1 Background and Motivation

It is commonly accepted that monetary policy affects the wider economy. There is also emerging evidence that there are monetary effects in financial markets. However, most work on these topics looks at broad-brush policy variables such as short-term interest rates or the quantity of money. There is a dearth of work on monetary economics or finance and banking that studies the micro-foundation of the monetary system and its impact on markets and the economy. The broad objective of this book is to contribute toward filling that gap. This is important in light of the ongoing challenges in the global economy, where central banks are engaged in quantitative easing and other forms of unconventional monetary policy in an effort to stabilize and support the economy, banks, and the financial markets. In the euro area, monetary policy is even in the vanguard in the fight to save the euro and European project itself.

Banking and finance are central to the broader economy because money flows through the banking sector and the financial system. A better understanding of how this works requires, in the first instance, a deeper and more detailed knowledge of monetary system architecture. Modern monetary systems are organized around central banks and their money, what bankers call liquidity. Central bank money is injected by central banks into the banking system against collateral on terms defined, not in a market, but by central banks through their collateral frameworks. In some jurisdictions, or currency areas, central bank independence means that collateral frameworks are not subject to formal supervision, review, or even much by way of discussion. Public focus is instead directed toward interest rates or monetary aggregates. This book therefore

aims to bring to light the functioning, reach, and impact of collateral frameworks.

Different central banks have different collateral frameworks. There are common features, but details can vary a great deal. The focus in this book is on the framework of the Eurosystem, i.e., the collective structure of national central banks in the euro area spearheaded by the European Central Bank (ECB). The ECB plays a principal role because it is authorized to design and update the euro area's collateral framework. This is an especially interesting case to study because of the richness and complexity that arise from a single currency across multiple countries and the very wide range of collateral banks can use to obtain liquidity directly from the Eurosystem. The euro area also represents one of the largest economies in the world. Its well-publicized financial, economic, and political problems have significant impact on global markets and the world economy. Concerns about the euro itself are intermingled with and, arguably, at the core of these problems. Gaining a more sound understanding of the euro area's monetary system at the most fundamental level is therefore of great value.

In the main part of this book, I lay bare how the Eurosystem operates with respect to its collateral framework. This is done partly through a study of the details of the official rules that define the collateral framework. But equally importantly, to put flesh on the bare bones of these rules, the book provides a large number of empirical findings through a forensic-style analysis that help make the collateral framework more concrete and shed light on how monetary policy actually functions in the euro area.

As an example, the book documents that rating agencies and sovereign guarantees to bank-issued collateral play an important role in the implementation of the collateral framework and, by implication, Eurosystem monetary policy. This raises a host of questions, such as: Are some rating agencies more central than others? What is the distribution of sovereign guarantees across euro-area countries? Is there a link between ratings and guarantees? What is the estimated

value of the guarantees? How much of this can be attributed to generous ratings? How do ratings and guarantees interact with other aspects of the collateral framework and (unconventional) monetary policy? This is only one example of the kind of issues that relate to collateral frameworks and that I study. The book provides an overall assessment of the Eurosystem's collateral framework, and, through that, general issues are raised.

Toward the end of the book, starting with Chapter 11, I use these findings and the insights they provide to comment on the ECB's usage of various unconventional monetary policies to preserve the euro. Combined, these policies essentially serve as indirect bailouts of banks and the weaker sovereigns. While many of the policies may be necessary to keep the eurozone together, they are not sufficient. The euro's fundamental problem lies outside the realm of monetary policy. Yet, I propose that it may be possible to address this fundamental problem, at least in part, through modifications to the collateral framework.

Finally, I use some of the insights gained from my study of collateral to comment on the organization of the interbank market for liquidity as well as on the idea of full reserve banking, a notion that has received increasing attention in recent years as a way to stabilize the financial system. Once one recognizes that full reserve banking places great demands on collateral, my comments on this topic are simply a corollary to my main investigation into collateral frameworks.

1.1 MONEY MATTERS IN FINANCIAL MARKETS

There is an enormous amount of work in economics on monetary policy transmission channels. This book complements and contributes to that literature, but does not emanate from it. Instead, it can be characterized as the product of the literatures on the market for liquidity, monetary effects in financial markets, collateral, and financial intermediation. With respect to the first of these, what is especially

relevant for this book is the literature that studies open market operations and the interaction of banks and the central bank. I will touch on this in the next section. Collateral is discussed toward the end of this chapter, and the most relevant literature on financial intermediation is touched on in the next chapter. In this section, I briefly review the evidence on monetary effects in financial markets from a rather "selfish" perspective.

