Monetary analysis: price and financial stability

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Abstract

In a world with self-generated, endogenous risk and time-varying risk premia, price stability and financial stability are inseparable. A monetary analysis based on the distribution of liquidity mismatch across sectors provides valuable information about the build-up of vulnerabilities in tranquil times and helps to identify balance sheet impaired sectors in volatile times. When the monetary transmission mechanism becomes "sectorally impaired", monetary policy action disproportionally favours issuers of government and large corporation debt over small and medium-sized enterprises (SMEs). Reviving a prudently designed asset-backed securitisation market for SME and consumer loans would alleviate this discrepancy and establish a pan-European intermediation market.

1 Introduction

The monetary policy framework of the European Central Bank (ECB) stands on two pillars. The first pillar, economic analysis, aims to identify risks for price stability at short to medium-term horizons. It relies on a wide range of economic data and the new area-wide (DSGE) model. The second pillar, monetary analysis, originates from the fundamental long-term relationship between monetary aggregates and prices. Importantly, it also includes a sectoral analysis of various monetary and credit aggregates.

This paper starts by drawing a sharp contrast between the monetary textbook view and the finance view. Monetary economics made large strides by emphasising the importance of expectations within fully dynamic models. The expected future short-term interest rate, which pins down the long-term yield via the expectations hypothesis, lies at the heart of this analysis. Price and wage rigidities are the key frictions. However, financial markets function perfectly. In contrast, the empirical finance view stresses that most asset price movements are driven by changes in risk premia rather than news about future cash flows. The expectations hypothesis fails miserably in empirical tests. Moreover, surprise interest rate cuts by the Federal Reserve System shift the ten-year real yield in the Treasury Inflation-Protected Securities (TIPS) market. It is difficult to argue that prices are sticky for ten years.

In "The I Theory of Money" (Brunnermeier and Sannikov 2012), risk premia vary over time and most of the risk is endogenous. The paper also highlights the close links between price stability, financial stability, and fiscal stability. Indeed, the framework can be seen as a generalisation of the fiscal theory of the price level (FTPL). Unlike standard FTPL models, government debt and money have different maturities, and money creation and credit extension by the financial system are endogenous. Monetary policy redistributes wealth to the ailing sector by changing the relative value between government debt and money in order to stabilise the overall economy. Ex post monetary policy avoids unnecessary endogenous risk due to liquidity spirals and Fisher deflationary spirals. However, trade-offs between price stability and financial stability can arise, when deflationary pressure is offset by inducing banks to take on more risk. Ex ante monetary policy can be seen as an insurance scheme that partially "completes" markets. Financial

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instability affects numerous key factors – real growth, the formation of endogenous risk, the risk-bearing capacity of the financial system, the creation of inside money – and hence cannot be separated from price stability. Monetary policy and macro-prudential policy tools are closely intertwined, as they induce or restrict financial sector risk taking. Congruency of the two policies thus forms a key conceptual element.

In a world with financial frictions the most dangerous risk is endogenous, created by the system itself, and so are the movements in risk premia. Endogenous risk is most evident if it involves multiple equilibria. This paper argues that in such a world a sectoral analysis of aggregates provides valuable indicators of the vulnerability of the economy to sharp shifts, beyond the information contained in risk premia alone. The division of the economy into sectors should be such that capital is easily redeployable within, but not across, sectors. Expertise in holding certain asset classes segments the markets.

Traditionally, two schools of thought fought over the importance of two prime quantities: credit aggregates versus money aggregates. Credit is on the asset side of banks' balance sheets, while money is on the liability side. This paper takes a dynamic risk perspective based on "The I Theory of Money". It argues that sector-specific quantities, especially the build-up of imbalances, the mismatch of the liquidity of assets and liabilities, and the concentration of risk are important indicators of the economy's vulnerability to sudden shocks and risk dynamics. In tranquil times imbalances are more likely to build up due to the "volatility paradox" (Brunnermeier and Sannikov 2014). Also, since specific triggers vary from crisis to crisis, while amplification mechanisms exhibit similar patterns across episodes, it is more sensible to focus on the build-up of imbalances instead of looking for signs of shocks that can trigger a crisis.

Quantities provide useful information both in tranquil times, and in volatile times after a crisis has erupted. Policy interventions – in a world with balance sheet impaired sectors and debt overhang – must follow the "bottleneck approach". Quantity information helps identify the ailing sectors. Moreover, relying on price signals alone is suboptimal, especially since their informational content might decline as markets freeze.

Monetary policy should be used to stem further amplification and to avoid undesired redistributive effects. Leaving balance sheet problems unaddressed leads to liquidity spirals, along with the associated fire sale losses and Fisher disinflation. These processes redistribute additional wealth away from the distressed indebted sectors. The damage inflation or deflation causes depends on whether it redistributes wealth towards or away from the distressed sectors. A single integrated inflation index cannot capture this.

In models with financial frictions the monetary transmission mechanism can be impaired in many ways, which unlike the standard zero lower-bound problem cannot be alleviated by simply lifting the inflation target. Indeed, the monetary transmission mechanism can be "sectorally impaired"; for example, lending to small and medium-sized enterprises (SME) is disadvantaged compared to sovereign government debt. Monetary policy should not favour national sovereign debt and large corporate debt issuers over SMEs and households. With a revived, more transparent securitisation market for SMEs this discrepancy would be reduced. Moreover, the launch of a prudently designed asset-backed securities market focused on consumer and SME loans could be seen as an opportunity to establish a truly integrated European market. Dipping into a global investor pool, with USD 26 trillion in global pension savings alone and strong interest in long-term fixed income products, can provide enough risk-bearing capital to fund the currently credit-constrained parts of the economy. As a side benefit it would also reduce the diabolic loop that makes the prices of sovereign risk and bank credit risk move in lockstep. The paper also sketches the implications of such an SME securitisation scheme for monetary analysis.

