

Is collateral becoming scarce? Evidence for the euro area

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The global financial crisis has driven several trends in wholesale financial markets that have led to a higher demand for high-quality collateral. More transactions are now secured instead of unsecured on the money market, and, in over-the-counter derivatives markets, central counterparty 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 what rate. On the one hand, many euro area governments now need to finance high budget deficits. While this is not a favorable 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 soon become scarce, which could impair the smooth functioning of financial markets. This paper quantifies the trends in demand for and supply of collateral, and concludes that collateral is likely to become more scarce, but not scarce in absolute terms. We also discuss the expected economic effects and policy implications of this conclusion.

1 INTRODUCTION

Collateralization is one of the most widespread counterparty credit risk mitigation techniques employed in wholesale markets (Committee on the Global Financial System (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 secure their credit operations. The global financial crisis of 2008 profoundly affected the demand for and supply of collateral. Many expect collateral to

become scarce. As an example, take the following quote from *Risk* magazine (Whittall (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” that this quote refers to are the regulations for over-the-counter (OTC) derivatives markets. Given that OTC derivatives were an important driver of the last financial crisis, authorities are taking several steps to make these markets more secure and transparent. The second set of rules affecting the demand for collateral are the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR) of the new Basel III framework (Basel Committee on Banking Supervision (2010)). Finally, the decline of the unsecured money market after the default of Lehman Brothers in September 2008 has also boosted the demand for collateral, as market participants at the time of writing need more liquid high-quality assets to secure their loans on the private money markets.

It is not clear in advance whether this increase in the 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 necessitates the issuance of new government debt. However, some of this debt is no longer considered suitable collateral by market participants since the high indebtedness of some countries has negatively affected their creditworthiness. Market participants' critical attitude also sparked concerns about the valuation of other assets, especially structured products, and led to stricter collateral requirements in financial markets (Hördahl and King (2008) and IMF (2010)).

Given the increase in demand for collateral and the uncertain development in supply, there is an unanswered question about whether collateral could become scarce in the near future. The answer to this question is relevant to market participants (as collateral scarcity may impair their ability to conduct desired financial transactions) but also to prudential supervisors and central banks (as they must safeguard the smooth operation of financial markets). This paper aims to provide an answer by quantifying the current trends in demand for and supply of high-quality liquid assets. Since suitable collateral will differ between currency areas, this paper focuses on the euro area only. Moreover, the paper only considers the demand for high-quality assets by banks. Of course, there are other investor types (insurance companies, pension funds and reserve managers) that also may desire to hold more safe assets. Moreover, there are additional forces (apart from the three mentioned above) that could further boost the demand for high-quality liquid assets such as a renewed flight to quality and demand induced by the benchmark properties of the safest assets. A recent International Monetary Fund

(IMF) study gives a good overview of the demand for and supply of the safest assets, considering different investor types and different sources of demand, and suggesting that the pressures on safe assets are increasing (International Monetary Fund (2012)). However, the IMF study does not give empirical estimates. As it is impossible to obtain meaningful quantitative estimates for all these different factors, this study focuses on banks' demand for high-quality assets originating from their collateral needs in secured money markets, derivatives markets and monetary operations and their need to comply with the Basel III liquidity standards. Further background to this research has been published in Levels and Capel (2012).

The next section develops a practical definition of "high-quality collateral". The recent trends in the supply of and demand for collateral will then be discussed and quantified in Sections 3 and 4. Section 5 discusses the likelihood of collateral becoming scarce and discusses the policy implications of scarcer collateral. Section 6 summarizes.

2 WHAT IS HIGH-QUALITY COLLATERAL?

For the purposes of this study an operational definition of "high-quality collateral" is required. Although there is some consensus on the theoretical properties of high-quality liquid assets, it is difficult to agree on an operational definition. There are several reasons for this. First of all, there is actually 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. Finally, the perceived quality of assets is sensitive to overall market sentiment and there is a tendency for procyclical credit ratings and haircuts (Committee on the Global Financial System (2010)). With these considerations in mind, we use a practical definition of high-quality collateral.

In this paper, high-quality collateral is defined as the assets that all relevant authorities and market participants would accept for all purposes.

The first relevant authority is the Basel Committee on Banking Supervision. In its new "Basel III" liquidity framework, the Basel Committee defined two categories of high-quality liquid assets: level 1 and level 2 assets. 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. These assets can be used as high-quality liquid assets without any quantity restrictions and are valued at market prices. Level 2 assets are subject to a 15% haircut and may not exceed 40% of the total stock of high-quality liquid assets. 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.

The second relevant authority is the Eurosystem, because central bank eligibility makes assets more attractive as collateral given that these assets can then be used to obtain central bank liquidity. Hence, for the euro area, high-quality collateral consists of the smallest intersection of the asset classes accepted by the Basel Committee and the 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.

Table 1 on the facing page shows the definition of high-quality collateral, based on Eurosystem and Basel Committee practice. In fact, two categories of high-quality collateral are distinguished to reflect the quality differences between level 1 and level 2 assets. The category “high-quality collateral” only incorporates level 1 assets while “quasi-high-quality collateral” consists of level 2 assets, provided that these assets are eligible within the Eurosystem. To check whether this operational definition was in line with market practice, we reviewed collateral practices in the European repurchase (repo) market (secured money market) and the global OTC derivatives market. Data from GC Pooling and the International Swaps and Derivatives Association (ISDA) indicates that the preferred asset types in these markets and market participants’ attitudes toward credit ratings and haircuts support our practical definitions (for more details, see Levels and Capel (2012)).¹

In this study an operational definition of high-quality collateral is needed to make estimates of the collateral’s supply. However, we do not suggest that financial institutions automatically take on bad risks if they accept collateral that does not meet our definition. In general, counterparty risk can be managed by

- (1) conducting transactions with financially sound institutions only (ie, counterparty requirements),
- (2) setting quality requirements on the collateral (collateral requirements), or
- (3) imposing a set of control measures, such as haircuts or concentration limits.