Work I have done with Per Östberg on the details of the interaction between the market for liquidity and the broader financial markets shows that money matters in financial markets in part because frictions in interbank markets spill over into the broader markets through what we call liquidity pull-back (Nyborg and Östberg 2014). There is also evidence that asset prices and measures of liquidity in financial markets are affected by monetary shocks (see, e.g., Fleming and Remolona 1997; Fair 2002; Flannery and Protopapadakis 2002; Bernanke and Kuttner 2005; Chordia, Sarkar, and Subrahmanyam 2005). Liquidity pull-back is a monetary phenomenon acted out in financial markets. It is based on the important role played by central bank money in modern banking and financial systems. Central bank money is the currency, or liquidity, banks need to satisfy reserve requirements, allow for depositor withdrawals, settle interbank transactions, etc. It is injected into the banking system through central bank operations and then reallocated among banks. For many transactions, there is no substitute for central bank money. Thus, for any bank, having sufficient central bank money at any point in time is a constraint that needs to be satisfied.

However, conditions in the interbank market may fluctuate. At times it may be "tight," in the sense that the price of liquidity is high and some banks may have exhausted interbank credit limits. If so, banks may seek alternative sources of central bank money. But, as observed by Friedman (1970): "One man can [increase] his nominal money balances only by persuading someone else to [decrease] his."[1]

[1] In Friedman (1970), the sentence reads: "One man can reduce his nominal money balances only by persuading someone else to increase his."

The same holds true for banks. Friedman's observation is echoed by Tobin (1980): "[T]he nominal supply of money is something to which the economy must adapt, not a variable that adapts itself to the economy – unless the policy authorities want it to." These restrictions can be overcome by borrowing from the central bank's lending facility (discount window), but this is expensive. A bank can also attempt to attract new, or retain old, deposits, but this is a slow process. Liquidity pull-back offers an alternative approach, namely to obtain liquidity through interacting with financial markets, by pulling liquidity back from them.

This can be done in several ways, most obviously by selling financial assets directly.[2] The mechanism within a bank through which this may happen is that the bank's internal liquidity management system feeds into trading desks' limits, reducing them. Alternatively, liquidity pull-back can be achieved by increasing margins to levered investors or haircuts in repos (repurchase agreements). In turn, this may lead to asset sales by the affected counterparties. Liquidity pull-back does not increase the quantity of central bank money in the system. However, the actions I have described can increase the selling (or acting) bank's liquidity balances, as long as the (ultimate) buyer banks with another bank.

Östberg and I emphasize that a feature of the theoretical idea we sketch in our paper is that financial assets serve as a storage facility for liquidity that a bank can tap into if it should face a shortfall. We draw out the implications of this idea with respect to the link between interbank tightness and volume, order flow, and returns in the broader financial markets. The empirical evidence is strongly supportive. A general conclusion of our work is that the way banks obtain central bank money affects financial markets. This supports the perspective in this book that collateral frameworks matter since they determine the terms at which banks can obtain liquidity directly from the central bank. The process of allocating central bank money

[2] See Kashyap and Stein (2000) for evidence on banks' holdings of securities.

in an economy starts with the interaction of the central bank vis-à-vis banks, and this interaction needs to obey the rules and constraints imposed by the central bank's collateral framework.

1.2 THE MARKET FOR LIQUIDITY

Before the crisis, money markets were viewed by many academics and policy makers alike as uninteresting with respect to the broader financial markets and the economy. This is not because they were thought of as not serving an important function, but because they were regarded as functioning extremely well. They were considered to be highly competitive and liquid – in a word, "boring" – with no significant impact on the broader financial markets. Yet, the money-market literature shows that this view was never quite correct.

Hamilton's (1996) seminal study finds that the federal funds rate (US overnight rate) reacts to calendar effects relating to the reserve maintenance period. There is also evidence that the overnight rate reacts to the supply of reserves (Hamilton 1997; Carpenter and Demiralp 2006). Similar effects can be found in the euro area (e.g., Nautz and Offermanns 2007; Angelini 2008; Beirne 2012). Fecht, Nyborg, and Rocholl (2008) and Rösler (2015) also document calendar effects with respect to volume. These findings are indications of a less-than-perfect market for liquidity. Furthermore, using primary market data from ECB main refinancing operations (repo auctions) well before the crisis, Bindseil, Nyborg, and Strebulaev (2009) find evidence that the market for liquidity is informationally efficient but, at the same time, allocationally inefficient.

