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Is Collateral Becoming Scarce?

Evidence for the euro area

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The global financial crisis has propelled several trends in wholesale financial markets that are causing an increase in the demand for high-quality collateral. On the money market more transactions are now secured instead of unsecured and in OTC derivatives markets CCP clearing for standardized contracts becomes mandatory, raising collateral needs for market participants. Moreover, the Basel III liquidity standards will probably increase banks' need for high-quality liquid assets. It is not clear in advance whether the supply of collateral will grow and at which rate. On the one hand, many euro area governments now need to finance high budget deficits. While this is not a favourable development, it does imply that more debt instruments will become available as potential collateral. On the other hand, there are concerns about the creditworthiness of several euro area sovereigns which limits the debt's collateral value. Due to these developments, some market participants expect that collateral will become scarce in the near future, which could impair the smooth functioning of financial markets. This study quantifies the trends in demand for and supply of collateral and concludes that collateral is likely to become scarcer but not scarce in absolute terms. It also discusses the expected economic effects and policy implications of this conclusion.

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Abbreviations

BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlement
CEBS	Committee of European Banking Supervisors
CCP	Central Counter Party
CGFS	Committee on the Global Financial System
CPSS	Committee on Payment and Settlement Systems
EADB	Eligible Asset Data Base
EC	European Commission
ECB	European Central Bank
EEA	European Economic Area
EMIR	European Market Infrastructure Regulation
ESCB	European System of Central Banks
ICMA	International Capital Market Association
ISDA	International Swaps and Derivatives Association
IMF	International Monetary Fund
LCR	Liquidity Coverage Ratio
NSFR	Net Stable Funding Ratio
OTC	Over-the-counter
PSE	Public sector entity

I Introduction

The use of collateral is one of the most important and widespread counterparty credit risk mitigation techniques employed in wholesale markets (CGFS, 2001 p. 2). Most collateral is used in secured money markets, derivatives markets, and in payment and settlement systems. Moreover, central banks require collateral to mitigate counterparty risk in their credit operations. The global financial crisis propelled several changes in wholesale financial markets that profoundly affected the demand for and supply of collateral. Many expect that the demand for collateral will increase. As an example, take the following quote from Risk Magazine (Nov. 1st 2010):

'Incoming rules will create demand for large quantities of liquid assets – principally government bonds – and will also require those assets to be locked away. It's not clear there are enough bonds to go round, and nobody knows how the system will function when it's less well lubricated'.

Among the 'incoming rules' this quote refers to are the new regulations for OTC derivatives markets. The OTC derivatives markets, which were characterized by high levels of customization, illiquidity and opacity, were an important driver of the last financial crisis. In order to make these markets more secure and transparent, the G20 made a strong commitment at the Pittsburgh summit in September 2009 to clear all standardized OTC contracts via CCPs by the end of 2012. In the United States this commitment has been translated into the Dodd-Frank Act, while in Europe new regulations are being laid down in the European Market Infrastructure Regulation. These initiatives to promote CCP clearing stem from the fact that CCPs performed relatively well during the crisis, while private derivatives arrangements revealed weaknesses (G20, 2009). CCP clearing is expected to raise the collateral requirements for market participants, because CCPs typically require higher initial and variation margins (and calculate the variation margin more frequently) than most bilateral clearing arrangements. Also, CCPs have a clearing fund, to which clearing members must contribute. Moreover, market participants expect that only large global players will be able to benefit from increased netting possibilities, which would reduce collateral needs. ICE Clear Europe, for instance, reported to Risk Magazine (10 Nov. 2010) that

scarcity of high-quality collateral may require clearing houses to accept other instruments such as gold:

‘As more instruments are moved into clearing, the demand for high-quality collateral is going to increase dramatically, and therefore having further strings to the bow in terms of what users can use to secure their original margin requirement with clearing houses is going to be incredibly important’.

The second set of rules affecting the demand for collateral are the new liquidity standards introduced by the Basel Committee on Banking Supervision in its Basel III framework (BCBS, 2010a). The Liquidity Coverage Ratio (LCR) states that banks should maintain a sufficient buffer of high-quality liquid assets to survive an acute liquidity stress scenario lasting 30 days. The purpose of the LCR is to promote the short-term resilience of banks to liquidity problems. The Net Stable Funding Ratio (NSFR) should induce banks to fund long-term assets with sufficient amounts of stable (long-term) liabilities, thereby reducing maturity mismatches. In order to comply with these new standards, banks may need to increase their holdings of high-quality liquid assets. These are also the assets that they use as collateral.

The decline of the unsecured money market after the default of Lehman Brothers in September 2008 has been a third factor boosting the demand for collateral. Before 2008, monetary and financial institutions were willing to lend each other substantial amounts of money without any form of collateral, as mutual trust was high. Once the crisis hit, however, this mutual trust started to decline and financial institutions became more risk averse, especially when doubtful about their counterparties’ financial health (Capel, 2011, pp. 23-24; ECB, 2009a). This caused transactions to shift towards the secured money market. As a result, market participants nowadays need more liquid high-quality assets for collateral purposes than in the past to attract funding on the private money markets.

It is not clear in advance whether this increase in demand for collateral will be matched by an increase in supply. The fact that many euro area governments now run high budget deficits, and need to refinance high debt levels in the future, necessitates the issuance of new government bonds. However, not all of these debt instruments will be considered suitable collateral by market participants (CGFS, 2011). The reason is that the high government debt levels in some EMU countries have had a negative effect on the creditworthiness of these countries. Since market participants regard only highly liquid assets with a low probability of default as high-quality collateral, the sovereign crisis has narrowed the range of assets that market participants accept as collateral. Market participants’ critical attitude towards collateral has also sparked concerns about the valuation of other assets, especially structured products, leading to stricter collateral requirements in financial markets (Hördahl & King, 2008; IMF, 2010).

As a consequence of these developments, market participants have come to expect that high-quality collateral will become scarcer in the near future (Capel, 2011; see quotes). However, since both demand and supply increase by unknown amounts, it is not clear from the outset whether this will be the case. It is the aim of this paper to study and quantify the current trends in demand for and supply of high-quality liquid assets which can be used as collateral, in order to investigate whether collateral is likely to become scarce in the near future. As suitable collateral will differ between currency areas, this paper answers the collateral scarcity question for the euro area only. This question is relevant to market participants since collateral scarcity may impair their ability to conduct desired financial transactions. The (potential) friction between supply and demand is also relevant to prudential supervisors and central banks, who must safeguard the smooth operation of financial markets. In this regard, it is important to note that collateral scarcity can be perceived as a counterparty risk bubble too: a situation in which there is too much risk built up relative to real economic fundamentals. The liquidity crunch after Lehman's default has shown that the pre-crisis levels of leverage were not sustainable when confidence in the economic fundamentals of financial instruments plummeted. Hence, evidence of collateral scarcity is indicative of the need to de-leverage the financial system further so as to reduce systemic counterparty risk. Banks that do not have enough high-quality collateral to secure their transactions could opt for lower-risk activities.

The structure of this paper is as follows. Chapter 2 develops a practical definition of 'high-quality' assets that can be used by financial institutions as collateral. Then, the recent trends in the supply of and demand for collateral will be discussed and quantified in Chapters 3 and 4, respectively. Chapter 5 discusses the likelihood of collateral becoming scarce, and discusses the policy implications of the results in this study. Chapter 6 summarizes.

2 What is High-Quality Collateral?

For the purpose of this study we must first define what ‘high-quality’ collateral is. This definition should encompass the assets that meet the quality standards of market participants, central banks and regulators. Although there is quite some consensus on the theoretical properties of high-quality liquid assets, it is difficult in practice to achieve consensus on what high-quality assets are. This has several reasons. First of all, there actually is a continuum of collateral options, which makes it difficult to draw a strict line between ‘good’ and ‘bad’ assets. Second, the quality of collateral assets may change over time, due to idiosyncratic or systemic shocks that affect the creditworthiness of the issuer. The sovereign debt crisis is exemplary for this fact (CGFS, 2010; 2011). Finally, the perceived quality of assets is sensitive to overall market sentiment. There is a tendency for procyclical credit ratings and haircuts, which means that an asset’s quality is biased upwards in booming periods and downwards in times of crisis (CGFS, 2010). With these considerations in mind, we use a practical definition and define the highest quality collateral for a bank as the assets that all relevant authorities and market participants would accept, and that can be used for all purposes. Therefore, we start by exploring the acceptance criteria of (i) the Basel Committee on Banking Supervision and (ii) the Eurosystem and then have a closer look at market practices.

2.1 Authorities and high-quality collateral

2.1.1 The Basel Committee on Banking Supervision

The new liquidity framework of the Basel III Accord (BCBS, 2010a) is a starting point for the discussion about ‘high-quality’ collateral. In this new framework, two liquidity standards (i.e. LCR and NSFR) are introduced with the aim of improving the liquidity risk profile of banks. According to the Basel Committee on Banking Supervision, there are several theoretical properties that high-quality liquid assets share. There are several fundamental characteristics which concern the assets themselves: (i) their credit and market risks are low, (ii) their values can be computed with ease and certainty, (iii) the assets should have a low correlation with risky assets and (iv) they must be listed on a developed and recognized exchange. In addition, there are several market-related characteristics determining whether an asset is high-quality or not: (i) the market for the asset must be active and sizeable, (ii) price quotes must be readily available, (iii), the group of buyers and sellers

must not be concentrated and (iv) the asset should be attractive in times of distress (i.e. when there is a flight to quality). Finally, only ‘unencumbered’ assets – i.e. assets that are not already in use to secure, collateralize or credit-enhance another transaction – can be considered high-quality.¹

For the purpose of the new liquidity standards, the Basel Committee has categorized the assets that satisfy these theoretical conditions into two groups: *Level 1* and *Level 2 assets*. Level 1 assets can be used as high-quality liquid assets without any quantity restrictions and are valued at market prices. Level 1 assets consist of cash, central bank reserves and certain classes of marketable securities issued or guaranteed by sovereigns, other public sector entities (PSEs) and central banks. Level 2 assets are subject to a 15% haircut and may not exceed 40% of the total stock of high-quality liquid asset. They consist of riskier classes of marketable securities issued or guaranteed by sovereigns, other PSEs and central banks. Certain classes of covered bonds and corporate bonds are also included. More information on the theoretical properties of ‘high-quality’ liquid assets and the practical classification of these assets (*Level 1* and *Level 2*) are presented in Appendix A1.² The Basel Committee on Banking Supervision thus provides both a theoretical and an operational measure for high-quality liquid assets, which can be used to develop a practical definition of high-quality collateral for the euro area. Note that the Basel III criteria for (quasi) high-quality liquid assets apply to assets that banks should keep on their balance sheet to cover cash outflows and do not formally apply to assets used as collateral. But since Basel III’s high-quality liquid assets will be the most attractive assets for collateral takers, we use the same criteria to develop a practical definition of collateral. Moreover, the mere fact that banks must obtain certain amounts of high-quality liquid assets for compliance with the liquidity standards makes these assets attractive as collateral.

2.1.2 The Eurosystem

The second authority we would like to consider when developing a definition for high-quality collateral is the Eurosystem. The Eurosystem’s collateral framework (ECB, 2011) is of great significance for the current discussion on high-quality collateral. First of all, it defines high-quality assets in terms of both theoretical characteristics and practical eligibility criteria. Second, assets with the property of central bank eligibility are more attractive to financial institutions, because they can

¹ There are two exceptions to this last rule. First, assets that are received in reverse repo and securities transactions which are legally owned by the bank can be considered part of the stock of high-quality liquid assets, provided that these have not been re-hypothecated. Second, high-quality liquid assets that have been pledged to the central bank or a public sector entity (PSE) but have not been used, may also be included in the stock.

² The Basel Committee on Banking Supervision has announced that the observation period for the liquidity ratios (until 2015 and 2018) will be used to ensure that the design and calibration of the liquidity ratios is right and that there are no unintended consequences, at either the banking sector level or the broader system level. Hence, there is a possibility that the definition of level 1 and level 2 assets will change. This paper works on the basis of the current definition.

be used to obtain central bank liquidity. This, in turn, enhances these assets' overall market liquidity. Hence, a practical definition of high-quality collateral for the euro area should incorporate the practices of the Eurosystem.

The Eurosystem requires '*adequate collateral*' to be posted by monetary and financial institutions that wish to make use of their central bank's credit facilities. Adequate collateral in this sense means that the assets used as collateral should exhibit low credit, market and liquidity risk (Statute of the ESCB, Art.18.1 (ECB, 2008)). These properties are made operational in a broad collateral framework, known as the Single List (ECB, 2011). The Single List provides general eligibility criteria and covers both marketable and non-marketable assets. For marketable assets, it dictates that only debt instruments are potentially eligible. A second requirement is that the debt instruments are denominated in euro. Third, the assets must be issued in the European Economic Area (EEA) or issued by an entity resident in the EEA or a non-EEA G10 country, and they must be settled in the euro area. Fourth, the assets should be traded on regulated markets or non-regulated markets that have been approved by the ESCB. Finally, the assets must have a minimum credit rating of BBB- (which corresponds to a probability of default of 0.40%)³⁴, with the exception of asset backed securities.⁵ With respect to the category of non-marketable assets, three types of asset classes are eligible as collateral: fixed-term deposits from eligible counterparties, credit claims and non-marketable retail mortgage-backed debt instruments. Each of these asset classes must meet specific criteria, such as being issued in the euro area, being denominated in euro, and having a minimum credit classification of BBB- (ECB 2009b, p. 19). A detailed overview of the Eurosystem's collateral framework is presented in Appendix A1.

2.2 A practical definition of high-quality collateral

A practical definition of high-quality collateral focuses on the assets accepted by the relevant authorities and by market participants for all activities that require collateral. Hence, for the euro area high quality collateral consists of the smallest intersection of the asset classes accepted by the Basel Committee and the

3 Originally, the pool of eligible collateral was restricted to debt instruments with a credit rating of A- to AAA. In response to the crisis the collateral pool was extended to include assets with a credit rating of BBB+ to BBB- (ECB 2010a).

4 Recently, the ECB decided to suspend the application of the minimum credit rating threshold in the collateral eligibility requirements in the case of marketable debt instruments issued or guaranteed by sovereigns that take part in an IMF and or EU programme <http://www.ecb.int/press/pr/date/2010/html/pr100503.en.html>.

5 Asset backed securities (ABS) are eligible when they receive a AAA rating from two external credit assessment institutions at the time of issuance, and retain a rating of A- or higher during their time to maturity. On 11 December 2011, the ESCB decided that in addition to the aforementioned products, ABS with a second-best rating of at least 'single A' at issuance and at least A- at all times thereafter are eligible, if the assets meet certain criteria w.r.t. the underlying asset of the ABS, the counterparty's activities and contractual provisions. For more information see: http://www.ecb.int/press/pr/date/2011/html/pr11208_1.en.html.