These three elements of a risk management framework should be set in relation to each other. For instance, financial institutions may decide to set lower quality requirements on collateral, but to compensate for 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.

¹ The only exception is cash, which is not part of the definition but is extensively used as collateral in OTC derivatives markets. However, to obtain cash or payment capacity, financial institutions need to have assets that are eligible as collateral for the central bank or on the repo market. Our focus is therefore on these underlying assets.

TABLE 1 Practical definition of high-quality liquid assets.

(a) General criteria
<ul style="list-style-type: none"> • Denominated in euros • 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
(b) High-quality collateral
<i>Debt instruments</i> <ul style="list-style-type: none"> • Marketable securities issued or guaranteed by sovereigns, PSEs or central banks <ul style="list-style-type: none"> – with a credit rating of AAA to AA– • Marketable sovereigns or CB debt securities <ul style="list-style-type: none"> – with a credit rating of A+ to BBB–
(c) Quasi-high-quality collateral
<i>Debt instruments</i> <ul style="list-style-type: none"> • Marketable securities issued or guaranteed by sovereigns, PSEs or central banks <ul style="list-style-type: none"> – with a credit rating* of A+ to A– • Corporate bonds (if not issued by a financial institution) <ul style="list-style-type: none"> – with a credit rating of AA– or higher • Covered bonds <ul style="list-style-type: none"> – 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.

3 SUPPLY OF COLLATERAL

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

The European Central Bank (ECB) annual reports show that the amount of eligible collateral within the Eurosystem has grown significantly over time. Focusing on the nominal values of eligible marketable assets (there is no data available for nonmarketable assets), this figure increased from €5.3 trillion in January 1999 to an average of €13.2 trillion in 2011. The Eurosystem's eligible asset database (EADB), which is published on the ECB website, 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 and calculated their collateral value after haircuts (CVAH). 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,² adding accrued interest, and subtracting the applicable haircut.³ Data on the outstanding nominal amounts, bid price factors and the starting date of the interest accrual was obtained from Bloomberg. Where no price data was available, we used the average bid price factor for the asset type concerned.

Figure 1 on the facing page shows that the eligible collateral within the Eurosystem had a market value of €12.61 trillion on June 1, 2012. Applying our definition of (quasi-) high-quality collateral to this set of assets, we found that €6.94 trillion qualified as high-quality collateral and €1.71 trillion as quasi-high-quality collateral. Then the haircuts set by the Eurosystem and Basel III were applied. The Eurosystem applies stricter 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, 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 €6.44 trillion and that it is €1.45 trillion for quasi-high-quality collateral.

3.2 The future supply of (quasi-) high-quality collateral

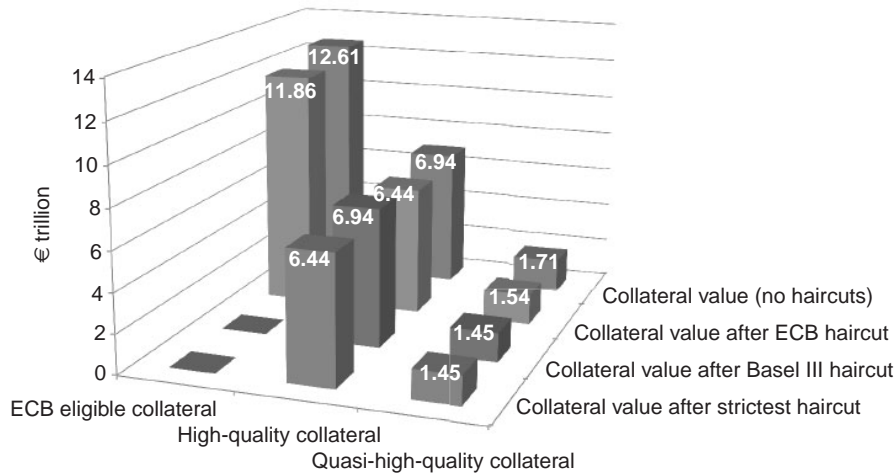
To determine the future supply of high-quality collateral, we looked at the changes in general government debt of the euro area countries, where "general government" covers different governmental levels (central, state, regional and local) as well as PSEs such as social security funds. The change in 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 is also a good proxy for the total future supply of high-quality collateral, since only 18% of high-quality collateral is guaranteed by the public sector but issued by the private sector (according to the EADB and Bloomberg). Moreover, the value of the latter would be very difficult to predict. Finally, we focused on euro area countries' debt, since, according to our definition, high-quality collateral

² 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).

³ In formulaic terms, the collateral value after haircuts can be expressed as:

$$\text{CVAH} = [(\text{nominal amount outstanding} \times \text{bid price}) + \text{accrued interest}] \times (1 - \text{haircut})$$

where accrued interest is calculated as the coupon rate/365 multiplied by the number of days and the nominal amount outstanding.

