Essays in financial economics

Golec, P.M.

Publication date
2019
Document Version
Other version
License
Other

Chapter 3

Safe assets: a review

3.1 Introduction

The recent banking crisis was largely unanticipated, and has forced a major reassessment of views on risk creation during credit cycles. The macro finance research agenda is seeking a more integrated framework to describe the evolution of aggregate endogenous risk. There appears to be a clear division of tasks. New macro models study the dynamics of economic propagation of financial shocks under financial constraints. Financial research looks at how risk incentives shape the distribution of shocks and how contracts redistribute their impact. Novel concepts such as maturity races, volatility spirals, information sensitivity, induced runs and correlated risk strategies have come to enrich our understanding of excess risk creation over the financial cycle. These new insights complement the established notion of the liquidity risk externality associated with banking.

A novel insight comes from the recognition of a fundamental demand for safety, distinct from liquidity and money demand, with a major role in shaping contracting and the structure of financial intermediation. This survey focuses on the nature and consequences of safe asset demand, in particular how it shapes the behavior of financial intermediaries, and encourages the private supply of (quasi) safe assets. This enables to understand financial innovation during the credit boom, when novel forms of tranching, funding and hedging were developed to satisfy a strong demand for safety. Ultimately, a critical issue is whether pressure for safety contributes to aggregate risk.

Considerable evidence has emerged on a strong demand for financial safety. Krishnamurthy and Vissing-Jorgensen (2012) find long-term evidence of a safety premium on Treasury debt distinct from its liquidity premium. Whereas the liquidity premium reflects the ease of converting Treasuries into money, one can think of the safety premium as their implicit value of offering *absolute* security of nominal repayment.

The safety premium is especially elevated at times of scarcity of U.S. public debt, the primary safe asset. This is consistent with the evidence of a historically very stable demand for safe assets in U.S. household portfolios (Gorton et al., 2012). These results indicate a structural demand for safety rather than a new phenomenon. This implies a sharp market segmentation between safe and speculative asset markets.[1]

[1] A discontinuity at the zero risk boundary may explain low empirical estimates of CAPM market

A consequence of a stable demand for safe assets is that a period of low supply of government debt tends to boost (in fact, crowds in) the creation of private safe assets in the form of short-term liabilities issued by the financial sector, such as repo and commercial paper (Krishnamurthy and Vissing-Jorgensen, 2015). On the asset side, this appears to be associated with credit expansion and an increase in net long-term investment by intermediaries, increasing maturity transformation.

This insight has major implications for the macro and banking literature, where the volume of credit is assumed to be demand driven. The existence of shocks to credit supply suggests an independent component of credit cycles next to real shocks driving the business cycle. Their impact on aggregate credit volume and liquidity risk needs to be understood by macro finance research, so as to inform preventive prudential policy.

3.1.1 A global demand for safety

The earliest recognition of a strong demand for safety came with research on the large capital inflows into the US during the credit boom in 2002-2007, associated with the recycling of global imbalances (Bernanke (2005), Caballero et al., 2008). Historically, capital flowed from rich to developing countries. However, since 1998 net capital flows have reversed (Prasad et al., 2007), as emerging country investors have invested their rising trade surpluses abroad (Gourinchas and Rey, 2007), especially in safe dollar assets (Bernanke et al., 2011). Foreign holdings now represent more than 20 per cent of US debt securities, and over half of the Treasury market. US public debt is mostly held by central banks as reserves against sudden capital outflows. As foreign demand for safety has grown faster than US public debt, US intermediaries have issued more "safe" claims to foreign private investors, who by some measures account for 80 per cent of total foreign inflows (Forbes, 2010).

A common explanation is that safe asset markets are less developed in emerging markets (Caballero et al., 2008), and are more exposed to enforcement risk (Quadrini et al., 2009) or face expropriation risk (Ahnert and Perotti, 2015). At the same time, the dollar also acts as the reserve currency for the international monetary system.[2] This makes dollar assets a prime target for safety seeking flows. Indeed, the dollar is a safe haven in times of crisis, when a global flight to quality takes place (Maggiori, 2013).

The direct effect of safety seeking inflows is a higher risk concentration for US residents and intermediaries (Caballero and Krishnamurthy, 2009).[3] As these safety seeking foreign flows appear to be stable, they do not contribute to exchange rate risk, and indeed the 2007-2008 financial crisis did not lead to sharp outflows from dollar assets. However, huge inflows are bound to reshape the scale and risk profile of credit, and can lead to runs on individual assets or intermediaries. A better understanding of the demand and supply for safe assets is needed to clarify whether pressure to create

beta.

[2] There is a large literature on the international monetary system, see Farhi et al. (2011) and references therein. He et al. (2016) model the endogenous emergence of a dominant safe asset. Strikingly, they show how relative market size plays a significant role next to fundamentals, favoring large country currencies such as the dollar versus the Swiss Franc.

[3] Govillot et al. (2010) show that the US provides insurance to the rest of the world, in the form of a lower yield during normal times, and a transfer of wealth to foreign investors in crises.

safe assets ultimately contributes to aggregate instability.

The remainder of the survey is structured as follows. Section 3.2 defines various concepts and introduces an asset classification used in the review. Section 3.3 reviews the empirical evidence on demand and supply of safe assets. Section 3.4 discusses possible fundamental causes of safety demand by investors. Section 3.5 looks at theoretical models of private (quasi) safe asset creation, identifies the main contractual forms and their effect on risk creation. Section 3.6 discusses the policy implications. Section 3.7 concludes.

