the 18th century; see, e.g., Ashton (1959) and Hoppit (1986).

So, coins were not generally 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), Gandal and Sussman (1997), Nightingale (1985) and Oddy (1983)). Weighing coins required that the scales be fair, another problem. Eventually, the government certified 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, not necessarily government banks, but embryonic central banks. From the fifteenth century on these institutions sought to create money-like liabilities in a credible way, but this was not always successful. The "money" created by these banks might have been a demandable bank deposit, bond, time deposit, an equity-like claim, or circulating notes (see Roberds and Velde (2016) and Ugolini (2011)). But, problems remained. For example, Checkland (1969): "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" (p. 155).

[6] Hill (1922) explains the technologies successively used to make coins.

[7] The technology of milling coins was introduced in England. Milling coins means making the coins from a machine, a process which replaced the process of hammering coins into shape. Coins with milled edges could have uniformly serrated edges so they were less likely to be clipped. But then the silver content of the milled coins was greater than that of the clipped coins, driving the milled coins out of circulation.

Still, even today gold is considered a safe asset; see, e.g., Baur and McDermott (2010), Baele, Bekaert and Inhelbrecht (2014), and Rickards (2016).

B. 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, bills of exchange (all the forms were, however, exchangeable into coins!). Davenant (1698): "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" (p. 161-162).[8] In this subsection we 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), and de Roover (1999). And, these bills could also be in small denominations in areas where there was a shortage of coins (see Ashton (1945)), or larger denominations related to trade. But, these latter bills could also circulate. Anderson (1970) describes the transferable bill as "a decisive turning-point in the development of the English credit system" (p. 90). Over time, the legal infrastructure developed to make these bills credible forms of safe debt (see Rogers (1995) and 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 here is that the bill could circulate. Ashton (1945) 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. (p. 25)

Figure 1 (from Santarosa (2015)) 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.

When a bill circulated, each successive party endorsed it, assuming liability for the ultimate cash payment if the debtor were to default at maturity. Maturities were usually two, three, six or twelve months (see

[8] "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" (p. 5725); *Spink & Son's Monthly Numismatic Circular* (1903). Also see Lawson (1850, p. 16).

Ashton (1945, p. 25)). That there was a high velocity is attested to by the number of endorsements (see Ashton (1945) and 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.

Bills of exchange were vulnerable to runs, and this 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 and 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 and Roberds (2015) and Schnabel and 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 pawn-brokers began issuing notes, orders, and bills (see Richards (1927), Heal (1935), Quinn (1997) and Temin and Voth (2006, 2013)).[9] Goldsmiths had safes, which were expensive.[10] 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 point 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. Thornton (1807): "[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." (p. 32). These were two different forms of "backing" the debt.

Goldsmiths also allowed their customers to draw drafts on demand (see Hilton Price (1881)). But, demand deposits had their origin with merchant bankers in London in the 17th 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 bearer. Such instruments required a legal infrastructure and this developed in the late 17th and 18th centuries. For example, the practice of endorsing a check over to a third party took some time to develop legally. So, the innovation allowing these private debt claims to function was legal. See Rogers (1995).

Convertibility, or short maturity, is important so these debt claims can be used to monitor the issuers, i.e., check if the backing collateral is sufficient.[11] The debt is backed by collateral that is either precious metals, in the case of goldsmiths, or real property, in the case of bills of exchange, and eventually loans, in the case of deposits. But, 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

[9] Early checks were not widespread, see Horsefield (1952). Also, see Usher (1967).

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

[11] See Calomiris and Kahn (1996) and Diamond and Rajan (2000) who provide theoretical rationales for this convertibility option.

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, we discussed above that the joint liability of the endorsers to the bill meant that the backing collateral was their assets. A related contract design to assure creditors was unlimited liability, as 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, Scottish banks faced unlimited liability.[12] Although not without problems (see, e.g., Goodspeed (2016)), overall the system appears to have been a success. Although there were bank failures, no losses were suffered; see Douglas (1975, p. 2). Adam Smith reported in 1776 that "the business of the country is almost entirely carried on by means of the paper lf those different banking companies . . . silver very seldom appears . . . and gold still seldomer" Smith (1812, p. 442).

Other institutions designed to maintain the integrity of circulating bank debt include monitoring systems such as the U.S. pre-Civil War Suffolk bank system in New England (see, e.g., Calomiris and Kahn (1996) and Mullineaux (1987)). Prior to the U.S. Civil War, banks issued their own private bank notes. In Free Banking states, these notes had to be backed by state bonds, while in other states the backing was bank loans. These bank notes traded at par only within a short radius around 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 insurance. In the U.S. 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) and Calomiris (1990). Some other states followed the example of New York, but ran into similar problems. After the Panic of 1907 some U.S. 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., Canon (1910), Timberlake (1984) and Gorton and Mullineaux (1987).

C. Government Debt

The production of safe debt by sovereigns took centuries to develop. Embryonic nation states began borrowing in the 13th century, but repayment was a problem since it depended on confiscation of land, repayment in worthless currency, or having 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. Indeed, prior to 1770 financial crises were about sovereign debt, and after 1770 crises often involved both public and private debt.

[12] Three banks, the Bank of Scotland, the Royal Bank of Scotland, and the British Linen Company had limited liability, granted by the Scottish Parliament. See Checkland (1975).

The development of credible safe government debt occurred in England, as described by Dicksinson (1967) (also see Hamilton (1947)). In a famous article, North and Weingast (1989) argue that the key change making promises to repay English public debt credible was the rise of Parliament's power relative to the king's power. Power-sharing institutions essentially forced the King to commit to not renege on the government debt. However, Sussman and Yafeh (2006) argue that the cost of government finance did not go down right away, but took time to reflect the institutional changes. Stasavage (2002) argues that it was important that the holders of British government debt were important because they constituted an important partisan force. Also see Stasavage (2016). On France see Velde and Weir (1992) and Conklin (1998) on Spain.

Still, further development occurred in the 19th century before sovereign debt could be viewed as safe. Flandreau and Flores Zendjas (2009) study the period of 1820-1830 and argue that governments relied on the reputations of financial intermediaries to issues debt. Also see Flandreau and Zumer (2004).[13]

D. Summary

Early forms of money, whether coins or short-term debt, evolved over time toward forms that could be used efficiently for transactions and for storing value. Information about the value of a coin had to be produced, as it was never obvious that it was worth its face value. Bank debt took a number of forms that were designed to convince users that there was sufficient backing for the debt that no information production was necessary. Unlimited liability, joint liability, monitoring and mutual monitoring, backing by state bonds, were all ways to do this. The commonality is that all short-term bank debt was based on the option to convert the debt into currency, or was so short-term as to amount to the same thing. But, none of the institutional and contractual features that evolved overcame the vulnerability to bank runs. Bank runs were a common and persistent feature of the economic landscape by the late 18th century.

3. Privately-Produced Safe Debt and Government-Issued Safe Debt

The above brief history suggests attributes that an asset must have to be "safe." Historically, it has been hard 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 there 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 been different types of debt, usually mortgages as land usually preserves value. This section focuses on more details, identifying and discussing the attributes of public and privately-produced debt that make debt "safe." Since 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 try to be clear here by saying a bit more.

[13] Ratchford (1947) discusses the case of the United States.

A. 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's bonds) and AAA asset-backed securities. 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.[14] 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 return that bond would paid if these nonpecuniary returns did not exist but everything else was constant. We return to the convenience yield below.

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 a AAA U.S. corporate bond and a U.S. Treasury of (roughly) the same maturity will be positive because corporations are riskier than the U.S. government. If both are also valued for their safety but Treasuries more so, then there would be a higher demand for Treasuries become Treasuries are scarce (ceteris paribus), so agents would bid up the price of Treasuries, lowering its yield relative to the AAA corporate, suggesting that there is a component of the spread which is due to convenience. Krishnamurthy and Vissing-Jørgensen (2012) look at this, as discussed below.

B. 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 backs this promise, perhaps land, a portfolio of loans, a bond, etc. 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. While this is all true, it does not necessarily add up to debt being "safe."

There are different notions of "safe." In Diamond and Dybvig (1983) bank debt is 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 and Dybvig posit this maturity mismatch as an inherent feature of an economy and 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 consumer (a need

[14] 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. Also, see Amihud and Mendelson (1991).

for “liquidity”). Agents with no such need wait for the real investment to payoff. 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. But, Diamond and Dybvig (1983) show that such debt is vulnerable to runs, requiring deposit insurance to make it safe in order to reliably smooth consumption.

