

Grandia, Roel (Ed.); Hänling, Petra (Ed.); Russo, Michelina Lo (Ed.); Aberg, Pontus (Ed.)

Research Report

Availability of high-quality liquid assets and monetary policy operations: An analysis for the euro area

ECB Occasional Paper, No. 218

Provided in Cooperation with:

European Central Bank (ECB)

Suggested Citation: Grandia, Roel (Ed.); Hänling, Petra (Ed.); Russo, Michelina Lo (Ed.); Aberg, Pontus (Ed.) (2019) : Availability of high-quality liquid assets and monetary policy operations: An analysis for the euro area, ECB Occasional Paper, No. 218, ISBN 978-92-899-3679-8, European Central Bank (ECB), Frankfurt a. M., <https://doi.org/10.2866/3211>

This Version is available at:

<https://hdl.handle.net/10419/207605>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



EUROPEAN CENTRAL BANK

EUROSYSTEM

Occasional Paper Series

Roel Grandia, Petra Hänling,
Michelina Lo Russo, Pontus Åberg (editors)

Availability of high-quality liquid assets and monetary policy operations: an analysis for the euro area

No 218 / February 2019



Disclaimer: This paper should not be reported as representing the views of the European Central Bank (ECB). The views expressed are those of the authors and do not necessarily reflect those of the ECB.

Contents

Abstract	2
Non-technical summary	3
1 What counts as euro-denominated HQLA?	5
2 Supply of HQLA by governments and the private sector	8
3 The relationship between the Eurosystem's balance sheet and the availability of HQLA	11
3.1 Outright monetary policy operations	12
3.2 Refinancing operations	14
4 Overview of HQLA held by banks and other economic agents	16
5 Demand for HQLA due to the LCR and other factors	21
5.1 HQLA demand from the banking sector due to the LCR	21
5.2 HQLA demand from the financial system due to the EMIR	23
5.3 Effects of secured money market activity on HQLA demand	26
6 HQLA availability in an environment with less sizeable excess reserves	29
Annex	32
References	34

Abstract

This paper provides an overview of supply and demand factors influencing the availability of euro-denominated debt instruments that qualify as high-quality liquid assets (HQLA) in the euro area. The paper estimates the supply of HQLA issued by the public and private sectors as well as the aggregated impact of Eurosystem monetary policy operations on the amount and composition of HQLA held by banks and other economic agents. An assessment of the main demand factors is also presented. Finally, the paper provides some insights into the interaction with and implications for the Eurosystem monetary policy implementation framework in the longer run.

Keywords: regulatory changes, central bank policies, bank regulation, credit operations, asset purchase programme.

JEL codes: D41, E58, G1, G28

Non-technical summary

Regulatory reforms implemented in the wake of the financial crisis and structurally higher risk aversion are commonly cited as factors that can boost demand for secure and liquid assets among economic agents. Instruments with these features that are suitable for the euro area are defined in Delegated Regulation (EU) 2015/61, which classifies so-called HQLA in terms of the liquidity coverage ratio (LCR) requirement for banks. This paper aims to quantify the supply of HQLA in the euro area and to analyse the most relevant factors affecting their availability (i.e. amount and composition) to banks and other economic agents, so as to assess whether scarcity of HQLA is an issue in the euro area.

The paper shows that there is a large supply of HQLA, since public and private entities incorporated in the EU issue *marketable* euro-denominated debt instruments qualifying as HQLA in considerable quantities (€10.9 trillion as of Q3 2017), mostly in the form of government (89%) and covered bonds (6%). This supply has been relatively stable over time and is substantial compared with euro area GDP. This confirms the assessment of the European Banking Authority (EBA) that HQLA are, on an aggregated level, not scarce in the euro area.

In the current environment, euro area banks hold EUR 3.8 trillion of euro-denominated HQLA, of which 47% consist of excess reserves (i.e. reserves supplied by the Eurosystem in excess of the euro area banking system reserve requirements) and the remaining 53% of *marketable* assets, mainly government bonds. The aggregate HQLA holdings of the euro area banking system correspond to an aggregated LCR of just under 150% as of Q3 2017, versus a required minimum of 100% as of 1 January 2018. Pension funds and insurance companies (€2.1 trillion), investment firms, non-financial corporations and similar economic agents (€1.4 trillion) and non-euro area entities including foreign central banks (€2.6 trillion) also hold considerable quantities of HQLA.

Aside from the LCR requirement, demand for HQLA can also be driven by other factors such as the European Market Infrastructure Regulation (EMIR) for the OTC derivatives market and the increased preference for secured money market transactions. The maximum demand due to the EMIR is estimated to be €0.7 trillion for the euro area financial system. An assessment of the relationship between repo market activity and HQLA availability highlights that: (i) a sufficient level of marketable HQLA outstanding should be available for the repo market to function properly; (ii) if the role of margins and haircuts is neglected, secured transactions mainly redistribute securities and cash among different economic agents, although repo transactions between banks and non-banks affect the amount of HQLA available to the banking sector.

The amount and type of HQLA available to banks and other economic agents also depend on central banks' balance sheet developments, i.e. on HQLA held, encumbered or provided via central bank operations through both the asset and liability side of the balance sheet. Specifically, the Eurosystem has absorbed around €2.6 trillion of HQLA through outright portfolios and refinancing operations. The

amount of HQLA provided stands at €1.8 trillion of excess reserves and €1.1 trillion of banknotes. Moreover, Eurosystem securities lending operations, non-monetary policy deposits and other liquidity-absorbing instruments can potentially affect the amount and type of HQLA available in the market.

The net impact of Eurosystem *monetary policy* operations on the aggregated stock of HQLA is currently slightly positive and depends on the factual degree of liquidity transformation. In general, outright monetary policy operations can increase the amount of HQLA if the central bank buys non-HQLA or HQLA for which non-zero LCR haircuts are applicable. Refinancing operations can increase HQLA if the central bank accepts non-HQLA as collateral or applies lower haircuts on pledged HQLA collateral as opposed to LCR haircuts. More specifically, assuming that every euro injected via the Eurosystem asset purchase programme (APP) or via refinancing operations increases the level of excess reserves, which is not necessarily the case on an aggregated level but serves to illustrate the marginal impact of operations, monetary policy operations increased the amount of HQLA outstanding by around €751 billion. Of this figure, €633 billion is attributable to refinancing operations, while liquidity transformation due to the APP is relatively contained (€119 billion). On the other hand, APP purchases substantially change the composition of outstanding HQLA by turning marketable securities (available to all economic agents) into non-marketable assets (reserves available to banks only), with implications for the competition between banks and other economic agents for HQLA assets. To sum up, the availability of (different types of) HQLA for banks and other economic agents also depends on the design of the monetary policy implementation (MPI) framework of the Eurosystem.