Eurosystem, provided that market participants accept them as well. Due to the broad collateral framework of the Eurosystem, the definition of high-quality liquid assets of the Basel Committee will be the restrictive factor. In constructing the definition, a distinction is made between high-quality collateral and quasi high-quality collateral. High-quality collateral only incorporates *Level 1 assets* as defined by the Basel Committee. This is so because *Level 1 assets* represent the highest quality and most liquid assets so that these assets are preferred by authorities and market participants. Accordingly, there are no haircuts or quantity restrictions for these Level 1 assets in the Basel framework. However, should high-quality collateral become scarcer, pressure on these assets' prices may become too great and market participants could start accepting a wider range of assets as collateral. Because of this possibility, this study also considers what will be called 'quasi high-quality' collateral. Quasi high-quality collateral consists of the *Level 2 assets* from the Basel framework that are eligible within the Eurosystem. These assets were argued to be of lower quality than high-quality collateral assets. This also explains why they are subject to a haircut and to quantity restrictions. Table 1 show the definition of high-quality and quasi high-quality collateral, based on the practices of the Eurosystem and the Basel Committee.

Table 1 shows that both high-quality collateral and quasi high-quality collateral must meet several general criteria. That is, the collateral assets must be (i) denominated in euro, (ii) issued in the EEA or issued by an entity resident in the EEA or a non-EEA G10 country and settled in the euro area, and (iii) traded on regulated and ECB approved exchanges. High-quality collateral then comprises '*marketable debt instruments issued or guaranteed by sovereigns, other public sector entities or central banks with a credit rating of AAA to AA- and marketable sovereigns with a credit rating of A+ to BBB-*'. Quasi high-quality collateral comprises: '*high-rated corporate and covered bonds (AA- or higher) and marketable debt instruments issued or guaranteed by sovereigns, other public sector entities or central banks with a credit rating of A+ to A-*'.

In this study we need an exact definition of high-quality collateral to make estimates of the supply of high-quality collateral. Our definition in Table 1 is based on the idea that high-quality assets are the assets that meet the quality standards of all the relevant agents (market participants, central bankers and regulators). However, while using this definition for our estimates, we by no means suggest that financial institutions that accept assets as collateral that are not covered by our definition take on bad risks. In general, counterparty risk can be managed by (i) doing transactions with financially sound institutions only (i.e. counterparty requirements), (ii) setting quality requirements on the collateral (collateral requirements) or (iii) imposing a set of control measures, including haircuts, concentration limits and measures to avoid a high correlation between the counterparty's financial health and the collateral's value (risk control measures). The three elements of a financial institution's risk management framework should be interrelated. For instance, financial institutions

may decide to set lower quality requirements on collateral, but to compensate that through tougher counterparty requirements and/or risk control measures. An example here is the Eurosystem, which has opted for a broad collateral framework to give potential access to many different financial institutions throughout Europe and which therefore actively uses risk control measures.

2.3 Market participants and high-quality collateral

The definition of high-quality and quasi high-quality collateral developed above is only of practical use when it is in line with market participants' perception of asset quality. In this section we therefore examine the collateral practices in the European repo market (secured money market) and the global OTC derivatives market.

Collateral practices among European repo market participants can be examined by looking at (i) the types of financial assets that are used to collateralize repo transactions, (ii) the credit ratings of the collateral, and (iii) the haircuts that are

Table 1: Practical definition of high-quality liquid assets

General criteria

- Denominated in euro
- Issued in EEA or issued by an entity resident in the EEA or non-EEA G10, and settled in euro area,
- Traded on regulated markets

High-quality collateral

Debt instruments

- Marketable securities issued or guaranteed by sovereigns, PSEs or central banks
 - with a credit rating of AAA to AA-
- Marketable sovereigns or central bank debt securities
 - with a credit rating of A+ to BBB-

Quasi high-quality collateral

Debt instruments

- Marketable securities issued or guaranteed by sovereigns, PSEs or central banks
 - with a credit rating of A+ to A-*
- Corporate bonds (if not issued by a financial institution)
 - with a credit rating of AA- or higher
- Covered bonds
 - With a credit rating of AA- or higher

* Sovereign debt with a rating between A+ and A is excluded as it is already part of the stock of high-quality liquid assets.

applied to the posted collateral. Useful information on the asset types used as collateral can be found by looking at collateral practice of repo CCPs. Repo CCPs allow anonymous trading against a pre-specified basket of general collateral. As members do not know their direct counterparty, the collateral assets received must be of high quality and liquid so that they can successfully mitigate any credit risk arising from a counterparty's default. One of the main and fast-growing repo market platforms in Europe offering euro money market trading via CCPs is EurexRepo. EurexRepo has a funding-oriented market segment named Euro GCPooling so that market participants' perception of asset quality can be derived from the collateral baskets offered by Euro GCPooling. Data from EurexRepo (2011) suggest that the assets contained in the most widely used ECB Basket,⁶ which contains a subset of assets eligible with the Eurosystem, are in line with the definitions of high-quality and quasi high-quality assets given in section 2.2 above. Approximately 73% of the collateral value in the GCPooling ECB basket stems from bonds and 91% of the total collateral value is issued by governments (central, local and regional), supranational entities and government agency institutions.

Next to the asset class and issuer type, credit ratings also form an important component of the definition of high-quality and quasi high-quality collateral. Since 2001, the International Capital Market Association (ICMA) has surveyed the developments in the European repo market. As of June 2009, the survey includes the credit ratings of collateral used in tri-party repos. These figures indicate that approximately 87% of the collateral used in repo transactions has a credit rating of A or higher. The largest category is AAA, which accounts for approximately 48% of the total stock of collateral. The share of collateral with a credit rating below BBB is negligible, with an average share over June 2009-June 2011 of just 2.5%. These observations also support our practical definition.

The haircuts on collateral are a third indicator of perceived asset quality. Haircuts are a discount to the value of the asset and reflect its perceived risk. A large haircut indicates high expected volatility of the asset's value and especially its expected downward potential. The Committee on the Global Financial System (CGFS, 2010) studied the development of haircuts during the financial crisis and documents a clear segmentation of asset classes. Haircuts on short- and medium-term government⁷ and agency (covered) bonds were small before the onset of the crisis (ranging from 0% to 1% for prime counterparties) and increased marginally (1 percentage point maximum) during the crisis. These are the asset classes that are

⁶ Figures of GCPooling indicate that this basket is preferred by market participants over the ECB Extended basket, which includes less liquid assets: approximately 90% of all transactions are collateralised with assets from the ECB Basket (EurexRepo, 2011).

⁷ The CGFS (2010) takes the G7 countries as sample for the government bond category. Government bonds have generally been considered to be relatively safe investments. However, the European sovereign debt crisis illustrates that not all government bonds can be used as high-quality collateral at all times.

included in our definition of (quasi) high-quality collateral. On the other hand, asset-backed securities (ABS), prime mortgage-backed securities (MBS), other high-rated structured products, equity and high-yield bonds received larger haircuts before the crisis (ranging from 4% for prime MBS to 10% for ABS, other structured products and G7 equities), and also faced stronger increases in their haircuts during the crisis (the minimum increase was 5 percentage points for equity). Prime MBS (AA- to A-) and structured products faced the largest increase in haircuts, of 92 and 90 percentage points, respectively.

The International Swap and Derivatives Association⁸ (ISDA) provides valuable information on collateral used in OTC derivatives transactions. These transactions have become increasingly more collateralized over the last decade. ISDA (2011) documents an increase in the number of collateral agreements among its survey respondents from 16,000 in 2000 to 149,518 in 2010, a more than ninefold increase. Collateral agreements in OTC derivatives markets are often governed by ISDA Master Agreements and the related Credit Support Annex (CGFS, 2010 p. 5). ISDA reports that in 2010, 90% of the collateral agreements reported by its respondents were ISDA collateral agreements (ISDA 2011, p. 13).⁹ The collateral criteria for OTC derivatives transactions have been very stable over time, and did not change during the financial crisis. Cash has been the most common type of collateral, averaging 80% of the total collateral stock between 2005 and 2010. Of the non-cash collateral, 73% consist of government securities and government agency securities, supranational bonds and local government bonds. A significantly smaller part of the non-cash collateral (27%) consists of equity and commodities.

All these sources indicate that the (quasi) high-quality assets as defined in Table 1 correspond with the assets that are used as collateral in today's financial market practices. First of all, data from GCPooling and ISDA indicate that the preferred asset types in repo and OTC derivatives transactions correspond with the asset types that are included in the practical definitions. The only exception is cash, which is not part of the definition but extensively used in OTC derivatives markets. However, to obtain cash or payment capacity financial institutions need to have assets that are eligible collateral for the central bank or on the repo market. We thus focus on these underlying assets. Second, market participants' attitude towards credit ratings and applied haircuts also supports our practical definition.

⁸ ISDA is one of the world's largest financial trade organisations with over 820 member institutions from 57 countries (ISDA, 2011). ISDA aims at identifying and reducing sources of risk in the derivatives and risk management business.

⁹ In the other cases other, often local, collateral agreements were used such as the European Master Agreement, German DRV, French FBF or Japanese Credit support annex (CGFS, 2010).

3 Supply of Collateral

3.1 The current supply of (quasi) high-quality collateral

The ECB Annual Reports show that the amount of eligible collateral within the Eurosystem has grown significantly over the course of the years. Focusing on the nominal values of eligible marketable assets (there are no data available for non-marketable assets), this figure increased from € 5.3 trillion in January 1999 to € 14 trillion in 2010. The available stock of (quasi) high-quality assets for financial institutions in the euro area can be derived from the Eurosystem's Eligible Asset Database (EADB¹⁰). The EADB contains information about all marketable debt securities that are eligible for the Eurosystem's monetary policy operations. We focus on the subset of the EADB-securities that can be called (quasi) high-quality by the above definition.

To determine the current supply of (quasi) high-quality collateral we calculated the collateral value after haircuts (CVAH) of this subset of securities. The CVAH is a good measure for the supply of collateral as it is based on the current market value of the assets (including accrued interest) and also incorporates the haircuts applied against the assets' risks. As financial institutions may differ in their risk assessment, the haircut and the CVAH may differ too, depending on where the collateral is used. In this paper we calculated the CVAH by multiplying the outstanding nominal amounts of the asset by the respective bid price factor,¹¹ adding accrued interest, and subtracting the applicable haircut.¹² Data on the outstanding nominal amounts, bid price factors and the starting date of the interest accrual were obtained from Bloomberg. Where no price data were available, we used the average bid price factor for the asset type concerned. To obtain a conservative estimate for the CVAH we looked at both the Eurosystem's haircuts and the Basel III haircuts and used the highest of the two to compute the CVAH.

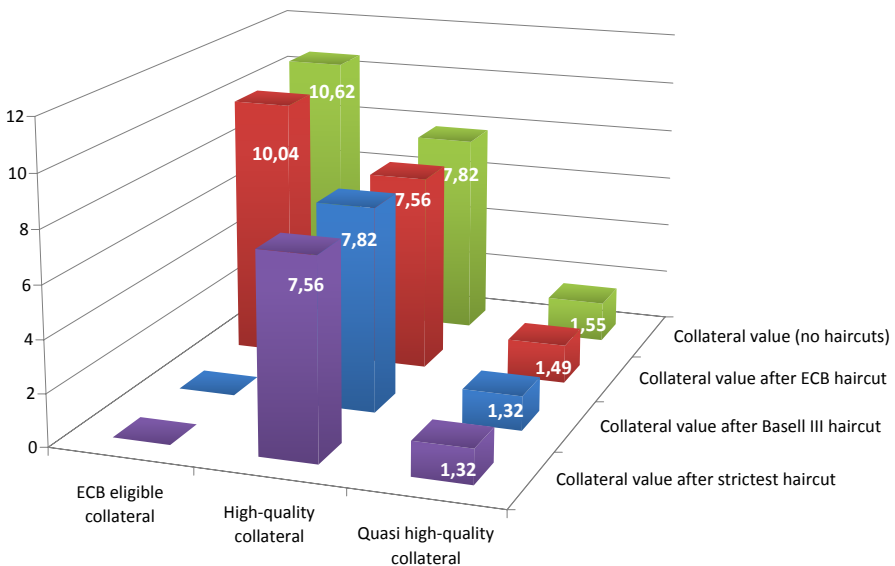
¹⁰ The list of eligible marketable assets is downloadable from the ECB website.

¹¹ The bid price is the highest price for which market participants are willing to buy the asset and is often quoted as a percentage of the nominal amount outstanding (the bid price factor).

¹² In formula: $CVAH = [(nominal\ amount\ outstanding * bid\ price) + accrued\ interest] * (1 - haircut)$.
Accrued interest is: coupon rate/365 multiplied by the number of days and the nominal amount outstanding.

Figure 1 shows the results of this calculation. On 17 November 2011 the eligible collateral within the Eurosystem had a market value of € 10.62 trillion. Applying our definition of (quasi) high-quality collateral to this set of assets, we found that € 7.82 trillion qualified as high-quality collateral and € 1.55 trillion as quasi high-quality collateral. Then the haircuts set by the Eurosystem (green bars) and Basel III (red bars) were applied. The Eurosystem applies stiffer haircuts to high-quality collateral than Basel III, whereas for quasi high-quality collateral the Basel III haircuts are higher. In order to obtain a conservative outcome for the CVAH (blue bars), we used the Eurosystem’s haircuts for high-quality collateral and the Basel III’s haircuts for quasi high-quality collateral. This leads to the conclusion that the current supply of high-quality collateral is € 7.6 trillion and that for quasi high-quality collateral it is € 1.3 trillion.

Figure 1 Collateral value of (quasi) high-quality collateral, before and after haircuts, in EUR trillion



Source: DNB, EADB, Bloomberg (data 17-11-2011)¹³

¹³ Hence, these calculations do not incorporate the December 11 changes in the eligibility criteria for ABS. Since ABS are not included in the definitions of high-quality and quasi high-quality collateral, their values will not be affected by this new rule.

3.2 Future supply of high-quality and quasi high-quality collateral

3.2.1 High-quality collateral

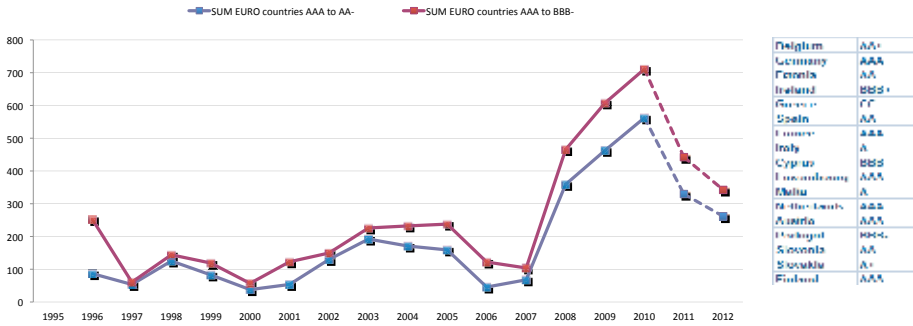
High-quality collateral was defined above as (i) debt *issued* or *guaranteed* by sovereigns, PSEs or central banks with a credit rating of AAA to AA- and (ii) debt *issued* by sovereigns or central bank debt with a credit rating of A+ to BBB-. To determine the future supply of such collateral we used the change in general government debt of the euro area countries as a proxy, where ‘general government’ covers different governmental levels (central, state, regional and local) as well as public sector entities (PSEs) such as social security funds. The change in general government debt determines the financing needs of the public sector and can be used as a proxy for the debt instruments *issued* by public sector entities. It also is a good proxy for the *total* future supply of high-quality collateral, since only 17% of high quality collateral is guaranteed by the public sector but issued by the private sector (source: *EADB, Bloomberg*). Another consideration is that the value of publicly guaranteed but privately issued debt would be very difficult to predict. Finally, we focused on euro area countries’ debt (rather than on debt from EEA and non-EEA G10 countries) since according to our definition, high-quality collateral for the euro area should be denominated in euro.¹⁴ Data were taken from the European Commission’s AMECO database.