Holmström and Tirole (1998, 2013) think of liquidity as being “pledgeable” cash flows, assets with cash flows that are readily verifiable. “Pledgeability” is at the root of all debt instruments because they 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 the property that the cash flows are “pledgeable” provide insurance against possible bad events in which agents need “liquid” instruments. In Holmström and Tirole (1998) “safety” refers to “instruments (market and nonmarket) that can be used to transfer wealth across periods” (p. 2). 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 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, marketable securities, or 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, an inefficiency. A bank can resolve this problem; it can hold the liquidity and distribute it to firms in need if the face a shock, via credit lines for example. 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 (discussed further below).

In both Diamond and Dybvig (1983) and Holmström and Tirole (1998), 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. In Diamond and Dybvig (1983) and Holmström and Tirole (1998), 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 in Diamond and Dybvig most resembles demand deposits and the debt in Holmström and Tirole looks most like a security a marketable asset or a line of credit with a bank, but in any case it 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.

Another concept of safe debt is that it can be used without fear of being taken advantage of by privately-informed agents in transactions. Such debt is produced by banks. This is the argument of Gorton and Pennacchi (1990). By tranching cash flows, information is also tranched, (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 and Pennacchi (1990) argue that this is the importance, and specificity, of bank debt.

In Gorton and Pennacchi (1990) the debt produced by banks is riskless. The form of the contract, 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 and Pennacchi (1990) equated "liquidity" with the idea of 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 "no questions asked" property) so that it can be used efficiently for trade.

In Gorton and Pennacchi (1990) bank debt is riskless and the asset side of the bank balance sheet does not play much of a role. More generally, there is the question of how banks produce safe debt. What are the inputs? How are they chosen? These issues are addressed by Dang, Gorton, Holmström, and Ordoňez (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 just accept the money NQA. This can be accomplished if the bank makes loans that are costly for outsiders to learn about, loans like consumer loans and loans to small businesses. Large firms go to capital markets.

C. Information-Insensitive Debt

One characteristic needed for short-term safe debt is the NQA property. 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 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) while the second characteristic is associated with long-term debt. However, as discussed below, long-term debt is used as collateral for short-term debt.

Why is the contractual form debt? This question is addressed by Dang, Gorton and Holmström (2013) and Holmström (2009, 2015). Dang, Gorton and Holmström (2013) (DGH) 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. Agent C can produce private information at a cost. Agent B wants to obtain a known and fixed amount after trading with 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?

DGH show that the optimal contract that agent B offers agent C is debt. Some intuition for why debt is optimal comes from Figure 2 (from Holmström (2015)). 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.

The implication of this is that debt is designed to keep the collateral value (the "state of the world") secret. As we saw above, this can be done by increasing the collateral value with joint liability, monitoring, etc. As we will see below, 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.[15]

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, ABS/MBS, refers to the AAA tranches. The transition from information-insensitive to information-sensitive corresponds to a rating 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.

D. Collateral

The main result in DGH, 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. DGH show that "debt-on-debt" is the optimal contract. The intuition is roughly 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 s high-grade (U.S. Treasury of 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 and so on) will also be debt.[16] So, short-term safe debt means that long-term safe debt is needed for collateral. For example, in Free Banking states in the U.S. 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 and Weber (1983, 1984)). Demand deposits are backed by portfolios of loans, and are over-collateralized to the extent that the bank has equity. National Bank notes, issued by banks in the U.S. during the period 1863-1914, were required to be backed by U.S. Treasury bonds. Sale and repurchase agreements (repo) are backed by a specific bond that the lender takes as collateral. Asset-backed commercial paper was backed by ABS/MBS, which themselves were backed by bank loans.

E. Financial Crises

[15] This is the same as Townsend (1979) although that setting does not involve trade.
[16] In the case of insured demand deposits, the "collateral" is the taxing power of the government.

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

The DGH 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 NQA attribute becomes suspicious; there are questions 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 U.S. National Banking Era and shows that a panic occurs when a leading economic indicator unexpectedly exceeds a threshold. There is no panic without the threshold being exceeded and the threshold is never exceeded without there being a panic. A financial crisis corresponds to short-term debt switching from information-insensitive to information-sensitive. Also see Gorton and Metrick (2012).

Figure 3 portrays a suggestive example of the switch from information-insensitive to sensitive debt at the start of the crisis in the Euro zone. Sovereign bonds which were perceived to be safe, i.e., information-insensitive, became sensitive, meaning that information is produced such that the degree of "safeness" is 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 insensitive debt? Notably, the answer is *not* to make debt more information-sensitive by revealing the state of individual bank's backing collateral. Quite the opposite. 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.[17] See Gorton and Tallman (2015).

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 towards government collateral and away from privately-

[17] In this period the New York City Clearinghouse Association solvency was essentially equivalent to the solvency of the entire system.

produced collateral. It 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 and Ordonez (2016b).

Understanding the logic of the response to financial crises, which has developed over the past 250 years, is instructive for understanding what the crisis is about to begin with.

4. Types of Safe Debt

Safe debt can be sovereign debt (although obviously not all sovereigns can produce safe debt) or privately-produced safe debt.[18] Safe debt can be short-term or long-term. Gorton and Metrick (2010) outline two ways to create safe debt. First, debt that is credibly backed by the government, 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 also on contracting (i.e., legal) technology.[19] Privately-produced safe debt has taken the form of goldsmith notes, bills of exchange, bank notes, demand deposits, certificates of deposit, commercial paper, sale and repurchase agreements, to name a few. But, aside from financial histories there is little work (and little data) on the relative size of the components of safe debt and how they change through time.

A. Overview

At the aggregate level, Schularick and Taylor (2012) constructed a data set on money and the banking sector of fourteen major economies since 1870. They show that the ratio of broad money, M2 or M3, to GDP was relatively stable until World War II, after which it rose sharply. They label the post-war period the "second financial era" because of this growth.[20] It is not clear though whether the composition of the bank liabilities changed over the period they study.

For the U.S. more can be said about the components of safe debt. Figure 4, from Gorton, Lewellen, and Metrick (2012) (GLM), shows privately-produced safe debt and U.S. Treasury debt outstanding (in the hands of the public) as a percentage of total assets in the U.S. 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, repurchase agreements ("repo"), short-term interbank loans, U.S. Treasuries, agency debt, municipal bonds, securitized AAA debt, and high-grade financial-sector AAA corporate debt. Long-term

[18] Due to space limitations, I omit discussion of a small, but interesting, literature that looks at bubbles as safe assets. See, e.g., Caballero and Krishnamurthy (2005), Gourinchas, and Jeanne (2012), Farhi and Tirole (2012) and Martina and Ventura (2015).

[19] Garbade (2012), for example, examines the evolution of the U.S. Treasury market, exploring the problems and solutions as this market evolved.

[20] Jordà, Schularick and Taylor (2014) examine disaggregated data for seventeen advanced economies since 1870. The main finding is that there has been a sharp rise in mortgage lending during the 20th century, when banks' balance sheet doubled in size. But, it is not clear what bank liabilities financed this.

debt, the last five categories of debt, is often used as collateral in repo transactions and the asset-backed commercial paper market, or to safely store value through time.

With respect to this figure, GLM (2012) make two points. First, It is notable in the figure that over this almost 60 year period, the fraction of total "safe" liabilities to total assets in the economy is persistent at around 32 percent, suggesting a stable demand for safe debt (as a ratio of total assets). Second, the privately-produced safe debt component has always been substantial.

Figure 5, from GLM (2012), shows the composition of the privately-produced safe debt in the U.S. as a percentage of total privately-produced safe debt in the United States, since 1952. The figure shows a very significant transformation of the U.S. financial system starting roughly in the mid-1970s. Demand deposits were the dominant form of safe debt for roughly the first 25 to 30 years, starting at nearly 80 percent of the total and remaining high at 70 percent 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, 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 is 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 below.

In the period before the crisis there was a build-up of safe debt in the form of asset-backed securities (including mortgage-backed); see Bertaut, DeMarco, Kamin and Tyron (2012). Securitization collapsed during the crisis, so this source of safe debt has all but disappeared. Betaut, Tabova and Wong (2014) examine the supply and demand of safe debt since the financial crisis of 2007-2008. They have a number of interesting findings. First, they show that post-crisis, the (high grade) foreign financial sector has produced and supplied safe debt to meet U.S. demand for safe assets. And, a large portion of this 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 U.S. foreign portfolio of high-grade dollar-denominated bonds, whereas pre-crisis this share was 8% pre-crisis. 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."

Other countries similarly display a relatively constant demand for safe assets. Gourinchas and Jeane (2012) calculate safe asset shares for Japan, England, German and France. The share of safe assets to each country's GDP is quite stable and comparable to the U.S. After 2002 there is a rise in safe assets with most of the increase in the demand for safe assets coming from within the financial system (except for Japan). Most of the increase in demand for safe debt came from foreign financial institutions and foreign official agencies. Holdings of U.S. safe assets (SDRs, currency, Treasuries, and municipal debt) by the rest of the world went up significantly. (This is discussed further below.)