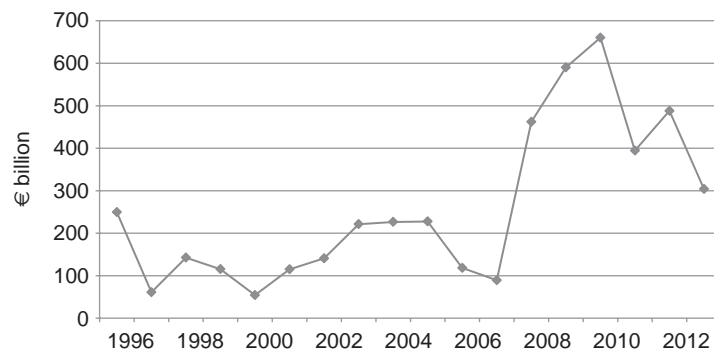
FIGURE 1 Collateral value of (quasi-) high-quality collateral, before and after haircuts.

for the euro area should be denominated in euros. Data was taken from the European Commission's AMECO database.

Figure 2 on the next page illustrates the changes in general government debt for the euro zone countries with a credit rating of BBB– or higher, using Standard & Poor's ratings as of June 1, 2012. This line presents an upper bound, as ratings between A+ and BBB– are allowed for sovereign or central bank debt, but not for other government debt (see Table 1 on page 33).⁴ Figure 2 on the next page shows a substantial increase in government debt between 2007 and 2011. This is due to the discretionary stimulus measures, automatic stabilizers and government support to the financial sector in the euro area that were triggered by the financial crisis and the subsequent economic downturn. While the sovereign crisis did have a negative impact (as soon as a sovereign's rating falls below BBB–, its debt no longer meets the definition of high-quality collateral), the overall pool of high-quality collateral still increased significantly, albeit at a lower rate after 2010.

Using the European Commission's estimates of financing needs in 2012 and 2013 (AMECO database), we project that the amount of high-quality assets will increase by €488 billion in 2012 and by €304 billion in 2013 and assume that the change in government debt in 2014 will be equal to the change in 2013. Given that in the EADB

⁴ An upper bound (rather than the lower bound of AA– and higher) was chosen, since the exclusion of publicly guaranteed but privately issued debt already gives a downward bias.

FIGURE 2 Change in high-quality collateral (S&P ratings as of June 1, 2012 shown below figure).

Country	Rating
Belgium	AA
Germany	AAA
Estonia	AA–
Ireland	BBB+
Greece	CCC
Spain	BBB+
France	AA+
Italy	BBB+
Cyprus	BB+
Luxembourg	AAA
Malta	A–
Netherlands	AAA
Austria	AA+
Portugal	BB
Slovenia	A+
Slovakia	A
Finland	AAA

Source: European Commission (AMECO database) and Standard & Poor's website.

sovereign and local government debt issuances with a credit rating between 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 €468 billion in 2012, €292 billion in 2013 and 2014, implying that, by the end of 2014, the stock of high-quality collateral will have grown by €1052 billion, or €1.1 trillion.

Quasi-high-quality collateral consists of different assets (see Table 1 on page 33), but covered bonds are the main component, with a share of 85%. Hence, the future supply of quasi-high-quality collateral is mainly determined by the future issuance of European covered bonds. This future issuance depends on how banks finance

themselves over the next couple of years, which makes it difficult to predict. As banks can choose from various types of debt and/or equity, funding decisions will depend on opportunities in different financial markets as well as the bank's own credit rating and the broader economic environment. A review of current trends does not give a clear picture on the future development of the covered bonds market. On the one hand, there are several trends that could boost further growth, such as higher capital requirements under Basel III on unsecured loans, other supervisory initiatives to discourage unsecured lending (eg, the "bail-in" of unsecured debt and "depositor preference") and the preferential treatment received by covered bonds under the new Basel III liquidity standards (Basel Committee on Banking Supervision (2010)).⁵ On the other hand, there is a maximum to the covered bonds that can be issued, because banks need good quality assets to secure these bonds. Alternatively, supervisors or overly hefty risk premiums on unsecured lending may impede the issuance of too many covered bonds. Finally, the current financial market situation and sovereign crisis is likely to discourage the issuance of new covered bonds.

Data on the covered bonds market does not give a clear sense of future development either. Data from the European Covered Bond Council (available from 2003 to 2010) suggests quite rapid growth in the total amount of euro-denominated covered bonds outstanding until 2008 and a leveling off in 2009 and 2010. Market intelligence from Dealogic shows that the net issuance in the euro area of covered bonds (available since 1992) has varied significantly from one year to another with positive (and sometimes substantial) net positive issuances until 2006, negative net issuances in 2007–10 and a modest net positive issuance for 2011. Data for the first months of 2012 suggests very little growth for this year. Given the relatively high amounts of covered bonds that will expire in 2013 and 2014, and considering that, according to our definition, covered bonds need a rating of at least AA– and that many good quality assets have already been used in past issuances, we assume that the increase in the amount of quasi-high-quality collateral until 2014 will be insignificant for the purpose of this study (ie, rounded off to €0 trillion).