3.2 What are safe assets?

We introduce some definitions to distinguish safety, liquidity and money demand.
Naturally, no asset is absolutely safe. We will use the term *safe assets* to describe unconditional financial promises with no credit risk, so that nominal repayment is certain. This defines as safe any debt issued or guaranteed by a "safe" government, implying a country with an own central bank, stable currency and good protection of property rights.[4] Although the safe asset literature has so far ignored inflation risk, a low inflation environment presumably is a prerequisite for a safe asset.

We define the safest privately issued claims as *quasi-safe*, implying that they have no credit risk outside of major crises. Most private quasi-safe assets arise in the process of inside money creation by private intermediaries, such as short term and secured debt. While generally safe, at time of systemic distress, these private assets lose their perceived safety and become rapidly illiquid.

Two conventional definitions also belong to a general classification. *Outside money* is the stock of liabilities of the central bank, the statutory legal tender at face value for any obligation. *Inside money* is the stock of liabilities issued by the financial sector that can be used for immediate payment by households and firms.

Traditional money demand seeks claims that serve as immediate form of payment, such as cash, reserves or demandable bank debt. It is the ultimate liquid and nominally safe asset, which also has zero interest-rate risk. While it can serve as a low return store of value, for purely safety purposes it is dominated by other safe assets, since it also enjoys a convenience yield due to its immediate use as payment (Stein, 2012). This transactional view of money demand formalized in the "money in the utility function" approach (Sidrauski, 1967) is still at the core of many money demand models.

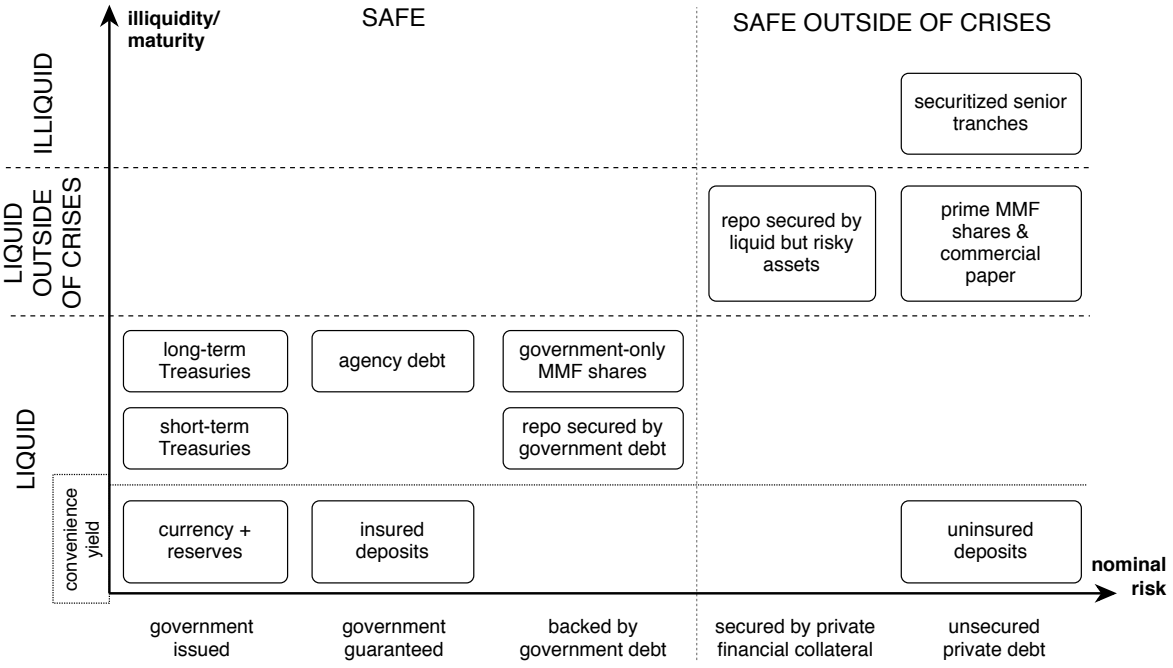
Liquidity demand seeks assets easily converted into money quickly, such as government debt and short term debt issued by borrowers with access to liquidity. Asset liquidity is valued as it can satisfy sudden needs for consumption or investment, either for consumption (Diamond and Dybvig (1983), Gorton and Pennacchi, 1990) or productive purposes (Holmström and Tirole, 1998, 2001). Holding liquid or unencumbered pledgeable assets serves as a precaution to avoid costly access to external finance caused by asymmetric information or moral hazard. When illiquid assets trade at fire-sale prices, hoarding liquidity is particularly profitable (Allen and Gale (2004),

[4] A central bank can always honor any nominal debt in domestic currency by expanding outside money.

Diamond and Rajan (2011), Gale and Yorulmazer (2013), Malherbe, 2014). Thus both a hedging or speculative demand for liquidity can justify a lower yield for liquid assets (Vayanos and Vila, 1999). In contrast, safety demand does not seek access to means of payment, but is aimed at wealth preservation in all states, resulting in extreme risk avoiding behavior. It therefore targets public debt or the safest private assets.