The paper is organised in the following way. After briefly outlining the historical evolution of the ECB's monetary analysis, we discuss the current textbook treatment of monetary economics and contrast this view with empirical evidence from finance. Section 3 makes the case that quantities can serve as informative vulnerability indicators and hence help to predict sudden shifts in risk premia and risk dynamics. Section 4 illustrates the usefulness of quantity information during volatile times. Section 5 argues in favour of a prudently designed asset-backed securities market in order to avoid "sectoral impairment" of the monetary transmission channel. Finally, Section 6 concludes.

1.1 Historical evolution of the ECB's monetary analysis

One can divide the evolution of the ECB's monetary analysis into two different phases. In the first phase, which lasted from the introduction of the euro in 1999 until 2003, the ECB followed the approach of the Bundesbank by assigning a prominent role to money growth. The intent of continuing the successful Bundesbank monetary policy framework was to extend the Bundesbank's excellent reputation as an inflation fighter to the ECB (ECB 1999a). It was also thought that proper attention to monetary developments in medium-term price movements would provide an antidote against the pitfalls of exceedingly forward-looking rules, such as inflation (forecast) targeting (Issing 2002, 2006). Money growth – in particular the growth of M3 – was the reference value of the "monetary pillar". The objective was to ensure price stability in the short and medium term, building on the premise that in the long term the quantity theory of money holds. However, as M3 growth overshot projections, the prominent role of money growth in the ECB's monetary policy framework resulted in big communication challenges in the first years of European Economic and Monetary Union.

During the second phase from 2003 to 2007, the ECB's monetary policy framework played down the role of money growth. Research that highlighted empirical and theoretical limitations of money-based indicators, notably Bordes et al. (2007) from the Banque de France; and Alves et al. (2007) from the Banco de Portugal, supported these developments. After a review of the ECB's monetary policy framework in 2003 the 1st and 2nd pillars became the "economic analysis" and the "monetary analysis". The latter was assigned only a cross-check role. The ECB relied on the monetary analysis to extract long-run inflationary signals from monetary aggregates, to cross-check the information from the economic pillar. The emphasis shifted first to M3 and credit growth, which were also seen as early warning indicators of financial imbalances (ECB 2004), and then to a broad range of monetary and financial variables. The search for a new approach became evident in a high-level conference organised in 2006 (see Stark 2006).

Starting from 2007, with the onset of the financial crisis, liquidity provision became the ECB's focal point. This provided further challenges to monetary analysis as traditional results were more difficult to interpret. At the same time the ECB had started a comprehensive research programme aimed at strengthening the analytical underpinnings of its monetary analysis (see Papademos and Stark 2010).

2 Prices: interest rates and spreads

2.1 Textbook monetary model

In recent decades, monetary economics has focused on and made huge strides towards incorporating expectations in a fully dynamic context (see, for example, Woodford, 2003). However, monetary

aggregates and credit are de facto pushed into the background in the current textbook model.[2] Instead, the central focus is "the" equilibrium interest rate, together with the rule that governs its evolution, e.g., the Taylor rule. The expected future short-term interest rates also pin down long-term rates via the expectations hypothesis. Risk premia are assumed to be constant or to change gradually.

The implicit assumption underlying most of these models is that money markets function perfectly all the time. Markets are complete and all contracts are enforceable. Credit counterparty risk is absent and hence no collateral is needed. In addition, there are no frictions in the interbank and reserves markets. The central bank can always provide sufficient liquidity, i.e. adjust the money supply in the market for reserves, to ensure that the policy rate is implemented. Liquidity provision ensures that the policy rate can be separated from the target policy rate. In short, a separation principle between setting a policy rate and supplying liquidity can be applied.

Price and wage rigidities can cause the interest rate to deviate temporarily from the long-run Wicksellian "natural" rate, the rate that would prevail in the absence of any frictions and rigidities. The exclusive focus on the interest rate is often attributed to Knut Wicksell (1898), which is ironic since he was an unwavering advocate of the quantity theory of money.[3]

In the monetary textbook model, no imbalances in the form of bubbles or other excessive lending can emerge. These models typically also abstract away from credit risk. Default and counterparty credit risk are not a concern. Hence, the central bank does not need to apply any collateral requirements. Often government debt and bank loans are lumped together with other debt instruments in a "bond market".[4] There is also no place for the central bank's worries that their aggressive liquidity provisioning might prop up zombie banks.

There is no liquidity spread, whereas in reality, financial institutions are active in liquidity and maturity transformation. This exposes them to a serious risk of a run due to the mismatch in liquidity of assets and liabilities. Overall, the analysis focuses on the first moments, and on stocks and flows. The risk dynamics, i.e. the endogenously time-varying aspect of volatility, plays at most a minor role. Likewise, non-linearities and jumps due to multiple equilibria are absent from textbook models.

2.2 Textbook finance view

The current empirical view in finance could not be more different. Modern finance considers changes in risk premia, and not news of future cash flows, to be the primary driver of asset price movements. This is probably most clearly summarised in Cochrane (2011). The disagreement within finance is not about whether, but only about why risk premia vary so much over time. During episodes of low risk premia, bubbles emerge, whereas high risk premia see depressed asset prices. Some researchers attribute changes in risk premia to financial frictions, while others favour behavioural theories in which agents have distorted expectations.

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2 For a straightforward treatment see King (2001).

3 See, for example, https://research.stlouisfed.org/publications/mt/20050301/cover.pdf

4 Bernanke and Blinder (1988) break away from the trend of grouping all debt together in a "bond market", which is then suppressed via Walras' Law.

The term premia also vary over time. Long-run rates are not simply driven by expected future short rates. The expectations hypothesis embedded in most textbook New Keynesian models fails dramatically. Researchers such as Shiller (1979), Fama and Bliss (1987), Campbell and Shiller (1991), Cochrane and Piazzesi (2005) and Cieslak and Povala (2013) have documented that excess returns on long-term bonds are highly predictable, with an R-squared exceeding 45% on a one-year horizon. Changes in term premia (as opposed to innovations in expected short-term rates far in the future) account for roughly 70% of price movements in distant forward contracts.

These empirical results also hold for real bonds with very long maturities. Specifically, monetary policy decisions affect risk premia. Hanson and Stein (2013) document that a surprise interest rate cut by the Federal Reserve System leads to a sizable decline in the ten-year real yield on TIPS. Without assuming that prices or wages are sticky for very long horizons (which is arguably unrealistic), this finding is difficult to reconcile with models of constant risk premia. Gertler and Karadi (2013) combine a high-frequency identification approach with vector autoregressions to analyse output in combination with inflation and a variety of interest rates.