General government debt levels within the euro area rose significantly in recent years because of the discretionary stimulus measures, automatic stabilizers and government support to the financial sector that were triggered by the financial crisis and the subsequent economic downturn. Between 2007 and 2010 the average budget deficits of advanced economies increased from 1% to 8% of GDP, and government debt rose from 73% to 93% of GDP (CGFS, 2011 p. 3). The sovereign crisis also affected the pool of high-quality collateral because of the sovereign credit downgrades in some euro area countries. If a sovereign’s rating falls below BBB-, its debt no longer qualifies as high-quality collateral as defined above. Debt from lower levels of public sector entities is excluded when ratings fall below AA-.

Figure 2 illustrates the changes in general government debt for the euro zone countries with a credit rating of (i) AA- or higher (blue line) and (ii) BBB- or higher (red line), using Standard & Poor’s ratings on 21 November 2011. According to our definition, high-quality collateral should at least have a rating of AA- unless the debt is issued by a sovereign (in which case the minimum rating is BBB-). Hence, the blue line gives a lower bound of high quality assets (since it excludes sovereign debt with a rating between A+ and BBB-), whereas the red line presents an upper bound (since it includes other public sector debt with a rating between A+ and

¹⁴ We assume that all government debt issued in the euro area is denominated in euro. The OECD’s Sovereign Borrowing Outlook shows that 99% of the debt issued by governments is denominated in the local currency.

Figure 2 Change in general government debt, in EUR billions



Source: AMECO database (European Commission), Standard & Poor's (21-11-2011).

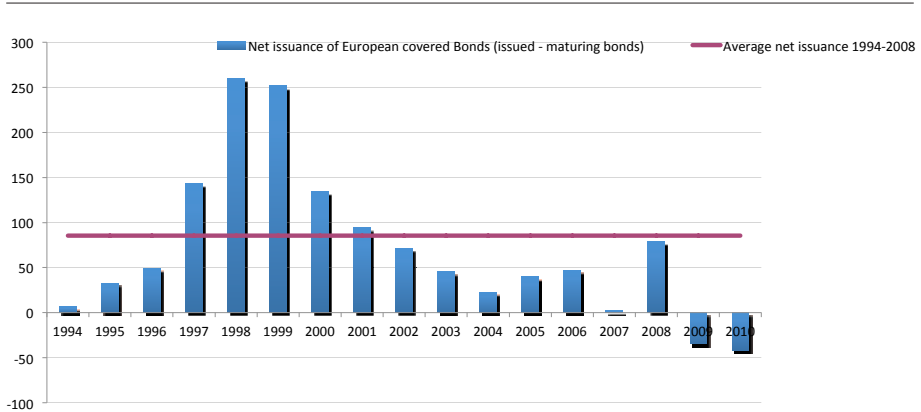
BBB-). The figure illustrates the enormous growth in government debt since the onset of the financial crisis. Given our definition of high-quality assets, this has led to a substantial increase in the supply of high-quality collateral.

Using the European Commission's estimates of financing needs in 2011 and 2012 (AMECO database), we project that the amount of high-quality assets will increase by €330-€442 billion in 2011 and by €261-€342 billion in 2012. Given that in the EADB sovereign and local government debt issuances with a credit rating between of AAA and BBB- are assigned haircuts between 0.5% and 7.5%, we assume that the haircut on newly issued general government debt will be 4%. The collateral value after haircuts of new high-quality government debt will then be €317-€424 billion in 2011 and €251-€328 billion in 2012, implying that by the end of 2012 the stock of high-quality collateral will have grown by €568-€752 billion. We will use €700 billion (€0.7 trillion) as a point estimate below, considering that new debt guaranteed but not issued by the public sector has not been incorporated in the analysis.

3.2.2 Quasi high-quality collateral

Quasi high-quality collateral as defined above consists of (i) marketable securities issued or guaranteed by sovereigns, PSEs and central banks (with a credit rating of A+ to A-)¹⁵, (ii) corporate bonds of non-financial institutions (with a credit rating of AA- or higher) and (iii) covered bonds (with a credit rating of AA- or higher). In practice, covered bonds are the main component of quasi high-quality collateral

¹⁵ With the exception of sovereign debt instruments with a rating between A+ and A-, as these are considered to be high-quality collateral (see above).

Figure 3 Supply of European covered bonds, in EUR billions

Source: Dealogic, DNB. Data in this figure are for the euro area and the United Kingdom.

with a share of 85%. Figure 3 shows that net issues of covered bonds in the euro area and the United Kingdom were quite high in the late 1990s, somewhat lower in the period 2000–2008 and negative in 2009 and 2010 as a result of the financial crisis. On average, the covered bond market grew by an annual € 85 billion in 1994–2008.

The future supply of quasi high-quality collateral can be estimated by looking at the future issuance of European covered bonds. The latter depends on how banks are going to structure their funding in the next couple of years. As banks can fund their activities by various types of debt and/or equity, a bank's funding decisions will depend on opportunities in different financial markets as well as the bank's own credit rating and the broader economic environment. This makes it very difficult to project what amount of covered bonds will be issued relative to other funding possibilities.

There are currently several trends that stimulate the further development of the covered bond market. Some of these trends favour secured over unsecured lending, indirectly promoting the issuance of covered bonds as a particular form of secured lending. Other trends have a direct positive impact on the covered bonds market. First, there will be an indirect positive impact on the covered bonds market as under Basel III capital requirements for secured loans are lower than for unsecured loans (as was the case in Basel I and Basel II). Recent regulatory discussions to promote the 'bail-in' of unsecured debt (i.e. its conversion into equity in case of stress) and 'depositor preference' (deposit owners get to claim before unsecured lenders) could further discourage unsecured lending. Among the new trends with a direct effect on covered bonds is the preferential treatment received by covered bonds under

the new liquidity standards of Basel III (BCBS, 2010a).¹⁶ Indeed, many banks have reported that they intend to hold more covered bonds because of this. Another direct trend is a tendency in some countries for covered bonds to replace the riskier and less liquid asset-backed securities (ABS), because covered bond markets remained relatively liquid during the financial crisis while some (but certainly not all) ABS markets dried up completely and some ABS haircuts skyrocketed.¹⁷ In these countries banks are expected to issue more covered bonds for the purpose of obtaining liquidity from the central bank in what is called ‘own use of covered bonds’, as well as on the private repo market.

At the same time there are other trends that discourage the further growth of the covered bonds market. First, there are natural limits to the overall size of this market. If banks issue covered bonds, they need good quality assets (e.g. high-quality mortgage loans) to secure these bonds. If all the bank’s ‘suitable’ assets are encumbered, the bank can no longer issue covered bonds. Second, the issuance of new covered bonds will lower the amount of unencumbered assets that are available to fulfil commitments to other debtors if the bank defaults. Therefore, several supervisors in the euro area have imposed ceilings on the issuance of covered bonds to protect other debtors. Even where there are no such regulatory ceilings imposed, banks themselves may see limits as unsecured funding may become unaffordable (as unsecured lenders ask hefty risk premiums) if they issue too many covered bonds. Finally, the current financial market situation is also likely to discourage the issuance of new covered bonds. Banks in many countries, for instance German banks (traditionally a large issuer of covered bonds), are deleveraging, meaning that these banks will issue less debt. Also new covered bonds issues in some euro area countries are discouraged by the sovereign crisis, as this crisis has raised concerns about the health of the banking sector in some euro area countries as well as about the quality of the mortgage loans used to secure the banks’ covered bonds. There are some early indications that these concerns also have negative effects the covered bonds markets in other euro area countries.

Looking at all these different trends, some encouraging and others discouraging the covered bonds market, it is impossible to say which trends will prevail or to give an accurate estimate of the future size of the covered bonds market. We therefore simply assume that the covered bond market will grow by an annual €85 billion in 2011 and 2012 as it did in the years 1994-2008. Accordingly, compared to the last

¹⁶ Banks that hold covered bonds on the asset side of their balance sheet need less stable funding than banks that hold unsecured loans. Moreover, covered bonds are included in the Basel III definition of high-quality liquid assets. Focussing on the liabilities side, covered bonds funding is more attractive than unsecured wholesale borrowing, because the former has a lower run-off rate in the LCR-stress scenario and therefore requires a lower level of highly liquid assets (see Chapter 4).

¹⁷ Other euro area countries such as the Netherlands have a strong ABS market with qualitatively good products. Moreover, in some countries (e.g. the Netherlands) covered bonds are reported to be substantially overcollateralized, thus putting a disproportionate claim on the bank’s assets. In these countries the covered bond sector will probably not grow as strongly as in other countries.

available figure of late 2010, we estimate an increase of €170 billion in covered bonds outstanding by the end of 2012, which – after applying the 15% Basel III haircut (see above) – yields a collateral value after haircuts of €145 billion or €0.1 trillion. Some anecdotal market evidence supports an estimate of this magnitude.

3.3 Summary

This chapter has quantified the current and future supply of high-quality and quasi high-quality collateral. The current value of high-quality collateral after haircuts is €7.6 trillion and is expected to be around €8.3 trillion by year-end 2012. The value of quasi high-quality collateral currently stands at €1.3 trillion after haircuts, and is expected to be around €1.5 billion at the end of 2012. Hence, by year-end 2012, the combined value after haircuts of high-quality and quasi high-quality collateral is expected to be around €9.8 trillion.

4 Demand for Collateral

The shift in transactions from unsecured to secured money markets, the new regulations for OTC derivatives transactions and the liquidity standards of Basel III will affect the future demand for high-quality collateral. This chapter identifies and quantifies the effects of these new developments. Our study focuses on the euro area. But sometimes data were only available at the European level. In those cases we used a scaling factor to estimate the euro area's share. Considering three different measures of the euro area's weight in the European economy or financial sector and taking their average, we assumed a scaling factor of 72% and used this where necessary.¹⁸

4.1 The secured money market

4.1.1 The repo market and the financial crisis

To determine the future collateral needs in the euro area repo market, we first discuss the recent developments in the private European repo market. The European repo market has grown significantly over the last decade. The average daily turnover more than doubled between 2002 and 2010, from € 111 billion euro to € 231 billion, based on an ECB survey among 105 financial institutions from 25 EU countries (ECB, 2010a). In terms of amounts outstanding (see Figure 4), the repo market tripled between 2001 and 2010, from € 924 billion to € 3.0 trillion (International Capital Market Organisation (ICMA), 2011). Generally, the growth of the repo market prior to the crisis reflects the fact that investors found repo-transactions a relatively safe investment and an efficient means for shifting liquidity (Cossin et al., 2003; ECB, 2010a). But there were also several exogenous factors that contributed to

¹⁸ To obtain a reasonable scaling factor, we looked at the euro area's share in Europe's (i) financial balance sheet, (ii) financial transactions, and (iii) gross domestic product (GDP). Financial balance sheet data are indicative for the overall size of the euro area's financial market, providing information on financial assets and liabilities positions at one point in time (stock data). Figures from Eurostat indicate that between 1999 and 2009, the euro area accounted for 70.9% of Europe's financial balance sheet. Second, the number of financial transactions measures the activity in financial markets over a certain period of time (flow data). Between 1999 and 2009 the euro area's transaction volume accounted for 70.8% of the European volume. Third, with respect to economic activity, Eurostat data indicate that the euro area's share in the EU27's GDP amounts to 74.0% on average over the same period. Taking the average of these three factors results in a scaling-factor of 72%.

this strong growth.¹⁹ At its peak in 2007, the repo market had a value of €3.4 trillion in amounts outstanding.

Figure 4 also shows that amounts outstanding on the repo market plummeted after 2007. At its lowest point in 2008, the value was reduced to €2.3 trillion. Although the financial crisis led to a shift in transactions from unsecured to secured money markets (i.e. an increase in the share of the secured market in the overall private money market), the secured market also suffered badly from the financial crisis (Capel, 2011, p. 23-24; ECB, 2009a). Market participants' concerns about the valuation of collateral assets and counterparties' creditworthiness put a strain on secured money markets (Hördahl & King, 2008; IMF, 2010). Indeed, only creditworthy counterparties were able to obtain loans provided that they offered high-quality collateral or accepted large haircuts on other collateral (GCFS, 2010). Activity on the repo market was also negatively affected by the decline in economic activity caused by the financial crisis. Finally, transactions on the secured money markets were 'crowded-out' by the special measures that the Eurosystem took to alleviate the funding problems of financial institutions. The resulting abundant liquidity provision by the Eurosystem (ECB 2010a) reduced banks' need to obtain liquidity from the private money markets. Moreover, as the spread between the money market interest rates and the ECB deposit rate decreased, banks were less willing to take on the credit risk associated with interbank lending and sought recourse to the deposit facility.

Since December 2008 the European repo market has recovered²⁰ and there are good reasons to expect further growth. Two positive exogenous factors that boosted growth before the crisis (see note 19) continue to exist. Given the benefits of CCPs, their good performance during the crisis and market participants' current risk aversion, this share can be expected to increase. Second, compared to unsecured money market transactions, repo transactions – especially those covered by high-quality and liquid collateral – receive preferential treatment under Basel III, in terms

19 First of all, repo market infrastructure became more efficient through the increased use of CCPs (IMF, 2010 pp. 64-65; ECB 2007, p. 18; CPSS, 2010). CCP-clearing reduces credit and settlement risk by multilateral netting of positions. Moreover, trading limits are often based on the size of open positions vis-à-vis each counterparty and CCPs reduce these open positions via multilateral netting. In this way CCPs can positively affect market activity. The fact that CCPs can organize anonymous trading could also contribute to more market activity. Second, the available pool of collateral increased, which made more repo transactions possible. This increase in the collateral pool was due to the increased securitization of illiquid assets such as mortgages (IMF 2010 p. 64-65; ECB 2007, p. 18) and less stringent collateral requirements in the Eurosystem, which made higher quality collateral available for other uses (ECB, 2011; ECB 2009b; ECB 2004). Third, regulations under Basel I and II favoured repo lending over unsecured lending, as the former were assigned a lower risk-weight and thus lower capital charges (BCBS, 2006).

20 Note the sharp rise and subsequent decline of the outstanding volume in the repo market in 2010. A possible explanation is a change in the sample of respondents to the ICMA survey on which the data are based. According to ICMA, the peak in 2010 can be explained by 'exceptional' factors that unwound in the second half of the year. However, 'beneath these unusual swings in activity, there is still a discernible trend towards recovery in the repo market' (ICMA 2011, p. 12).

of both capital requirements and the new liquidity standards. These developments are supportive of future growth.