The distinction between safety and liquidity is conceptually sharp but has long been neglected, for good reasons. First, safe assets are typically very liquid, provided they have an active secondary market. However, empirically the distinction is possible. Some safe assets are illiquid by construction (e.g. insured savings deposits, or term repo on safe collateral). In contrast, some very risky assets such as listed shares can be more liquid during a crisis than much safer assets such as corporate bonds or rated ABS. A second reason is that banking theory has long explained demandable debt exclusively as a response to contingent liquidity demand. However, a distinct safety premium suggests a demand for an absolutely safe store of value distinct from demand for liquidity. We consider the emerging literature on the nature and implications of this demand.

Figure 3.21: Asset safety and liquidity under our definition.



We offer in Figure 3.21 a classification of low-risk assets in terms of their safety, liquidity or moneyness. There is a clear positive correlation between safety and liquidity though the two concepts remain distinct.[5] On the bottom are money assets, mostly safe and (almost) always liquid, whose issuers benefit from a convenience yield. While money claims with a government guarantee (including insured deposits) are safe and liquid, uninsured deposits are quasi-safe forms of immediate payment, and are accepted until banks become insolvent.

Private quasi-safe assets are safe and liquid only outside of systemic crises. The

[5] For non-marketable claims, liquidity here equals maturity.

safest among non monetary private claims are repos,[6] ranked by the quality of their collateral, followed by short term financial debt and money market fund shares. In the upper right quadrant are senior tranches of AAA asset backed securities, which were designed to be extremely safe but proved otherwise.[7] This graph implicitly defines which assets enjoy a (measure of) safety, convenience or liquidity premium. While these yields are usually fairly stable, in a crisis, the liquidity and perceived safety of private quasi safe assets drops sharply. The rapid adjustment of safety and liquidity premia leads to sharp changes in relative yields. As we will see in the theoretical review in section 3.5, a strong safety demand may then lead to (or reinforce) a market breakdown, with no rollover at any price, all the more when the supply of quasi safe assets has been excessive.

3.3 Demand and supply for safe assets

3.3.1 Evidence on safety and liquidity premia in safe assets

Krishnamurthy and Vissing-Jorgensen (2012) provide historical evidence of a strong price sensitivity of safe assets to demand and supply shocks. The yield spread between corporate and Treasury bonds, controlling for default risk, is strongly negatively correlated with the ratio of privately held government debt to GDP from 1926 to 2008. Whenever the supply of public debt is low, investors are willing to pay a higher premium for Treasuries. The magnitude of the effect is large, with an average spread of 73 bp between Baa-rated corporate bonds and Treasuries explained by Treasury supply. A similar relationship exists for the yield spread of commercial paper over Treasury bills. This evidence is inconsistent with the classical portfolio theory, where asset prices are determined exclusively by the discount factor (pricing kernel), and are independent of their supply.[8] It strongly suggests that the Treasury rate is determined on a segmented market, and its size is presumably linked with aggregate income and wealth. The relationship is stronger for lower rated corporate bonds (Baa vs Aaa) and commercial paper (A2/P2 vs A1/P1), suggesting that also the highest rated private debt claims offer some safety and liquidity that investors value. This insight allows to decompose the premium on Treasuries into a liquidity (at most 46 bp) and safety premium (at least 27 bp). To identify the liquidity premium, they regress public debt on the yield spread between 6 months insured certificates of deposits (CDs) and Treasury Bills, finding a negative relationship. This spread captures the liquidity premium, as both assets are equally safe but CDs are illiquid until maturity. Their measure of the short-term safety premium is the spread of lower (A2/P2) and higher (A1/P1) rated commercial paper with 3 months maturity, both illiquid claims. Finally, a measure of the long-term safety premium is the yield spread of Baa and Aaa rated corporate bonds, whose liquidity is quite similar (Chen et al., 2007). Also the safety spreads have a significant negative relation with the stock of public debt.

[6] Overnight repo are private claims, but so safe and liquid that they are often added to an enlarged definition of monetary aggregates such as M3.

[7] They were never very liquid even during the credit boom, as they were mostly held for their extra yield, and were at the epicenter of the 2007-2008 crisis.

[8] If changes in Treasury supply reflects more fiscal expenditures and a structural change in future output, in principle the pricing kernel will change, though the effect is hard to predict.

Nagel (2014) questions whether the liquidity premium on Treasuries is determined by supply and demand effects. He argues that money (reserves, deposits) and near-money assets (Treasuries) are substitutes in providing liquidity, so liquidity premia and convenience yield must be linked. Thus it is necessary to control for the opportunity cost of holding money (such as the federal funds rate) when estimating the impact of Treasury supply on the price of liquidity.[9] Indeed, the federal funds rate is strongly correlated with the liquidity premium, and has a better fit than the highly persistent Treasury supply. The interpretation is that the Fed effectively neutralizes liquidity shocks by adjusting the amount of reserves (money) to keep the federal funds rate on target. However, Nagel finds some transitory effects of liquidity shocks. Changes in t-bill supply affect liquidity premia in the same month even controlling for changes in interest rates, but the effect reverts during the next month. Vissing-Jorgensen (2015) reports that the effect of Treasury supply on the *safety* premium remains significant, just as its impact on the Aaa-Treasury yield spread, a combined measure for safety and liquidity. The part of the Baa-Treasury spread explained by low-frequency variation in Treasury supply (73 bp) thus presumably consists mainly of a safety premium.