B. Sovereign Debt

Holmström and 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.[21] Caballero and Farhi also provide a rationale for government debt, discussed below.[22]

Today, the sovereign debt of some countries is safe debt and is used globally as a mechanism for storing value.[23] Modern government debt issuance amounts and the outstanding amount 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 is never enough U.S. Treasury debt, which is the motivation for the private sector to produce substitutes. Below the shortage of safe government debt is discussed, as is the foreign demand for U.S. government debt.

In the last forty years or so there has been an enormous demand by foreigners for U.S. Treasury Debt. See Figure 6. Bernanke, Bertaut DeMarco, and Kamin (2011): ". . . a large share of the highly rated securities issued by U.S. residents from 2003 to 2007 was sold to foreigners—55 percent. This share was even higher than in the 1998-2002 period—22 percent—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.)" (p. 8). And Maggiori (2013): "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" (p. 2).

The foreign demand for safe assets is motivated by a desire to store value. Gourinchas, Govillot and Rey (2014): " . . . we 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 literature. See, for example, Caballero (2006), Bernanke (2005, 2007), Caballero and Krishnamurthy (2009); Gourinchas, Govillot and Rey (2010), Bernanke, Bertaut DeMarco, and Kamin (2011), Bertaut, DeMarco, Kamin, and Tyron (2011), Gourinchas, and Jeanne (2012), among others.

Foreign demand for U.S. safe government debt and U.S. agency debt has contributed to a domestic U.S. shortage of safe assets. For example, prior to the crisis the Bank for International Settlements (2001) noted: "The increase in collateralized transactions has occurred while the supply of collateral with

[21] An earlier literature is also relevant, Issues to do with government debt—set of issues not discussed here, e.g., Diamond (1965), Woodford (1990). Woodford (1990) shows the value of government debt in a neoclassical economy where agents are liquidity constrained.

[22] These rationales are for safe government debt. See, e.g., Woodford (1990), which implicitly assumes that government debt is safe.

[23] He, Krishnamurthy and Milbradt (2015) provides 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.

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" (p. 2). Gorton and Muir (2015) provide some direct evidence of this shortage. The implications of this are discussed below.

C. 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. With shortages developing when the economy transformed 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. Gorton and Metrick (2012b), Gennaioli, Shleifer, and Vishny (2011), Stein (2010), and others, argue that one of the main purposes of securitization is to produce safe assets.

Securitization is the private production of safe debt. Securitization 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. Gorton and Metrick (2013) provide a survey of the literature on securitization. Also, see Gorton and Souleles (2006). This section is only a brief summary.

As we saw in Figure 5, with demand deposits declining and other forms of privately-produced safe debt growing, it became necessary to produce safe debt to back money market instruments. This was particularly true because of the foreign demand for U.S. Treasuries and agency bonds (see Figure 6).

Securitization was driven by a shortage of long-term safe debt. The AAA/Aaa tranches of ABS/MBS were viewed as safe debt and, as discussed below, have a convenience yield. Xie (2012) finds that, on average, 86.3% of an ABS/MBS deal was rated AAA.

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, and less so now. In other words, if we wanted to conduct a Monte Carlo analysis of an ABS/MBS we would have to know the riskiness of different characteristics of the borrowers, and 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 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 is very information-insensitive. An ABS/MBS is a bond backed by a portfolio of loans.

Below we will see some evidence of the convenience yield on 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. There should be implicit recourse to the banks (see Gorton and 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 *Financial Times*, June 24, 2009). In the same spirit, Albertazzi, Eramo, Gambacorta and Salleo (2011) study a 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 non-securitized ones. We show that this finding is consistent with banks caring about their reputation for not selling lemons" (p. 33).[24] On the other hand, 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 it. Examining whether there is a convenience yield empirically is important for verifying that the attributes of safe debt are valued in nonpecuniary ways, that safe debt is special in this sense.

A. Measuring the Convenience Yield and its Components

Figure 6, from Krishnamurthy and Vissing-Jørgensen (2012), shows the yield spread between Aaa-rated U.S. corporate bonds and Treasury securities (on the y-axis) and the ratio of U.S. government bonds outstanding to U.S. 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 than do Aaa-rated corporate bonds. The basic intuition that comes from Figure 6 is econometrically confirmed for a variety of spreads by Krishnamurthy and 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 three month commercial paper and three month Treasury bills and find similar effects.

The Krishnamurthy and 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 U.S. Treasuries to GDP. The magnitudes of the response of the long-term spreads (AAA to Treasuries and BBB to Treasuries) and the short-term spreads (the highest rated commercial paper to T-Bills and a lower rated commercial paper yield to T-Bills) are basically the same.

[24] On the other hand, securitizations of subprime mortgages seems to have been accompanied by a decline in lending standards.

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

Greenwood, Hanson and Stein (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, Hanson and Stein (2015) show this by calculating the difference between actual Treasury bill yields and fitted Treasury yields. Figure 8 is from Greenwood, Hanson and Stein (2015). It shows the average spread, over the period 1983 to 2009, between actual Treasury bill yields (on-the-run Treasury bills with maturities from one to 26 weeks) and fitted yields (based on a flexible extrapolation of the Treasury yield curve from Gurkaynak, Sack and Wright (2007)). The figure shows large differences, e.g., for the one-week bill, the difference is about 60 basis points. The authors interpret this is a premium for moneyness and show how the premium varies with the mix of T-bills and longer-term government debt. Relatedly, Greenwood and Vayanos (2014) find that yields on short-term Treasuries decrease relative to long-term Treasuries when the supply of short-term bills decreases. Amihud and Mendelson (1991) and Duffee (1996) have also noted that the yields on T-bills are low relative to those on longer-term U.S. Treasuries.

Carlson, Duygan-Bump, Natalucci, Nelson, Ochoa, Stein and Van den Huevel (2014) look at an interesting experiment to distinguish the convenience components on short-term and long-term Treasuries. They examine the one-month holding period return relative to the overnight rate and examine Treasury bills with *n* weeks to maturity in excess of the one-week rate. The pattern shows that this spread increases sharply but 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. In Krishnamurthy and Vissing-Jorgensen (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 and Weisbach (2012) study collateralized loan obligations (CLOs). A CLO securitizes 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 way to interpret this result is that there was a strong demand for AAA debt and one way to produce is was by securitizing BB-rated loans (because this can create a large amount of AAA debt). The 17 basis points is the convenience yield.

B. 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 U.S. government Treasuries to use as safe debt, so the private sector has consistently produced the bulk of it (at least in the U.S.). 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 and Tirole (1998, 2011) show a connection between the supply of liquid securities supplied by the government and the amount privately-produced. Holmström and 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, Lewellen, and Metrick (2012) show that government debt and privately-produced safe assets in the U.S. are strongly negatively correlated. Krishnamurthy and Vissing-Jørgensen (2012) also document this negative relationship between the supply of privately produced safe assets (by the U.S. financial sector) and the supply of U.S. government debt. Krishnamurthy and Vissing-Jørgensen (2012) show that the outstanding amount of U.S. Treasuries to GDP have large impacts on a variety of yield spreads corresponding to measures of liquidity and safety. Krishnamurthy and Vissing-Jørgensen (2015) then show that a shortage of Treasuries, causing an increase in measures of the convenience yield, leads to an increase in short-term debt issued by the private sector. Consistent with the crowding-out/crowding-in view of government debt, Greenwood, Hanson and Stein (2015) show that changes in government debt maturity choices affects private-sector debt maturity choices. Also, see Carlson, Duygan-Bump, Natalucci, Nelson, Ochoa Stein and Van den Huevel (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 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 asset-backed commercial paper (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.

C. 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 and Tirole (2001) in a paper 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 . . ." (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 collaterizable assets are in short supply and 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. While asset prices in the model are driven solely by the agency problem, it is quite rich and suggestive.

Another direction 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 collaterizable assets that are privately-produced depends on their 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 a liquidity constraint, then they might not be able to respond to a change in the convenience yield. Asset pricing models that for these reasons view financial intermediaries at the center of asset pricing include He and Krishnamurthy (2012), Adrian, Etula and Muir (2014), Brunnermeier and Sannikov (2014), and Moreira and Savov (2016).

6. The Regulation of the Private Production of Safe Debt

Banks are universally regulated because they are opaque in order to produce short-term debt, which is vulnerable to runs. 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" meaning that there could be too much short-term debt creation with free entry into banking. This would create systemic fragility. See Alhadeff (1962), Stein (2012a), Shleifer and Vishny (2010).

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, and then banks must satisfy a multitude of requirements, capital and reserve requirements, and also restrictions on activities.[25] Because of the huge

[25] There are many issues to do with bank regulation and there is a large literature on the topic. I only scratch the surface here to note that the private production of safe debt has historically been regulated. See Macey, Miller and Carnell (2001), Grossman (2010, Chapter 6), Calomiris and Haber (2014) and Gorton (2010, chapter 5).

scope of this topic, I restrict attention to a very brief discussion of entry restrictions via charter requirements mostly in the U.S.