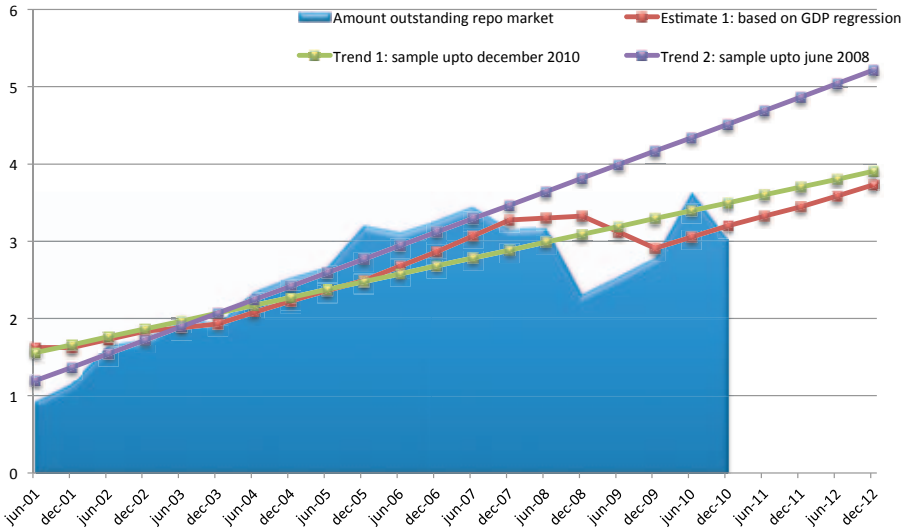
However, we do not expect the same rates of growth as before the crisis. First, market participants are likely to remain more risk averse than before the crisis, which – as indicated above – puts strains on the development of the market. Second, banks in many euro area countries are deleveraging, which will lower their demand for funding. Finally, there is an endogeneity issue: rapid growth of the secured money market would make high-quality collateral scarce, leading to countervailing forces. In the event of collateral scarcity, repo market interest rates would decrease (in return for scarce high-quality assets a cash lender has to accept a lower return) and market participants would become more willing to pay higher interest rates on unsecured loans. This might prompt some liquidity suppliers to accept unsecured lending.

4.1.2 Estimating collateral needs in the repo market

To project the future development of the European repo market, we assume that the current positive trends will continue in the next couple of years. We also assume that other relevant factors, such as the size of the Eurosystem's monetary policy operations and the relative costs of repo transactions, remain constant. This implies that we focus on 'first-round effects' and do not consider the possible feedback of scarcer high-quality collateral and its impact on secured money market interest rates. To estimate future activity on the European repo market we used data from the ICMA surveys since amounts outstanding (stock variable) give a better indication of the collateral value needed in this market than the turnover data (flow variable) provided by the ECB.²¹ The estimation results are presented in Figure 4. The first two models estimate a trend through time (with June 2001 set equal to $t=1$) based on least squares estimation with either the complete data sample or the pre-crisis data only (i.e. up-to and including June 2008). Considering the pre-crisis data only (purple dotted line in Figure 4), we get a statistically significant and highly positive trend. According to this trend, the amount outstanding could rise from €3.0 trillion (Dec. 2010) to €5.2 trillion in 2012. If estimates are based on the complete data sample (green line), they also reflect the market's decline during the crisis. The trend is then less pronounced but still significant positive and predicts that outstanding amounts could rise to €3.9 trillion in 2012. Finally, considering that repo market activity is likely to be positively correlated with economic activity, we also used a model that related the outstanding amount in the European repo market to the

²¹ There are some limitations to these data. Since the stock data from the ICMA (2011) (and also the turnover data from the ECB (2010a)) are based on surveys, some of the variation in the data will be caused by changes in the survey respondents and not be indicative of developments in the whole market. Due to the bilateral nature of repo transactions, higher-quality data are not available. An additional difficulty is the limited number of observations available: ICMA provides semi-annual data between 2001 and 2010.

Figure 4 Trends in the European repo market – amount outstanding, EUR trillions



Trend repo market	Coefficients	Std. Error	t.	P>t	R ²
Trend: complete sample	Const. 1.46e+12	2.23e+11	6.54	0.000	0.6050
	Time 1.02e+11	1.86e+10	5.49	0.000	
Trend: up-to June 2008	Const. 1.02e+12	1.32e+11	7.73	0.000	0.9112
	Time 1.75e+11	1.45e+10	12.03	0.000	
Model: GDP	Const. -4.03e+12	1.112e+12	-3.623	0.002	0.661
	GDPEU ₂₇ 0.59	0.100	5.922	0.000	

GDP of the 27 EU Member States. This led to an estimate on outstanding amounts of €3.7 trillion in 2012.

Based on our analysis above, we expect further growth of the secured money market but at a lower rate than before the financial crisis. As there is no precise way to forecast this growth rate, we use the estimation results from the trend model covering the complete data sample and the GDP model and project that the amount outstanding in the European repo market rises from its current level of €3.0 trillion to €3.8 trillion in 2012. By implication, the collateral needs will also rise to these amounts for the European Union. Given that the euro area accounts for 72% of the European Union’s financial market (see above), the collateral needs for the euro area with respect to repo markets can be expected to rise from its current estimated

level of € 2.17 trillion to € 2.75 trillion in 2012 (i.e. an increase of € 580 billion or € 0.6 trillion between 2010 and 2012).

4.2 The OTC derivatives market

4.2.1 The derivatives market and the financial crisis

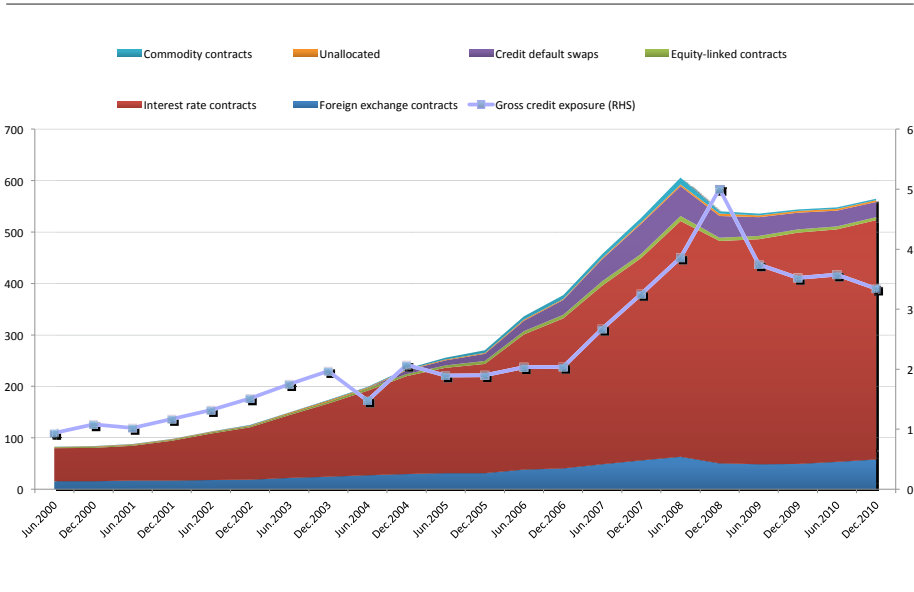
The demand for high-quality collateral will also increase as a result of recent developments in the OTC derivatives market. The derivatives market is a global market where both standardized and non-standardized products are traded. Fully standardized products are traded on exchanges, while idiosyncratic and more complex products are traded bilaterally over the counter (OTC). Both the exchange traded and OTC derivatives market have grown markedly over the last decade. Notional amounts – i.e. the nominal values on which derivatives contracts are based – are a good indicator for the size of the derivatives market (ECB 2010b, p. 99; Hull, p. 778). In terms of notional amounts outstanding, the exchange traded derivatives market grew from \$14 trillion to \$83 trillion between June 2000 and June 2011, while the OTC market expanded from \$94 trillion to \$708 trillion (BIS, 2011). Figure 5 shows the growth of the OTC derivatives market for different derivatives types. This section focuses on the OTC derivatives because there are some important policy changes (see below) that will affect the demand for collateral on this market. Moreover, this market is much more sizeable. We will return briefly to the exchange-traded derivatives market in Chapter 5 where we look at the total demand for high-quality collateral.

If the market price of the underlying value changes, the value of the derivatives contract changes too, affecting the open position or (credit) risk exposure of the ‘recipient’ party to the other. This implies that notional amounts outstanding do not measure the (counterparty) risk that the derivatives contract entails. The best available measure for risk exposure in the derivatives market seems to be the gross credit exposure. It sums the absolute market values of all open contracts with either positive or negative replacement values after allowing for netting possibilities.²² Between June 2000 and June 2011, gross credit exposure rose from \$ 937 billion to \$ 3.0 trillion (Figure 5). During the financial crisis, notional amounts outstanding decreased because of increased risk aversion among market participants and due to trade compression.²³ However, gross credit exposure still rose sharply in 2008 because of the impact of increased asset price volatility on the market values of

22 Another measure for risk in the derivatives market is gross market value. It is the sum of the absolute market value of all open contracts with either positive or negative replacement values. As it does not consider bilateral netting agreements, which many OTC contracts allow for, the gross market value overestimates the true exposure in the OTC derivatives market. See further ECB (2010 p. 99) and BIS (2010, p. 2)

23 Trade compression is the reduction of the notional amount of trades outstanding while maintaining the same risk profile. The process involves aggregating a large number of trades with similar characteristics such as cash flows, into fewer trades with less capital exposure (Source: DTCC: http://www.dtcc.com/downloads/products/derivserv/tiw_data_explanation.pdf)

Figure 5 OTC derivatives market – notional amounts and gross credit exposure, USD trillions



derivatives contracts. During the first half of 2011, notional amounts increased again, but gross credit exposure decreased.

Besides being affected by the crisis, the OTC derivatives market played a significant role in exacerbating the financial crisis.²⁴ This was not a coincidence. First of all, the very nature of the derivatives market has the potential of spreading and exacerbating systemic risks. Derivatives transfer risk in a highly leveraged fashion. A position in a derivatives contract thus generates more exposure than a position in the underlying asset itself. Secondly, OTC markets are characterized by high levels of customization and hence illiquidity, lack of transparency, high market concentration and interconnectedness, and lack of regulations. By contrast, the exchange traded derivatives market is on the whole liquid, more regulated and less opaque (European Commission, 2010; ECB 2010b, p. 94).

²⁴ This was especially true for the credit segment of the market, which caused the crisis to spread beyond the US subprime mortgage crisis. Financial institutions that had written large amounts of credit default swaps, which protected buyers from losses in the subprime mortgage sector, incurred large losses. Once the credit segment of the OTC market was hit, the problems spread to other segments due to the interconnectedness and high level of concentration in the market (European Commission, 2010). The near-collapse of Bear Stearns in March 2008, the default of Lehman Brothers in September 2008 and the bailout of AIG are exemplary for the problems in the OTC derivatives market (European Commission, 2010).

In response to these problems, the G20 made a strong commitment at the Pittsburgh summit of September 2009 to reform the market, by mandating that standardized contracts be cleared through central counterparties (CCPs) by end-2012, and that all trades should be reported to trade repositories. Moreover, the G20 announced that non-centrally cleared contracts should be subject to higher capital requirements. This latter factor should induce banks to seek CCP clearing and to improve margining practices for bilaterally cleared derivatives. In Europe, the stricter regulations for the OTC market are laid down in the *'EU Regulation on OTC derivatives, central counterparties and trade repositories'*, and will be finalized in EMIR (EC, 2010). The initiatives to increase clearing through central clearing counterparties (CCPs) stem from the fact that CCPs performed well during the crisis, while – as just discussed – bilateral derivatives arrangements revealed weaknesses (G20, 2009).

Moving a large share of the OTC derivatives market to CCPs for clearing will raise the demand for high-quality collateral. Although bilateral clearing arrangements require collateral too, as counterparties have to post variation margin with the other party according to marked-to-market changes in the value of the contract (and sometimes initial margin as well), in practice many bilateral trades are not fully collateralized and margin calls are not always made frequently. In the case of CCPs, on the other hand, margins are typically set at market level and margin calls are made daily (sometimes even intraday if necessary). In addition, CCPs require collateral in the form of guarantee fund contributions. This collateral is meant to cover potential future losses that would occur in a stressed market situation so that the CCP should be able to withstand crisis situations. CCPs also offer multilateral netting and this netting lowers open positions and therefore collateral demanded from banks. Most banks, however, expect that only large dealer banks in OTC derivatives will be able to benefit from the netting effect of CCPs and have to post less collateral while others will have to put forward more collateral for their OTC derivatives trade (Capel, 2011, p. 30).

4.2.2 Estimating collateral needs in the OTC derivatives market

Several methods have been used in the literature to estimate the collateral needs in OTC derivatives markets. All these methods rely on the OTC derivatives data provided by the Bank for International Settlement (BIS) and the International Swap and Derivatives Association (ISDA). The first is the method developed by the International Monetary Fund (IMF), which compares derivatives payables to collateral paid (Singh, 2010). The derivatives payables of a financial institution are the sum of that institution's liabilities to all other counterparties in the financial system.²⁵ The institution exposes the financial system to credit risk unless these derivatives payables are fully collateralized. Following this line of reasoning,

²⁵ On the other hand, the derivatives receivables (as far as they are not collateralized) represent the credit risk of all other counterparties to which the financial institution is exposed.

exposure of the financial system to the failure of a particular counterparty can be defined as *'the liabilities of a counterparty to all others in the financial system. These liabilities stem from the counterparty's OTC derivatives payables after netting under a master netting agreement such as ISDA, or a cross-margining agreement, which have been further reduced by assigning cash or equivalent collateral'* (Sing and Aitken, 2009; Segoviano and Singh, 2008).

Considering that gross credit exposure includes both derivatives payables and derivatives receivables, the total collateral needs in the OTC derivatives market are half of the gross credit exposure as reported by the BIS under the assumption that the BIS data cover the complete market.²⁶ The collateral value that is already paid in the OTC derivatives market can be obtained from ISDA figures. Since these figures report both collateral paid and delivered, the ISDA-figures are halved to measure only collateral paid.²⁷ By comparing total collateral needs (i.e. derivatives payables) to collateral actually paid, we get a measure of the additional collateral needs (or the amount of under-collateralization) in the OTC derivatives market as it is today: a market that is characterized primarily by bilateral trades. Given that new regulations are underway to mandate CCP-clearing for a large share of OTC derivatives trades by the end of 2012 (G20, 2009; EC, 2010), further collateral will be required in the form of initial margin and guarantee funds (see above). The IMF (Sing, 2010) has extrapolated the 'CCP-effect' by using the ratio of initial margin and guarantee fund to notional amounts from two existing CCPs in the OTC derivatives market for the total market, assuming that two-thirds of the current notional value will be moved to CCPs.