Other research documents a segmentation between short-term and longer-term Treasuries. The yields on short-term Treasuries are affected by changes in the supply of Treasury bills (at high frequency), but not of notes and bonds. A priori it is unclear whether this segmentation reflects the superior liquidity or a lower interest rate risk of T-bills. They may also contain a convenience yield because of their close conversion into cash. Combined, these characteristics are by some authors referred to as "moneyness". Another view is that the segmentation reflects investors preferred habitat, i.e. that there are investor clienteles with a preference for specific maturities (Greenwood and Vayanos, 2010).

Duffee (1996) provides some early evidence of a segmentation at the short end of the yield curve. He finds a unique common component in Treasury bill yields not shared by Treasury notes and bonds, nor private claims of equal maturity in monthly data from 1975 to 1994. Also, when changes in yields of bills close to maturity are regressed on changes in yields of bills further from maturity to filter out time-varying common components, the residuals are correlated with the supply of short-term bills. Interestingly, his results are stronger since the 1980s.

Greenwood et al. (2015) seek to explain the spread over 1983-2009 of actual T-bill yields over fitted Treasury yields. Bill yields closer to maturity (with less than 3 months to maturity) are significantly lower than the extrapolation of a yield curve estimated using only notes and bonds with remaining maturities greater than three months. A reduction in the supply of T-bills further decreases the spread, which in contrast is unaffected by the supply of Treasuries with longer maturities.[10]

Carlson et al. (2014) observe how the average excess one-month holding return to buying Treasury bills from 1988 to 2007 increases sharply at the short end of the

[9] As a measure of liquidity premium he uses the general collateral (GC) repo - t-bill yield spread. As GC repo is collateralized by government debt it is fully safe, but the investment is locked in until maturity.

[10] They exploit time variation in short-term government financing patterns associated with seasonal tax receipts to address endogeneity concerns.

maturity spectrum. An decrease in Treasury bill supply increases the average excess return, more so for short maturities.

Greenwood and Vayanos (2014) get similar results in their sample from 1952 to 2007. They find that the returns to short-term on short-term bills decrease compared to those on longer-term Treasuries when the supply of Treasury bills increases.

Interestingly, safe asset demand can explain a puzzling behavior of monetary aggregates ("missing money") since the 1980s. Money balances (M1) rose only slightly as interest rates dramatically fell. Krishnamurthy and Vissing-Jorgensen argue that massive foreign demand for safe dollar assets reduced net supply of Treasury in this period. The effect was an increase in the convenience yield, as Treasuries are needed to back demand deposits. Households thus shifted to savings deposits, counteracting the effect of lower interest rates on demand deposits.

Summarizing, the evidence suggests a segmented and inelastic demand for Treasuries due to their safety and liquidity. While the safety premium is subject to supply and demand shocks, the liquidity premium is correlated with the federal funds rate (and thus by the convenience yield on money assets) at the business-cycle and long-run frequency. There also is evidence for a a segmented and inelastic demand for Treasury bills with less than 3 months to maturity, reflecting "moneyness".

3.3.2 Supply of (quasi-) safe assets

The evidence points to a private supply response by financial intermediaries of (quasi-) safe assets as a substitute to scarce government debt. Krishnamurthy and Vissing-Jorgensen (2015) find a strong negative correlation of privately held government debt/GDP with the net supply of financial short-term debt in a long time-series from 1875 to 2014. The magnitude is quite large, a one dollar increase in Treasury debt decreases financial short-term debt by 50 cent. Interestingly, intermediaries appear to expand long-term lending one for one with short-term debt issuance. Thus a scarcity of privately held government debt increases not just credit supply but also the degree of maturity mismatch. Krishnamurthy and Vissing-Jorgensen argue for a causal relationship, as shocks to government debt supply are in part driven by war financing and the business cycle. As a robustness check they rule out a standard crowding out of investment via higher rates. They also use gold inflows in the 1930s and increased foreign official holdings of Treasuries from the 1970s as exogenous supply shocks.

Short-term debt issued by the financial sector may provide a closer substitute for short-term Treasuries than long-term Treasuries due to their "moneyness". Under that premise short-term Treasury supply should have a stronger crowding out effect than long-term Treasuries. Greenwood et al. (2015) indeed find some evidence that T-bill supply is more strongly correlated with highly rated, unsecured financial commercial paper than the non-bill Treasury supply at high frequency (weekly, monthly & quarterly).

A common measure for liquidity and money demand is the spread between T-bill yields and the overnight indexed swap rate (OIS) (Sunderam, 2014).[11] Sunderam shows

[11] The OIS rate represents the expected average of the federal funds rate over a given term. OIS

how asset-backed commercial paper (ABCP) issuance positively responds to weekly variation in the T-bill-OIS yield spread and is crowded out by T-bill supply from 2001 to 2007.

Xie (2012) finds that even private claims whose issuance is less flexible also respond to high-frequency variation in liquidity premia. Using daily data from 1978-2011, he finds that ABS/MBS issuance positively responds to seasonal variation in liquidity premia, proxied by the GC repo - Treasury bill spread.

Krishnamurthy and Vissing-Jorgensen (2015) however do not find a stronger crowding out effect of short-term financial debt in their historical yearly sample.

There is also evidence of a gap-filling behavior by highly rated non-financial firms at the long end of the maturity spectrum. Greenwood et al. (2010) find that corporate debt maturity is negatively correlated with government debt maturity from 1963 to 2005, more strongly for firms with stronger balance sheets. Using more granular data on debt maturity, Badoer and James (2015) show that corporate gap-filling behavior is more pronounced at the long end of the maturity spectrum (20+ years) and for firms with higher credit ratings. This evidence is supported by Graham et al. (2014), who additionally find that corporate long-term debt issuance responds more strongly to changes in the supply of government debt after the 1970's when foreign holdings of Treasuries increased. There is no significant evidence however that changes long-term Treasury supply also affect highly-rated firms propensity to invest. Also, the magnitude of long-term corporate debt issuance is dwarfed by short-term debt issued by the financial sector.