4 DEMAND FOR COLLATERAL

The relative 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 section identifies and

⁵ Covered bonds are a relatively attractive asset for banks since they require less stable funding than unsecured loans and since they are considered high-quality liquid assets under Basel III. Covered bonds are also a relatively attractive liability (compared with unsecured wholesale borrowing), because of their lower run-off rate in the LCR-stress scenario (implying that the bank needs a lower level of highly liquid assets).

quantifies these effects for the euro area. Sometimes data was only available at the European level. Then 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 used a scaling factor of 72% where necessary.⁶

4.1 The secured money market

In terms of amounts outstanding (see Figure 3 on page 40), the repo market tripled between 2001 and 2011, from €924 billion to €3.1 trillion (International Capital Market Association (2012)). Generally, this growth reflects the fact that investors found repo-transactions a relatively safe investment and an efficient means for shifting liquidity (Cossin *et al* (2003) and European Central Bank (2010a)). But several exogenous factors contributed to this strong growth: repo market infrastructure became more efficient through the increased use of central counterparties (CCPs), more collateral became available due to increased securitization of illiquid assets and Basel I and II regulations favored repo lending over unsecured lending. The repo market reached its peak in 2007 (with a value of €3.4 trillion in amounts outstanding⁷) and then plummeted (reaching its lowest point in 2008 with a value of €2.3 trillion). This downturn was caused by market participants' concerns about the valuation of collateral assets and counterparties' creditworthiness (Hördahl and King (2008) and International Monetary Fund (2010)), the decline in economic activity caused by the financial crisis, and the "crowding out" of transactions on the secured money markets by the Eurosystem's crisis-related liquidity provision. From 2009 onward the European repo market recovered again.

There are good reasons to expect further growth. The exogenous factors that boosted growth before the crisis continue to exist: CCPs are likely to assume a greater role on the repo market (considering market participants' current risk aversion and the

⁶ The scaling factor was determined by the euro area's share in Europe's financial balance sheet, financial transactions and gross domestic product (GDP). Financial balance sheet data is indicative of the overall size of the euro area's financial market (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 indicates that the euro area's share in the twenty-seven EU countries' 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%.

⁷ As ICMA gives survey data, some "noise" may be caused by changes in the sample of respondents. For instance, the sharp rise and subsequent decline of the repo market in 2010 can probably be explained by "exceptional" factors that masked a gradual trend toward recovery.

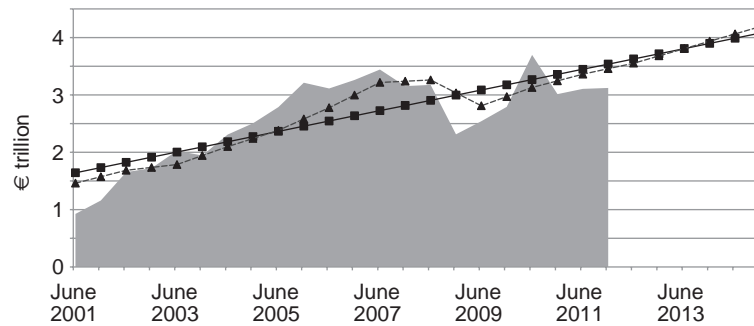
good performance of CCPs during the recent crisis) and Basel III will also give preferential treatment to repo transactions in terms of both capital requirements and the new liquidity standards. However, we do not expect the same rates of growth as before the crisis. Banks in many euro area countries are deleveraging, which will lower their demand for funding. There is also an endogeneity issue: rapid growth of the secured money market would make high-quality collateral more scarce, leading to countervailing forces. In the event of scarcer collateral, 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 willing to pay higher interest rates on unsecured loans, which may prompt some liquidity suppliers to lend unsecured.

To project the development of the European repo market in 2012–14, we assumed that other relevant factors such as the size of the Eurosystem's monetary policy operations and the relative costs of repo transactions remain constant⁸ and estimated a trend through time (with June 2001 set equal to $t = 1$), using least squares estimation and the complete data sample. We used the complete sample (rather than the pre-crisis data only) since we expect further growth of the secured money market, but at a lower rate than before the financial crisis. The trend model yielded a significantly positive trend and an estimated outstanding amount of €4.1 trillion at the end of 2014. Finally, considering that repo market activity and overall economic activity are likely to be correlated, our second model related the outstanding amount in the European repo market to the GDP of the twenty-seven EU member states. This led to an estimate of €4.2 trillion in 2014. Taking the average of these two estimation results, we assumed that the amount outstanding in the European repo market will increase from its current level of €3.1 trillion to €4.1 trillion in 2014. By implication, this reflects collateral needs for the European Union. Given that the euro area accounts for 72% of the European Union's financial market (see footnote 6), the collateral needs for repo markets by euro area banks can be expected to rise from its current estimated level of €2.25 trillion to €2.98 trillion in 2014 (ie, an increase of €730 billion, or €0.7 trillion).

4.2 The OTC derivatives market

Both the exchange-traded and OTC derivatives markets have grown markedly over the last decade. Notional amounts, ie, the nominal values on which derivatives contracts are based, are a good indicator for the size of the derivatives market (European Central Bank (2010b, p. 99)). In terms of notional amounts outstanding, the exchange-traded derivatives market grew from US\$14 trillion to US\$58 trillion between June 2000 and December 2011, while the OTC market expanded from US\$94 trillion to

⁸ Our focus is therefore on “first-round effects”. The possible feedback of scarcer high-quality collateral on secured money market interest rates is not considered.

FIGURE 3 Trends in the European repo market: amount outstanding.

Shaded area: amount outstanding repo market. Solid line: estimate based on trend, with sample up to December 2011. Dashed line: estimate one, based on GDP EU27 regression.

TABLE 2 Data for Figure 3.

Trend repo market	Coefficients	Standard error	<i>t</i>	<i>P</i> > <i>t</i>	<i>R</i> ²
Trend: complete	Const. 1.55E+12	2.134E+11	7.270	0.000	0.6066
Sample	Time 9.02E+10	1.625E+10	5.553	0.000	—
Model: GDP	Const. -4.53E+12	1.112E+12	-5.322	0.000	0.779
	GDP EU27 0.62	0.100	8.398	0.000	—

US\$648 trillion (Bank for International Settlements (2012)). Risk in the derivatives market is usually measured by the so-called gross credit exposure. This measure sums the absolute market values of all open contracts with either positive or negative replacement values after allowing for netting possibilities. Between June 2000 and December 2011, gross credit exposure rose from US\$937 billion to US\$3.9 trillion.