The credit default risk premium of corporate bonds can also vary over time. Gilchrist and Zakrajšek (2012) develop a new credit spread index and break it down into two components: one part which captures movements in default rates (cash flow news) and the other documenting the excess bond premium caused by time-varying risk premia (stochastic discount factor news). They show that the excess bond premium is a good predictor of future economic activity.

Liquidity risk premia are captured by interest rate spreads, such as the LIBOR-OIS spread. Moreover, the VIX seems to be a very good "fear gauge" as it commoves substantially with credit and liquidity risk premia. A rise in the VIX indicates that investors are withdrawing from various arbitrage trading strategies.

These empirical findings are consistent with models, such as "The I Theory of Money", in which financial frictions are the key drivers and in which a reduction in the effective risk-bearing capacity of the financial sector is accompanied by an increase in various excess risk premia. The contraction of credit supply leads to a negative impact on the real economy. As a countermeasure, for example, an interest rate cut leads to a "stealth" recapitalisation of the financial sector, strengthening its net worth and risk-bearing capacity. This lowers the long-term real yield, possibly in a non-linear way. The effects can be even more dramatic in the presence of multiple equilibria. Moreover, Quantitative Easing (QE) affects asset prices and can therefore be used to recapitalise sectors that suffer from debt overhang problems or impaired balance sheets. For example, purchasing mortgage-backed securities in the United States lowered mortgage rates and supported house prices. This in turn helped the undercapitalised household sector.

3 Quantities as vulnerability indicators in tranquil times

In a world with financial frictions, one of the main objectives of monetary policy is to reduce endogenous, self-generated systemic risk. Cutting out avoidable risk reduces the required risk premia: the hurdle rates for real investments and consumption. Policies that reduce endogenous risk and avoid sharp rises in risk premia are welfare enhancing – their effects are particularly visible if they reduce the probability that the economy will jump into a bad equilibrium outcome (in a multiple-equilibrium setting).

It is important to ask whether quantities such as monetary and credit aggregates provide information about the build-up of potential endogenous risk? And if so, which quantities merit the most political and regulatory capital? One might be tempted to draw the conclusion, for example from the empirical findings of Gilchrist and Zakrajšek (2012), that it suffices to focus exclusively on the time-varying component of risk premia. Is it therefore sufficient to simply modify existing models to include exogenous time-varying "risk premium wedges"? After all, prices and shadow prices reflect the scarcity and abundance of quantities.

In fact, quantitative aggregates can be extremely useful as indicators of vulnerabilities before they appear in spreads and risk premia. Otherwise, the vulnerability of the economy to abrupt changes may be hard to assess. Prices often follow a trend and are prone to large corrections: they move little and then suddenly act erratically. Quantities can give us some indication about the likelihood of such shifts in prices and jumps in volatility. This is especially the case when imbalances are building up in the background. In short, quantity aggregates are useful indicators for answering the question: "how close is the system to the cliff?".

The vulnerabilities and amplification mechanisms are often strikingly similar across crises. However, the actual triggers – the subprime market, the internet bubble, etc. – vary from crisis to crisis. Hence, it may be more sensible to study commonalities that explain the vulnerability of the system to spiralling amplification effects and runs, instead of watching out for particular events that may trigger a sharp downturn. Triggers that prompt adverse spirals may be distinct, but the build-up is invariably common.

Central bankers should be particularly interested in these amplification mechanisms for another reason. Not only may amplifications lead to high volatility environments, but the associated sharp drops may also impair the monetary transmission mechanism, which is described below.

3.1 Impairment of monetary transmission mechanism

From a monetary policy perspective, it is important to use quantities to better predict possible erratic shifts in the economy because (i) monetary policy actions only become effective with a lag and (ii) the monetary transmission mechanism might become impaired, especially in times of financial instability. Figuratively speaking, the central bank might then end up trying to "push on a string". There are several reasons why monetary policy might lose its punching power and fail to overcome deflationary or inflationary pressures.

First, by now there is a large literature, which points out that the policy rate cannot be pushed far below zero. If the short-term interest rate is set far enough below zero, then agents will store their wealth in cash notes at zero interest. This limits the central bank's conventional toolset. The literature offers a host of unconventional monetary policy tools that help at least partially to soften this constraint. One of them is "forward guidance", which requires that a central bank have some credible commitment power.

Second, a central bank's space to manoeuvre is limited when the economy is vulnerable to runs or eruptions of illiquidity triggered by sunspots.[5] These events are possible after a sufficient build-up of liquidity mismatch. The economy can end up in a scenario in which multiple equilibria are possible. Then, any news can trigger a jump to the bad equilibrium. In such circumstances, the central bank has to be very

[5] Runs can be credit-supply driven, when creditors refuse to rollover their debt. They can also be debtor driven. That is the case, when some debtors start fire-selling their assets thereby depressing collateral values of all debtors who are then forced to join the fire sale.

careful. An interest rate cut could be interpreted as a weak signal about the economy and may be used as a coordination device to start a run. Even the perception of an increased risk of jumping to the bad equilibrium could undermine the goal of a particular policy measure. Note that a higher inflation target is not a panacea for this second form of impairment of the monetary transmission mechanism.

Third, the central bank might be constrained since monetary policy measures may bring about undesirable responses from some financial institutions. First, the reaction may be heterogeneous, differing from institution to institution. Second, weak, zombie banks might react in an undesirable way by gambling for resurrection. Jimenez et al. (2014) use Spanish data to document that weak banks take on excessive risk. Interestingly DeNicolo et al (2013) come to a different conclusion using a different data set. A trade-off between price and financial stability might emerge. Accommodative monetary policy that helps to fend off deflationary pressure has the potential to compromise financial stability.

Importantly, the monetary transmission mechanism can work differently across various regions and sectors in the economy. This can lead to sectoral or regional impairment of the monetary transmission mechanism. For example, it may be difficult to reach SMEs and certain households without over-stimulating other parts of the economy. Sections 4.1 and 5 will zoom in on this aspect and provide some possible remedies for it.