Summarizing, the evidence suggests a strong crowding out effect of Treasury supply on financial sector short-term debt at low and business-cycle frequency. The effect appears to be driven by changes in the safety premium, which affects the spread financial intermediaries earn by issuing short-term debt. At high frequencies, it is short-term government debt that crowds out financial sector debt. The channel is likely via changes in the money or liquidity premium. There is also some evidence of a crowding out effect on high quality long-term debt issued by non-financials. The secular increase in foreign Treasury holdings from the 1970s on strengthens the crowding-out effect, as it amounts to a reduction in net safe debt supply.

3.4 Origins of safe asset demand

A traditional approach explains demand for (safe) money in terms of transaction costs or "money in the utility function" (Tobin (1965), Sidrauski, 1967). This view justifies a convenience yield on demandable debt because of its payment services (see Stein (2012) for a modern formulation).[12]

Other views on why intermediaries provide short term debt involve agency costs or a liquidity rationale. Calomiris and Kahn (1990) and Diamond and Rajan (1998) view

contracts carry little credit risk because initially no principal is exchanged and they are relatively liquid, thus serving as a good proxy for risk-free rates.

[12] There is a large literature on the role of money for transactions purposes in place of barter, which provides micro-foundations for this (Williamson and Wright (2010)).

short-term debt as a commitment device for bankers to maximize bank value. Finally, Diamond and Dybvig (1983), Gorton and Pennacchi (1990) and Dang, Gorton and Holmstrom (2010) focused on the ability of banks to create liquidity. These approaches argue that claims providing convenience or liquidity or commitment should be safer than other claims, but they do not identify absolute safety as the main benefit of short term debt.

3.4.1 Models of demand for absolute safety

The introduction of a segmented demand for absolute safety requires some discontinuity in the classic utility maximization framework. For example, infinite risk aversion arise episodically in response to shocks to beliefs. In some extreme contingencies, agents may no longer be able to assess the risk return tradeoff of assets or the allocation of losses across counterparties, a form of Knightian uncertainty (Caballero and Krishnamurthy, 2008). As a result they only consider worst-case scenarios, as if they had infinite risk aversion.

A different framing presumes that all investors have a structural demand for safety in the context of their portfolio choice. Ahnert and Perotti (2015) model directly a structural safety demand by assuming a version of the Stone-Geary utility function, which is often used in the context of development economics. Under such preferences, individuals need to attain a minimum subsistence (survival) level of wealth in all states to avoid a huge loss in utility. Thus a safe storage of value needs to be secured before agents absorb any risk in their residual portfolio. The subsistence level may be subjective and depend on wealth. A dynamic version of these preferences (habit formation) have become standard in recent asset pricing models, where a strong reluctance to adjust consumption downward appears necessary to explain the time series behavior of stock prices (Campbell and Cochrane, 1999).

Intuitively, when investors choose some assets to ensure this subsistence level, they may act very risk intolerant at the zero risk boundary. Thus behavior in (quasi) safe asset markets may be subject to sudden runs, even when new information suggests even a minimal chance of loss (Gennaioli et al. (2013), Ahnert and Perotti, 2015).

When agents face different access to safe assets, this can lead to large safety-seeking flows (Caballero and Krishnamurthy, 2009). Investors from emerging markets have a particularly strong demand for safety, as domestic assets suffer from weaker property or contractual rights (Mendoza, 2000). Under a demand for subsistence wealth, the distinction is important. Poor contractual enforcement reduces the value of local investment and asset price. However, unsafe property rights cuts deeper, as it exposes risk intolerant savers to full expropriation. This creates an acute need to find safety in developed markets, often in anonymous form. The massive role of off shore centers in transferring wealth across borders is explained by their essential role to anonymize holdings.[13]

Next to individual demand for safety, there are institutional reasons for safety demand. A leading example is the reserve accumulation by central banks from emerging

[13] Anonymity may be essential to avoid prosecution or taxation.

countries for liquidity self insurance, especially pronounced since the Asian crisis in 1997 (Prasad, 2014). Such public institutions have a strict mandate to avoid risk, with the effect of reducing the available supply of public debt for private investors. At present public foreign institutions hold over half of the entire US Treasury bond supply. As a result, private demand for safety is crowded out and induced to turn to (quasi) safe private claims (Bernanke et al., 2011).

3.4.2 Demand for safe assets driven by liquidity needs

In recent models based on endogenous adverse selection, a demand for safe assets may also originate from a demand for liquidity (Dang et al. (2012), Farhi and Tirole, 2014). When fundamental risk is low an asset is "safe" from illiquidity because there are little incentives to acquire information about it. However, relying on common ignorance for liquidity provision in good times may create occasional sharp crises. When bad news arrives and fundamental risk passes a threshold, investors have incentives to learn about risk, so in principle all quasi safe claims may become illiquid. This forces sharp deleveraging, in order to restore an information-insensitive payoff structure (Gorton and Ordonez, 2014).

We now turn to consider the private response to a segmented demand for safety, particularly at time of scarce public supply of safe assets.