The OTC derivatives market played a significant role in exacerbating the financial crisis, which was caused by the fact that the OTC markets, compared with exchange-traded derivatives markets, were less liquid, less transparent, more concentrated and interconnected and less regulated. In response to these problems, and considering that central CCPs performed well during the financial crisis, the G20, at its Pittsburgh summit in September 2009, mandated that standardized OTC contracts should be cleared through CCPs by the end of 2012, and that all trades should be reported to trade repositories (see G20 (2009)). Moreover, the G20 announced that noncentrally cleared contracts should be subject to higher capital requirements, which should induce banks to seek CCP clearing and to improve margining practices for bilaterally

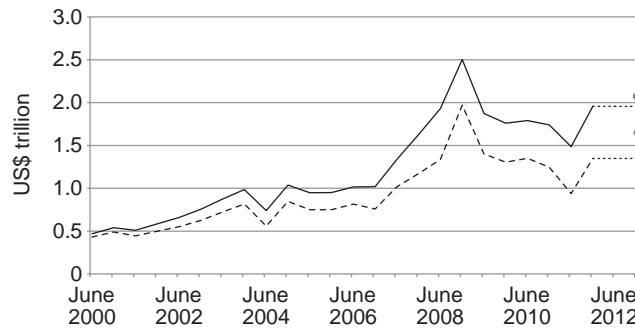
cleared derivatives. In Europe, the stricter regulations for the OTC market will be finalized in the European Market Infrastructure Regulation (see European Commission (2010)).

More CCP clearing in the OTC derivatives market will raise the demand for high-quality collateral. Although bilateral clearing arrangements require collateral too, in practice they are not fully collateralized and margin calls are often made irregularly. In the case of CCPs, margins are typically set at market level and margin calls are made daily (sometimes intraday if necessary). In addition, CCPs require collateral in the form of guarantee fund contributions to further strengthen the CCP's capacity to withstand crisis situations. An advantage of CCP use is the multilateral netting provided by the CCP. 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 post less collateral due to this netting effect, while others will need more collateral for their OTC derivatives trade.

To estimate future collateral needs in OTC derivatives markets we use the method developed by the IMF, which was published in Singh (2010a). In this method, total collateral needs are measured by total derivatives payables⁹ in the OTC derivatives market, which can be approximated by half of the gross credit exposure reported by the Bank for International Settlements (BIS). Figure 4 on the next page illustrates that, as of December 2011, a total amount of US\$1.96 trillion was needed in collateral value after haircuts for OTC-derivatives transactions. This figure, however, measures collateral needs in the current OTC derivatives market, where bilateral clearing is common practice. Given mandatory CCP clearing for a large share of OTC derivatives trades by the end of 2012 (G20 (2009) and European Commission (2010)), in the near future more collateral will be required in the form of initial margin and guarantee funds (see above). This "CCP effect" was calculated by applying the ratio of initial margin and guarantee fund to notional amounts from two existing CCPs in the OTC derivatives market to the total market, and assuming that two-thirds of the current notional value will be moved to CCPs. The results show that an extra CCP-induced collateral value of approximately US\$209 billion would be required. Under the assumption that gross credit exposures remain approximately stable between the fourth quarter of 2011 and the fourth quarter of 2014, the total collateral needs after mandatory CCP clearing are estimated to be around US\$2.16 trillion at year-end 2014. To measure the additional

⁹ The derivatives payables of a financial institution are the sum of that institution's liabilities to all other counterparties in the financial system. The gross credit exposure published by the BIS consists of both derivatives payables and derivatives receivables. Note that this measure slightly underestimates the exposure of the financial system, since the figure does not include exposures created by credit default swap contracts other than for the US market (Bank for International Settlements (2009)).

FIGURE 4 Total and additional collateral needs in the global OTC derivatives market (IMF method).



Solid line: total collateral needs. Dashed line: additional collateral needs. Dots above lines show total and additional collateral needs including the CCP effect. Source: BIS statistics, ISDA margin surveys, Singh (2010), Bank for International Settlements (2009).

collateral needs in the OTC derivatives market (or the current extent of undercollateralization) total collateral needs were compared with collateral already paid. This latter figure was calculated by half of the “total estimated collateral figures”,¹⁰ which is published by the ISDA and correcting this figure for rehypothecation.¹¹ Under the assumption that 30% of ISDA estimated collateral is not rehypothecated, additional collateral needs are calculated by subtracting 30% of the single counted collateral value from derivatives payables. Figure 4 shows that the additional collateral requirements amount to US\$1.35 trillion in the years 2011 to 2014. If the CCP effect is added to this figure, the additional future collateral needs would be US\$1.56 trillion for the global OTC derivatives market.

As the above-mentioned data is only available at the global level, we now need a reasonable approximation of the euro area’s share. One method would be to determine the area’s share in the global exchange-traded derivatives (ETDs) market and to use the same percentage for the OTC derivatives market. According to BIS data, Europe accounted for 35% of the global ETD market in March 2012 (BIS data for the euro is not available). Using our 72% scaling factor (see footnote 6), the euro area’s share in the global OTC derivatives market could be approximated at 25.2%. The second

¹⁰ This figure incorporates both collateral paid and delivered.