The existence of inefficiencies in the market for liquidity explains the positive support in the data for the liquidity pull-back idea. Indeed, that work was motivated by the empirical evidence that interbank markets are not efficient, even during times of normalcy. An earlier ECB working paper by Nyborg, Bindseil, and Strebulaev (2002) also finds evidence consistent with the idea that the collateral framework affects banks' willingness to pay for liquidity.

After the onset of the financial crisis in August 2007, the significance of the market for liquidity and collateral has become greatly magnified, as will be explained below.

1.3 THE FINANCIAL CRISIS AND UNCONVENTIONAL MONETARY POLICY

A central (and much-studied) aspect of the financial crisis is the emergence of severe frictions in the interbank market for liquidity. Interestingly, therefore, the liquidity pull-back effect as a day-to-day phenomenon became weaker, or harder to identify statistically. A potential explanation for this is that the financial crisis represented a massive liquidity pull-back event, where money-like securities (e.g., Treasury bills) were sought by investors and banks, and the day-to-day liquidity pull-back effect was dwarfed by the much larger pattern of the crisis (think fractals). Kindleberger (1978) and Allen and Gale (1994, 2007) have stressed that financial crises often involve the (forced) sale of assets in order to obtain liquidity to, for example, settle financial obligations. In addition, the large injections of liquidity by central banks in response to the crisis eventually made it less necessary for banks to engage in liquidity pull-back. Instead, they could post collateral to the central bank and receive liquidity directly that way.

While the market for liquidity did not stop functioning during the crisis, it functioned less well than before.[3] Dysfunction in the market for liquidity was a central feature of the crisis. The price of liquidity shot up (Figure 1.1) while volume shifted in from longer to shorter maturities and fell overall (Abbassi, Bräuning, Fecht, and Peydró 2014; Gabrieli and Georg 2014; Rösler 2015). The turmoil in the interbank market for liquidity was accompanied by a massive loss of value in asset prices. This is also illustrated in Figure 1.1, using equities as an example. While Figure 1.1 uses euro-area data, graphs

[3] See, e.g., Cassola, Holthausen, and Lo Duca (2010) for the euro area and Afonso, Kovner, and Schoar (2011) for the United States.

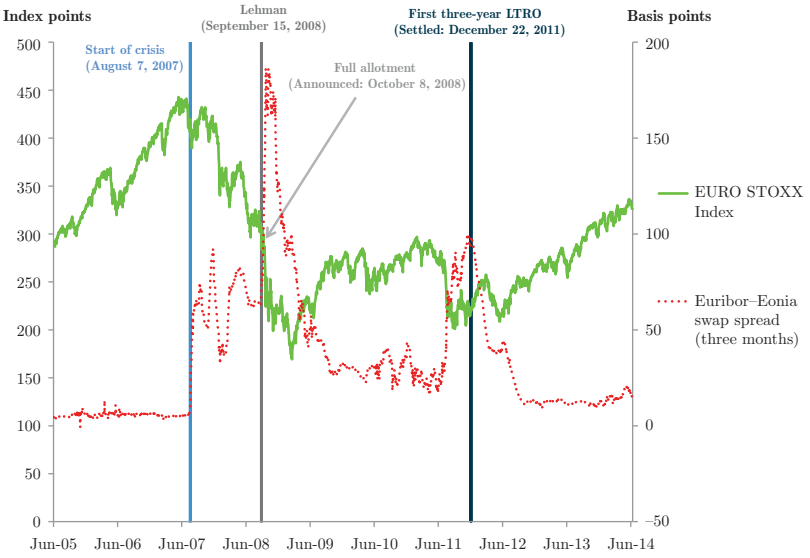

FIGURE 1.1 EURO STOXX Index and Euribor–Eonia swap spread (three months)

Time period: June 20, 2005, to June 30, 2014.
The spread is the difference between Euribor and the Eonia swap and is in basis points. Euribor: Euro Interbank Offered Rate. Eonia: Euro Overnight Index Average.
Data sources: `www.stoxx.com/indices/index_information.html?symbol=SXXE` and `www.emmi-benchmarks.eu/`.

using corresponding data from other markets (e.g., the United States) would exhibit the same patterns.