3.5 Safe asset creation and instability

To take advantage of the safety premium, intermediaries can promise safety by carving out safer claims and/or pledging safer assets. Diversification is the classic solution to reduce the risk of assets against which investors lend. In response to strong safety demand during the credit boom, intermediaries shared risks via loan securitization, and created safer ABS tranches that may be pledged or placed in special investment vehicles that may be funded by risk avoiding investors. Diversification via real estate loan securitization had the effect to redistribute credit risk across intermediaries, but as a consequence it led to a major increase in their return correlation. This reinforced systemic runs once risk materialized (Allen et al., 2012), all the more dramatic as investors had not fully appreciated the underlying exposure to systemic events (Gennaioli et al., 2012b, 2013).

The ability of intermediaries to issue safe claims requires first and foremost a reliable enforcement of property rights. Thus only intermediaries in countries with a solid political and fiscal position may become eligible as issuers of safe assets. Next, a nominal safe asset needs to be an unconditional promise, thus a debt claim.[14] But debt safety may be further strengthened by contractual terms, such as collateralization (secured debt), maturity (time priority) and seniority (contractual priority at default). As the safety afforded by seniority is dominated by maturity and collateralization, the literature has focused on the latter two features.

[14] Debt is the claim least sensitive to value fluctuations. The corporate finance literature has further highlighted how debt is most robust to adverse selection and moral hazard issues.

3.5.1 Safety through short-term debt

In traditional banking models, intermediaries have incentives to issue short-term debt to satisfy either money demand for transaction purposes (Perotti and Suarez (2011), Stein, 2012) or liquidity demand (Diamond and Dybvig (1983), Gorton and Pennacchi, 1990). The associated liquidity transformation enables banks to capture the convenience yield or liquidity premium, even when it creates a liquidity risk externality. From the perspective of safety, debt of shorter maturity is better because asset risk is less likely to materialize during a shorter interval.[15] Hanson et al. (2015) argue that banks can replicate the inexpensive funding associated with deposit insurance by giving their investors an early exit option in the form of short-term claims.

However, there are more subtle reasons why short-term debt is safer. First and foremost, short-term creditors enjoy special protection, as they can demand repayment ahead of debt with contractually higher priority when default appears imminent. This idea is advanced by Brunnermeier and Oehmke (2013b) in a novel, supply-driven motivation for short term debt. In their model, short-term creditors can frequently adjust their claim to new information at the rollover date, in contrast to long-term creditors. This repricing dilutes long-term creditors, so short-term creditors are de facto senior. This can create a spiral of increasing shorter term funding, even if all agents are risk neutral.

As debt becomes more short term, its rollover risk becomes more salient. In the extreme case of demandable debt, a coordination problem may occur even when fundamentals are sound. Essentially, the sequential service format of immediate payments makes it impossible to reprice claims so as to encourage rollover, which creates extreme strategic complementarity among investors (Diamond and Dybvig, 1983). As withdrawals force costly liquidation of assets and reduces the value left for those who roll over, inefficient runs may occur even in solvent states (Rochet and Vives (2004), Goldstein and Pauzner, 2005). Bank runs may also be triggered by temporary asset liquidity risk, even when fundamental risk is arbitrarily small (Matta and Perotti, 2015).

As discussed earlier, short-term debt enhances the consequences of runs triggered by shocks to beliefs, such as in a sudden emergence of Knightian uncertainty (J Caballero and Farhi, 2017), or sudden recognition of an unanticipated loss state (Gennaioli et al., 2012b, 2013).

Demandable debt turns out to be the optimal insurance contract that intermediaries may issue to meet the demands of extremely risk averse agents (Ahnert and Perotti, 2015). Besides avoiding any dilution, a demandable claim may be withdrawn by safety-seeking investors even when default risk is minimal. As these investors run more easily, also less risk averse agents may be induced to run to avoid dilution, even when the intermediary offers a significant rollover premium. The possibility of induced runs implies that ensuring absolute safety for some investors may increase aggregate instability. Yet because of its low cost, safety seeking funding will remain attractive to private intermediaries, which will accept more instability in exchange for a higher

[15] Risky debt is analogous to riskless debt and a short position on a put option, so its value decreases in its maturity.

return in good states.

3.5.2 Safety through secured debt

The credit boom saw a massive expansion in the creation of financial collateral. Banks increased their effective leverage by securitizing loans and shifting their senior tranches off balance sheets, funded by inexpensive short term debt. Shadow banks sought to replicate the safety and liquidity of bank liabilities by relying on collateralized financial credit (repos as well as margins on derivatives). This funding source grew enormously in 2002-2007 (Gorton and Metrick, 2012), until shadow bank credit surpassed total assets held by traditional intermediaries.

Thanks to the pledge of tradeable securities, repo debt can largely eliminate credit and counterparty risk.[16] Short term repo adjusts haircuts on a frequent basis, so it can be designed to be virtually riskless. Crucially, its absolute safety derives from its exemption from automatic stay in bankruptcy. Repo lenders can immediately take possession of collateral upon default and sell it. It is impossible to achieve such propriety by contract alone, as the exemption grants a proprietary right that holds in all contingencies against any third party. Secured debt provides the most safety to creditors, and is preferred over (uninsured) short term debt by risk avoiding investors.

A key question is whether the use of secured lending contributes to aggregate risk. Martin et al. (2014) argue that issuing only secured debt is stabilizing as it eliminates panic-based runs when payoffs are "first come, first serve" by solving the common pool problem.[17] However, a critical issue is its indirect effect on its collateral value and on other debt.