¹¹ In practice, a large share of the posted collateral in OTC derivatives markets is rehypothecated to secure other risks. According to the ISDA, large institutions in the OTC derivatives market rehypothecate 74% of their collateral and medium/smaller institutions 28%. Section 5.3 discusses rehypothecation in more detail.

method is to consider the share of euro-denominated contracts in different segments of the OTC derivatives market (see European Central Bank (2009b)), which led to an estimated share of euro-denominated contracts of 37.4% (for more details, see Levels and Capel (2012)). We took the average of these two approaches and therefore assumed that the euro area accounted for 31.3% of the global OTC derivatives market, implying that the euro area will require US\$487 billion (€375 billion) of additional collateral in the near future. Total future collateral needs in the euro area for OTC derivatives transactions amount to US\$678 billion (€521 billion).

4.3 The Basel III liquidity standards

In 2015 and 2018, respectively, banks will have to comply with the two new liquidity standards of the Basel Committee on Banking Supervision: the LCR and the NSFR (Basel Committee on Banking Supervision (2010)). 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 thirty days. The measure aims to make banks more resilient to acute adverse liquidity shocks. The NSFR requires banks to fund long-term assets with sufficiently long-term funds. It is designed to promote the longer-term liquidity position of banks by reducing maturity mismatches and over-reliance on short-term wholesale funding. At the time of writing, banks had not yet complied with these new standards. The Basel Committee conducted a quantitative impact study (Basel Committee on Banking Supervision (2012)) among twenty-three of its members, and found LCR and NSFR shortfalls of €1.76 trillion and €2.78 trillion, respectively (see Table 3 on the next page). The Committee of European Banking Supervisors (2012) conducted a similar study for twenty-one European countries, and concluded that the LCR and NSFR shortfall for these countries would be €1.20 trillion and €1.90 trillion, respectively. Finally, a report from McKinsey (2010) used data from the top forty-five European banks and estimated the LCR and NSFR shortfalls to be €1.30 trillion and €2.30 trillion, respectively, for the twenty-seven EU countries plus Switzerland.

Given that many banks need to implement changes in order to comply with the LCR in 2015 and the NSFR in 2018, banks' total demand for high-quality liquid assets will surely be affected. However, it is impossible to predict what the precise impact will be. First, when calculating the total LCR shortfall, only banks with a shortfall (ie, not those with a surplus) were considered (Table 3 on the next page therefore reports gross shortfalls). If banks with LCR surpluses would sell or lend these assets to banks with shortfalls, the overall impact on the demand for high-quality liquid assets would be reduced. Second, the LCR and NSFR shortfalls reported in Table 3 on the next page are calculated independently from each other, under the assumption that banks do not take any mitigating action to reduce these shortfalls. In reality, banks are expected to

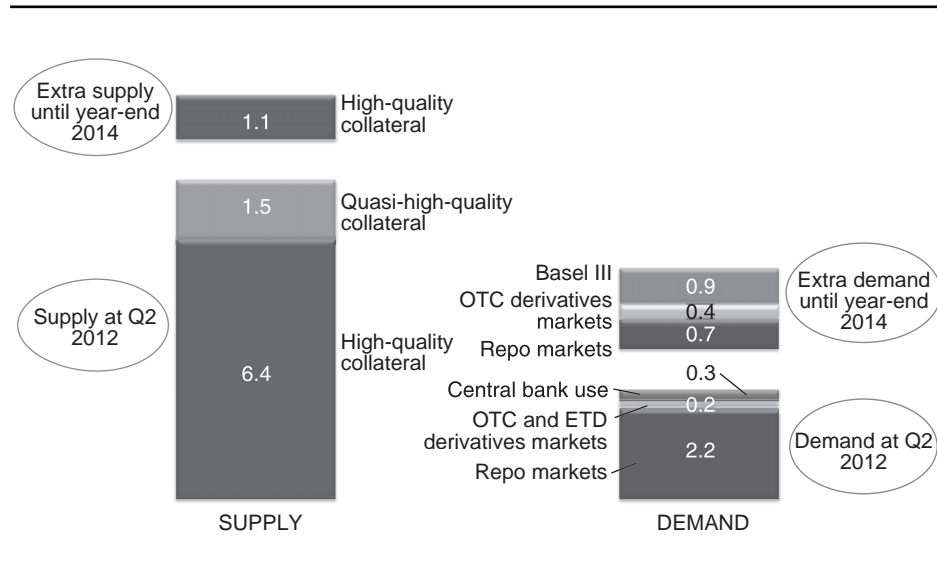
TABLE 3 Impact of the Basel III liquidity standards (billion/trillion euros).

Study	Scope	LCR shortfall	NSFR shortfall
Basel Committee on Banking Supervision (2012)	Global, 23 member countries	€1.76 tr	€2.78 tr
Committee of European Banking Supervisors (2012)	21 European countries	€1.20 tr	€1.90 tr
McKinsey (2010)	EU 27 plus Switzerland	€1.30 tr	€2.30 tr
Extrapolation from McKinsey (2010)	Euro area	€923 bn	€1.63 tr

act upon these shortfalls and actions to improve the LCR are likely to affect the NSFR too, and vice versa. For instance, if a bank decides to attract more stable funding, it could improve both the NSFR and the LCR (since it reduces the net cash outflow in the stress scenario) at the same time (a further analysis of the interaction between the LCR and the NSFR is given in Levels and Capel (2012)). Hence, to calculate the impact of Basel II's liquidity standards on the euro area's demand for high-quality liquid assets, information is needed on how banks will adjust to the LCR and NSFR and on the overall size of the LCR surpluses of some banks and their possible willingness to sell or lend these surpluses to others. Since this information is not available, the estimated LCR shortfall for Europe was used as a proxy for the extra need for high-quality liquid assets in the European Union. In the absence of information on the LCR and NSFR shortfalls in the euro area, we took 71% (the euro area's share in the European Union's balance sheet (see footnote 6)) of the LCR shortfall calculated by McKinsey (see Table 3) to obtain a rough estimate for the euro area's additional demand for high-quality liquid induced by the liquidity standards. This leads to an estimate of €923 billion, or €0.9 trillion.