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 beyond 65 miles of London and with no branches in the city of London. See Broz and Grossman (2004). A similar approach was taken in America. In early America 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 1871, and the 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 charters via separate acts of legislation. See Hammond (1934). Later, the First Bank of the United States organized was in 1791 and the Second Bank of the United States was organized in 1817. These were two large monopolistic banks.

In pre-Civil War America, state legislatures eventually granted more charters. Weber (2006) found that 2,291 banks were in business in the U.S. sometime between March 24, 1782 and December 31, 1860. But the 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. According to Ng (1988), there was not much entry. And 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, passed in 1804 ("an Act to Restrain Unincorporated Banking Associations") was passed 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." See N.Y. Fireman's Insurance Co. v. Ely (2 Cowen, 711). Prior to this act, the right of banking was a common-law right, which could be exercised by individuals and non-chartered institutions. Once the law was passed, entering banking depended on having a charter. See Cleaveland (1857) and Symons (1983).

Regulated banks may also receive subsidies to the extent that entry is limited, 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."[26] 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 which would jeopardize their charter. See Marcus (1990). In this way, charter value helps align the banks' private propensities for risk-taking with the social goal of producing safe short-

[26] Informally, large banks are members of a "club" with the central bank and the club restricts entry, e.g., the Canadian banking system. The club is the source of the entry restrictions.

term debt. Saunders and 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 non-banks (e.g., money market mutual funds, junk bonds), and they faced deregulation (e.g., of interest rate ceilings and branching restrictions). U.S. 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). 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 and Rosen 1995). This has been documented by Keeley (1990). Keeley noted an increase in risk-taking and a decline in capital levels. Banks became less profitable; see Berger, Kashyap, and Scalise (1995). The shadow banking system developed coincidentally with the disappearance of charter value not by accident. As shown in Figure 5, this development was fairly long in the making, but it was not hidden. But, it was there for all to see.[27]

7. The Macroeconomic Implications of Privately-Produced Safe Debt

Financial crises are not rare.[28] 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, in the past and currently. If the recent financial crisis of 2007-2008 made one thing clear, it is that financial crises are not events of only historic interest. In the 17th century and before, financial crises were typically related to sovereign debt. Since then, a financial crisis is a run on privately-produced short-term debt such that the financial *system* is effectively insolvent. 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. So, there is an intimate connection between "safe" debt and aggregate economic activity.

A. Credit Booms and Aggregate Economic Activity

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

Jorda, Schularick, and Taylor (2011) study fourteen developed countries over almost 140 years, 1870-2008, and conclude that ". . . credit growth emerges as the single best predictor of financial stability." Laevan and Valencia (2012) study 42 systemic crises in 37 countries over the period 1970-2007 and reach the same conclusion. Gorton and Ordoñez (2016) 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. Also, see Mendoza and Terrones (2008),

[27] For example, Pozdena (1986) 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."

[28] See, e.g., Laevan and Valencia (2012), Cassis (2011) and Kindleberger (2006).

Desmirguc-Kant and Detragiache (1998). And there are many more papers with essentially the same finding.

Gorton and Ordoňez (2014, 2016) link credit booms to crises. In their setting short-term debt consists of collateralized loans from households to firms, abstracting from intermediation. In Gorton and Ordoňez (2014) the driving issue is whether lenders should produce 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 and Ordoňez (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 the shock. This has the effect that over time all the collateral comes to appear as collateral of average quality. And if the average quality is high enough, more and more firms will get loans, 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 and Ordoňez (2016) go further to 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 the remainder. With an agnostic definition of a boom, that three consecutive years of at least five percent average credit growth is the start of a boom which then continues until there are two consecutive years of non-positive credit growth, they find, as mentioned above that booms are not rare and that the average boom is ten 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 and Ordoňez (2014) mechanism (although now both borrowers and lenders can produce information, which is critical for the results), the average quality of firms' projects is declining over time until such date as lenders want to produce information, a crash.

In Gorton and Ordoňez (2016) 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 in the standard paradigm of business cycles of "deviations from trend."

Moreira and Savov (2016) build a dynamic macro model of shadow banking in which banks transform risky assets into securities that are "safe" in normal times but which become illiquid when there is an uncertainty spike. Investors require liquid securities in order 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; 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 labelled "shadow money."

There are two types of capital in the model. One type has high but risky cash flows, while the other type is low, but safe cash flows. The mix of capital in the economy is endogenous and depends on 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, and what drives the model is that agents learn about the probability over time based on the occurrence or non-occurrence of crashes. Agents' beliefs about the likelihood of a crash determines 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. Then it 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 de-lever 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 Gorton and Ordoñez (2016), the credit boom results in an increase in investment and output, but when the crisis comes it is worse to the extent that credit boom has been going on. In both Gorton and Ordoñez (2016) and Moreira and Savov (2016) there is an externality from the "money" produced during the boom, namely, the quality of the collateral is declining. This provides a rationale for government intervention.

B. Safe Asset Shortages and the Global Savings Glut

Consistent with the trends noted in Figures 5 and 6, Gourinchas and Rey (2007) show that the U.S. went from a larger creditor position in the early 1950s to a large to a large debtor position in the early 2000s. The turning point is around 1980 (see Gourinchas and Rey (2007) Figure 1).[29] Bernanke (2005), among others, noted the existence of the global savings glut, that is the net foreign asset position of the U.S. is

[29] Gourinchas, Rey and Govillot (2014) updates Gourinchas and Rey (2007).

negative and large: U.S. gross liabilities exceed gross assets—a persistent current account deficit. Caballero and Farhi (2014b) noted: "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 (see Figure 1)." And Caballero (2006) noted that the "world has a shortage of financial assets" and argued that this point could explain the global savings glut, low real interest rates, and low inflation.

Bernanke 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 the U.S. was essentially selling insurance to the rest of the world via the rest of the world buying U.S. Treasury and Agency debt. Caballero, Farhi and Gourinchas (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 U.S. portfolio. Gourinchas and Rey (2007) 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" (p. 21). This change has been interpreted as being consistent with the U.S. essentially selling insurance to the rest of the world in the form of safe debt (U.S. Treasuries and agency bonds). Gourinchas and Rey (2007)) and Caballero, Farhi and Gourinchas (2008), Caballero and Krishnamurthy (2009) and Maggiori (2013) provide models of this. In general these models provide a rationale for why the U.S. has a greater ability to handle financial risks.

The picture of the global savings glut is further complicated by another aspect. While the main focus 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. And further, Obstfeld (2012): "For the rich industrial countries, much of the expansion of gross external asset and liability stocks has necessarily taken the form of debt instruments" (p. 9). In fact, there are sizeable two-way debt flows, particularly between the U.S. and the U.K. and between the U.S. 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 U.S. These would net out, but then hide what was going on. These flows are discussed in detail by Bernanke, Bertaut, DeMarco, and Kamin (2011) and Bertaut, DeMarco, Kamin, and Tyron (2011).

The shortage of safe assets has continued. For example, the IMF *Global Financial Stability Report* (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 and Muir (2015) also provide evidence on the shortage. Bertaut, Tabova, and Wong (2014) show that post-crisis U.S. 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 post-crisis view of monetary policy continues to be that monetary policy should not be concerned with financial stability, credit booms or macroprudential issues, but should focus exclusively on inflation.[30] The proponents of this view have in mind that proposition that the central bank should not use interest rates to "prick" asset bubbles. Sometimes this viewpoint is presented as a practical problem: booms cannot realistically be identified, particularly for individual asset classes. Macroprudential issues, in this view, are best left to bank regulators and specially-tasked groups like the Financial Stability Board and individual countries' macroprudential bodies, such as the Financial Stability Oversight Council in the U.S. 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 incorporates the important features of the current financial system and financial crisis to argue that monetary policy should not be solely focused on inflation.

There are three 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 which is based on the demands of a different clientele, wholesale investors; again see Figure 5. Secondly, there is a convenience yield on Treasuries which cannot be perfectly replicated by private substitutes. And this is important in a system which 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. In this context, what implications are there for monetary policy, if any?

A. Monetary Policy and Wholesale Banking

Stein (2012) examines a world in which unregulated production of private money—short-term uninsured debt—has an externality.[31] Such bank money is special and this is modelled 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 (2012) then asks how this problem could be addressed. Suppose the regulator is imperfectly informed about the banks' investment opportunities. Then Stein (2012) shows examines a cap-and-trade system under which the regulator which 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 the regulator

[30] Recent articulations of this view include Bernanke (2015) and Svensson (2015). See Williams (2015) for further references.