3.2 Credit vs money dispute

Two schools of thought have fought over the two different prime quantities: credit aggregates and monetary aggregates. The two schools are sometimes referred to as the "credit view" and the "money view". The goal of the money view is to determine the price level, ignoring risk premia. In the credit view, risk premia play an indirect role, but less attention is given to how vulnerabilities affect shifts in risk and risk premia, and how those affect overall output and money creation.

Tobin and Brainard's (1963) portfolio balancing approach focuses on credit on the asset side of banks' balance sheets, hence the name the "credit view". Banks may shift their asset and loan allocation, for instance in times of crisis they may be unwilling to provide credit and instead park their funds in safe assets. The credit view is also reflected in the literature on the bank-lending channel, as emphasised by Bernanke and Blinder (1988) and Bernanke and Gertler (1995).

In contrast, monetarists, following Friedman and Schwartz (1963), focus on the liability side of banks' balance sheets. This "money view" offers a simpler theory, which argues that it is primarily the link between (broad) money supply and inflation that matters. This view focuses on the transaction role of money, while the "credit view" emphasises the role of money as a store of value.

"The I Theory of Money" incorporates both elements, i.e. both sides of the intermediaries' balance sheets. It reflects the fact that the "output" of financial intermediaries, including shadow banks, is two-sided: on the asset side, intermediaries create credit, while on the liability side they create (inside) money. Viewed from this perspective, it is clear that funding is not an input – an aspect that distinguishes financial institutions from other corporations.

In the I Theory, just as in the portfolio balancing approach, the intermediaries' asset composition plays an important role. At the same time, as described in the "money view", (inside) money creation from banks'

liabilities determines the price level. Both elements are endogenously driven by the health of the financial system. The health of the financial sector also affects endogenous risk and risk premium dynamics, which in turn affect the banks' willingness to extend credit to the real economy and to create money.

The I Theory goes beyond stocks and flows as captured by flow of funds data and derives endogenous risk dynamics. The model also stresses the importance of continued uncertainty, especially in a recession. Papers that study the amplification effects after a one-time unanticipated shock implicitly assume that agents know that the economy will recover back to its steady state after the shock. In reality, market participants do not know this for certain. They face great uncertainty about the length of the downturn and the possibility of continued adverse shocks. With weakened balance sheets, agents' behaviour becomes especially erratic and sensitive to further shocks. This anticipation of uncertainty results in significant amplifications, counteracting the Kocherlakota (2000) critique that the calibrated impact of financial frictions has to be small.

The distinction between credit and money in a simple stylised economy with a representative banking sector is fairly straightforward. Credit is on the asset side, arguably including lending to the government sector. Money, on the other hand, is on the liability side of the banks' balance sheets. Things get more complicated in a world characterised by long intermediation chains, a web of contracts, and cross-holdings among various financial institutions. Then, the distinction between credit and money is less obvious and the aforementioned balance sheet definitions are less meaningful.

Going beyond the I Theory model, an important distinguishing feature of money in a complex world of instruments is that it is a standardised IOU for which the counterparty does not matter. In other words, short-term IOUs with very limited credit and liquidity risk are a defining characteristic of money. Money has the convenient property that opposing positions can be easily netted without any controversy. Money is not informationally sensitive: no one (except possibly the government) should have an informational advantage about the value of the money.[6] Moreover, credit can be transformed into money through collateralisation, by removing default and liquidity risk. Repos are a classic example of this transformation.

An overarching definition of money is made elusive by the changing views of market participants on securities that can be treated as substitutes for money. Prior to the crisis, financial market participants treated AAA-rated securities as close substitutes of money. During the crisis, the situation changed drastically: when volatility rose there was a severe scarcity of credit contracts that could be considered closely substitutable with money. Even inside money might lose its "moneyness" in crises.

On the other hand, there exists a portfolio rebalancing effect in crises: as credit becomes more short-term, it is officially classified as money (rather than credit). This effect leads to artificial distortions in statistics: M3 growth becomes artificially overstated. There may be also an accompanying shift to safer forms of savings, which shows up as an increase in M2. Implicitly, the ECB has already modified its monetary growth decision criteria by resolving to ignore M3 growth in 2001-2003. In contrast, after 2004, M3 growth correlated more strongly with credit expansion, and more weight was put on M3 growth. In a sense, the ECB indirectly applied a "modified" M3 growth criterion during that period.

[6] There are many other distinguishing features of money, such as, for example, the anonymity of physical cash.

3.3 Liquidity mismatch and its topography

The vulnerability of the financial system depends on the degree of leverage in the economy as well as on its liquidity mismatch: the difference between the difficulty of selling assets in a crisis, and the reliability of access to funding in such times. Credit aggregates are important from a financial stability perspective as they reflect the aggregate leverage in the economy. Since money is short-term debt, monetary aggregates also reflect the maturity mismatch in the economy. However, for a number of reasons, neither money nor credit is an ideal measure.

Liquidity has many dimensions. A proper measure should take into account the mismatch between technological illiquidity of holdings on the asset side of balance sheets and funding liquidity on the liability side. For physical assets, technological illiquidity depends on (i) the duration of physical investment, and (ii) the redeployability and reversibility of the physical project. If a factory is built to operate for 30 years and, owing to its specificity, it cannot be redeployed for other uses, then the liquidity of the factory is very low. In the case of fire sales triggered by adverse shocks, the prices of illiquid physical assets drop significantly. A similar argument holds for financial assets, which are claims on cash flows generated by physical capital or other financial assets. The prices of illiquid financial assets drop significantly in crises.

Holders of physical or financial assets may be pushed to fire sales if they cannot roll over existing debt on account of the short-term nature of their financing. Wholesale funding, defined as the short-term funds provided by money market investors, is one of the most fleeting sources out there in terms of liquidity provision.

Liquidity mismatch is the discrepancy between the technological illiquidity of assets and the funding liquidity of liabilities, i.e. the maturity structure and reliability of funding. An important measure of reliability is the sensitivity of margins/haircuts to market conditions. For example, if someone buys a financial asset on a margin of 10% and this margin can jump overnight to 70%, then he has effectively funded 60% of the asset purchase with overnight debt.