5 IS COLLATERAL BECOMING SCARCE?

This section gives an overview by adding up the demand and supply estimates of the different financial market segments that were discussed above. Please note again that these are only rough estimates due to all sorts of data limitations. Section 5.2 discusses the impact of the possible reuse or rehypothecation of collateral, a phenomenon that was already briefly touched upon in the context of the OTC derivatives market. Section 5.3 discusses the policy implications of greater collateral scarcity.

FIGURE 5 High-quality collateral: demand versus supply, in € trillion.

5.1 Demand versus supply

Figure 5 gives a graphical representation of our estimates so far. In Section 3 the supply of high-quality collateral (as defined in Section 2) was estimated to be around €6.4 trillion at the time of writing (June 2012) and was expected to grow by €1.1 trillion up to the end of 2014. The supply of quasi-high-quality collateral is currently €1.5 trillion and is expected to be at the same level at the end of 2014. Section 4 showed that the demand for high-quality collateral will increase significantly over the next couple of years. The natural growth of the repo market is expected to require an additional €0.7 trillion in collateral by the end of 2014. Moreover, developments in the OTC derivatives market (mitigation of undercollateralization and CCP clearing of standard OTC derivatives) are estimated to lead to an additional collateral need of €0.4 trillion. Finally, the new liquidity standards of Basel III could create an additional demand for high-quality liquid assets of €0.9 trillion. These three trends combined show that the demand for high-quality collateral at the end of 2014 could be approximately €2.0 trillion higher. This leads to the observation that the projected increase in the demand for high-quality collateral (€2.0 trillion) is significantly higher than the increase in collateral supply of €1.1 trillion. Hence, we conclude that high-quality collateral will become scarcer (ie, scarce in relative terms) in the near future. This 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 with total supply.

Disregarding the possibility of collateral reuse for the moment, the total demand for collateral is calculated by summing the total collateral needs of various financial market segments. At year-end 2011, 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 ETDs in the euro area by the end of 2014 is €0.1 trillion.¹² Hence, total current use of collateral in derivatives markets is estimated at €0.2 trillion. To determine the high-quality collateral needed for payment and settlement systems and monetary policy operations (“central bank use of collateral”), we know that the average amount of collateral put forward by counterparties in Eurosystem credit operations was slightly below €1.8 trillion in 2011 (European Central Bank (2011, 2012, p. 85)). Of this €1.8 trillion, an average of approximately €0.5 trillion was actually used in credit operations in 2011 while peak use was around €0.9 trillion (European Central Bank (2011, 2012, p. 85)). Considering the composition of collateral put forward to the Eurosystem (European Central Bank (2011, 2012, p. 85)), at most 35% of this collateral would be high-quality or quasi-high-quality collateral as defined above.¹³ So the current use of (quasi-) high-quality collateral within the Eurosystem should be around €0.3 trillion. 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 €6.4 trillion (€7.9 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 €7.5 trillion while a rough estimate of future demand for high-quality collateral gives €4.7 trillion.

¹² Outstanding notional values in the ETD market were US\$58.331 billion at the end of 2011 (Bank for International Settlements (2012)), which was just slightly above the 2010 level. The euro area’s share in this market is estimated to be 35% (see above). Given the TABB report’s result (see TABB Group (2010)) 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 2011 would be $0.61\% \times 0.35 \times \$58.331 \text{ billion} = \124 billion , or €96 billion. It seems reasonable to assume that, by the end of 2014, collateral needs would still be around €0.1 trillion.

¹³ The ECB does not publish detailed data on the collateral put forward by counterparties. However, we know from the ECB (2011) annual report that the average share in 2011 of central government bonds was 14% and that the other components of quasi-high-quality collateral (regional government bonds, corporate bonds, covered bonds) sum up to 20–25% of collateral put forward. However, these categories also include assets with ratings below the benchmarks set in our definition of (quasi-) high-quality collateral.

5.2 Reuse of collateral

The above estimates were based on the assumption that financial institutions cannot reuse the collateral received for their own collateral needs. While it is known that many current repo or derivatives contracts allow for the possibility of rehypothecation or the reuse of collateral, there is no reliable data on the extent of rehypothecation in euro area repo and derivatives markets. The ISDA Margin Survey (International Swaps and Derivatives Association (2012)), however, reports that in the OTC derivatives markets large dealers (mainly large global banks) rehypothecate some 74% of their received collateral, while small and medium dealers rehypothecate 28% on average. Reuse of collateral acts as a “collateral multiplier”, the size of which depends on the reuse rate. For instance, if, in practice, 50% of collateral is reused, €100 billion of assets could in practice collateralize €200 billion of transactions.¹⁴

How does rehypothecation affect the results of this study? We have shown that the combined collateral needs for the euro area’s repo and derivatives markets (both exchange traded and OTC) could be around €3.5 trillion ($2.9 + 0.2 + 0.4$) by year-end 2014.¹⁵ Supposing that the reuse of collateral assets is indeed 50%, then a collateral pool of half of this amount would suffice to cover collateral needs in these markets. This would lower the pressure on the available stock of (quasi-) high-quality assets. Yet our conclusion that pressures on high-quality collateral are increasing remains: the projected increase in collateral supply is €1.1 trillion, while the projected increase in collateral demand is €2.0 trillion. However, from the latter amount, €0.9 trillion is not available for reuse at all since these assets must be kept unencumbered to comply with the Basel III liquidity standards. So, even if 50% of the remaining €1.1 trillion could be rehypothecated, collateral needs increase by €1.5 trillion. To conclude, the possibility of rehypothecation does not change the main conclusion of this study: that collateral will become scarcer.