Other methods to estimate the collateral needs in OTC derivatives markets are those of the BIS (BIS, 2009) and TABB Group (2010). The BIS method measures under-collateralization in the OTC derivatives market by comparing gross credit from BIS data to the total collateral value as reported by ISDA (instead of halving both figures, as the IMF approach does) and does not quantify the CCP-effect. The TABB Group method estimates the collateral needs in the OTC derivatives market by looking at the ratio of total margin (collateral) to notional amounts outstanding in the exchange traded derivatives (ETD) markets and using this percentage (0.61%) to calculate the collateral needs for the OTC derivatives markets. The current under-collateralization is determined by subtracting the single counted collateral value – i.e. half of the collateral value reported by ISDA – from this amount. Because ETD markets are already cleared by CCPs, this method already includes the effects of CCP clearing.

²⁶ If one assumes that the institutions reporting to the BIS represent the total market, it follows that these institutions must run matched books. This means that for the total market, derivatives payables must equal receivables. By implication, derivatives payables are represented by half of gross credit exposure.

²⁷ In addition, a correction has to be made for any re-hypothecation of collateral. We discuss this below.

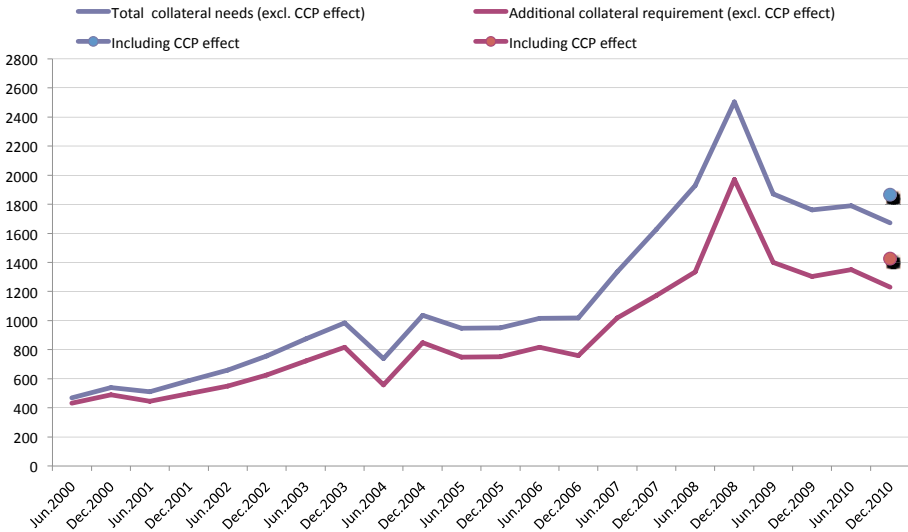
We prefer to use the IMF method to calculate future collateral needs in OTC derivatives markets. The TABB Group does not take into account that ETD and OTC markets may have different risk characteristics. For instance, credit default swaps are much more volatile than interest rate derivatives, in part because of their potential jump risk (see Singh, 2010; Heller and Vause, 2011; Zhang, Zhou & Zhu, 2005). Credit instruments are an increasingly more important category in the OTC market, while they are almost non-existent in the ETD market (BIS; TABB Group, 2010). The BIS uses gross credit exposure as a measure of risk, implying that both derivatives payables and derivatives receivables are part of the risk measure. If we want a measure for *systemic* risk, this makes sense since both derivatives payables and derivatives receivables can be a source of contagion, as banks may depend on their payments receivables as a source of liquidity to make their own payments on time. However, we focus on collateral needs as an instrument to reduce credit risk, which in our view makes it logical to consider derivatives payables only.

Figure 6 illustrates the total and additional collateral needs for OTC derivatives transactions in the 2000 to 2010 period, based on the IMF method. As argued earlier, total collateral needs in the OTC derivatives market can be measured by derivatives payables, which can be approximated by half the gross credit exposure (as reported by the BIS).²⁸ As of December 2010, this implies that on the OTC derivatives market an amount of \$ 1.67 trillion is needed in collateral value after haircuts. However, this amount does not include the effect of CCP clearing. According to the IMF (Sing, 2010), moving two-thirds of all OTC derivatives trades to CCPs for clearing and assuming that credit exposures remain at the December 2010 level, would require an additional collateral value between \$ 170 and \$ 220 billion (\$ 195 billion on average), resulting in a total future collateral need of \$1.87 trillion.

The additional collateral needs in the OTC derivatives market (or the current extent of under-collateralization) can be found by comparing total collateral needs to assigned collateral, correcting for re-hypothecation. The assigned collateral is half of the 'total reported collateral by respondents', as this last figure includes both collateral received and collateral delivered. However, ISDA's 'single counted collateral value' overstates the *true* amount of collateral assets available to cover for risks in OTC derivatives transactions, since a large share of the posted collateral is re-hypothecated to secure other risks (see Section 5.2 for a detailed discussion on re-use or re-hypothecation). ISDA reports that large institutions in the OTC derivatives market re-hypothecate 73.6% of their collateral. Based on the ISDA figures, we assumed that 30% of ISDA reported collateral is *not* re-hypothecated and therefore available as collateral. Hence additional collateral needs are measured by subtracting 30% of the single counted collateral value from derivatives payables.

²⁸ A drawback of this measure is that it slightly underestimates the exposure of the financial system, since the BIS statistics on gross credit exposure do not include exposures created by credit default swaps contracts other than for the US market (BIS, 2009).

Figure 6 Total and additional collateral needs in the global OTC derivatives market (IMF method), USD billions



Source: BIS statistics, ISDA margin surveys, Sing (2010), BIS, (2009).

Figure 6 shows that the additional collateral requirements amount to \$ 1.2 trillion in 2010. If the CCP effect is added to this figure, the additional future collateral needs would be \$ 1.4 trillion for the global OTC derivatives market.

On the basis of these estimates for the global OTC derivatives market we now proceed to make estimates for the total and additional collateral needs of euro area banks for the OTC derivatives trade. As OTC derivatives data are only available at the global level, we want a reasonable approximation of the euro area’s share. One method of determining this by looking at the share of the euro area in the global exchange traded derivatives market and applying this percentage to the OTC derivatives market. The BIS provides semi-annual data on the notional amounts outstanding in the ETD market per geographic region. Because data for the euro area are not available, we focus on the geographical region of ‘Europe’ and use our 72% scaling factor (see above) to obtain the euro area estimate. In December 2010, Europe accounted for 37.60% of the total ETD market so that the euro area would account for 27.5% of the global OTC derivatives market as of December 2010. A second method is to look at the share of euro-denominated contracts in the OTC derivatives market (see ECB, 2009c). For OTC interest rate and foreign exchange derivatives the shares of euro-denominated contracts (measured in terms of notional amounts outstanding) in December 2010 were 38.2% and 37.9% respectively. The

euro area share of OTC equity derivatives is estimated to be 30.1% in late 2010²⁹, whereas approximately 39% of credit derivatives are denominated in euro (ECB, 2009c). Finally, for commodity derivatives and ‘unallocated’ derivatives, we used the euro area’s share in the global ETD (see above) as a proxy leading to an estimate of 27.5% for 2010. Given the relative weights of these different derivatives types in the global OTC derivatives market, we estimate the overall share of euro-denominated contracts to be 37.4%. In sum, these two approaches indicate that between 27.5% and 37.4% of the global derivatives market is accounted for by the euro area. Under the assumption that the average of these two figures (i.e. 32.5%) provides a fair estimate of the euro area’s OTC derivatives market, the euro area will require \$ 465 (€325) billion of additional collateral in the near future. Total future collateral needs for OTC derivatives transactions amount to \$ 608 (€ 427) billion.

4.3 The Basel III liquidity standards

In order to make banks more resilient to liquidity shocks, the Basel Committee on Banking Supervision (BCBS, 2010a) introduces two new liquidity standards in its Basel III framework: the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR). The LCR states that banks should hold a sufficiently large buffer of high-quality and liquid assets to withstand cash outflows during a stress scenario that lasts 30 days. The measure aims to make banks less prone to acute adverse liquidity shocks. The NSFR requires banks to hold a minimum amount of stable funding on their books, depending on the maturity profile of the bank’s activities. The NSFR is designed to promote the longer-term liquidity position of banks by mandating that they should fund long-term assets with sufficiently long-term funds, in order to reduce maturity mismatches and over-reliance on short-term wholesale funding. The LCR and the NSFR will enter into force in 2015 and 2018, respectively. Banks will use the coming years to prepare for these new standards and make the necessary adjustments.

Several studies show that many banks do not yet comply with these new standards, and thus face a shortfall of high-quality liquid assets and/or stable funding. The Basel Committee itself (BCBS, 2010b) has conducted a quantitative impact study among 23 of its members,³⁰ and found respective LCR and NSFR shortfalls of € 1.73 trillion and € 2.89 trillion. The Committee of European Banking Supervisors (CEBS,

29 To determine this figure we used BIS data on the European share of equity derivatives in terms of notional amounts and correcting this for the euro area share in stock market capitalization of EU equity values (73% for 2007 according to the ECB (2009c)).

30 These jurisdictions contained in the BCBS (2010b) study are: Australia, Belgium, Brazil, Canada, China, France, Germany, Hong Kong, India, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, Saudi Arabia, Singapore, South Africa, Spain, Sweden, Switzerland, United Kingdom and the United States.

Table 2 Impact of the Basel III liquidity standards

Study	Scope	LCR shortfall	NSFR shortfall
BCBS (2010b)	Global, 23 member countries	€ 1.73 tr.	€ 2.89 tr.
CEBS study (2010)	21 European countries	€ 1.00 tr.	€ 1.80 tr.
McKinsey study (2010)	EU27 plus Switzerland	€ 1.30 tr.	€ 2.30 tr.
<i>Extrapolation from McKinsey (2010)</i>	<i>Euro area</i>	<i>€ 923 bn.</i>	<i>€ 1.63 tr.</i>

2010) has conducted a similar study for 21 European countries,³¹ and concluded that the LCR and NSFR shortfall for these countries would be € 1.00 and € 1.80 trillion. Finally, a report from McKinsey&Company (McKinsey, 2010) uses data from the top 45 European banks and estimates the LCR and NSFR shortfalls to be € 1.30 trillion and € 2.30 trillion for the EU27 plus Switzerland. Table 3 gives an overview of the studies' results.

4.3.1 Banks' adjustment to the LCR and NSFR and the demand for high-quality assets

We have seen that many banks need to implement changes in order to comply with the LCR in 2015 and the NSFR in 2018. Now what would be the effect of this on their demand for high-quality liquid assets? A simple approach would be to focus on the LCR shortfall, since this is the amount of highly liquid assets that European banks still need to be able to withstand the 30-day stress scenario. However, this simple approach can be criticized for two reasons. The first is that the Quantitative Impact Studies (QIS) of both the Basel Committee and the CEBS calculate the LCR and NSFR shortfall as the sum of all shortfalls of banks with a LCR and NSFR ratio that is below 100%. In other words, the shortfall represents a gross amount that does not correct for the fact that some banks have a surplus of high-quality and liquid assets. Indeed, the CEBS (2010) report shows that in Europe, approximately 20% of the 'large' banks and 55% of the 'small' banks already comply with the LCR.³² If these surplus liquid assets can be transferred efficiently to banks facing a shortage, additional pressure (i.e. extra demand) for high-quality and liquid assets need not occur. The second reason is that the reported LCR and NSFR shortfalls

³¹ The jurisdictions contained in the CEBS study are: Austria Belgium, Cyprus, Czech Republic Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovenia, Spain, Sweden and the United Kingdom.

³² The QIS of the Basel Committee (BCBS, 2010b) and the CEBS (2010) reports the LCR and NSFR for Group 1 and Group 2 banks. Group 1 banks are 'large banks', which are defined as well diversified and internationally active banks with Tier 1 capital in excess of € 3 billion. All other 'small' banks fall under Group 2. The CEBS study indicates that in Europe, Group 1 banks have an average LCR of 67%, while Group 2 banks have an LCR of 87%. The NSFR equals 91% and 94% for Group 1 and Group 2 banks, respectively.

are calculated independently from each other, under the assumption that banks do not take any mitigating action to reduce these shortfalls. However, banks will restructure their balance sheets and it is the intention of Basel III that they do. In this context, it should be noted that the LCR and the NSF are linked. The LCR consists of two components: the stock of liquid assets and the net cash outflows³³. Hence, banks can improve their LCR by (i) holding more high-quality liquid assets on their balance sheets, which increases the pool of liquid assets that can cover net cash outflows; (ii) replacing long-term assets with short-term assets (within the 30-day horizon), so as to increase cash inflows and hence reduce net cash outflow; and (iii) attracting more stable funding, which reduces (net) cash outflow. These factors are obviously related to the NSFR, which is defined as available amount of stable funding over required amount of stable funding. There are two ways in which banks can improve their NSFR, namely by (i) attracting more stable funding, or (ii) engaging in activities that require less stable funding, which means reducing long-term investments (with maturities above one year) and increasing short-term assets. All in all, this means that when a bank improves its funding profile by increasing stable funding, both the NSFR and LCR will be improved: the first through an increase in available stable funding, the latter through a decrease in cash outflow. Alternatively, when a bank improves its NSFR by reducing its required amount of stable funding – for instance by attracting more high-quality liquid assets such as government bonds – the LCR will improve through an increase in the stock of liquid assets. To determine how the new liquidity standards of Basel III will affect the euro area’s demand for high-quality liquid assets, we need information on how exactly banks are going to make the necessary adjustments. This information is not available. To illustrate possible outcomes we present in Appendix A2 some stylized examples of how different strategies of banks to improve their NSFR have quite different implications for the LCR (and on the demand for high-quality liquid assets). The results indicate that issuing covered bonds and attracting more retail deposits could improve both the NSFR and the LCR (thereby lowering the additional demand for high-quality liquid assets). By contrast, substituting secured long-term wholesale funding for unsecured short-term wholesale funding improves the NSFR but erodes the LCR. Depending on banks’ restructuring strategies, therefore, there will be either more or less additional demand for high-quality and liquid assets.

³³ Cash outflows arise during times of distress because a part of the bank’s deposits and unsecured or secured wholesale funding dries up and credit lines provided by the bank are drawn down more than usually. Cash inflows indicate contractual receivables that relate to the bank’s assets. The difference between cash out- and inflows represent a bank’s net cash outflows.