Furthermore, the market illiquidity of assets depends on the availability of natural buyers willing to step in and purchase assets without a significant discount. The existence of potential buyers depends on the distribution of liquidity mismatch across the economy, and it is a key determinant of the system's susceptibility to liquidity spirals and runs. If investors with similar expertise are all exposed to a similar liquidity mismatch, then they will absorb liquidity after an adverse shock, instead of providing it.

Therefore, for a coherent analysis, it is essential to define sectors based on their expertise for holding certain assets or asset classes. Expertise segments markets. Expertise also has a regional dimension; often the knowledge of local culture and language is crucial for successful operation in a given region. Proper analysis has to identify the liquidity mismatch within each sector to map out the overall mismatch topography. Such an analysis goes far beyond simple aggregate credit and money supply measures or simple flow of funds arithmetic in order to identify risk concentrations and risk pockets.

It should not come as a surprise that focusing on net positions in a representative economy grossly underestimates risk. The simple fact that net debt in a closed economy is zero – for each euro lent out, there is a euro borrowed – clearly shows the importance of a sectoral analysis. A traffic analogy might make this point even more striking. We would certainly consider it unreasonable to study traffic patterns by netting out the number of people who commute from A to B against the people who commute in the

opposite direction. Such an analysis would grossly underestimate total traffic volume and accident rates. A similar observation is true about risky credit, as default and liquidity risk are impossible to net out. Overall, an economy-wide risk topography analysis is needed, as outlined in Brunnermeier, Gorton and Krishnamurthy (2013).

Special attention should be paid to the financial and government sector. The financial sector is typically part of any episode of excessive debt levels in the economy. This may well be for strategic reasons, as times of crisis often see losses being pushed onto the financial sector, providing it is well capitalised. The government sector is unique because it can fund itself through taxes. Taxes can even be levied on as yet unborn generations. If government debt is primarily held by the domestic banking sector, the government sector and the banking sector are inextricably linked. As government debt levels become unsustainable, banks suffer losses on their bond portfolios. They cut back their credit, lowering real economic activity. This, in turn, lowers the government's tax revenue, which makes the official debt level even less sustainable.

3.4 Risk build-up phase

How does the mismatch in liquidity build up over time? Credit bubbles which are accompanied by liquidity mismatches are much more detrimental than equity financed bubbles. Credit growth is closely linked with asset price growth and an increasing probability of a subsequent financial crisis. Schularick-Taylor (2012) document this based on a cross-country study using historical data. While the bursting of the technology (asset) bubble (which was not financed by credit) starting in 2000 caused large wealth destruction, its implications on the real economy were minor compared to the bursting of the recent credit-financed housing bubble.[7]

Liquidity mismatch can build up over time in three different ways:

1 Excessive short-term debt financing

2 Extension of the duration of physical projects

3 Increased specificity and specialisation of physical capital

The first reason is an increase in short-term credit financing. The ideal breeding ground for lending booms and credit bubbles is an environment with low volatility. High loan to value (LTV) ratios or equivalently low margins and haircuts allow market participants to lever up. When levering up with short-term debt, each individual investor only takes into account that he might not be able to roll over his own debt and might be forced to sell off his assets at fire-sale prices. However, he does not take into account the pecuniary externality that his selling depresses the price for other investors as well. In addition, increased volatility raises margins and haircuts for all levered investors, as in Brunnermeier and Pedersen (2009). Moreover,

[7] Similarly, the run-up in stock prices during the "roaring 1920s" was to a large extent based on margin trading, i.e. finance with short-term loans. This credit-fed boom ultimately led to the Great Depression with hardships felt in all parts of the economy. The Scandinavian crisis in the early 1990s and the Japanese lost decade were also preceded by lending booms that had led to excessive asset prices. Arguably, financial liberalisation made credit and asset prices more important drivers of economic fluctuations. It is the simultaneous emergence of both excessive credit growth and unwarrantedly high asset prices that make the dangerous cocktail.

credit-financed real estate bubbles are often accompanied by increases in consumer spending. Their bursting therefore also affects aggregate consumption, especially that of durable goods.

These inefficiencies led Borio and Drehman (2009) and Drehman (2013) to propose the aggregate debt-to-GDP ratio as an early warning signal for the build-up of imbalances. However, significant credit growth is not a sign of instability per se. Credit growth that leads to productivity enhancements can reflect a financial deepening and a weakening of financial frictions. On the other hand, short-term credit flows that target sectors with low total factor productivity are worrisome, see, for example, Gorton and Ordonez (2014). Brunnermeier and Reis (2014) show that the capital flows in the 2000s from the core to the periphery of the European economy did not lead to any growth in total factor productivity (TFP) in the periphery. The increase in GDP in the periphery before the crisis was mostly driven by an increase in factor input, in the form of additional capital and labour rather than an increase in productivity. Subsequent financial instability has been further exacerbated by the fact that most of these credit flows were in the form of short-term wholesale funding within the banking sector.

Excessive credit can build up in different sectors, highlighting the importance of sectoral analysis.[8] Part of the liquidity mismatch can be concentrated in the corporate sector, as long-run investments are largely financed with short-term debt, often in foreign currency. In Japan the business sector became overleveraged in the 1980s, while in the United States and Spain in the 2000s it was the household sector that borrowed too much. See, for example, Brunnermeier and Sannikov (2012).

The second form of build-up occurs when firms shift to physical investment projects whose cash flows materialise far into the future. Each individual firm does not internalise that by investing in a project with longer duration; its increased urge to fire-sell after an adverse shock also adversely affects other investors. Investors are typically willing to accept longer-term investments when they expect that the real interest rate and overall volatility will remain low for an extended period of time. This second form of liquidity mismatch build-up resonates with the ideas from the Austrian school of economics. Low interest rates flatten and stretch the "Hayekian triangle". As the time costs of capital decline, the production process becomes stretched into more stages and takes longer to complete.[9]

An increase in specialisation is the third way in which liquidity mismatch can build up. As the specificity of investments increases, price drops in fire sales become larger. Each individual agent does not fully take into account that a higher degree of specialisation also reduces his ability to absorb possible fire sales from others when they face negative shocks. In other words, by specialising more he worsens his potential to become a liquidity provider for others. This applies to investment not only in physical capital but also in human capital. As sectors become more specialised – as they use more special physical capital and become more reliant on industry-specific human skills – liquidity problems worsen. As an economy climbs the development ladder, it becomes more specialised and its sector structure becomes more granular.