Finally, there are good reasons to expect that the extent of reuse is diminishing. Singh and Aitkin (2010) observe that reuse has declined significantly since 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

¹⁴ Suppose that bank B receives €100 billion of assets from bank A as collateral for a loan. With a reuse rate of 50%, bank B would use €50 billion (for example, to collateralize a derivatives transaction with bank C), bank C would use €25 billion with bank D, etc. In the limit this would add up to €200 billion. The collateral multiplier is thus $1/\text{reuse rate}$ (see Bottazzi *et al* (2011) for further details).

¹⁵ Collateral pledged to or repurchased with the central bank will not be reused. Also, if banks hold high-quality liquid assets to comply with Basel III’s liquidity standards, the assets need to be unencumbered and therefore cannot be reused.

banks to hold more high-quality liquid assets on-balance-sheet. Reuse, 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 rehypothecation 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)).

5.3 Economic effects and policy implications

If high-quality collateral becomes more scarce (ie, scarce in relative terms), this will have important implications for the financial system. First of all, banks are likely to use their collateral as efficiently as possible, reserving high-quality collateral 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, a development that has already set in (European Central Bank (2012, p. 85)). 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 if market participants 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 transformation services as an additional service to their clients. For instance, Cameron (2011) expects that, in the OTC derivatives markets, large broker-dealers will stand ready to transform their clients' noneligible financial instruments into cash or government bonds, which these clients can then post as collateral with the CCP. As many institutional investors possess large amounts of liquid assets, these institutions may also be lending these assets and engaging in liquidity swaps with banks for extra revenue. This can be risky if the contracts include a trigger that unwinds the flow of liquidity under a stress scenario (liquidity run). Cameron (2011) argues that collateral transformation will increase the credit and liquidity risks of CCP members. Institutional investors providing collateral transformation or liquidity swaps would also encounter new risks. Such new collateral services and elevated levels of securities flows require adequate risk and collateral management by institutions providing and obtaining these services. Finally, if collateral becomes scarcer, 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.

More fundamentally, collateral scarcity can be seen as 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 example, by leveraging). Until 2007 rising asset prices and confidence in economic and financial markets enabled financial institutions to leverage their balance sheet, mostly through unsecured short-term and repo lending (Adrian and Shin (2010a)). With abundant liquidity, financial institutions started providing loans to increasingly less creditworthy borrowers, fueled real estate booms (eg, the US subprime mortgage market) and supported consumption (Perotti (2011)), creating unsustainable credit risk bubbles that led to the current financial crisis. Securitization, which enabled financial institutions to buy each other's securities, reinforced this process (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 (ie, raising their capacity to deal with these risks) and by discouraging maturity mismatches (ie, 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 risk management by banks, will bring banks' risks more 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 that started in 2008 brought about several changes in wholesale financial markets that are boosting the demand for high-quality collateral. As a result, some market participants fear that high-quality collateral will become scarce in the near future. This paper has investigated whether this fear is justified for the euro area. We examined current trends in the euro area's demand for and supply of high-quality collateral and made quantitative estimates of their future developments. To do this we needed an operational definition of high-quality collateral. We defined the highest-quality collateral as the assets that are accepted (without restriction on quantity) by relevant authorities (the Eurosystem and the supervisor under

the Basel III regulations) and by market participants for transactions on repo markets and OTC derivatives markets. Quasi-high-quality collateral is also accepted by all these institutions but these assets are subject to some quantity restriction under Basel III regulations. Our operational definition of (quasi-) high-quality collateral is summarized in Table 1 on page 33.

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 of €6.4 trillion and is likely to be €7.5 trillion at the end of 2014. This estimate reflects the crisis-induced budget deficits and debt levels of many European governments that need to be financed (increasing the pool of potential collateral) as well as the credit rating downgrades in some countries (disqualifying some government debt as high-quality collateral). The current supply of quasi-high-quality collateral is €1.5 trillion and is expected to be at approximately the same level by the end of 2014 due to modest net issuances of covered bonds.

We then showed that the demand for high-quality liquid assets is likely to increase substantially because of expected further growth of the money or repo market, mandatory clearing of all standardized OTC-derivatives contracts by CCPs at the end of 2012 and the standards of Basel III. This study estimated that, together, these three developments will require around €2.0 trillion of extra collateral by the end of 2014. 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 €4.7 trillion.

Comparing the forecasted increases in collateral demand (€2.0 trillion) and collateral supply (€1.1 trillion), we conclude that high-quality liquid assets are likely to become more scarce (ie, scarce in relative terms) in the next couple of years. But we do not expect collateral scarcity in absolute terms (total supply in 2014 of €7.5–8.9 trillion, total demand of €4.7 trillion). Increased collateral scarcity will create pressure on the prices of high-quality assets, especially considering that many institutional investors now hold large portfolios of high-quality liquid assets and that banks will demand more of those. We also discussed the possible impact of the reuse or rehypothecation 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 gave reasons why we expect the extent of reuse to tail off.

What are the expected consequences of scarcer collateral? First and foremost, we have argued that banks facing collateral scarcity can accommodate this by reducing their risks. 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 they 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.

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