4.3.2 Estimating euro area demand for high quality assets due to the liquidity standards

Since there is no information available on the surplus of highly liquid assets held by banks that already comply with the liquidity standards (nor on their willingness to sell or lend them to banks facing a shortage) or on how banks will adjust to the NSFR (with either a positive or negative impact on the LCR), we have to resort to the simple approach and assume that the estimated LCR shortfall for Europe is a good approximation of the need for high-quality liquid assets in the European Union. As to date, no QIS has been conducted for the euro area, the implications for the euro area can only be extrapolated from European data. This is problematic because the LCR and NSFR shortfalls depend on a bank's individual characteristics and because banks in the euro area may differ significantly from banks in other European countries. An estimate based on a scaling factor must therefore be taken as a rough estimate. Table 2 reported that the LCR shortfall has been estimated at €1.30 trillion for the EU 27 plus Switzerland (McKinsey, 2010). Given that the euro area's financial balance sheet accounts for approximately 71% of the European Union's balance sheet (see note 18), we assume that the LCR shortfall and the resulting additional demand for high-quality liquid assets will be €923 billion or €0.9 trillion for the euro area.³⁴

4.4 Summary

This chapter has shown that the recent developments in the private European repo market and the OTC derivatives market, plus the new Basel III liquidity standards will lead to an increase in demand for high-quality liquid assets in the euro area. First, estimates based on a linear trend and GDP model indicate that the euro area repo market will have grown by €580 billion at year-end 2012 (compared to year-end 2010). This amount will also be needed in the form of collateral value after haircuts. Second, it has been estimated that moving two-thirds of OTC derivatives contracts to CCPs for clearing, to resolve the current extent of undercollateralization in the OTC derivatives market relative to its exposure, would require an additional collateral value of €325 billion. Finally, the shortfall of liquid assets that banks face due to the new liquidity standards of Basel III, approximates €923 billion for the euro area. While euro area banks' actual demand for high-quality liquid assets will depend on the specifics of their balance sheet restructuring and is therefore impossible to forecast precisely, we have taken this €0.9 trillion as a rough approximation. Taken together, these developments will lead to an estimated additional demand for high-quality collateral of €1.8 trillion by the end of 2012 (assuming that adjustments to new policy measures have been made at that date).

³⁴ By analogy, the NSFR shortfall would be around $(0.71 * € 2.30 \text{ trillion}) = € 1.63 \text{ trillion}$ for the euro area.

5 Is Collateral Becoming Scarce?

This chapter examines whether collateral is likely to become scarce in the near future. We emphasize again that given data limitations, the quantitative estimates throughout this paper should be considered rough estimates only. Nevertheless they do give an indication of the trends in the supply of and demand for collateral as well as their overall levels. Section 5.1 gives an overview of the analysis so far and adds up the demand and supply estimates of different financial market segments, without considering the possibility of re-using collateral across or within financial market segments. While section 4.2 briefly touched on re-hypothecation within the OTC derivatives market, section 5.2 gives a fuller picture of the possibilities for and the implications of the re-use of collateral for this study. Section 5.3 discusses the policy implications of greater collateral scarcity.

5.1 Demand versus supply

To determine whether collateral in the euro area will become scarce in the near future, demand and supply developments are compared. Figure 7 gives a graphical representation of our estimates so far. Chapter 3 showed that the current supply (November 2011) of high-quality collateral, as defined in Chapter 2, is around €7.6 trillion and that this can be expected to grow by €0.7 trillion until the end of 2012. The supply of quasi high-quality collateral is currently €1.3 trillion and is expected to have grown by €0.2 trillion at the end of 2012. Chapter 4 showed that the demand for high-quality collateral will rise significantly over the next couple of years. The natural growth of the repo market is expected to require an additional €0.6 trillion in collateral by the end of 2012. Moreover, developments in the OTC derivatives market (mitigation of undercollateralization, CCP-clearing of standard OTC derivatives) are estimated to lead to an additional collateral need of €0.3 trillion. Finally, the new liquidity standards of Basel III could create an additional demand for high-quality liquid assets of €0.9 trillion.³⁵ These three trends combined show that the demand for high-quality collateral in 2012 could be approximately €1.8 trillion higher. Comparing the growth of demand and supply in Figure 7, we see

³⁵ While the LCR will only become mandatory in 2015, we can expect that banks will already start to prepare and increase their demand for high-quality liquid assets in the next few years.

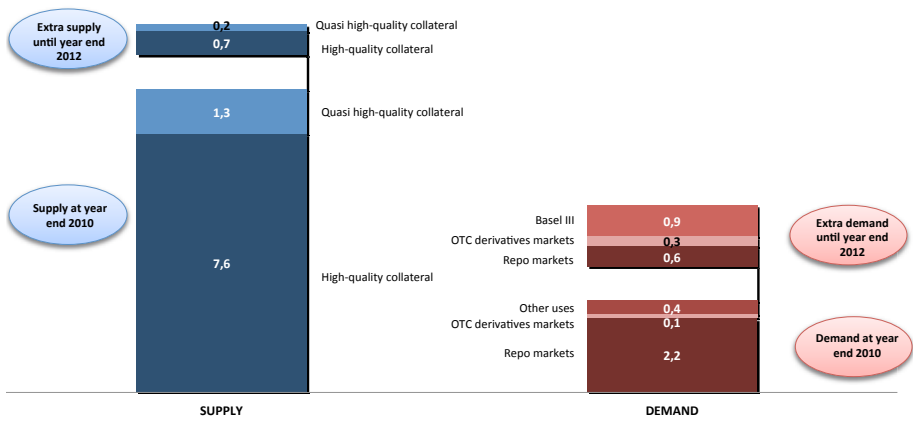
the increase in the demand for high-quality collateral (€1.8 trillion) is significantly higher than the increase in collateral supply (€0.7 trillion, €0.9 trillion if quasi high-quality collateral is included). Hence, we expect that high-quality collateral will become scarcer (i.e. scarce in relative terms) in the near future, which could create pressure on the prices of high-quality assets.

To judge whether high-quality collateral will also become scarce in absolute terms, we need to compare the total demand for high-quality collateral to its total supply. Disregarding the possibility of collateral re-use for the moment, we calculate the total demand for collateral by summing the total collateral needs of various financial market segments. In Chapter 4 it was shown that in late 2010 euro area banks needed some €2.2 trillion for the private repo market and some €0.1 trillion to collateralize their OTC derivatives transactions. In addition, banks need collateral for transactions in exchange-traded derivatives, payment and settlement systems and monetary policy operations. A rough estimate of collateral needed for exchange traded derivatives in the euro area by end 2012 is €142 billion or €0.1 trillion.³⁶ To determine the high-quality collateral needed for payment and settlement systems and monetary policy operations, we first looked at the average value of marketable and non-marketable assets put forward by counterparties as collateral in Eurosystem credit operations, which was slightly over €2 trillion in 2010 (ECB Annual report 2010, 2011, p. 97). Of these €2 trillion, an average of approximately €0.7 trillion was actually used in credit operations in 2010 while peak use was around €0.9 trillion (ibid, p. 97). Considering the composition of collateral put forward to the Eurosystem (ibid, p. 98), at most 35% of this collateral would be high-quality or quasi high-quality collateral as defined above.³⁷ So the current use of (quasi) high-quality collateral within the Eurosystem should be €0.3 trillion at most. These figures show that no absolute shortage of collateral exists at present: the current demand for high-quality collateral is estimated to be €2.7 trillion while current supply is €7.6 trillion (€8.9 trillion if quasi high-quality collateral is included). Nor do we expect absolute scarcity of high-quality collateral in the near future, as future supply is estimated to be €8.3 trillion (€9.8 trillion including quasi high-quality collateral) while a rough estimate of future demand for high quality collateral gives €4.5 trillion.

36 Outstanding notional values in the exchange-traded derivatives market were \$67.93 trillion at the end of 2010 (BIS database, 2011) and - extrapolating the high growth rates of the market in 200-2010 to 2011 and 2012 - could be \$102 trillion at the end of 2012. As the euro area's share in this market can be assumed to be 32.5% (see Chapter 4) and given the TABB report's result that collateral needs are 0.61% on average of notional value, the collateral needed for the euro area's exchange-traded derivatives at the end of 2012 would be $0.61 \times 0.325 \times \$102 \text{ trillion} = \$202 \text{ billion}$ or €142 billion.

37 The ECB does not publish detailed data on the collateral put forward by counterparties. However, from the ECB 2010 Annual Report we know that the average share of central in 2010 of central government bonds was 13% and that the other components of quasi high quality collateral (regional government bonds, corporate bonds, covered bonds) sum up to just over 20% of collateral put forward. However, these categories also include assets with ratings below the benchmarks set in our definition of (quasi) high-quality collateral.

Figure 7 High-quality collateral: demand versus supply, EUR trillions



While collateral is not expected to become scarce in absolute terms, we do think collateral will become scarcer in relative terms. Basel III's liquidity standards, the new regulations for OTC derivatives and the current trend towards secured lending will have an impact on financial markets. The lower growth of supply as compared to demand will lead to pressure on the prices of (quasi) high-quality collateral assets. Further economic effects and policy implications will be discussed in section 5.3.

5.2 Re-use of collateral

The above estimates were based on the assumption that financial institutions cannot re-use the collateral received in repo or derivatives transactions for their own collateral needs. However, many current repo or derivatives contracts allow for the possibility of re-hypothecation or the re-use of collateral. Unfortunately, there are no reliable data on the extent of re-hypothecation in euro area repo and derivatives markets. The ISDA Margin Survey (2011), however, reports that in the OTC derivatives markets large dealers (mainly large global banks) re-hypothecate some 74% of their received collateral, while small and medium dealers re-hypothecate 28% on average. Moreover, little research has been done so far on re-hypothecation and the implications of defaults (the borrower cannot return the money) or fails (the cash lender cannot return the securities) (Bottazzi, Luque and Páscoa, 2011).

Re-use of collateral acts as a 'collateral multiplier'. The size of this multiplier depends on the re-use rate. For instance, if in practice 50% of collateral is re-used,

€100 billion of assets could in practice collateralize €200 billion of transactions.³⁸ Now what would be the implications of such a scenario for the above results? It was argued earlier that the combined collateral needs for the euro area's repo and derivatives markets (both exchange traded and OTC) could be around €3.3 trillion (2.8+0.1+0.4) by year-end 2012.³⁹ Suppose the re-use of collateral assets is indeed 50%, then a collateral pool of half of this amount would suffice to cover collateral needs in the repo and derivatives markets. This would lower the pressure on the available stock of (quasi) high-quality assets. Yet, our conclusion that high-quality collateral becomes scarcer in the near future remains. The projected increase in collateral supply was €0.7 to €0.9 trillion. The projected increase in collateral demand of €1.8 trillion was much higher, and of this last amount €0.9 trillion is not available for re-use at all as these are assets that must be kept unencumbered to comply with the Basel III liquidity standards. Hence, more new collateral will be demanded than supplied, so that collateral becomes scarcer.

Finally, there are good reasons to expect that the extent of re-use is falling off. Singh and Aitkin (2010) observe that re-use has declined significantly after the default of Lehman Brothers, because market participants now attach more importance to legally owning and holding high-quality liquid assets on-balance sheet or in segregated collateral accounts. Moreover, the liquidity standards of Basel III will encourage banks to hold more high-quality liquid assets on-balance sheet. Re-use, however, is only allowed if the collateral is held off-balance sheet in trading accounts, since collateral listed as an asset or liability at one bank (on-balance-sheet) cannot be listed as such at another bank. Finally, the possibilities for re-hypothecation will also be reduced in OTC derivatives markets, because CCP clearing will become mandatory for standard contracts by the end of 2012 and CCPs are required to hold this collateral in segregated accounts (Singh, 2010b). Exposures on CCPs that do not re-hypothecate collateral receive a 2% capital requirement. If the collateral is re-used, the trade is considered a bilateral trade which requires more capital (BCBS, 2010c). In sum, increased risk aversion after the default of Lehman Brothers, the liquidity standards of Basel III and the new regulations for OTC derivatives will reduce the possibilities for re-using collateral in the market.

5.3 Economic effects and policy implications

If, as we find in this study, high-quality collateral becomes scarcer (i.e. scarce in relative terms), there are likely to be some important implications for the financial

38 Suppose bank B receives €100 billion of assets from bank A as collateral for a loan. With a re-use rate of 50%, bank B would use €50 billion (e.g. to collateralize a derivatives transaction with bank C), C would use €25 billion with bank D etc. In the limit this would add up to €200 billion. The collateral multiplier is thus 1/re-use rate. See further (Bottazzi, Luque and Páscoa, 2011)

39 Collateral pledged to or repo-d with the central bank will not be re-used. High quality liquid assets that are kept on the bank's balance sheet to comply with the Basel III's liquidity standards need to be unencumbered and therefore cannot be re-used.

system. First of all, financial institutions are likely to use their collateral as efficiently as possible in order to maintain their desired level of transactions and liquidity. It can then be expected that high-quality collateral will be reserved for transactions that cannot be collateralized with lower quality collateral. Financial institutions that accept a wide range of collateral, such as the Eurosystem, can expect to receive collateral that is less diversified and potentially of lower quality. Data in the ECB's Annual Report indicate that this development has already set in (ECB Annual report 2010, 2011, p. 98). The central banks in the euro area will need to address the risks of this changed collateral pool through adequate risk control measures (such as haircuts and limits). Furthermore, securities flows are likely to increase as market participants will try to allocate high-quality liquid assets as efficiently as possible. For instance, banks that have an LCR surplus could lend their unused high-quality liquid assets to banks facing a shortfall in return for less liquid assets (securities lending transactions). Moreover, some financial institutions will probably be offering collateral transformation services. At present, there already are institutions offering tri-party collateral management services to their clients, aimed at optimizing clients' collateral allocation. Collateral transformation could be an additional service. For instance, Cameron (2011) expects that in the OTC derivatives markets large broker-dealers will stand ready to transform their clients' non-eligible financial instruments into cash or government bonds, which these clients can then post as collateral with the CCP. Institutional investors are likely to play a key role in this process, since they possess large amounts of liquid assets they can lend out. Institutional investors may also engage on a large scale in liquidity swaps with banks. This can have negative side effects when the contracts include a trigger that unwinds the flow of liquidity under a stress scenario (liquidity run). Collateral transformation and other forms of increased collateral flows require adequate risk and collateral management by institutions providing and obtaining these services. Cameron (2011) argues that collateral transformation will increase the credit and liquidity risks of CCP members. Institutional investors providing collateral transformation (potentially in the form of liquidity swaps) would also encounter new risks. Finally, if collateral becomes scarcer, market participants may lower their collateral standards or even partially switch back to unsecured transactions. Supervisors and regulatory authorities should investigate these risks and take appropriate measures as needed.

A more fundamental perspective on collateral scarcity is that it reflects a discrepancy between the real economic fundamentals (the basis of collateral) and the risks in the financial system. A bank that does not have enough high-quality assets to collateralize its business activities could attract more high-quality assets and/or opt for business opportunities with lower risks. In other words, our result that high-quality collateral will become scarcer can be taken as evidence that financial risks need to be reduced further, for instance by de-leveraging. There is evidence that rising asset prices and confidence in economic and financial markets enabled financial

institutions to leverage their balance sheet up until 2007, mostly through unsecured short-term and repo lending (Adrian and Shin, 2010a). Many financial institutions, searching investment opportunities for their abundant liquidity, started providing loans to increasingly less creditworthy borrowers, fuelling real-estate booms (e.g. the U.S. subprime mortgage market) and supporting consumption (Perotti, 2011a). This created unsustainable credit risk bubbles that led to the current financial crisis. This process was accommodated by securitization, which enabled financial institutions to buy each other's securities (Adrian and Shin, 2010b).