While the aggregated picture shows that the availability of HQLA in the euro area financial system is substantial, the downside is that it could blur the (perceived) availability of HQLA for individual banks or banks in certain jurisdictions. For instance, as a result of risk management considerations or cross-border fragmentation, the actual demand for HQLA from certain banks could be limited to only a subset of HQLA considered as safe assets, with implications for the relative pricing of and demand for different HQLA categories. This suggests that many references to “HQLA scarcity” might actually be more accurate if they are narrowed down to a particular subset of HQLA (safe assets) based on market preferences.

An environment with less sizeable excess reserves implies that either less marketable HQLA are absorbed via monetary policy operations, making these assets again available to the market, or liquidity in excess of the banking system’s needs is absorbed via other central bank liabilities. This could in theory mean that HQLA are provided in the form of debt certificates, term deposits or reverse repos, for instance. Consequently, the overall stock of HQLA would not necessarily decrease substantially. In such an environment, however, banks, which currently hold considerable amounts of excess reserves, might need to substitute excess reserves with marketable HQLA in order to maintain their current LCR buffers. If there is a *safe asset premium* for the preferred marketable HQLA (e.g. highly rated government bonds), banks might need to pay a higher price compared with the current situation to hold a liquidity buffer of the same size. Consequently, the level of excess reserves could have an impact on the relative cost of holding a liquidity buffer for banks.

1 What counts as euro-denominated HQLA?

Regulatory requirements introduced with Basel III aim to raise the overall resilience of the financial system. Basel III is an internationally agreed set of measures developed by the Basel Committee on Banking Supervision in response to the financial crisis of 2007-09. The measures aim to strengthen the regulation, supervision and risk management of banks. This is intended to be achieved inter alia by introducing stronger and harmonised global liquidity standards, including the LCR. The LCR is calculated by dividing a bank's stock of unencumbered HQLA by its projected net cash outflows over a 30-day horizon under assumptions for outflows in a stressed environment, while the application of a cap on inflows may apply as specified by regulators.

$$LCR = \frac{\text{Stock of unencumbered HQLA}}{\text{Net cash outflows over the next 30 calendar days}}$$

Delegated Regulation (EU) 2015/61¹ standardises the minimum level of the LCR (100% as of 2018) and the composition of the liquidity buffer for banks in the EU, and defines which instruments qualify as HQLA.

Table 1 provides an overview of euro-denominated assets that qualify as HQLA and the applicable LCR haircuts. HQLA are classified as either Level 1 (L1) or Level 2 (L2). Furthermore, the contribution to the total stock of HQLA is capped for L2 assets at 40% for L2A and 15% for L2B assets. Euro-denominated exposures to central banks², EU governments and public sector entities treated as government for regulatory purposes and high-rated covered bonds qualify as L1 HQLA. Many other private debt securities qualify as L2 HQLA, including other covered bonds, investment-grade corporate bonds and highly rated asset-backed securities (ABS).

Under specific conditions, the Delegated Regulation also allows for HQLA denominated in foreign currencies to be held to cover outflows denominated in domestic currency. These include, among others, non-euro-denominated government bonds with a rating equal to or above AA-, which implies a sizeable addition to the pool of eligible HQLA. However, to prevent excessive currency mismatches between liquid assets and net liquidity outflows supervisory authorities can apply limits to these assets according to Article 8(6) of the Delegated Regulation. Holding foreign currency-denominated assets also results in the requirement to hold additional capital for banks due to increased forex risk. This paper excludes non-euro-denominated

¹ [Commission Delegated Regulation \(EU\) 2015/61](#) of 10 October 2014 to supplement Regulation (EU) No 575/2013 of the European Parliament and the Council with regard to liquidity coverage requirement for Credit Institutions.

² More specifically, reserves in excess of minimum reserve requirements are eligible (based on an agreement between the ECB and competent authorities).

assets due to data limitations.³ This understates the available universe and the holdings of HQLA of euro area banks. The impact on the representativeness of the results, however, appears to be relatively limited since banks in the euro area, in part due to the factors mentioned above, mostly use euro-denominated assets to satisfy their HQLA needs under the LCR requirement.

Table 1
Euro-denominated assets that qualify as HQLA in the EU

Asset class	Description	Level	Haircut
Exposures to central banks	Coins and banknotes	1	0%
	Excess reserves held with the Eurosystem		
	ECB debt certificates		
	Fixed-term deposits ¹⁾		
Public sector bonds	Bonds issued by Member States of the EU or their regional government or local authorities if exposure is treated (for regulatory purposes) as exposure to the respective Member State	1	0%
	Bonds issued by public sector entities (credit institutions, promotional banks) if exposure is treated as exposure to the respective central government, multilateral development bank or international organisation		
	Regional governments and other public sector entities of Member States where exposures are assigned a risk weight of 20% in accordance with the Capital Requirements Regulation (CRR)	2A	15%
Covered bonds	≥ AA- issue size ≥ EUR 500 m Overcollateralisation ≥ 2%	1	7%
	≥ AA- issue size ≥ EUR 250 m Overcollateralisation ≥ 2%	2A	15%
	≥ A- issue size ≥ EUR 250 m Overcollateralisation ≥ 7%	2A	15%
	Other ²⁾ issue size ≥ EUR 250 m Overcollateralisation ≥ 10%	2B	30%
	Covered bonds where the bank has originated the underlying loans are not eligible		
Corporate bonds	≥ AA- Issue size ≥ EUR 250 million Max. time to maturity at time of issuance: 10 years	2A	15%
	At least investment grade Issue size ≥ EUR 250 million Max. time to maturity at time of issuance: 10 years	2B	50%
	At least AA- Most senior tranche	2B	25%
	Backed by a pool of underlying exposures which belong to specific residential loans; commercial loans; auto loans and leases or loans and credit facilities to individuals		(residential and auto loans) 35% (others)
	ABS where the bank has originated the underlying loans are not eligible		
Shares	Part of a major stock index	2B	50%
	Proven record as a reliable source of liquidity (i.e. stock price decline < 40% during a 30-day stress period)		

Sources: see footnote 1

Notes:

1) Fixed-term deposits qualify since they can be used as collateral for refinancing operations and based on a Memorandum of Understanding between the ECB and the SSM.