Figure 1.1 shows the spread between the three-month Euribor and three-month Eonia swap rates (Euribor–Eonia swap spread), with values on the right axis, and a broad euro-area stock market index (EURO STOXX), with values on the left axis. As explained by Nyborg and Östberg (2014), while the Euribor–Eonia swap spread may reflect credit risk, it represents more directly the price of liquidity (here, over three months).[4] A high spread is tantamount to the interbank market for liquidity not working well. The sharp increase in the

[4] The alternative to borrowing a given quantity of liquidity at Euribor over three months, for example, is to attempt to borrow the same quantity overnight and hedge with the Eonia swap (an overnight index swap). But under this alternative strategy, the borrowing bank faces the risk that it may not be able to borrow the

spread in August 2007 represents the beginning of the financial crisis. The spread is seen to peak just after the Lehman bankruptcy, which occurred on September 15, 2008. That the bankruptcy of a US institution should trigger a severe tightening in the market for liquidity in the euro area illustrates the interconnectedness of global markets. Since then, the spread has come down substantially, though not to pre-crisis levels.

The pattern for the stock market is analogous. As the interbank market for liquidity saw severe tightening, the stock market almost collapsed, losing around 50 percent of its value from August 2007 to the bottom in March 2009. Since then the stock market has reversed, gaining back much of the lost ground. Stock markets around the world reacted similarly.

In response to the meltdown that ensued after Lehman Brothers' bankruptcy, the ECB made significant changes to its monetary operations. On October 8, 2008, the ECB announced that it would switch from auctioning a limited quantity of liquidity in its operations to running fixed rate tenders at the policy rate with full allotment. It would do this for both the main and longer-term refinancing operations (MROs and LTROs, respectively). This represents one of the most significant actions taken by the ECB in response to the crisis. Under full allotment, central bank money is not rationed in the refinancing operations. Instead, banks receive everything they ask for. The only restriction is that they have to pledge sufficient collateral to cover these amounts. In October 2008, LTRO money was available with three-month maturities. In response to further problems, the ECB lengthened the maturity in the LTROs to three years in two operations, held in December 2011 and February 2012.

The availability of unlimited amounts of three-year money was not enough to calm the markets. The threat to the euro was real enough to move Mario Draghi, President of the European Central Bank, to make his famous declaration in July 2012: "Within our

desired amount every day. The price of having the liquidity for sure over the three months is the Euribor–Eonia swap spread.

mandate, the ECB is ready to do whatever it takes to preserve the euro."[5]

On September 6, 2012, this was followed up by the launch of the Outright Monetary Transactions (OMT) program.[6] The OMT allows for unlimited purchases of sovereign bonds of countries under a European Financial Stability Facility/European Stability Mechanism program, but has yet to be used.[7] Even so, it is often viewed as representing the "whatever it takes" in Draghi's famous statement quoted above. For example, a 2013 *Financial Times* article reports that:[8]

> The size of the programme is unlimited, lending credence to Mr Draghi's remarks that he would do "whatever it takes" to save the euro... As of February 2013 no country had yet applied for help under OMT, but the very fact of its existence had greatly calmed financial markets.

But the problems in the eurozone did not go away after the introduction of the OMT, as evidenced, for example, by the continued use of the full allotment policy in open market operations and ongoing considerations of further unconventional measures.[9] The mere promise of unlimited purchases of troubled sovereigns' paper (the OMT) was not enough. Real action was required. Thus, on

[5] See "Verbatim of the remarks made by Mario Draghi: Speech by Mario Draghi at the Global Investment Conference in London 26 July 2012," www.ecb.europa.eu/press/key/date/2012/html/sp120726.en.html.

[6] See the ECB press release, September 6, 2012, on "Technical features of Outright Monetary Transactions," www.ecb.europa.eu/press/pr/date/2012/html/pr120906_1.en.html.

[7] I have verified with the ECB (in November 2015) that no purchases have been made under the OMT. The Eurosystem's recent purchases of sovereign bonds are carried out under another program – the expanded asset purchase program. For details, see below.

[8] "Definition of outright monetary transactions OMT," *Financial Times*, ft.com/lexicon, http://lexicon.ft.com/Term?term=outright-monetary-transactions-OMT.

[9] See, e.g., Chapter 11 in this book or "Monetary policy communication in turbulent times: Speech by Mario Draghi, President of the ECB, at the Conference De Nederlandsche Bank 200 years: Central banking in the next two decades, Amsterdam, 24 April 2014," www.ecb.europa.eu/press/key/date/2014/html/sp140424.en.html.