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8 Special attention should be devoted to credit lines. They provide early indications that a crisis may be around the corner, since firms have an incentive to draw on outstanding credit lines as their financial outlook worsens and as access to new credit dries up. As a consequence, credit seems to expand or to remain strong, while in reality the economic situation worsens. Ivashina and Scharfstein (2010) provide empirical evidence of these phenomena in the United States in 2008. It might therefore be informative to look at newly extended credit lines to predict the onset of problems.

9 However, unlike in the teachings of the Austrian school, the lengthening of the duration of investment projects in present day economies does not necessarily occur as a result of an increase in the number of production stages, as nowadays production processes are streamlined with just-in-time supply chains.

3.5 Monetary policy and macro-prudential policy: an integrated view

In the spirit of clear accountability it might be tempting to separate and classify "quantity rules" as macro-prudential rules to ensure financial stability, and "interest rate rules" as monetary rules to ensure price stability. Treating them separately from each other and assigning them to two separate agencies – a regulatory authority and central bank, respectively – seems appealing.

However, the I Theory outlined in Brunnermeier and Sannikov (2012, 2013) questions this "separation view" and stresses the importance of spillover effects that link the various stability concepts. For example, financial instability prompts financial intermediaries to shrink their balance sheets and create less inside money. Consequently the money multiplier collapses and Fisher deflation pressure emerges. This increases the real value of banks' liabilities and worsens financial instability. Financial institutions may "corner" central banks by threatening contagion (financial dominance) if they are not bailed out – possibly through lax monetary policy.

It is also difficult to explain why certain quantity restrictions belong to the monetary policy toolbox while others are macro-prudential instruments. For example, reserve requirements are typically classified as a monetary policy tool, while many consider their close cousin, liquidity requirements, to be a macro-prudential tool. Central banks set collateral requirements, while leverage requirements are macro-prudential, and so on.

Importantly, macro-prudential regulation has direct implications on price stability. Tightening capital requirements leads to less credit extension and money creation and hence causes downward pressure on inflation. Counteracting this with loose monetary policy might not be an optimal policy mix. This calls for a close cooperation between monetary policy and macro-prudential measures. Such cooperation might be challenging if the two different authorities disagree. Imagine a situation in which the macro-prudential authority is reluctant to lean against the build-up of imbalances that may have the potential to impair the monetary transmission mechanism. In such circumstances should the central bank compensate for macro-prudential inaction with interest rate policy?

4 Quantities in volatile times

So far, we have made the case that monetary analysis should include quantities, such as the topography of liquidity mismatch, in order to prevent potential future financial and price instability. Ex ante crisis prevention is essential for central banks in order to avoid being cornered later and forced to conduct ex post redistributive monetary policy. In the worst case, we might enter a regime of "financial dominance", in which the financial industry corners central banks, forcing them to take measures that restrict their freedom to conduct the proper monetary policy. Hence, it is insufficient to restrict attention to current interest rates only: quantity aggregates have to be closely watched and acted upon as well to prevent the build-up of imbalances that make the economy vulnerable to sudden shifts.

This section focuses on volatile times after the crisis has erupted and makes the case for programmes that support prudentially designed asset-backed securities (ABS) in order to avoid sectoral imbalances. Central banks have to figure out which sectors suffer from impaired balance sheets and debt overhang problems. The key question is: where is the bottleneck in the economy? Quantity measures, in addition to various interest rate spreads and implied volatility measures, provide critical information. Typically all these

measures shoot up in tandem. However, price movements in these situations are mostly driven by news concerning political decisions, in particular, bailout expectations, rather than economic fundamentals. Even worse, markets might freeze or totally break down, and hence market price signals can become unusable as their informational content becomes diminished.

In this section we first argue that monetary policy can be used to avoid further amplification and redistributive effects due to endogenous risk. The monetary transmission mechanism can become "sectorally impaired" as banks find it less advantageous to lend to SMEs rather than hold sovereign government debt. With regard to the recapitalisation of the financial sector as a whole, there are two fundamentally opposed strategies. On one hand, the temporary monopoly strategy tries to recapitalise the struggling sector, say the banking sector, through increased earnings. Future earnings are enhanced if one restrains competition among banks. On the other hand, the exact opposite strategy is to invite new risk-bearing capital into the sector. This enhances competition in the undercapitalised sector and eases credit flow to the rest of the economy. One way to increase the sector-wide risk-bearing capital is to launch and establish prudentially designed ABS markets. Such a securitisation scheme would also reflect the ongoing shift away from traditional banking and the increased importance of asset management. By including all sectors and all regions in the economy into the securitisation scheme, it is possible to avoid the "sectoral (and regional) impairedness" of the monetary transmission mechanism.

4.1 Monetary policy: "sectorally impaired" transmission mechanism

The I Theory suggests the application of a "bottleneck monetary policy" in times of crisis. Whenever a major sector in the economy suffers from debt overhang problems, typically the financial sector is also in bad shape.

Leaving the balance sheet problems unaddressed leads to liquidity spirals, with associated fire-sale losses and the Fisher deflationary spiral. These processes/spirals redistribute additional wealth away from the distressed sectors with high debt levels. Monetary policy has to lean against liquidity and deflationary spirals – especially if fiscal policy measures cannot be implemented in a timely manner. Monetary policy that slows the flight of wealth away from these undercapitalised sectors, for example from borrowers to savers, reduces the required risk premia and the level of endogenous (self-generated) risk.

A purely inflation-focused monetary policy only tries to reduce the impact of the Fisher deflationary spiral, and stops short of ensuring that the financial sector extends sufficient credit to the real economy. It does not target the bottleneck, i.e. the core of the inefficient distortions that arise from impaired balance sheets.