[31] Stein (2014) takes the view that the risks of a financial crisis cannot be completely mitigated with conventional non-monetary tools.

knows the other parameters of the model (i.e., how the world works in general), by adjusting the quantity can the regulator can hit the market-clearing price consistent with the model.

Stein (2012) 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 increase the supply of reserves relative to T-bills is isomorphic to an increase in the regulatory limit on M [money] in the . . . cap-and-trade version of the model" (p. 80). This assumes that all banks in the system are subject to reserve requirements, which assumes the regulator know which firms are banks. Also see Stein (2014).

There was a shortage of safe assets prior to the financial crisis, but at the onset of the crisis this shortage took on even larger dimensions with implications for monetary policy. Caballero and Farhi (2014b) argue that the shortage of safe assets constitutes a "structural drag on the economy, undermining financial stability and straining monetary policy contractions" (p. 111). Caballero and Farhi (2014a, b) study the implications of a safe asset shortage following the crisis onset.[32]

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 tranched 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 there was a sudden reduction in safe assets. During the financial crisis GSE debt and AAA subprime mortgage-backed securities 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 by lowering nominal rates. Caballero and 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 9, from Caballero and Farhi (2014b), shows the 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. But, if there is some friction, of the type normally included in New Keynesian models, then this adjustment requires a decrease in nominal interest rates. And this 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 out of the safety trap to increase output is by reducing the demand for safe assets or increasing the supply of safe assets. In a post-crisis economy, the private sector cannot produce safe assets. so that the economy eventually gets to point E'. "It is our conjecture that the

[32] Also see Landau (2014): http://www.voxeu.org/article/why-euro-inflation-so-low .

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" (p. 120).

Gorton and He (2016) study optimal monetary policy when collateral plays a real role in the economy. Their starting point is the above Figure 5 that is the financial sector has permanently changed to 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, a credit boom, and this situation increase financial fragility. In the previous retailed-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 their model is that *cash cannot be securitized* which makes cash and Treasuries distinct, not substitutes.[33]

Their setting is an infinite-horizon game between the central bank and many small households/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 the 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.

But, if the ratio of MBS to Treasuries rises, the likelihood of a financial crisis increases. The central bank in the model understands this and maximizes the utility of the representative agent plus a term that depends negatively on the ratio of MBS to Treasuries. While 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 world, the central bank sometimes acts to tighten and reduce economic activity in order to avoid a higher likelihood of a financial crisis. A recession is triggered to reduce the likelihood of a crisis. And sometimes the opposite can occur.

B. Current Fed Policies

It is too early to evaluate recent Federal Reserve policies from the point of view of the subject of safe debt. The Fed's large scale asset purchases (LSAP) are " . . .likely not net zero in terms of its impact on the overall amount of safe debt and liquid assets available for private investors" (Krishnamurthy and Vissing-

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

Jørgensen (2015), p. 579). LSAPs contribute to a shortage of safe assets, but may still have the beneficial effects claimed for them. However, the LSAP replaced the assets purchased with cash, held by banks as reserves which bear interest from the Fed. On the other hand, the overnight reverse repo operations (ON RRP) allow for some of the safe assets on the Fed's balance sheet to re-enter the economy. Frost, Logan, Martin, McCabe, Natalucci and Remache (2015): ". . . 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 . . . " (p. 1).

What are the effects of this? Replacing assets purchased with interest-bearing reserves has the problem that Gorton and He (2016) raised, namely that interest-bearing reserves cannot be securitized, so they do not replace the assets purchased under the LSAP. The On RRP provides a mechanism to receive safe debt (collateral) in exchange for cash, but mostly only for money market mutual funds. The operational structure of the 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 it cannot be used to post as collateral to central clearing parties or as collateral in the bilateral derivatives market. These are topics for future research.

9. Conclusion

I have briefly touched on many topics. The main point is that safe assets play a critical role, a fundamental role, in any economy. In the modern era post 17th century system, safe assets take the form of debt. 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 privately-produced collateral. But, neither method is ironclad and when they fail, when the NQA attribute is gone, it is 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 technology, legal infrastructure, and institutions for producing safe assets had to develop and they change over time, and consequently so have the forms of safe assets 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 it can lead to sovereign debt crises. When there is a shortage of publicly-produced safe assets, the private sector produces substitutes. This the 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 revealed that the economy has evolved, changing from a system based on insured demand deposits to one which is 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 which is based on the demands of a different clientele, 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:

- For macroeconomics which has 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. In the U.S. the period from 1934 (when deposit insurance was implemented) to 2007, was a unique period in American history. The financial crisis of 2007-2008 suggests that the U.S. may have reverted to the earlier history. A macroeconomics that does not address, explain, and incorporate credit booms and financial crisis will not be of much use.
- For monetary policy because open market operations exchange one type of money for another: cash for Treasuries. When the financial system is very 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.
- For bank regulators: if Treasuries are a product sold around the world, then the U.S. 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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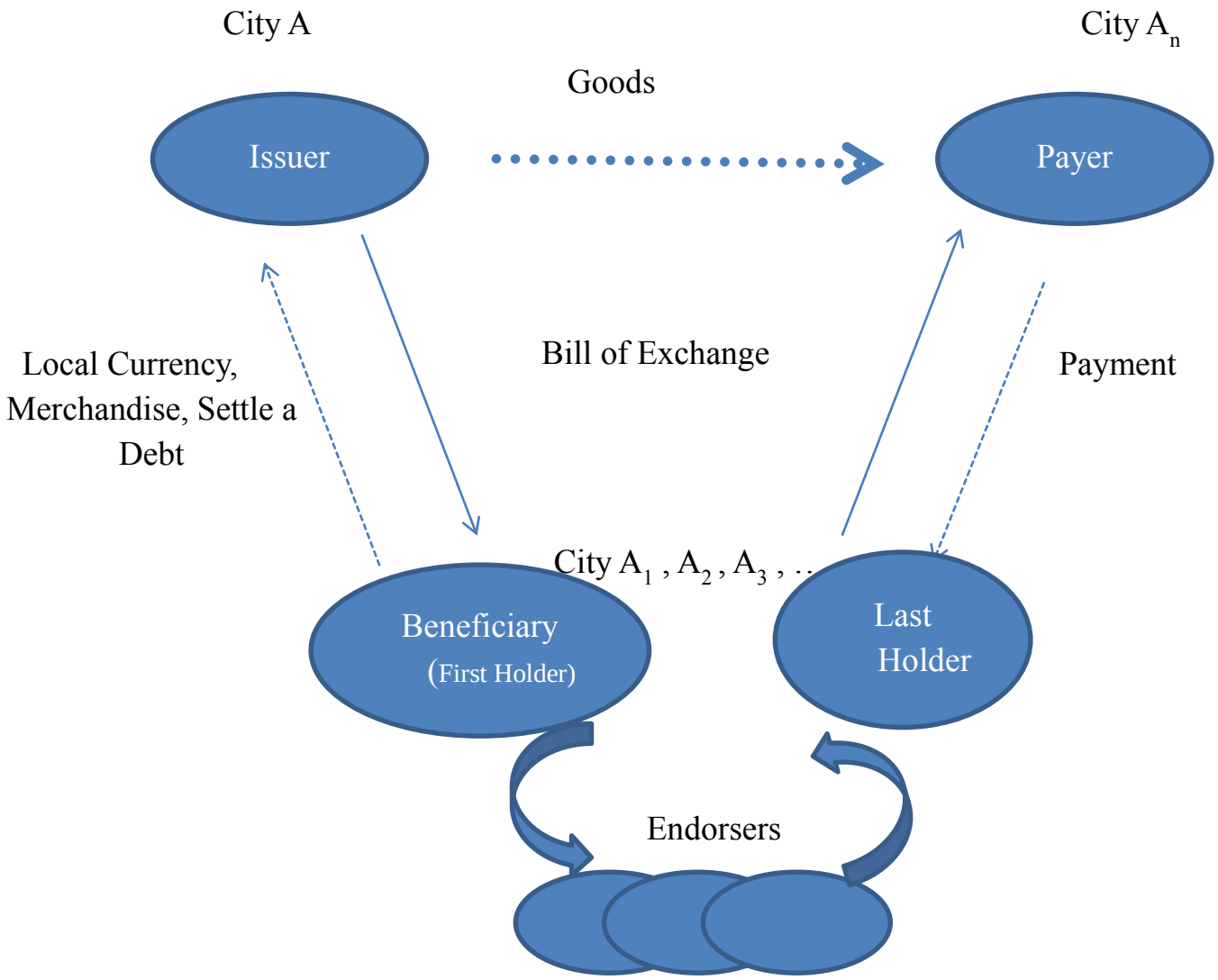
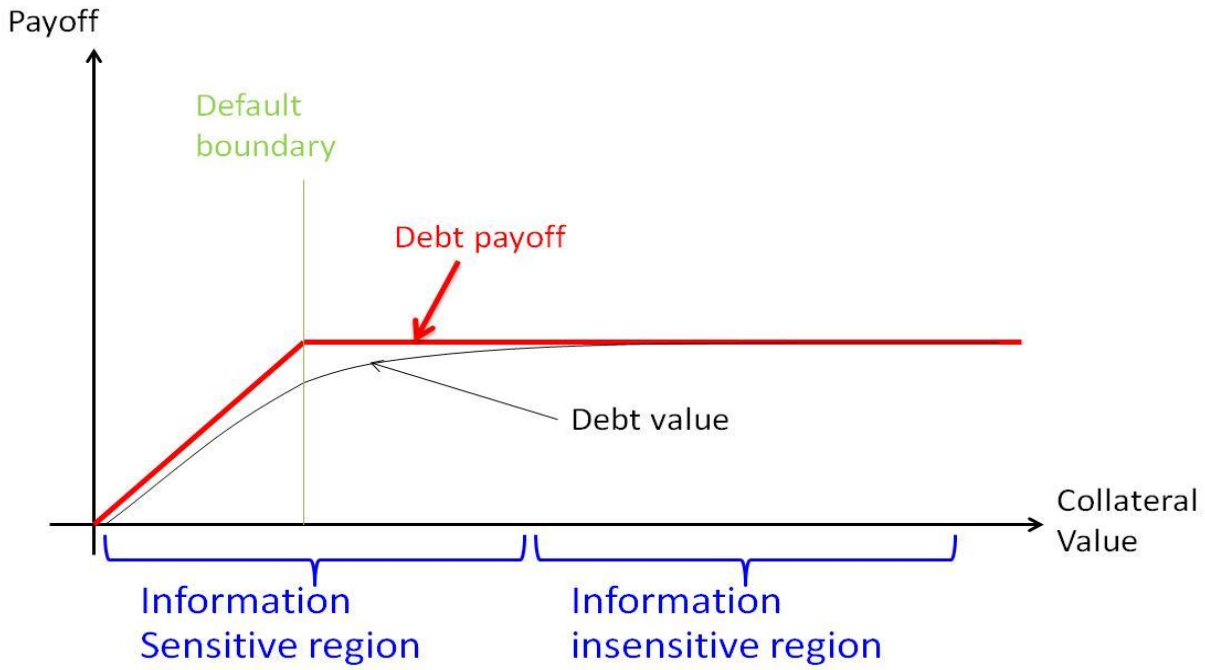
Figure 1: The Circulation of Bills of Exchange