Current initiatives of regulators and other authorities can be seen as attempts to ensure that banks' risks no longer exceed their capacity to bear these risks. This can be achieved by reducing these risks and/or by strengthening the banks' bearing capacity. Basel III regulations will make banks more resilient to liquidity risks both by requiring banks to hold more liquid buffers (i.e. raising their capacity to deal with these risks) and by discouraging maturity mismatches (i.e. lowering liquidity risks). Current regulation for OTC derivatives will stimulate banks to hold more collateral when trading in derivatives so that they become able to bear the risks entailed if necessary. Also wider efforts to make the financial sector healthy again – such as the discouragement of unsustainable business models and promotion of sound risks management by banks – will have the effect of bringing banks' risks in line with their capacity to bear risks. The main point here is that if there is insufficient high-quality collateral to engage in certain risky activities, banks should opt for activities with lower risks.

6 Summary

The global financial crisis of 2008 propelled several changes in wholesale financial markets that are boosting the demand for high-quality collateral. As a result, some market participants now fear that high-quality collateral will become scarce in the near future. This study investigated whether this fear is justified. We examined current trends in the demand for and supply of high-quality collateral and made projections about their future developments.

For this purpose we first needed an exact definition of the assets that could qualify as high-quality collateral. We defined the highest quality collateral as the assets that are acceptable – without restriction on quantity – to both the central bank (Eurosystem) and the supervisor (under the Basel III liquidity standards). According to this definition, high-quality collateral consists of:

‘marketable debt instruments issued by sovereigns, other public sector entities and central banks with a credit rating of AAA to AA– and marketable sovereigns with a credit rating of A+ to BBB– if these securities meet the requirements of being

I. denominated in euro;

II. issued (a) in the EEA and settled in euro area or (b) by an entity resident in the EEA or in a non-EEA G10 country, and

III. traded on regulated and ECB accepted markets’.

The second best quality of collateral, labeled quasi high-quality collateral in this study, is defined as the assets that are acceptable to both the supervisor and the central bank but with some quantity restriction under Basel III regulations. It consists of:

‘High-rated corporate and covered bonds (AA– or higher) and marketable securities issued or guaranteed by sovereigns, other public sector entities and central banks with a credit rating of A+ to A–, if these securities meet the above-mentioned requirements’

We then looked at market practice and concluded that the collateral used in repo market transactions and OTC derivatives markets was consistent with our definition of (quasi) high-quality collateral. We used this definition as a basis for our estimates, emphasizing that counterparty risk can not only be managed by setting strict collateral requirements but also by setting counterparty requirements or proper risk control measures. We therefore do not suggest that the assets that are not part of this definition cannot or should not be used as collateral.

Based on this definition, we estimated the supply of (quasi) high-quality collateral in terms of the collateral value after haircuts. The pool of high-quality collateral currently has a value after haircuts of € 7.6 trillion and this value is likely to be € 0.7 trillion higher at the end of 2012. This estimate reflects both the crisis-induced high budget deficits and debt levels of many European governments that need to be financed and the downgrades that some sovereigns faced because of the sovereign crisis. If sovereign ratings fall below BBB-, the assets issued in that country are no longer high-quality according to the definition above. For lower levels of government and other public sector entities, the cutoff level lies at a rating of AA-. The current supply of quasi high-quality collateral is € 1.3 trillion and is expected to increase in the future, since financial institutions have strong incentives to issue more covered bonds (within the limits set by regulatory authorities). It is expected that an additional € 0.2 trillion in collateral value after haircuts will have been issued as covered bonds by the end of 2012.

We then showed that the demand for high-quality liquid assets is likely to increase substantially because of three different trends. First, as a result of the financial crisis, the unsecured money market collapsed, transactions shifted to the secured money or repo market and collateral requirements on the repo market became stricter. As risk aversion is still high, the repo market is likely to grow further relative to the unsecured market, also because the repo market infrastructure has become more efficient through the use of central counterparties (CCPs) for clearing and because capital and liquidity requirements in Basel III are more favourable for repo transactions than for unsecured short-term transactions. Second, mandatory clearing of all standardized contracts by CCPs at the end of 2012 will also lead to more collateral being posted in the form of initial margins and contributions to guarantee funds. These buffers are meant to ensure CCPs' resilience in times of distress. While the multilateral netting offered by CCPs will reduce exposures and could lower collateral requirements for some big banks holding diversified OTC-derivatives portfolios, on aggregate banks are expected to need more collateral for their OTC derivatives trade. Finally, banks will need more high-quality liquid assets as a result of the new liquidity standards of Basel III. Due to the interaction between the liquidity coverage ratio and the net stable funding ratio, it is difficult to predict how the expected shortfall in high-quality liquid assets will affect the actual demand for these assets. This study estimated that together, these three developments will require around € 1.8 trillion of extra collateral by the end of 2012. Combined with the current demand for high-quality collateral of an estimated € 2.7 trillion, this would lead to a total demand for high-quality collateral of € 4.5 trillion.

Comparing the forecasted increases in collateral demand (€ 1.8 trillion) and collateral supply (€ 0.7-€ 0.9 trillion, depending on whether or not quasi high-quality collateral is included), we conclude that high-quality liquid assets are likely to become scarcer for financial institutions (i.e. scarce in relative terms) in the next couple of years.

But we do not expect collateral scarcity in absolute terms (total supply in 2012 of € 8.3-9.8 trillion, total demand of € 4.5 trillion). Increased collateral scarcity will create pressure on the prices of high-quality assets, especially when considering that many institutional investors now hold large portfolios of high-quality liquid assets on their balance sheet and that banks will demand more of those. We also discussed the possible impact of the re-use or re-hypothecation of collateral – a widespread practice about which little is known – on our conclusions, observing that while this practice lowers the pressure on the available stock of (quasi) high-quality assets, our main conclusion (‘collateral becomes scarcer’) remains. We also presented reasons why we expect the extent of re-use to fall off.

Now what does this observation of future collateral scarcity tell us? First and foremost, we argued that evidence of collateral scarcity is indicative of the need to lower risks in the financial system. If banks reduce their risks, they will need less collateral. Supervisors and regulators should play a key role in bringing the banking sector’s risks in line with its bearing capacity.

In addition, there are several ways in which euro area banks can adjust to a world with scarcer high-quality collateral. A common denominator in these options is that high-quality collateral will be used as efficiently as possible, which will lead to an increase in collateral flows. First, banks can post less liquid collateral with the Eurosystem, reserving high-quality collateral for transactions that require it. Second, banks with an LCR surplus can lend out high-quality assets to banks facing a shortage, in return for less liquid assets. Third, institutional investors or clearing members of CCPs in OTC derivatives markets may start to offer collateral transformation services. Finally, if pressure on (quasi) high-quality collateral becomes too severe, financial institutions may seek recourse to lower quality and less liquid assets for collateral purposes, or may even return to unsecured lending to trusted counterparties. These developments should be closely monitored by central banks and supervisors. Central banks should assess the implications of a less liquid collateral pool for their own risk management and may wish to reconsider their eligibility criteria. Supervisors should examine collateral transformation services and – more generally – increased securities lending transactions and their impact on the credit, liquidity, market and systemic risks of key market participants involved.

References

- Adriand, T., Shin, H.S. (2010a) 'Liquidity and leverage'. *Journal of Financial Intermediation*. Vol. 19. pp. 418-437.
- Adriand, T., Shin, H.S. (2010b). 'The changing nature of financial intermediation and the financial crisis of 2007-2009'. Federal Reserve Bank of New York: *Annual Review of Economics*, Vol. 2. pp. 603-618.
- Barrios, S., Iversen, P., Lewandowska, M. and Setzer, R. (2009). 'Determinants of intra-euro area government bond spreads during the financial crisis'. *Economic Papers, No. 388*. Brussels: European Commission (Economic and Financial Affairs).
- Basel Committee on Banking Supervision (BCBS) (2006). 'International convergence of capital management and capital standards: a revised framework and comprehensive version'. Basel: BCBS. Retrieved from: www.bis.org/publ/bcbs128.pdf.
- Basel Committee on Banking Supervision (BCBS) (2010a). 'Basel III: International framework for liquidity risk measurement, standards and monitoring'. Basel: BCBS. Retrieved from: www.bis.org/publ/bcbs188.pdf.
- Basel Committee on Banking Supervision (BCBS) (2010b). 'Results of the comprehensive quantitative impact study'. Basel: BCBS. Retrieved from: www.bis.org/publ/bcbs186.pdf.
- Basel Committee on Banking Supervision (BCBS) (2010c). 'Consultative document: Capitalisation of bank exposures to central counterparties'. Basel: BCBS. Retrieved from: www.bis.org/publ/bcbs190.pdf.
- Bank for International Settlement (BIS) (2009). 'Central counterparties for over-the-counter derivatives'. *BIS Quarterly Review*, Sept 2009. Retrieved from: www.bis.org/publ/qtrpdf/r_qto909f.pdf.

- Bank for International Settlements (BIS) (2010). 'Triennial and semi-annual surveys: Positions in global over-the-counter (OTC) derivatives markets at end-June 2010'. Basel: BIS. Retrieved from: www.bis.org/publ/otc_hy1011.pdf.
- Bank for International Settlements (BIS) (2010). 'BIS derivatives statistics'. Retrieved from: www.bis.org/statistics/derstats.htm.
- Bottazzi, J-M., Luque, J. and Páscua. M.R. (2011). 'Securities market theory: possession, repo and rehypothecation'. Retrieved from: <http://works.bepress.com/cgi/viewcontent.cgi?article=1000&context=luque>.
- Cameron, M. (01 July 2011). 'Client clearing poses acute liquidity risks'. *Risk Magazine*. Retrieved from: www.risk.net/risk-magazine/feature/2081918/client-clearing-poses-acute-liquidity-risks.
- Capel, J.J. (2011). 'The post-crisis World of collateral and international liquidity', Amsterdam: De Nederlandsche Bank (DNB), Occasional studies: Vol. 9/ No. 3.
- Committee of European Banking Supervisors (CEBS) (2010). 'Results of the comprehensive quantitative impact study'. London: European Banking Association – CEBS. Retrieved from: www.eba.europa.eu/cebs/media/Publications/Other%20Publications/QIS/EU-QIS-report-2.pdf
- Committee on the Global Financial System (CGFS) (2001). 'Collateral in wholesale financial markets: recent trends, risk management and market dynamics'. Basel: BIS - CGFS. Retrieved from: www.bis.org/publ/cgfs17.pdf.
- Committee on the Global Financial System (CCFS) (2010). 'The role of margin requirements and haircuts in procyclicality'. Basel: CGFS. Retrieved from: www.bis.org/publ/cgfs36.pdf.
- Committee on the Global Financial System CGFS) (2011). 'The impact of sovereign credit risk on bank funding conditions'. Basel: CGFS. Retrieved from: www.bis.org/publ/cgfs43.pdf.
- Cossin, D., Huang, Z., Aunon-Nerin, D., and Gonzáles, F. (2003). 'A framework for collateral risk control determination'. *ECB Working Paper Series: No. 209*.
- European Central Bank (ECB) (2004). 'Monthly bulletin. May 2004'. Frankfurt: ECB. Retrieved from: www.ecb.int/pub/pdf/mobu/mb200405en.pdf.

- European Central Bank (ECB) (2007). 'Euro money market study 2006'. Frankfurt: ECB. Retrieved from: www.ecb.int/pub/pdf/other/euromoneymarketstudy200702en.pdf.
- European Central Bank (ECB) (2008). 'Protocol (No. 4) on the statute of the European and of the European central bank'. *Official Journal of the European Union*, No. C115. Retrieved from: www.ecb.int/ecb/legal/pdf/en_statute_2.pdf.
- European Central Bank (2009a). 'Euro money market study 2008'. Frankfurt: ECB. Retrieved from: www.ecb.int/pub/pdf/other/euromoneymarketstudy200902en.pdf.
- European Central Bank (2009b) 'The collateral frameworks of the Eurosystem, the Federal Reserve System and the Bank of England and the financial turmoil', Frankfurt: ECB. Retrieved from www.ecb.int/pub/pdf/scpops/ecbocp107.pdf.
- European Central Bank (ECB) (2009c). 'Credit default swaps and counterparty risk'. Frankfurt: ECB Retrieved from: www.ecb.int/pub/pdf/other/creditdefaultswapsandcounterpartyrisk2009en.pdf.
- European Central Bank (2010a). 'Euro money market study 2010'. Frankfurt: ECB. Retrieved from: www.ecb.int/pub/pdf/other/euromoneymarketstudy201012en.pdf?e36ab5dadd83653e8c5632b7baof8574
- European Central Bank (ECB) (2010b). *The payment system: payments securities and derivatives, and the role of the Eurosystem*. Frankfurt: ECB.
- European Central Bank (ECB) (2011). 'The implementation of monetary policy in the Euroarea'. Frankfurt: 2011. Retrieved from: www.ecb.int/pub/pdf/other/gendoc2011en.pdf.
- European Commission (EC) (2010). 'Impact assessment: Accompanying document to the *'proposal for a regulation of the European Parliament and of the Council on OTC derivatives, central counterparties and trade repositories'*. Commission staff working document. Brussels: SEC (2010) 1058/2.
- EurexRepo (2010). 'Statistics: GC Pooling – Development of Outstanding Volume from March 2005 to July 2011 in million EUR'. Retrieved from www.eurexrepo.com/gcpooling/statistics.html
- EurexRepo (2011). www.eurexrepo.com.

- G20 (25 September 2009). 'Leaders' statement Pittsburg summit – September 24-25, 2009'. Retrieved from: www.g20.org/Documents/pittsburgh_summit_leaders_statement_250909.pdf.
- Henderson Global Investors, 16 August, 2011. Personal communication with Structured Finance Department.
- Heller, D., Vause N. (2011). 'Expansion of Central Clearing'. *BIS Quarterly Review, June 2011*. Basel: Bank for International Settlements. Retrieved from: www.bis.org/publ/qtrpdf/r_qtr1106h.pdf.
- Hördahl, P., King, M.R. (2008). 'Developments in repo markets during the financial crisis', *BIS Quarterly Review*. Retrieved from www.bis.org/publ/qtrpdf/r_qto812e.pdf.
- Hull, J.C. (2009). *Options, Futures and other Derivatives*. (7th edition). New Jersey: Pearson Prentice Hall.
- International Capital Market Association (ICMA) (2011). 'European repo market survey: no. 20 – conducted December 2010'. Zurich: ICMA. Retrieved from: www.icmagroup.org/ICMAGroup/files/c9/c94fc032-3ddr-4be6-bobd-45e7bb6291fd.pdf.
- International Monetary Fund (IMF) (2010). 'Global Financial Stability Report: Sovereigns, Funding and Systematic liquidity'. Washington D.C.: IMF. Retrieved from: www.imf.org/external/pubs/ft/gfsr/2010/02/pdf/text.pdf.
- International Swap and Derivatives Association (ISDA) (2011). 'ISDA Margin survey 2011'. New York: ISDA. Retrieved from: www2.isda.org/functional-areas/research/surveys/margin-surveys/.
- McKinsey&Company (2010). 'Basel III and European banking: its impact, how banks might respond, and the challenges of implementation'. Retrieved from: www.mckinsey.com/clientservice/Financial_Services/Knowledge_Highlights/~/_media/Reports/Financial_Services/Basel%20III%20and%20European%20banking%20FINAL.ashx.
- Perotti, E. (2011a). 'Systemic liquidity risk: a European approach'. Retrieved from: www.voxeu.org/index.php?q=node/7114.
- Perotti, E. (2011b). 'A Pigouvian approach to liquidity regulation'. Duisenberg school of finance – Tinbergen Institute Discussion Paper (TI-11040/DSF15). Retrieved from: www.tinbergen.nl/discussionpapers/11040.pdf.