2) No minimum rating is required. However, covered bonds should be collateralised exclusively by claims on or assets guaranteed by the central government, central banks, PSEs, regional governments or local authorities of a Member State; loans secured by residential property the pool of underlying assets consists exclusively of exposures which qualify for a 35% risk weight or lower in the Standardised Approach.

Besides excluding non-euro-denominated assets, the definition of HQLA has further been adapted slightly for the purpose of the analysis due to data availability. This study excludes covered bonds and ABS that are issued by the bank and subsequently

³ The following assets are also excluded: i) non-interest-bearing assets for reasons of religious observance ii) collective investment undertakings (CIUs), whereby assets of up to €500 million are to be treated as assets underlying the CIU iii) deposits and other funding in cooperative networks and non-investment-grade covered bonds that could be eligible under very specific conditions.

pledged as collateral with the Eurosystem by the same bank (so-called *retained assets*). For ABS, we have applied an average haircut of 30% on all types of ABS, which is a conservative approach given that the majority of ABS are residential mortgage-backed securities, for which a haircut of 25% should apply. For covered bonds, we have not taken into account the requirements on excess coverage in the cover pool due to data unavailability.

According to the adapted definition above, we have verified, at individual ISIN level, whether an asset qualifies as HQLA. This mapping has been done based on the information contained in the Eligible Assets Database (EADB) of the ECB. This database covers at ISIN level all assets eligible as collateral for refinancing operations of the Eurosystem. In line with the methodology herein described for the classification, this study excludes from the analyses marketable securities which are not eligible as collateral for refinancing operations of the Eurosystem, with the exception of (non-investment-grade) euro-denominated government bonds. Furthermore, caps for individual banks on the amount of L2 assets in the HQLA buffer, assets encumbered or borrowed/received as collateral in non-central bank operations, the diversification requirement and certain other general and specific requirements in accordance with the Delegated Regulation are not taken into account.

The overall impact of the above-mentioned adaptations and exclusions compared with the regulatory definition of HQLA on the aggregated amount of HQLA outstanding is considered to be negligible.

Finally, in the proposed analysis: (i) unless otherwise specified, all figures are reported in market value terms as of the end of Q3 2017; (ii) the assessment of the price effect resulting from monetary policy measures on HQLA portfolios is not taken into account; (iii) the extent to which HQLA transfers between economic agents affect the denominator of the LCR (net outflows) and, more generally, the fulfilment of the LCR is deemed to be out of the scope of this study.

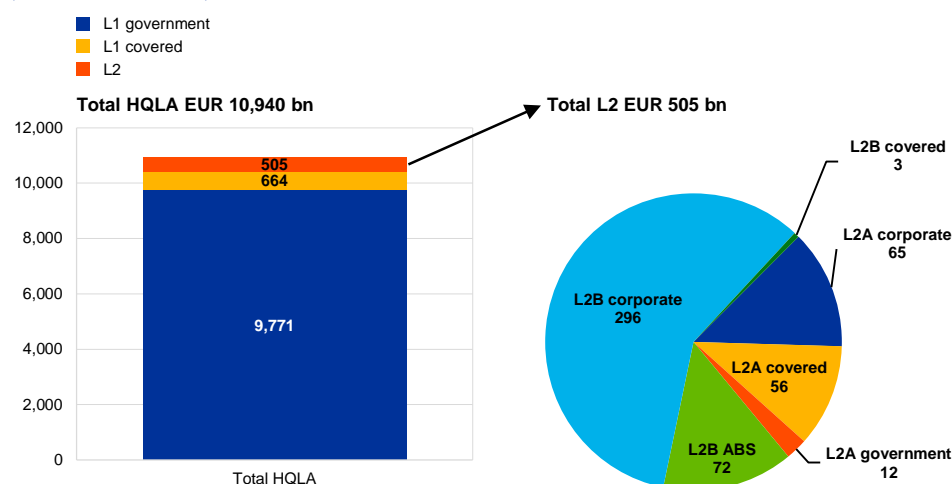
2 Supply of HQLA by governments and the private sector

Chart 1 shows that after applying LCR haircuts, governments and private entities in the EU supplied €10.9 trillion in market value of the outstanding stock of euro-denominated HQLA as of the end of Q3 2017.⁴ This is before taking into account the effect of central bank operations. 95% of HQLA consist of L1 assets, with L1 government bonds amounting to €9.8 trillion (89%) and L1 covered bonds €0.7 trillion (6%). L2B corporate bonds make up a substantial proportion of the L2 HQLA supply at €0.3 trillion (3%). By contrast, the amount of L2A assets is very small at €0.1 trillion (1%); the low weighting of L2A assets relates to the fact that most highly rated covered bonds qualify as L1 under the Delegated Regulation.

Chart 1

Total supply of HQLA by governments and private entities

(EUR billions; end-Q3 2017)



Sources: EADB for outstanding amounts and Centralised Securities Database (CSDB) for market prices. In the case of Cypriot government bonds, information from the Cypriot Debt Management Office and theoretical prices from the Common Eurosystem Pricing Hub were used.

Note: No cap on L2A and L2B is applied since these caps only apply on the level of individual banks and are not binding in aggregate.

The analysis shows that the total amount of HQLA supplied by governments and the private sector is substantial, namely equivalent to 98% of the GDP of the euro area as of the end of 2017. The total amount of HQLA has also been relatively stable over