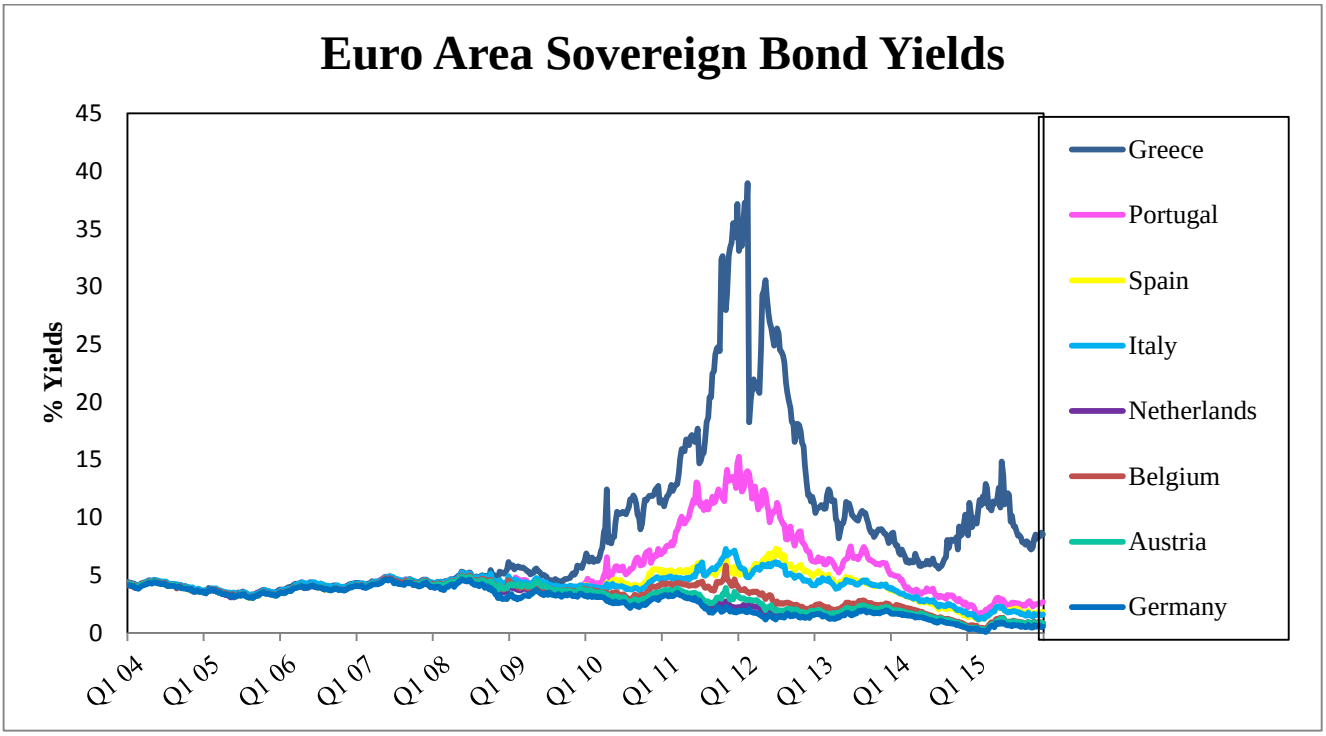
Source: Santarosa (2015).

Figure 2



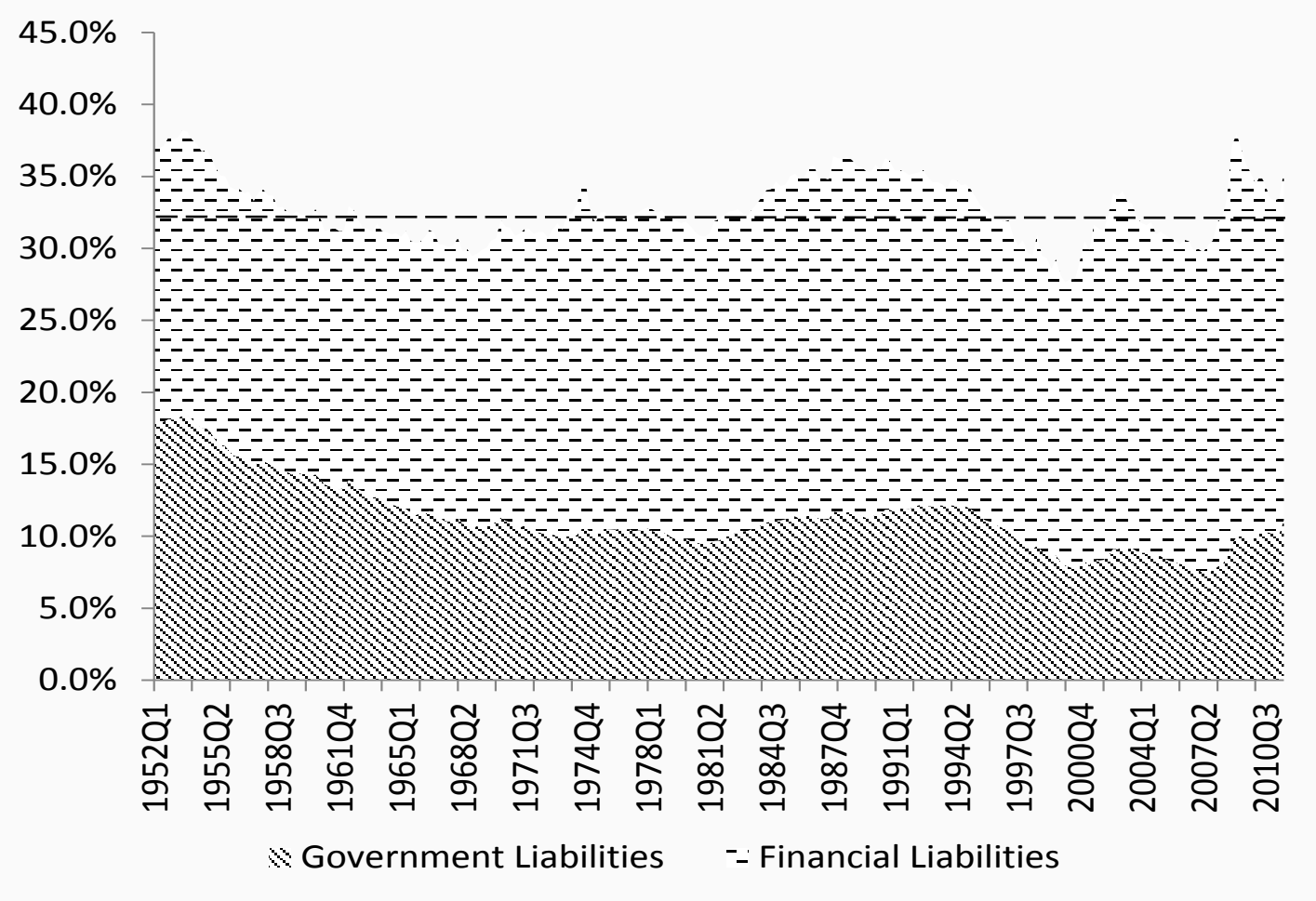
Source: Holmström (2015).