- Risk Magazine (Whittall, C.) (10 Nov. 2010). 'Concern over scarcity of high-quality assets forces CCPs to broaden eligible collateral'. Retrieved from: [www. Risk.net/risk-magazine/news/1895155/concern-scarcity-quality-assets-forces-ccps-broaden-eligible-collateral](http://www.Risk.net/risk-magazine/news/1895155/concern-scarcity-quality-assets-forces-ccps-broaden-eligible-collateral).
- Segoviano, M.A., Singh, M., (2008). 'Counterparty risk in the over-the-counter derivatives market'. IMF working paper series: wp/08/258. Retrieved from: www.imf.org/external/pubs/ft/wp/2008/wp08258.pdf.
- Singh, M. (2010). 'Collateral, Netting and Systemic risk in the OTC derivatives market'. IMF working paper series: wp/10/99. Retrieved from: www.imf.org/external/pubs/ft/wp/2010/wp1099.pdf.
- Singh, M. (2010b). 'Under-collateralisation and rehypothecation in the OTC derivatives market'. *Banque de France: Financial Stability Review*. No. 14 – Derivatives – Financial innovation and stability. Retrieved from: www.banque-france.fr/gb/publications/telechar/rsf/2010/etude13_rsf_1007.pdf.
- Singh, M., Aitken, J. (2009). 'Counterparty risk, impact on collateral flows, and role for central counterparties'. IMF Working Paper Series: wp/09/173. Retrieved from: www.imf.org/external/pubs/ft/wp/2009/wp09173.pdf.
- Singh, M., Aitkin, J. (2010). 'The (sizable) role of rehypothecation in the shadow banking system'. IMF working paper: wp/10/172.
- TABB Group (2010). 'The global risk transfer market: developments in OTC- and Exchange traded derivatives'. Retrieved from: www.world-exchanges.org/files/statistics/excel/V08-030%20Global%20Risk%20Transfer%20Market.pdf.
- Zhang, Y., Zhou, H., and Zhu, H. (2005). 'Explaining credit default swap spreads with equity volatility and jump risks of individual firms'. *BIS working paper series*: no. 181. Retrieved from: www.bis.org/publ/work181.pdf.

Appendices

AI. Authorities and high-quality collateral

Tables AI.1 and AI.2 give a schematic overview of the Basel Committee's and the Eurosystem's collateral requirements. According to the Basel Committee, high-quality liquid assets have several fundamental and market-related characteristics. For the purpose of the new liquidity standards, the Basel Committee has translated these theoretical properties into two sets of asset classes that meet these criteria: (i) *Level 1 assets*, which represent the highest quality assets and receive no haircuts, and (ii) *Level 2 assets* which are of slightly lesser quality and therefore receive a 15% haircut for the purpose of the LCR and NSFR (for more information, see BCBS, 2010a).

The Eurosystem accepts a broad range of collateral assets for its monetary policy operations. The collateral assets must meet several general criteria: the assets must (i) be debt instruments, (ii) be denominated in euro and (iii) have a minimum credit rating of BBB-.⁴⁰ For marketable assets that meet these criteria, the Eurosystem has implemented auxiliary criteria that relate to the issuer of the asset, the place of issuance and settlement, and the markets the asset is traded on. The Eurosystem also accepts several non-marketable assets as collateral, if these meet several specific criteria (see [ECB, 2011] for more details).

⁴⁰ With the exception of asset backed securities, which are eligible when they receive a AAA rating from two external credit assessment institutions at the time of issuance, and retain a rating of A- or higher during their time to maturity (See: www.ecb.int/pub/pdf/other/gendoc2011en.pdf). In order to increase the collateral availability, the ESCB decided on December 11, 2011, that in addition to the aforementioned products, ABS with a second-best rating of at least 'single A' at issuance, and at all times subsequently A- or higher, are eligible, if the assets meet certain criteria relating to the underlying asset of the ABS, the counterparty's activities, and certain contractual provisions (See http://www.ecb.int/press/pr/date/2011/html/pr11208_1.en.html).

Table A1.1 High-quality and liquid assets according to Basel III

Theoretical Properties of High-quality and Liquid Assets

Fundamental	Market
Low credit and market risk	Active and sizeable market
Value should be easy to calculate	Low concentration of buyers and sellers
Low correlation with risky assets	Asset should be attractive in times of distress
Asset must be listed on developed exchange	Preferably eligible with central bank for monetary operations

Practical Classification of High-quality and Liquid Assets

Level 1 assets: 0% haircut	Level 2 assets: 15% haircut
Cash	
Central bank reserves	
Marketable securities issued or guaranteed by sovereigns, other PSEs and central banks	Marketable securities issued or guaranteed by sovereigns, other PSEs and central banks.
- If 0% risk weight under Basel II (AAA to AA-)	- If 20% risk weight under Basel II (A+ to A-)
	- Max 10% increased haircut in times of stress
Non-0% risk weighted sovereigns or central bank debt securities	Corporate bonds
- Domestic currency: currency must match country in which liquidity risk is taken, or bank's home currency	- Issued by non-financial institutions
- Foreign currency: to the extent that it matches FX needs	- Minimum rating AA- or Probability of Default corresponding to AA- or higher
	Covered bonds
	- Minimum rating AA- or Probability of Default corresponding to AA- or higher

Table A1.2 High-quality collateral and the Eurosystem

General eligibility criteria	
Debt instruments only Denominated in Euro Accepted credit ratings: Step 1+2: $PD \leq 0.10\%$ over a one-year horizon (AAA to A-) Step 3: $0.10\% \leq PD \leq 0.40\%$ (BBB to BBB-)	
Marketable assets	Non-marketable assets
Issued in EEA and settled in euro area, or issued by entity resident in EEA or non-EEA G10 country	Issued in euro area
Traded on regulated markets, or non-regulated markets that have been approved by the ESCB	1) Credit claims <i>Counterparty chooses assessment source</i> 2) Fixed term deposits 3) Retail-mortgage backed debt instruments, A+ to A- <i>CB assesses eligibility</i>

A2. The interdependency of the LCR and NSFR

Section 4.3.1 showed that the LCR and NSFR are interdependent. This complicates the quantification of banks' additional demand for high-quality liquid assets, since the latter will then depend on the specific measures banks take to improve their ratios. For the purpose of illustration, this section discusses several of the options that banks have to reduce their LCR and NSFR shortfall, and shows how these will affect the demand for (quasi) high-quality liquid assets. We do so by means of stylized balance sheet examples for the EU27 banks on a consolidated basis, based on ECB statistics (end-June 2010). The total size of the consolidated balance sheet (€37 trillion) and the order of magnitude of each of the balance sheet items match reality. Because of the high level of aggregation of the ECB data, it is not possible to apply the specific factor weights⁴¹ given in Basel III (BCBS, 2010b p. 42-47) for each specific asset and liability class. Therefore, assumptions had to be made with respect to these factors. In the calibration, the factor weights of Basel III were followed as closely as possible. In addition, it was assumed that the consolidated 'EU27 bank' behaved as if it were a 'large' bank⁴² with an LCR of 67% and an NSFR of 91% (CEBS, 2010), with a resulting LCR shortfall of €1.2 trillion and an NSFR shortfall of €2.0 trillion. These shortfalls were chosen to lie in-between the estimates of the CEBS (2010) and McKinsey (2010). Figure A2.1 indicates the baseline scenario, before any restructuring has taken place. Figures A2.2 to A2.4 illustrate how banks can reduce their LCR and NSFR shortfalls. It is assumed banks will first reduce their NSFR, after which the remaining LCR shortfall is resolved by attracting high-quality liquid assets.

Figure A2.2 illustrates how banks can reduce their shortfall by issuing covered bonds that are collateralized by mortgages. Suppose banks reduce their (unstable) short-term unsecured wholesale funding by €2 trillion and fill their funding gap by issuing covered bonds for the same amount. Because covered bonds are considered to be stable funding under Basel III while unsecured wholesale funding is not, the NSFR will improve. Note, however, that there is a small countervailing effect because the assets that are used to collateralize the bonds require 100% stable funding. Because mortgage loans already require a high percentage of stable funding, the gains of issuing covered bonds are high relative to the costs.⁴³ The reduction in unstable wholesale funding also benefits the LCR, because cash outflows are reduced. In the example, the LCR shortfall even turned into a surplus.

⁴¹ These factors are: the high-quality liquid asset (HQLA) factor, the cash in- and outflow factors (LCR inflow and LCR outflow factor) and the available- and required stable funding factor (AFS and RSF).

⁴² See Footnote 31.

⁴³ On the other hand, issuing covered bonds that are collateralised by high-rated government securities is not as effective since the costs in the form of increased required stable funding are high.

Figure A2.1 EU 27 consolidated bank balance sheet: baseline scenario

Assets						Liabilities		
Item	Amount	RSF factor	HQLA factor	LCR inflow factor	Item	Amount	ASF factor	LCR outflow factor
High quality and liquid assets	2500	0%	100%	0%	Unstable funding	9000	0%	6%
Cash and Central bank reserves	250	0%	100%	0%	Deposits credit institutions	4000	0%	40%
Available-for-sale assets	2250	0%	100%	0%	Other unstable wholesale funding	5000	0%	80%
Non-liquid, more risky assets	34500	61%	0%	10%	Stable funding	28000	73%	0%
Held-to-maturity assets	440	20%	0%	10%	Deposits (non-credit institutions)	14000	50%	0%
Held-for-trade assets	7770	20%	0%	10%	Debt certificates	10000	100%	0%
Loans and advances	20000	75%	0%	10%	Covered bonds	2000	100%	0%
Other debt instruments	5500	75%	0%	10%	Equity	2000	100%	0%
Other	790	20%	0%	5%				
Total Assets	37000	20925	2500	3450	Total Liabilities	37000	19000	7200
		RSF	HQLA	Cash inflow			ASF	Cash outflow
All Balance Sheet items in EUR billions								
Calculation LCR						Calculation NSFR		
High-quality liquid assets	2500				Required amount stable funding	21425		
Net Cash outflow	3750				Available amount stable funding	21000		
LCR	66.67%				NSFR	98.02%		
LCR shortfall	1250				NSFR shortfall	425		

Figure A2.2 EU 27 consolidated bank balance sheet – issuing covered bonds

Assets						Liabilities		
Item	Amount	RSF factor	HQLA factor	LCR inflow factor	Item	Amount	ASF factor	LCR outflow factor
High quality and liquid assets	2500	0%	100%	0%	Unstable funding	9000	0%	62%
Cash and Central bank reserves	250	0%	100%	0%	Deposits credit institutions	4000	0%	40%
Available-for-sale assets	2250	0%	100%	0%	Other unstable wholesale funding	5000	0%	80%
Non-liquid, more risky assets	34500	62%	0%	10%	Stable funding	28000	75%	0%
Held-to-maturity assets	440	20%	0%	10%	Deposits (non-credit institutions)	14000	50%	0%
Held-for-trade assets	7770	20%	0%	10%	Debt certificates	10000	100%	0%
Loans and advances	18000	75%	0%	10%	<i>Covered bonds</i>	2000	100%	0%
<i>Encumbered mortgages</i>	2000	100%	0%	10%	Equity	2000	100%	0%
Other debt instruments	5500	75%	0%	10%				
Other	790	20%	0%	5%				
Total Assets	37000	21425	2500	3450	Total Liabilities	37000	21000	5600
		RSF	HQLA	Cash inflow			ASF	Cash outflow
All Balance Sheet items in EUR billions								
Calculation LCR						Calculation NSFR		
High-quality liquid assets	2500				Required amount stable funding	21425		
Net Cash outflow	2150				Available amount stable funding	21000		
LCR	116,28%				NSFR	98,02%		
LCR shortfall	-350				NSFR shortfall	425		

Figure A2.3 EU 27 consolidated bank balance sheet – issuing secured loans

Assets						Liabilities		
Item	Amount	RSF factor	HQLA factor	LCR inflow factor	Item	Amount	ASF factor	LCR outflow factor
High quality and liquid assets	500	0%	100%	0%	Unstable funding	9000	0%	62%
Cash and Central bank reserves	250	0%	100%	0%	Deposits credit institutions	4000	0%	40%
Available-for-sale assets	2250	0%	100%	0%	Other unstable wholesale funding	5000	0%	80%
<i>Used to collateralise loans</i>	2000	0%	0%	0%				
Non-liquid, more risky assets	34500	61%	0%	10%	Stable funding	28000	75%	0%
Held-to-maturity assets	440	20%	0%	10%	Deposits (non-credit institutions)	14000	50%	0%
Held-for-trade assets	7770	20%	0%	10%	Debt certificates	10000	100%	0%
Loans and advances	20000	75%	0%	10%	<i>Secured wholesale funding</i>	2000	100%	0%
Other debt instruments	5500	75%	0%	10%	Equity	2000	100%	0%
Other	790	20%	0%	5%				
Total Assets	37000	20925	500	3450	Total Liabilities	37000	21000	5600
		RSF	HQLA	Cash inflow			ASF	Cash outflow
All Balance Sheet items in EUR billions								
Calculation LCR						Calculation NSFR		
High-quality liquid assets	500				Required amount stable funding	20925		
Net Cash outflow	2150				Available amount stable funding	21000		
LCR	23,26%				NSFR	100,36%		
LCR shortfall	1650				NSFR shortfall	-75		

Figure A2.4 EU 27 consolidated bank balance sheet – attracting stable deposits

Assets							Liabilities			
Item	Amount	RSF factor	HQLA factor	LCR inflow factor	Item	Amount	ASF factor	LCR outflow factor		
High quality and liquid assets	2500	0%	100%	0%	Unstable funding	9000	0%	71%		
Cash and Central bank reserves	250	0%	100%	0%	Deposits credit institutions	2000	0%	40%		
Available-for-sale assets	2250	0%	100%	0%	Other unstable wholesale funding	7000	0%	80%		
Non-liquid, more risky assets	34500	61%	0%	10%	Stable funding	28000	71%	0%		
Held-to-maturity assets	440	20%	0%	10%	Deposits (non-credit institutions)	16000	50%	0%		
Held-for-trade assets	7770	20%	0%	10%	Debt certificates	10000	100%	0%		
Loans and advances	20000	75%	0%	10%	Equity	2000	100%	0%		
Other debt instruments	5500	75%	0%	10%						
Other	790	20%	0%	5%						
Total Assets	37000	20925	2500	3450	Total Liabilities	37000	21000	5600		
		RSF	HQLA	Cash inflow			ASF	Cash outflow		
All Balance Sheet items in EUR billions										
Calculation LCR										
High-quality liquid assets	2500				Required amount stable funding	20925				
Net Cash outflow	2950				Available amount stable funding	20000				
LCR	84,75%				NSFR	95,8%				
LCR shortfall	450				NSFR shortfall	925				
Calculation NSFR										

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