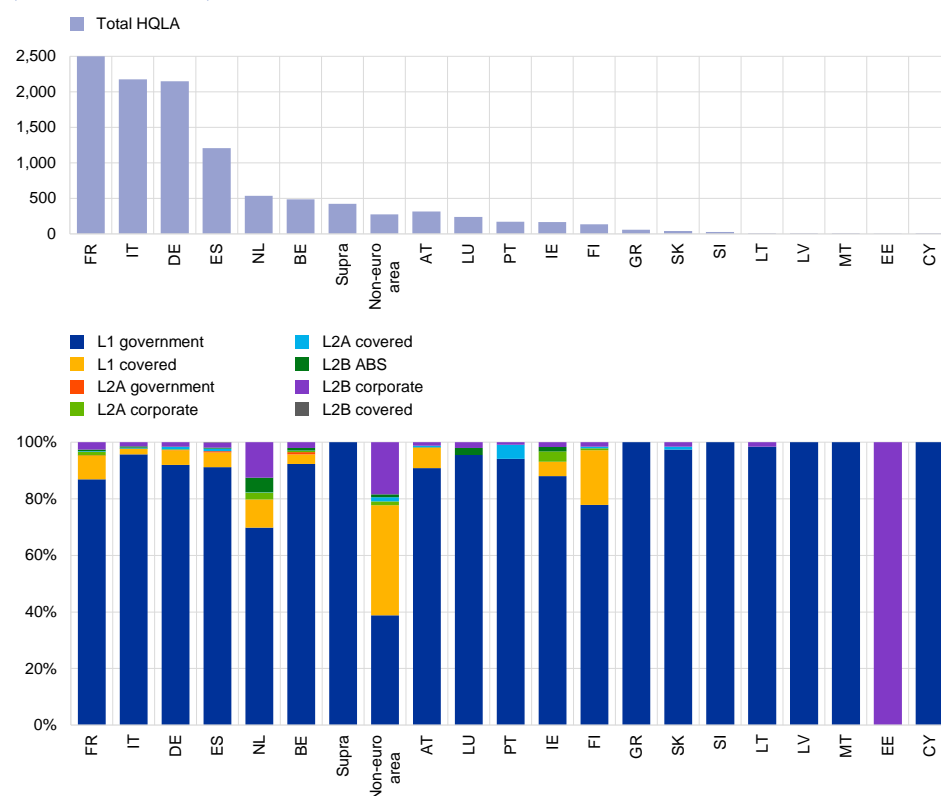
⁴ LCR haircuts refer to haircuts applied in the operationalised definition of HQLA used in this study. The aggregated market value of HQLA before haircuts is €11.3 trillion; haircuts mainly affect the value of L2 assets, which amount to €505 billion after haircuts versus €856 billion before haircuts.

time. This confirms the assessment of the EBA that HQLA on an aggregate level are not scarce in the euro area.⁵

Chart 2 shows the supply of HQLA by governments and private entities by country of issuance, highlighting that the supply of HQLA is not homogeneously distributed across the euro area. The highest amount of HQLA was issued in France (€2.5 trillion), followed by Italy and Germany (both €2.2 trillion) and Spain (€1.2 trillion). In Ireland, France, Finland and the Netherlands, the share of HQLA issued by private entities (“private assets”) was relatively high (12%, 13%, 22% and 30% respectively), while in Italy, Spain and Germany, more than 90% of the HQLA consisted of debt instruments issued by public entities (“public assets”). In Greece, Cyprus, Slovenia, Latvia and Malta, HQLA were only provided by the Government.

Chart 2
Distribution of HQLA by country of issuance

(EUR billions; end-Q3 2017)



Sources and notes: See Chart 1.

Downgrades do not affect the HQLA eligibility of government bonds. Conversely, for private assets a downgrade to a level below investment grade – with some specific exceptions for covered bonds – implies that these assets no longer qualify as HQLA.

⁵ Article 19 of the Delegated Regulation introduces the possibility of an alternative liquidity approach (ALA) if there are insufficient liquid assets for credit institutions to meet the LCR. The ALA is based on the Basel minimum standard (paragraph 55, 56). It applies to jurisdictions or currency areas where HQLA are scarce. The EBA has assessed that in Europe this only applies to Norway, a country with a comparatively low level of government debt (see [here](#)).

Since 89% of the total HQLA supply of €10.9 trillion consisted of government bonds, downgrades have a relatively limited impact on the outstanding amount of HQLA. The total available amount of HQLA is however affected by the issuance behaviour of governments and private entities and the market price of securities.

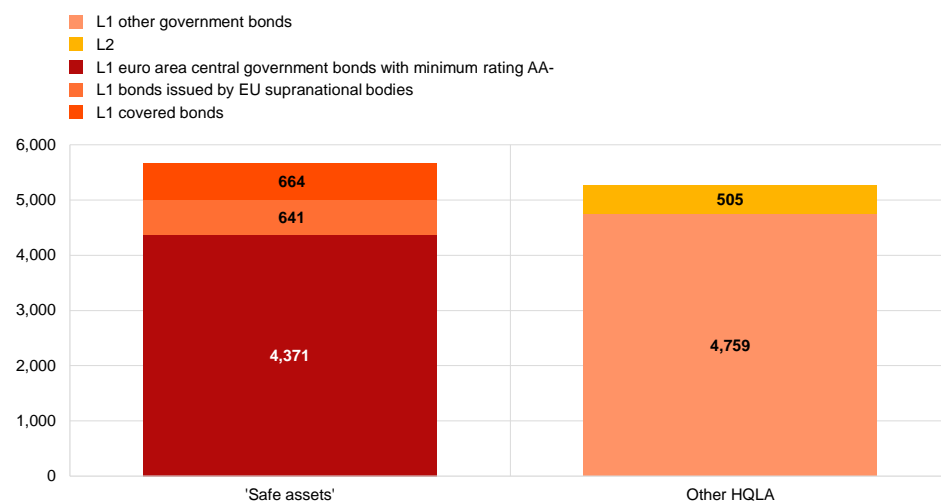
It should be acknowledged that the aggregated supply of HQLA in the euro area does not necessarily provide a representative picture of the HQLA effectively available to individual banks or banks in certain jurisdictions at all times. Indeed, the effective availability of HQLA for certain banks may be limited to a specific subset of highly rated HQLA deemed “safe assets”, i.e. highly rated debt securities and central bank excess reserves. This may be the case especially during periods of stress, when the perceived risk of different types of HQLA may differ across jurisdictions and economic agents, for example due to the risk management considerations of a specific bank or because only a subset of assets is accepted at relatively favourable conditions in repo transactions or by central counterparties (CCPs). This *flight-to-safety* phenomenon affects the relative pricing of these assets (“safe assets premium”). Stated differently, the concepts of HQLA and “safe assets” overlap extensively under normal conditions, while in stressed periods they tend to diverge since the perimeter for “safe assets” appears to be more contained than that of the HQLA definition.

To account for the relevance of this dynamic, Chart 3 compares euro area government bonds with a rating equal to or higher than AA-, bonds issued by EU supranational bodies (mostly rated AAA) and L1 covered bonds with other HQLA assets.

Chart 3

Marketable “safe assets” in a stress scenario

(EUR billions; end-Q3 2017)



Sources and notes: See Chart 1.

3 The relationship between the Eurosystem's balance sheet and the availability of HQLA

The amount and type of HQLA effectively available for the euro area banking and financial system depends not only on what is supplied by public and private entities but also on the composition of the Eurosystem's balance sheet.