Figure 3: Bond Yields of Selected Sovereigns of the Euro Area



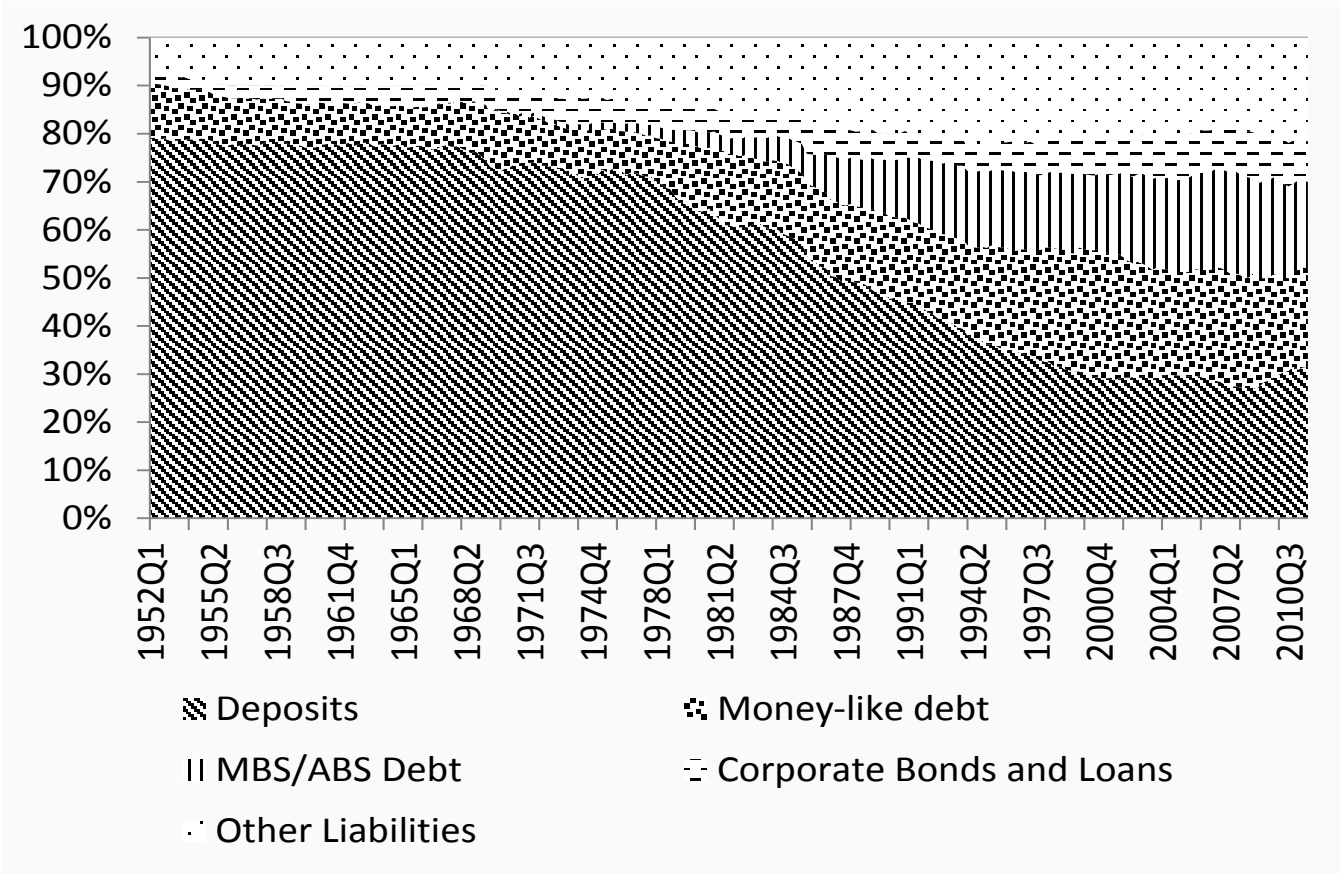
Source: Investing.com.

Figure 4: The Safe Debt Share

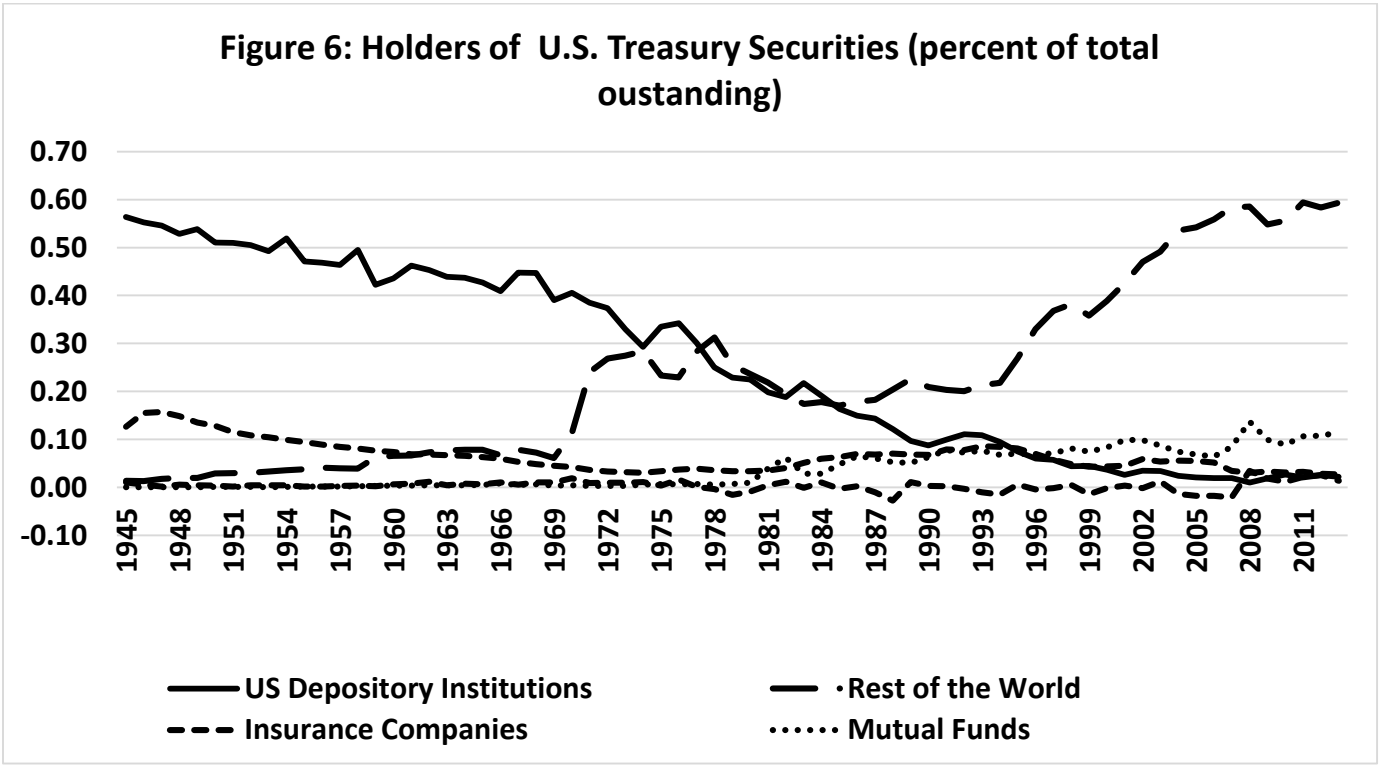


Source: Gorton, Lewellen, and Metrick (2012).