The effect of repo repossession on pledged collateral has been studied more extensively. While intermediaries may use unencumbered assets to raise repo debt in an emergency, once a default is triggered secured lenders have strong incentives to immediately resell collateral (Perotti (2013), Duffie and Skeel, 2012).[18] Correlated fire sales depress asset prices, inducing more runs. While runs on some intermediaries may be justified by fundamental risk, withdrawals may become self reinforcing as agents seek to avoid dilution (Goldstein and Pauzner, 2005).

More recent work considers explicitly the interaction of secured and unsecured debt. Matta and Perotti (2015) show how a strong demand for safety induces intermediaries to pledge liquid collateral to repo lenders, to capture the associated safety premium. A direct effect is to increase risk bearing for each unit of unsecured debt. Thus while repo is so safe that it never chooses to run, it makes other debt less secure and thus run-prone. While a social planner may reduce inessential runs by leaving high rollover rents to unsecured creditors, a private intermediary will tend to minimize funding costs. As a result, the private choice of repo debt results in more inefficient runs and default

[16] In general, collateral reduces credit frictions caused by limited verifiability, moral hazard or asymmetric information. For a review on collateral in corporate borrowing, see Coco (2000).

[17] They show that some market structures (trilateral repo market without "unwind") are more stable than bilateral repo transactions.

[18] They might be unwilling or unable to hold the asset, have incentives to front-sell (Oehmke, 2014), and may need to sell to avoid any legal challenge on their priority.

risk than the social optimum.

While most of the literature focuses on repo debt, the role of derivatives in safe asset creation is still underexplored, hampered by limited data availability. Margins pledged on derivatives also enjoy the bankruptcy privileges of secured debt. Bolton and Oehmke (2014) show how this privilege may induce risk shifting at the cost of unsecured lenders, and the associated higher cost of funding contributes to more frequent default.

3.6 Policy implications

3.6.1 Macroeconomic effects of a decline in safe assets

When trust in quasi safe assets is lost, it represents a drastic decline in the stock of safe assets. There are different theories on how this can affect the macroeconomy. A common theme is that they associate an insufficient supply of safe assets with a recession. Policy then should boost the supply of safe assets. We will discuss this in the next section.

In adverse selection models where safe assets serve as information-insensitive collateral, a shortage of safe assets as collateral constrains the flow of credit to productive agents (Gorton and Ordonez (2014), Moreira and Savov, 2017).

In the incomplete markets setup of Brunnermeier and Sannikov (2016), agents hold safe assets for precautionary reasons against idiosyncratic risk. There, banks act as diversifiers. When the stock of inside money shrinks, agents must bear more idiosyncratic risk, which in their model distorts production decisions. This effect is amplified by a supply side response. When the economy weakens, intermediaries' net capital drops substantially. This deteriorates their risk-bearing capacity as they wish to remain solvent to preserve their charter value. They decrease their leverage, which shrinks further the supply of safe assets available to investors. Moreover, the associated increase in the safety premium further deteriorates intermediaries financial position as the value of their liabilities increases.

J Caballero and Farhi (2017) argue that a sharp decline in (quasi-)safe assets can lead to a situation called the safety trap. While the market for safe assets usually clears via a reduction in the safe rate when there is a drop in supply, this is not possible at the zero lower bound. The only possible adjustment is through a deep recession that reduces demand for safe assets via a wealth effect. In contrast to the Keynesian liquidity trap, where there is a shortage of assets in general, the safety trap represents a shortage of safe assets. Therefore, policies such as forward guidance that increase the value of risky assets are futile in the safety trap.

3.6.2 Preventive policy

The literature we reviewed suggests that financial intermediaries have incentives to issue quasi-safe claims such as short-term or secured debt to take advantage of their low cost. As investors value safety and liquidity, a private supply of (quasi) safe assets (such as short-term or secured claims) is socially beneficial. It has long been appreciated that issuing short-term debt creates a risk externality, so intermediaries may issue too much of it. Short-term debt can trigger large-scale fire-sales that have real implications

as they lead to pecuniary externalities by creating quantity constraints on access to credit and thus do not just imply a wealth transfer.[19] A distinct demand for safety produces a potentially large reinforcement of this effect. The key insight is that even a minimal drop in perceived safety will lead to self-protective actions by safety-seeking investors.

Issuing secured debt also creates a risk externality, as creditors have incentives to immediately sell the collateral once they run or default is triggered. In some repo markets during the financial crisis, debt was rolled over at higher haircuts (Gorton and Metrick, 2012). While this type of deleveraging has no direct external effects, we reviewed literature that emphasized the indirect effect it has on the propensity of unsecured creditors to run.

Macroprudential policy has the task to adjust the private choice of credit volume, as it may differ from the social optimum. Rules need to be adjusted over the credit cycle, targeting excessive creation of short-term debt.

Rules that limit borrowing (Lorenzoni, 2008) can be implemented via capital requirements. Other authors propose Pigouvian taxation of short-term liabilities, which forces intermediaries to internalize the social costs of short-term funding (Jeanne and Korinek (2010), Kocherlakota et al., 2010). While Pigouvian taxation can achieve the first best allocation when risk incentives are moderate, direct limits may become necessary when solvency incentives deteriorate (Perotti and Suarez, 2011). Stein (2012) argues for a cap-and-trade approach, where the regulator issues tradable permits for banks to issue short-term debt. In contrast to Pigouvian taxation, the regulator may remain uninformed about individual banks characteristics, since each of them optimally acquires the right amount permits in line with the quality of their loan pool. Such a policy can be implemented with countercyclical reserve requirements and interest on reserves (Kashyap and Stein, 2012).