On the asset side, central bank operations can affect HQLA availability through outright operations by asset purchases⁶ and credit operations by encumbering assets as collateral. As of the end of Q3 2017, the Eurosystem had absorbed €2.6 trillion of HQLA through open market operations.⁷

The composition of the liability side of the central bank's balance sheet has an impact on the availability of HQLA in the market. Among the Eurosystem's liabilities, banknotes and excess reserves are classified as HQLA: as of the end of Q3 2017, they amounted to €1.1 and €1.8 trillion respectively.⁸ While excess reserves are available only to banks, banknotes are available to all economic agents. In practice, banknotes are held mostly by the general public, with only a limited amount held by banks to accommodate the general public's demand for banknotes and not for the purpose of fulfilling the LCR requirement.⁹

The Eurosystem could in theory also provide HQLA via other, currently not employed, liquidity-absorbing instruments such as debt certificates and term deposits that are classified as HQLA (see Table 1), although this is currently not envisaged. Other liabilities of the central bank could interact with the demand for HQLA even though they do not constitute HQLA. An example of this are non-monetary policy deposits on the Eurosystem balance sheet (e.g. deposits of governments, foreign central banks and supranational institutions), which, in the current environment of excess liquidity and negative rates, have grown and stand at around €500 billion. These deposits absorb liquidity in the banking system and as such reduce the amount of excess

⁶ Both monetary policy and non-monetary policy outright operations have an impact on the availability of HQLA. As of end-Q3 2017, the non-monetary policy portfolio had absorbed roughly €0.5 trillion of marketable HQLA but, for simplicity reasons, the remainder of this study focuses on the impact of monetary policy operations only.

⁷ It should be noted that through the securities lending of holdings under the APP, public and corporate sector bonds as well as covered bonds are made available to market participants in exchange for other collateral or cash. This facility serves as a backstop to allow counterparties to alleviate (to a certain extent) securities scarcity phenomena, especially on safe assets. As such, the effect on the overall availability of HQLA in the financial system due to the Eurosystem securities lending remains broadly unchanged.

⁸ The amount of excess reserves refers to the average for the maintenance period in Q3 2017.

⁹ The demand of the general public for banknotes is actually a driver of reserve absorption. An increase in such demand would need to be satisfied by the banking system, resulting in a reduction of excess reserves if no additional liquidity is provided by the central bank.

reserves held by euro area banks.¹⁰ Despite the fact that these deposits are not classified as HQLA, they are a liquid asset of the highest quality and as such are attractive for certain risk-averse public or supranational entities. Consequently, higher non-monetary policy deposits could reduce the demand for other liquid assets (i.e. HQLA) by the holders of these deposits.

In conclusion, via both the asset and liability side of its balance sheet, the central bank affects the size and composition of HQLA portfolios of banks and other economic agents. While the current aggregated impact of central bank operations is slightly positive (absorption of €2.6 trillion and provision of €2.9 trillion of HQLA), the impact on the available amount of HQLA could change and be potentially negative in an environment with less excess reserves, depending on the composition of the asset and liability side of the central bank's balance sheet.

The following two subsections focus on the specific impact of the two types of monetary policy operations currently in place in the MPI framework: outright and refinancing operations.

3.1 Outright monetary policy operations

The central bank can influence the amount and composition of HQLA by means of outright operations.¹¹ By purchasing assets and in turn creating excess reserves, the Eurosystem:

1. increases the amount of HQLA if non-HQLA or HQLA assets with an LCR haircut are purchased;
2. upgrades the level of HQLA to L1 if L2 assets are purchased;
3. transforms marketable HQLA (securities) into non-marketable HQLA (excess reserves).

The impact of the first two factors depends on the type of assets purchased. There is no impact on the amount of HQLA outstanding when government bonds are purchased since the LCR haircuts on both government bonds and excess reserves are zero (i.e. the purchase constitutes an HQLA-neutral swap of L1 assets). In contrast, purchases of private assets increase the amount of HQLA, since haircuts are applicable to these assets in the LCR framework. Furthermore, since mostly L2A and L2B assets are purchased via private asset purchase programmes, L2 assets are

¹⁰ The increase in the level of non-monetary deposits and other autonomous factors such as banknotes explain why the increase in liquidity injected through open market operations (to €2.3 trillion through the APP and €770 billion through credit operations) does not fully equate to the increase in the amount of excess reserves held by euro area banks (to €1.8 trillion).

¹¹ Besides the impact on the amount and composition of HQLA outstanding, central bank purchases can also have an indirect impact on the aggregated LCR of the banking sector. When the Eurosystem purchases from non-banks (i.e. a non-bank is the ultimate seller), the banking sector will experience an increase in assets (central bank reserves) accompanied by an increase in liabilities (deposits from non-banks). The net positive impact on the LCR depends on the run-off rate on the deposits from non-banks (ranging from 5% for retail deposits to 100% for transactions with a maturity of less than 30 days with banks or asset managers). This effect has not been quantified in this study.

effectively upgraded to L1 assets (which are not subject to a cap in the LCR calculation). More specifically, most of the covered bonds purchased are L1 (83%), while for the corporate sector purchase programme and asset-backed securities purchase programme, most of the purchases involved L2 assets (64% and 79% respectively). Some non-HQLA assets were also purchased. Table 2 shows the impact of the APP on the amount and composition of HQLA.

Table 2
Impact of the APP on the amount and composition of HQLA

(EUR billions; end-Q3 2017)

APP	HQLA absorption				HQLA provided (L1 central bank reserves)					Net effect on HQLA due to APP			
	L1	L2A	L2B	TOT	from L1 purchases	from L2A purchases	from L2B purchases	from non-HQLA purchases	TOT	L1	L2A	L2B	TOT
Public assets	1,790	-	-	1,790	1,790	-	-	-	1,790	-	-	-	-
Private assets	174	26	51	251	192	32	94	51	370	196	-26	-51	119
TOTAL	1,964	26	51	2,041	1,982	32	94	51	2,159	196	-26	-51	119

Source: Estimate based on ECB Market Operations data.

Note: Analyses based on aggregated distribution of purchases (e.g. ratings, issuance size).

Overall, as of the end of Q3 2017, the APP had drained €2.0 trillion of marketable HQLA from the market (88% of which were government bonds). Viewed in isolation and assuming that excess reserves increased for every euro of liquidity injected, which is not necessarily the case on an aggregated level but serves to illustrate the marginal impact of operations, €2.2 trillion of non-marketable L1 assets in the form of excess reserves would have been created. In net terms, the amount of L1 and L2 HQLA increased by €119 billion due to outright monetary policy purchases (the so-called *liquidity transformation effect*). This is the cumulative effect of the creation of €196 billion of L1 assets, which is the result of the “removal” of haircuts and the upgrade to the level of HQLA (recital 1 and 2 above), and the absorption of €77 billion of L2 assets.