Figure 5: The Components of Privately-Produced Safe Debt

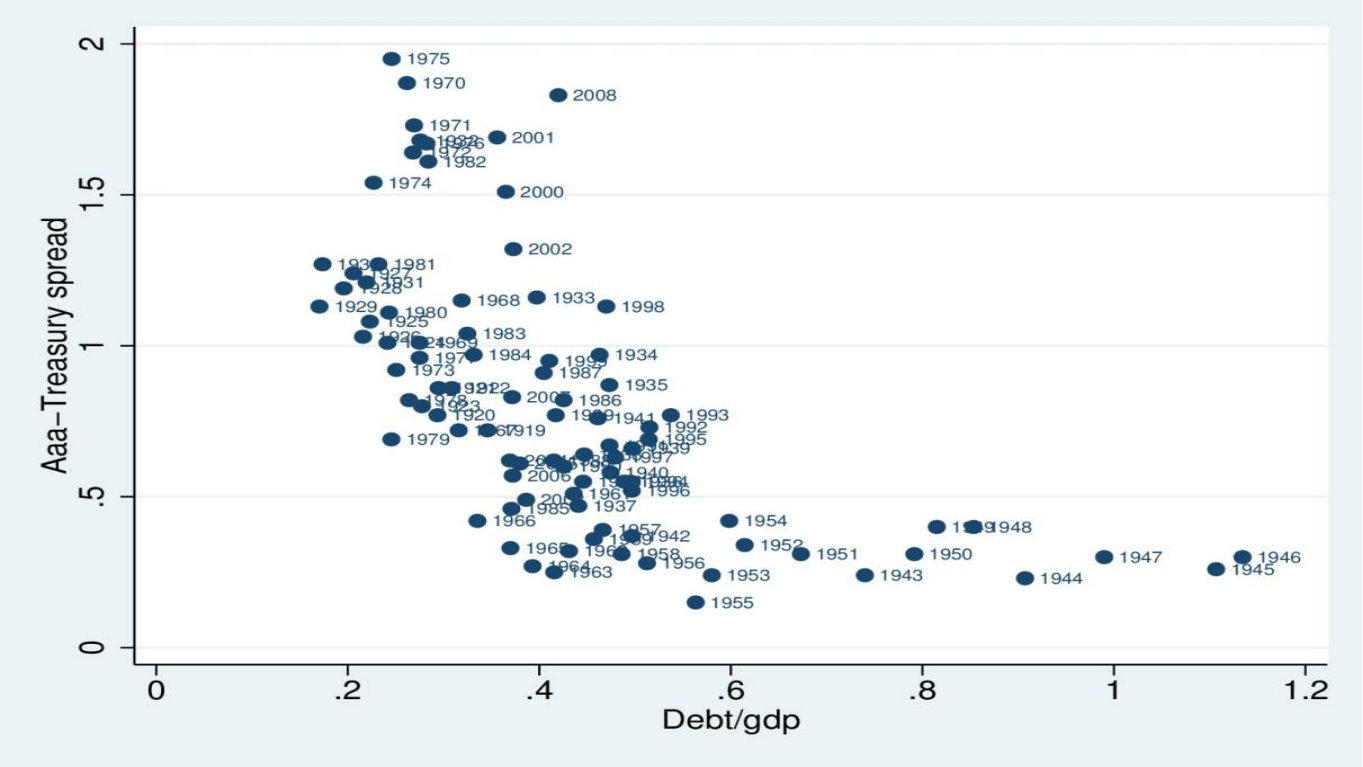


Source: Gorton, Lewellen, and Metrick (2012).



Source: Flow of Funds.

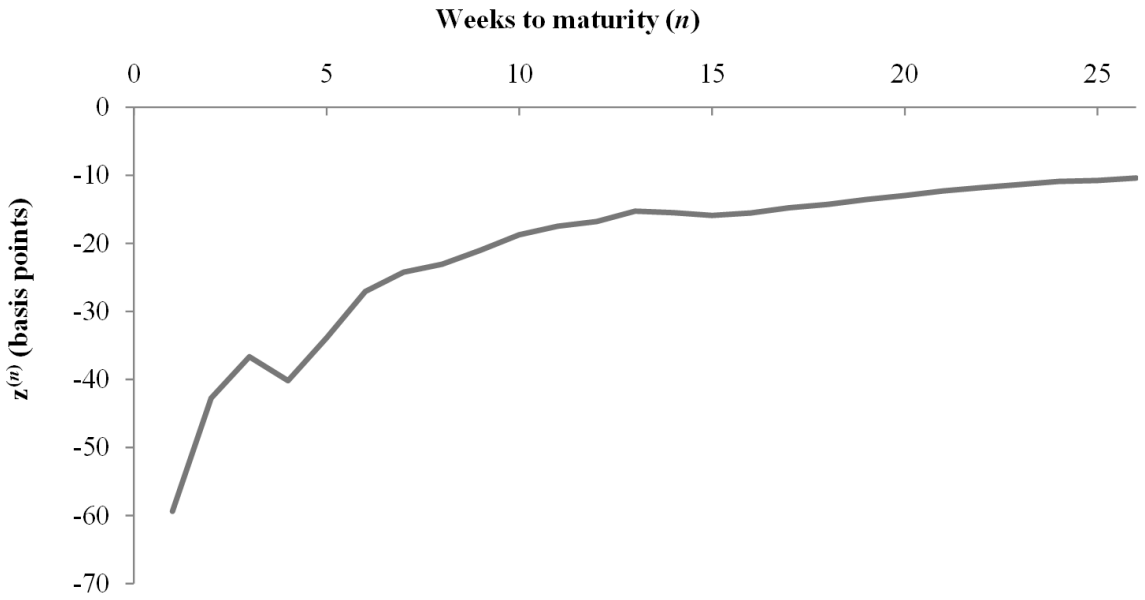
Figure 7: Corporate Bond Spread and Government Debt



Source: Krishnamurthy and Vissing-Jørgensen (2012).

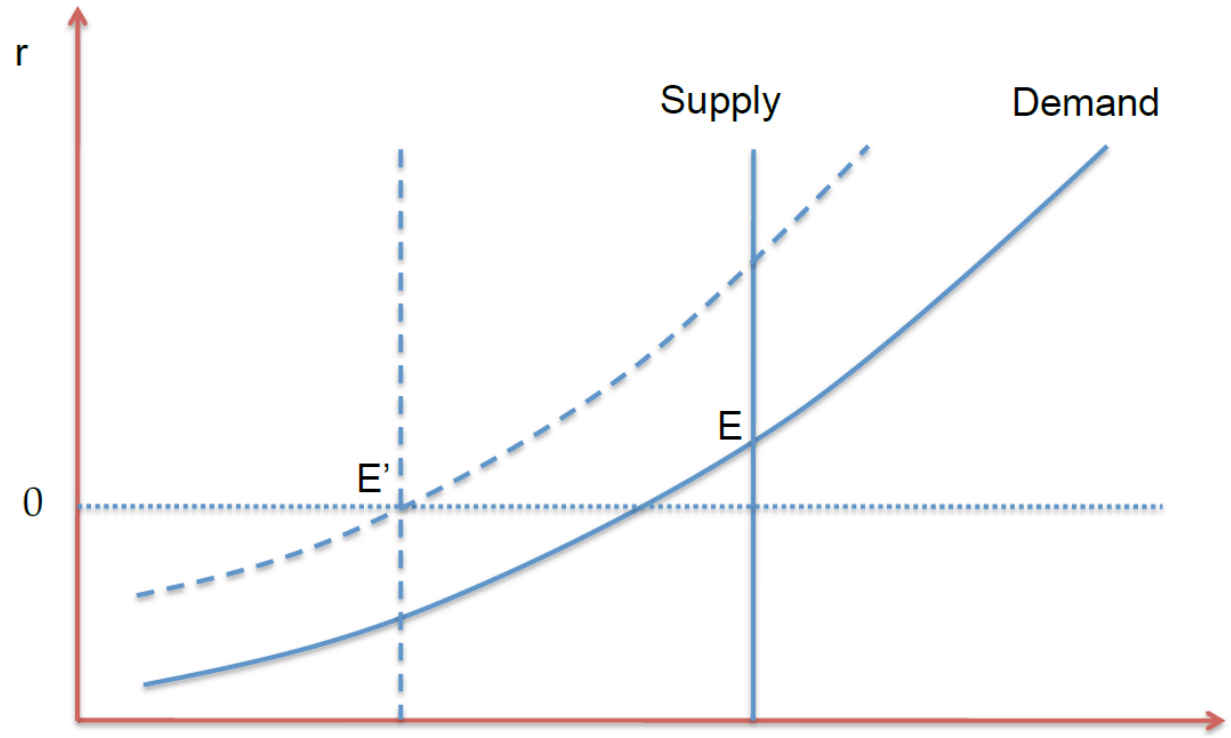
Figure 8

Average premium (actual T-bill yield minus fitted yield) by week to maturity, 1983-2009



Source: Greenwood, Hanson and Stein (2015).

Figure 9: Supply and Demand for Safe Debt as a Function of the Real Interest Rate



Source: Caballero and Farhi (2014b).