Aggregating various forms of inflation to a single index can obscure valuable information for optimal monetary policy. For example, inflation driven by an increase in wages and other input prices is anti-stimulus if corporations suffer from debt overhang problems. This type of inflation also undermines the international competitiveness of corporations. If, on the other hand, it is primarily the households' balance sheets that are impaired, then moderate wage inflation might be helpful to overcome the bottleneck in the household sector.

Unconventional monetary policy can only be effective if there exists the right set of assets through which the central bank can intervene. The recent set of quantitative easing measures of the US Federal Reserve

has focused on mortgage products. One could make the case that these measures aimed to stabilise the housing market in order to ease the balance sheet problems of a large part of the housing sector.

So far, the ECB's unconventional monetary policy measures have focused on various forms of government debt. From 2012 onwards the ECB's communication strategy, which suggested potential interventions in the sovereign debt market, was extremely effective in reducing the funding costs for sovereign governments. A spillover effect of this policy has been the lowering of corporate yields, which has helped large enterprises.[10] However, due to the lack of an effective securitisation market for SME and household loans, the impact of monetary policy on SMEs and households has been limited.

The monetary transmission mechanism is thus "sectorally impaired". Within the current financial structure, the central bank is forced to choose between leaving the SMEs' funding problems unaddressed, or overcorrecting on the sovereign debt market (leading yield observers to suspect a bubble in sovereign debt). Both alternatives are suboptimal and unbalanced, as the central bank's policy may have to be too loose for some sectors in order to at least partially alleviate the pressure on other sectors. Of course, the transmission mechanism might in addition be "regionally impaired". One potential solution to this dilemma is to develop a standardised and prudentially designed asset-backed securitisation market. We will return to this point in Section 5 after discussing some other recapitalisation strategies.

4.2 Recapitalisation strategy through monopoly rents and forbearance

One strategy to recapitalise impaired balance sheets, for example those of the banking sector, is to grant them temporary monopoly rents. If a whole sector is less well capitalised, firms in this sector retreat and compete less fiercely with each other. This boosts their profit margins and future earnings. This, in turn, lifts their franchise value and current stock price, thereby relaxing the funding constraints. This strategy only works for sectors that are critical for the functioning of the economy and not easily substitutable. The classic example is the financial sector. A higher concentration of banks within the financial sector might be tolerated. Regulation, such as a restricted issuance of bank licences, can make it difficult for potential new entrants to enter and compete with the incumbent banks. From an ex ante perspective the possibility of granting this monopoly power can be seen as an insurance scheme that the real economy extends to the financial sector.[11]

However, this strategy comes with at least two major drawbacks. First, preventing others from entering the market also limits the number of potential buyers of legacy assets. To avoid liquidity spirals due to forced fire sales, this recapitalisation strategy is typically accompanied with generous forbearance arrangements. Losses are hidden and not realised. In addition, banks continue to rollover zombie loans in the process of "evergreening".

The second even bigger problem of this "temporary monopoly strategy" is that the reduced competition can hurt other sectors in the economy more than it benefits the distressed sector. For example, the induced reduction in new lending by the financial sector might cause a sharp decline in real economic

[10] The Spanish and Italian ten-year yields trade below 3%, the Portuguese around 3.65% and the Bank of America Merrill Lynch Euro High Yield Index fell significantly below 5%.

[11] For a formal analysis within an international context, see Brunnermeier and Sannikov (2014b).

activity, which makes other outstanding loans more risky. Ultimately, if the feedback effects are sufficiently large the indirect costs could outweigh the benefits.

The second effect is less of a concern for regulators if the reduction in new lending occurs abroad, outside their jurisdiction. In the 1980s policy-makers pursued a strategy of forbearance for international banks that had overextended loans to Latin America. Instead of restructuring Latin American debt, international banks were "saved" and given time to rebuild their balance sheets through the 1980s Paris Club negotiations. This strategy led to international spillovers and dismal economic growth in Latin America for many years. In contrast, the credit crunch experienced in Japan during the 1990s was inflicted on its own economy and resulted in two lost decades.

4.3 Attracting new risk-bearing capital

An alternative strategy is to invite new risk-bearing capital and open up new funding channels. The inflow of additional risk-bearing capital enhances competition within the banking sector and restores credit. Ignoring indirect general equilibrium effects, profit margins typically suffer, which explains why incumbent firms tend to oppose such a strategy.

There are different ways to attract new capital. For example, one could allow foreign firms with similar expertise to enter the market. Korea followed this alternative strategy in the late 1990s,[12] but local banks arguably had to sell assets at fire sale prices to the entering foreign institutions.

Another simple form of attracting new capital is to force banks to issue new equity capital. Existing firms are reluctant to issue equity on their own, owing to the stigma associated with the action. Firms try to signal their strength to withstand the crisis by refraining from issuing additional equity. One of the main purposes of the ECB's Asset Quality Review (AQR) is to evaluate the solvency of major banks in order to reduce inefficiencies resulting from asymmetric information. This review should make it less costly for healthy banks to raise new equity, and potentially lead to an earlier closure of insolvent zombie banks.

A third way to attract new funding is to increase the efficiency of direct lending arrangements, for instance via the corporate bond market or private debt. This opens up a new funding source for large corporations.

Finally, one could also revitalise the shadow banking system, as was done in the US in 2009 through various programmes by the Federal Reserve and the US Treasury.

Importantly, as long as it is unclear whether a country is following a recapitalisation strategy through granting temporary monopoly rents or through inviting new risk-bearing capital and closing down zombie institutions, new investors may be reluctant to enter as they are uncertain whether they should support the incumbents or the new entrants.

5 Prudently designed asset-backed securities markets

Launching a prudently designed asset-backed securitisation market deserves special attention especially in the light of the global shift away from a bank dominated finance landscape to one in which asset

[12] See for example, Shin and Hahm (1998).

management and other forms of finance play a more prominent role. Pension funds and insurance companies are searching for longer-dated fixed income products in order to hedge their long-duration liabilities. They are also willing to assume some limited amount of credit risk if they can, in exchange, lower their duration risk. Global savings of pension funds alone is about USD 26 trillion.[13]

A standardised and transparent securitisation programme that transforms relatively illiquid loans to SMEs, real estate firms and consumers into an asset class with high market liquidity is appealing for several reasons.