This relatively small impact of the APP (compared with its size) on the amount of HQLA outstanding is due to the predominant weight of government bonds in the APP. While purchases of government bonds have no impact on the level of HQLA available in the market, they do change the composition of HQLA outstanding (recital 3). By means of these purchases, the Eurosystem injects liquidity in excess of what is needed to fulfil the banking system’s needs in a balanced liquidity environment and effectively transforms *marketable* HQLA, i.e. assets available to a wide range of economic agents, into *non-marketable* HQLA, i.e. reserves only available to banks. This results in a competitive advantage for banks vis-à-vis other economic agents, both of which compete for assets that qualify as HQLA. Consequently, in the current environment, the APP increases the *scarcity* of marketable HQLA, with implications for the price of these assets.

3.2 Refinancing operations

The collateral framework of the Eurosystem consists of a broader range of assets than those classified as HQLA. With a few exceptions, euro-denominated debt securities that qualify as HQLA are eligible under the Eurosystem collateral framework. Consequently, combined with the fixed-rate full allotment procedure currently in place, the current framework provides substantial scope for individual banks to improve their LCR through *liquidity transformation*.

At an individual level, banks can improve their LCR by obtaining central bank liquidity via refinancing operations, for which a zero outflow assumption applies in the LCR calculation, and pledge non-HQLA or HQLA for which the haircut applied in the collateral framework is lower than the haircut in the LCR framework.¹² This will have a positive impact on the LCR of a bank if these funds are subsequently held at the central bank (excess reserves¹³). There is also a positive impact when the proceeds are invested in ways that have a nearly equal positive impact on the LCR (“LCR-friendly” investments), i.e. purchasing of marketable HQLA or lending funds for a period shorter than 30 days (which decreases the net outflows – i.e. the denominator – in the LCR calculation).¹⁴

At an aggregate level, refinancing operations increase the amount of HQLA outstanding if non-HQLA or HQLA with a haircut lower than that of the LCR framework are pledged. This holds regardless of what individual banks do with the funds obtained. The focus of this study is specifically on the aggregate impact of refinancing operations on HQLA availability.

The left-hand side of Chart 4 shows the HQLA classification of collateral pledged in refinancing operations with the Eurosystem. The chart shows that L1 assets comprise 32% of the €1.6 trillion of total collateral pledged.¹⁵ By contrast, the amount of L2 assets pledged is small and stands at 3%. The remaining 65% of assets pledged are non-HQLA and consist of both marketable and non-marketable assets. The right-hand side of Chart 4 shows a more detailed breakdown of assets pledged as collateral for refinancing operations. This chart also illustrates the potential for *liquidity transformation* by showing the range of non-HQLA assets that can be pledged in refinancing operations, the largest proportion of which is formed of credit claims (non-marketable) and retained ABS and covered bonds.

¹² While a 0% outflow assumption applies to refinancing operations, for central bank operations with a maturity below 30 days, the positive effect of accepting non-HQLA collateral can be reduced at certain critical values because of the unwind mechanism (see Paragraph 3 of Annex I of the EU Delegated Act).

¹³ As stated above, reserves in excess of minimum reserve requirements are eligible as HQLA (based on an agreement between the ECB and competent authorities).

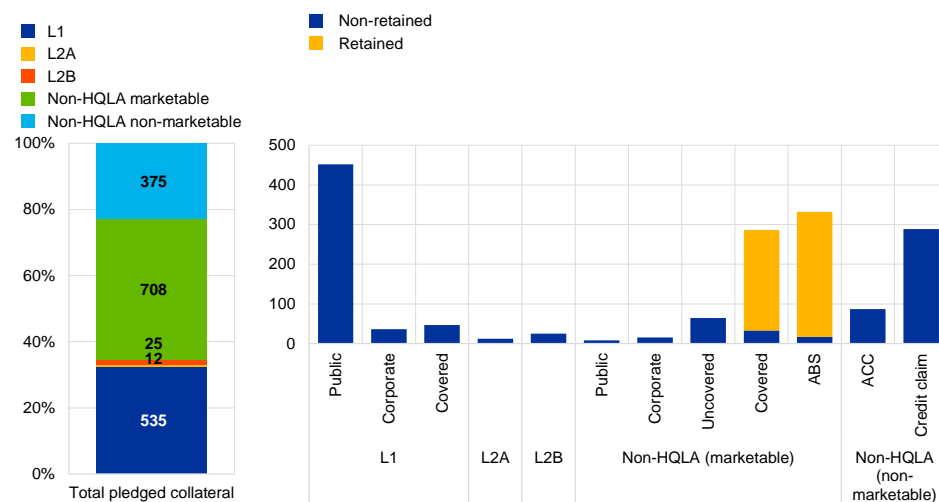
¹⁴ The incentive to hold excess reserves obviously depends on the opportunity cost versus alternative ways to fulfil the LCR requirement, such as holding government bonds and lending funds in the short term, the latter of which reduces the net outflows and hence improves the LCR unless inflows are above 75% of outflows (see also Bech and Keister, 2017). However, the relative attractiveness of holding excess reserves is not only linked to the LCR but also to changes in market risk perception (i.e. the attractiveness of reserves versus unsecured money market transactions), the overall higher demand from economic actors for (a subset of) HQLA and the impact of other factors such as capital regulation.

¹⁵ Value after Eurosystem collateral framework haircuts.

Chart 4

HQLA classification of pledged collateral (left chart) and its asset type distribution (right chart)

(EUR billions; end-Q3 2017)



Sources: EADB for securities classification, the Use of Collateral Database (UCDB) for outstanding amount and the Register of Institutions and Affiliates Database for information on retained assets.

Note: Retained assets are assets originated by the bank that pledges these assets as collateral.

When assessing the impact of refinancing operations on the amount of HQLA outstanding, it is important to note that there could be a (small) negative effect on the amount of HQLA outstanding if government bonds are pledged as collateral. Under the Delegated Regulation, encumbered HQLA are excluded from the calculation of the LCR. This also applies to HQLA encumbered for central bank refinancing operations, i.e. HQLA economically needed to collateralise central bank funding. Furthermore, in contrast to the haircuts in the LCR framework, a haircut on government bonds is applicable in the collateral framework of the Eurosystem, ranging from 0.5% to 13% depending on the rating of the specific government bond.