A systemic risk tax on non-core funding has also been suggested to manage unstable foreign inflows (Shin, 2011).[20]

Prudential policies also need to target risk creation outside of the regulatory perimeter, least new rules drive safe debt issuance into the shadow banking system. The empirical literature we reviewed documented that an expansion in (short-term) government debt crowds out the creation of financial sector short-term debt via market prices.[21] The size and composition of government debt could thus be used as a Macroprudential tool to manage financial sector short-term debt issuance.

Clearly, the amount of government debt should be traded off against the distortions from taxation (Gorton and Ordonez (2013)). Another consideration is that its ability

[19] As a result, marginal rates of return are no longer equalized, leading to welfare losses (Lorenzoni, 2008).

[20] Hahm et al. (2013) offer cross country evidence that more non-core bank liabilities (such as wholesale and foreign flows) is associated with erosion of risk premia and greater vulnerability.

[21] The government has a comparative advantage to the private sector in providing safe assets due to its power to tax, thereby being able to pledge more than private agents can (J Caballero and Farhi (2017)). Government debt also serves as safe collateral. Issuing Treasuries against pools of privately produced collateral can reduce the information-sensitivity of privately produced collateral (Gorton and Ordonez (2013)).

to serve as a safe asset may be compromised when it approaches some fiscal limit (Farhi et al. (2011), Farhi and Maggiori, 2016). Such a situation could lead to a strong reversal in investor flows.

An interesting argument suggests that government should issue long term debt in good times. Long-term public debt is a rare case of a large scale asset with negative beta, i.e. it appreciates in time of distress when safe rates drop. This makes it a good hedge in a portfolio of riskier assets (J Caballero and Farhi (2017), Moreira and Savov, 2017). By itself, however, improving portfolio diversification does not produce absolute safety.

A key question is whether short-term government debt is a closer substitute for short-term financial sector debt. This implies that the Treasury could decrease its debt maturity to counter excess short-term debt creation (Greenwood et al., 2015). Then, the effect on financial stability should be traded off against the fiscal risk associated with short-term funding.[22] Carlson et al. (2014) advocate that the central bank should maintain a large balance sheet, holding mostly less liquid or long-term safe assets and selling short-term Treasuries. A swap of short versus long term Treasury, a so-called twist operation, decreases the maturity of public debt held in private hands while absorbing some interest rate risk. At this stage it is unclear whether such a policy has an effect on risk premia (Krishnamurthy and Vissing-Jorgensen, 2011). The traditional approach employed during the recent crisis involves central bank purchase (or refinancing on favorable terms) of less liquid private assets, which has a direct effect on prices and increases the supply of safe bank reserves.

Greenwood et al. (2014) note that the Federal Reserve and the Treasury canceled each other out recently in supplying near-money assets. While the Federal Reserve lengthened the maturity of its assets (mainly due to quantitative easing), in the process providing more near-money assets, the U.S. Treasury was lengthening the maturity of it's debt (to reduce roll-over risk), thereby pulling in the opposite direction. Since the relevant amount and composition of government debt is the amount held in private hands, the Treasury and Federal Reserve policy should be coordinated to provide more safe assets.

3.7 Conclusion

We review the recent literature on safe assets. The demand for safe assets appears historically quite stable. The financial sector endogenously creates "safe" assets to fill any "gap" left by insufficient government debt, as safety premia increase. Privately produced safe assets are mostly in the form of short-term or secured debt, issued by banks or the shadow banking system. While safe in most circumstances, they are vulnerable to inessential runs by risk avoiding investors. In addition, the contractual forms chosen to promise safety may lead to induced runs, when even risk tolerant investors run in response to the threat of dilution or increased adverse selection. In conclusion, the emerging literature highlights how demand for safety has the potential

[22] While interest-rate risk has welfare effects by inhibiting tax-smoothing, Greenwood et al. (2014) argue there is a net gain from shortening public debt maturity.

to explain credit cycles, maturity mismatch and ultimately aggregate risk.

This leaves a major role for public policy. When the supply of private safe assets shrunk during the crisis, central banks intervened to compensate with stable funding and abundant liquidity, while governments expanded the supply of public debt. Such intervention is certainly justified during a crisis. A deeper consideration concerns the public interest in private safe asset production outside crisis periods. If an increasing amount of safe debt simply reflects investor preferences, a policy intervention would involve a trade off between individual safety needs and aggregate stability. But as risk intolerant investors may respond to even minimal risk by protective actions, they may trigger defensive action by more risk tolerant investors. Short term debt demand may be self reinforcing, exceeding the natural level of demand. The pursuit of self protection by investors may then force intermediary funding to become increasingly short term (Brunnermeier and Oehmke, 2013b), or to require pledging of collateral. Ultimately, this process may increase instability while decreasing the volume of credit. Thus encouraging the creation of quasi safe assets may be destabilizing, if it leads to a maturity race or induces more run vulnerability even by risk tolerant agents.

Finally, a separate issue is whether those governments able to issue safe debt should seek to provide insurance on a global scale, accepting any amount of safety-seeking inflows.

Overall, many open issues remain in this new literature calling for new research on this fundamental theme.