First, in the short-term this could stimulate credit and overcome the ongoing weakness of credit provisioning by banks. Some of the credit risk could be transferred to other financial institutions outside traditional banking. Given the strict standards applied to newly granted loans at the moment, the overall credit risk should be manageable especially for asset management firms with healthy balance sheets.

Second, this new prudently designed asset class would ensure that any unconventional monetary policy is more "sectorally balanced". Monetary policy should not favour national sovereign debt and large corporate debt issuers over SMEs. With an active SME securitisation market, this problem could be avoided. If the ECB were to intervene in the sovereign debt market again, it would crowd out private investors who then might find it attractive to shift into this new prudently designed asset class. This would improve SMEs' funding conditions. Moreover, the ECB could directly become active in this market as part of an unconventional monetary policy measure.

Third, securitisation designed on a euro area-wide scale would create a new European asset class. It would re-establish cross border financial intermediation inside the euro area, with sounder economic fundamentals than wholesale short-term interbank lending. It would also ensure that the monetary transmission channel is not only "sectorally", but also "regionally" more balanced.

Fourth, the senior component of ABS can serve as stable and high-quality collateral and take on the role as a European safe asset.[14] It can take on a stabilising function in times of crises when flight to safety capital flows from the periphery to the core or the euro area surge.

Fifth, establishing this asset class is an opportunity to launch a truly European market that does not suffer from the diabolic loop, i.e. the link between sovereign and bank credit risk. Note that the value of ABS only depends on the underlying securities.

There exist several technical and legal hurdles. While the statistical properties of default rates for consumer loans, especially for car loans, are by now well understood and stable, the reaction of the value of an SME loan portfolio to various risk factors is less known. As a consequence, tranching of SME loans has to be more conservative. In addition, securitisation has to be designed in a way that minimises asymmetric information problems. Pooling should ideally diversify away any soft informational advantage the initial

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13 About half of global pension savings of about USD 26 trillion are in the United States. The following highest pension savings are in Japan, the United Kingdom, Australia and Canada. As a share of GDP, the Netherlands has the highest rate of pension savings at 136%, while France and Italy have the lowest rates, both with less than 5% of GDP. See OECD data, available at http://www.oecd.org/pensions/pensionsataglance.htm

14 The Euro-nomics group has proposed a similar form of bond structuring involving the pooling and tranching of sovereign debt. The senior bonds, called ESBies, would form the European safe asset.

issuer of the SME loans might have. From a legal perspective, a harmonised bankruptcy law would be desirable but is not necessary.

Advanced standardisation and transparency is essential for the success of the asset class. If the ECB were to embark on a private asset purchase programme, it would have an opportunity to set the framework for the future development and standardisation of securitisation in the euro area. Currently, it does not have this power with its collateral policy, as it is constrained by the need to provide liquidity and does not directly influence the price of the securities taken as collateral. In contrast, if the ECB were to buy these new assets, it has to take a view on the price. That gives the ECB very strong leverage on the design and structure of securitised assets. This offers a unique opportunity to shape the market in the long run.

One of the key design issues is whether or not this new prudent securitisation should involve some maturity transformation in addition to pooling and possibly tranching. There are strong arguments in favour of staying away from maturity transformation. The absence of any maturity and liquidity mismatch removes the endogenously created risk of a run. As mentioned above, a large set of natural investors to purchase long-dated assets precludes the need to attach a maturity transformation element to this product. More generally, the fact that a world full of long-term savings and funding needs continues to be served by a financial system that relies mostly on short-term funding remains a paradox.[15]

Important undesirable complications arise if the securitisation scheme were to involve some maturity transformation, i.e. if the issued ABS were to be short-term, while the underlying assets were long-term. This has implications for the ECB's monetary analysis, policy, and financial regulation. The private sector's built in incentives for excessive maturity and liquidity transformation would provide a big challenge. Securitisation would produce "money-like" assets that would serve as a store of value and a medium of exchange. The monetary analysis has to take into account that this asset class also contributes to liquidity mismatch. The surveillance of traditional monetary aggregates should be adjusted on account of the complexity arising from portfolio substitution effects. Importantly, the new asset class would be subject to "run risk". Hence, tranching should be even more conservative owing to the potential for a build-up of liquidity mismatch to appear. Ultimately, whether the ECB should extend its lender of last resort function to this asset class, and, if so, what supervisory and regulatory steps the ECB has to adopt, remains an important question.

6 Conclusion

This paper tries to put forward a potential conceptual underpinning for the deepening of the monetary analysis within the ECB. To a large extent, the reasoning is based on more formal analysis developed in "The I Theory of Money". Importantly, in this framework risk premia vary over time and risk is endogenous, i.e. self-generated by the system. Both risk premia and risk can be mitigated with the appropriate monetary policy and macro-prudential policy. In this framework price stability, financial stability and fiscal stability are interconnected and difficult to separate.

[15] There are various economic theories that justify this fragile arrangement using primarily short-term debt. For example, Calomiris and Kahn (1991) as well as Diamond and Rajan (2001) make the case that the possibility of runs acts as a disciplinary device for debtors. In Brunnermeier and Oehmke (2013) short-term funding is excessive due to an inefficient maturity rat race.

Quantity aggregates at a sectoral level provide valuable information. Ideally, one would like to map out the topography and concentration of the liquidity mismatch in the whole economy. This helps to identify the build-up of imbalances and vulnerabilities in tranquil times and figure out the bottlenecks in volatile times.

As a result of missing asset markets, the monetary transmission mechanism may be unable to reach certain sectors (or regions) in the economy. Monetary policy should not favour national sovereign debt and large corporate debt issuers over SME and consumer loans. The paper makes the case for launching a prudently designed asset-backed securities market, which transforms illiquid SME and consumer loans into a liquid asset class, as a way to broaden the transmission mechanism of monetary policy. This would also establish a lasting intermediation market for this segment in the euro area.

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