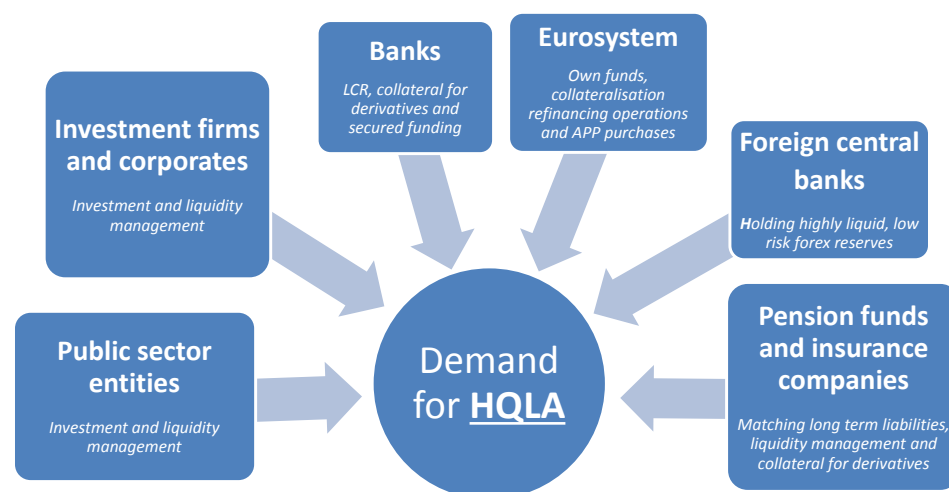
The LCR framework follows the *encumbrance rule*, which prioritises the encumbrance of assets in the following order: non-HQLA first, L2 second and L1 third. According to the mechanics described above, the Eurosystem creates HQLA when refinancing operations are *effectively* collateralised by non-HQLA. “Effectively” means up to the amount of the funding received (i.e. regardless of encumbrance in a legal sense). Based on data at the individual bank level and assuming, for the sake of simplicity, that one euro of liquidity provided through refinancing creates one euro of excess reserves, the total increase in the stock of HQLA due to refinancing operations is around €633 billion, which represents the *liquidity transformation effect*. This effect relates to the pledging of non-HQLA (€641 billion), while the impact of haircuts was slightly negative (–€8 billion). Due to the *encumbrance rule*, only €137 billion of HQLA are encumbered through Eurosystem refinancing operations. This is the difference between the amount of outstanding refinancing operations (€770 billion) and the *liquidity transformation effect* (€633 billion).

4 Overview of HQLA held by banks and other economic agents

Banks are not the only economic agent that can hold HQLA. Consequently, banks compete for assets that qualify as HQLA with other economic agents. The driving factors behind the demand for HQLA can differ between banks and other agents (see Figure 1), for example because of the specific regulatory requirements they are subject to (e.g. LCR, EMIR). The amount of HQLA economic agents ultimately hold depends, among other factors, on their price sensitivity resulting from existing regulation, the relative return on alternative investment opportunities and their perception of risk.

Figure 1

Overview of economic agents demanding HQLA and their motivation



In this section we provide a quantitative overview of HQLA holdings in different economic sectors and also show banks' holdings of HQLA across jurisdictions and time.¹⁶

Chart 5 shows that banks hold roughly €3.8 trillion of HQLA, of which excess reserves and government bonds each represent around 47% (€1.8 trillion). Around 4% of the HQLA portfolio is composed of L1 and L2 covered bonds (€168 billion); the remaining 2% is composed of other assets.¹⁷

¹⁶ The analysis is based on the Securities Holdings Statistics by Sector (SHS-S) database, which encompasses granular information on holdings of individual ISINs by euro area residents and by foreign investors that deposit their assets with euro area custodians and Eurosystem holdings.

¹⁷ Please note that for the banking sector: (i) the effect of asset encumbrance in refinancing and other operations and of borrowed HQLA is not taken into account due to data limitations; (ii) excess reserves also include excess reserves held by branches with a non-euro area parent.

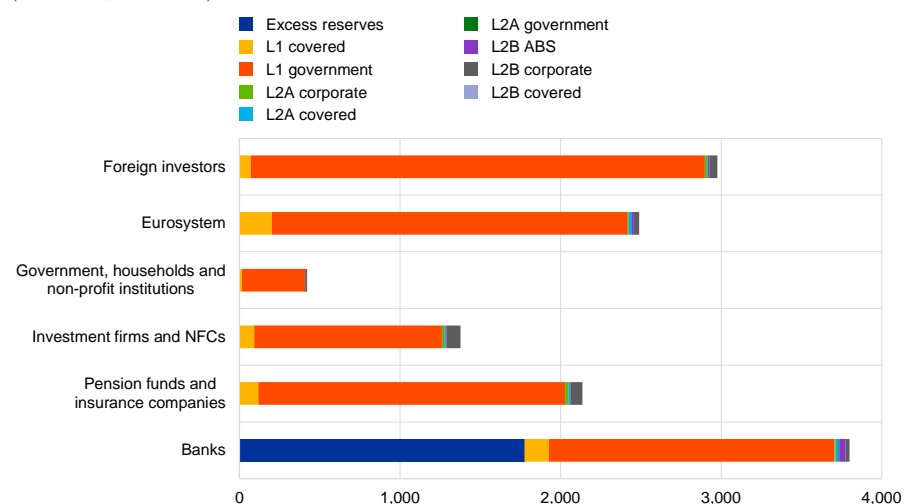
The Eurosystem holds €2.5 trillion of outright assets that count as HQLA in both monetary and non-monetary policy portfolios, most of which are purchased under the APP. Out of these holdings, government bonds amount to €2.2 trillion (89%) and L1 covered bonds €0.2 trillion (9%). L2B corporate bonds and ABS make up less than €0.1 trillion (2%).

Besides banks and the Eurosystem, non-euro area investors are the largest holders of euro-denominated HQLA (€3.0 trillion), followed by insurance companies and pension funds (€2.1 trillion). These holdings consist mostly of government bonds (95% and 90% respectively); in absolute cumulative amounts, these economic agents hold fewer covered bonds than banks.

Chart 5

Outright holdings of HQLA by economic sector

(EUR billions; end-Q3 2017)



Sources: SHS-S dataset for amounts of securities holdings. EADB and CSDB for classification and grouping. Excess reserves refer to the average in the maintenance period up to the end of Q3 2017.

Notes: This chart shows a higher amount of HQLA than the total supply of HQLA shown in Chart 1 because of the inclusion of excess reserves and HQLA absorbed by the central bank. Investment firms include money market funds, other financial corporates and financial vehicle corporations. Foreign investors refer to those whose bond holdings are deposited at euro area custodians. Malta is not included for confidentiality reasons.

Chart 6 shows the breakdown of HQLA holdings of banks by jurisdiction. As for higher-rated jurisdictions, excess reserves cover a large portion of the HQLA portfolio in Germany (50%), France (60%) and the Netherlands and Belgium (average across the latter two jurisdictions: 61%). In lower-rated jurisdictions, banks hold government bonds rather than excess reserves as liquid assets. In Italy, for instance, 66% of the HQLA portfolio is made up of government bonds and only 21% of the portfolio consists of excess reserves. In Spain and Portugal, government bonds account for 51% of HQLA holdings (average across the two jurisdictions), while excess reserves represent 22% of the HQLA portfolio¹⁸. Holding excess reserves is especially attractive if the return on other *LCR-friendly* investment opportunities – such as money market instruments or short-term (domestic) government bonds – is lower than the

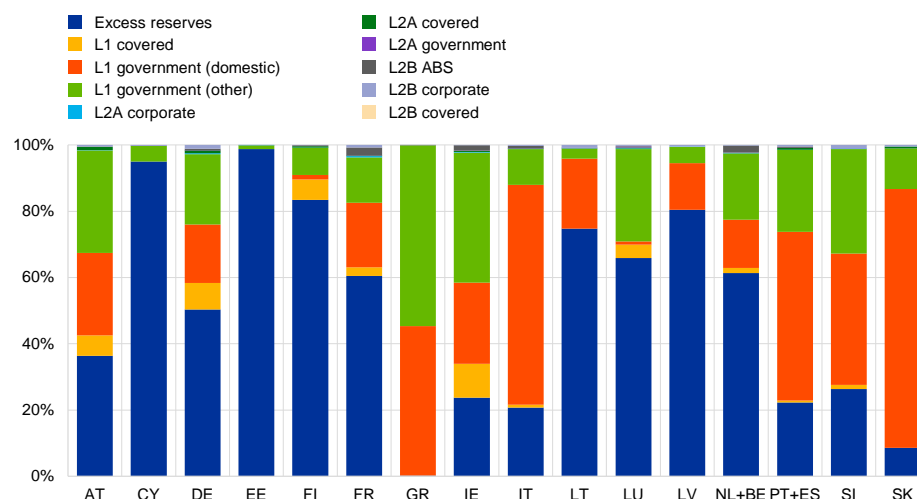
¹⁸ Baldo, L., Hallinger, B., Helmus, C., Herrala, N., Martins, D., Mohing, F., Petroulakis, F., Resinek, M., Vergote, O., Usciati, B. and Wang, Y. (2017), "The distribution of excess liquidity in the euro area", *Occasional Paper Series*, No 200, ECB, Frankfurt am Main, November.

deposit facility rate, also taking into account the risk-free nature of central bank reserves.

Chart 6

HQLA holdings of banks by jurisdiction

(EUR billions; end-Q3 2017)



Source: see Chart 5.

Notes: Domestic government bonds include bonds issued by the central or regional government of the country where the bank is resident. "Other" government bonds include government bonds issued by another Member State of the euro area, by international organisations, public sector credit institutions, promotional banks and multilateral development banks. MT is not included for confidentiality reasons. NL and BE, as well as PT and ES, were combined for confidentiality reasons. Holdings by jurisdiction also include excess reserves held by branches with a non-euro area parent.

Chart 7 shows the evolution of HQLA holdings by banks since the start of the APP, which also roughly corresponds with the phasing-in period of the LCR requirement for banks (60% as of 1 October 2015 to 100% as of 1 January 2018). The amount of HQLA held by banks significantly increased from €2.4 trillion to €3.8 trillion. The increase can largely be explained by the increase in excess reserves (€1.6 trillion) and a moderate reduction in government bond holdings (–€0.2 trillion).

These findings suggest that excess reserves, which are partially exogenous for banks (i.e. supply-driven through the APP), have become an important component of HQLA held by banks in many jurisdictions. The increase in HQLA holdings has been accompanied by a decline in government bonds in banks' portfolios in a time of increasing government debt outstanding. Interestingly, while the amount of government bonds held by banks slightly increased up to early 2016¹⁹, between Q2 2016 and the end of Q3 2017 euro area banks gradually reduced their government bond holdings by a total of 14% (€300 billion).

Generally speaking, preferences for different types of HQLA depend on the terms and conditions economic agents (banks and non-banks) are willing (or forced) to accept and alternative investment opportunities. Economic agents face different levels of price sensitivity, which may explain why some economic agents (non-EA entities, for

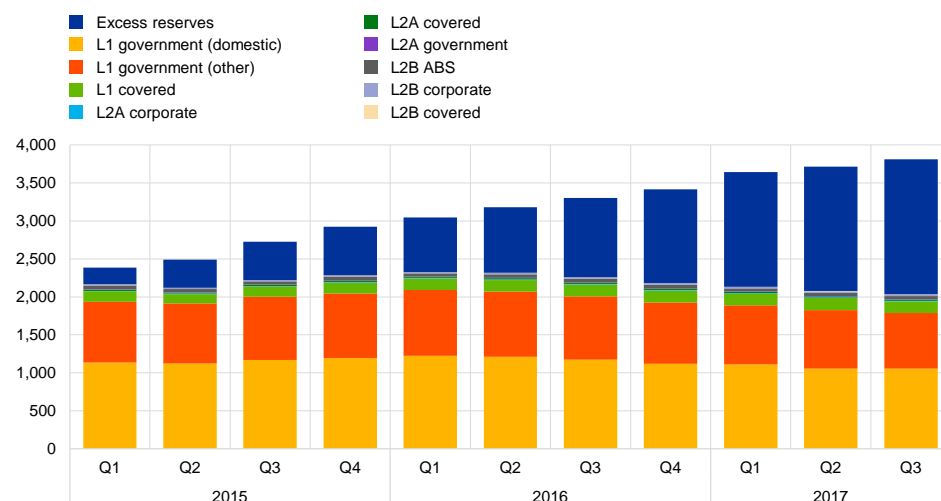
¹⁹ These findings are in line with Kojien, Koulischer, Nguyen and Yogo (2018), "Quantitative Easing in the Euro Area: The Dynamics of Risk Exposures and the Impact on Asset Prices", *Working Paper Series*, Revised WP No 601, Banque de France, February.

instance) have been more willing to sell HQLA to the Eurosystem under the APP compared with others.

Chart 7

Evolution of HQLA holdings of euro area banks

(EUR billions; from Q1 2015 to Q3 2017)



Sources and notes: See Chart 5. Excess reserves refer to the average for the maintenance period up to the respective quarter end. Holdings also include excess reserves held by branches with a non-euro area parent.

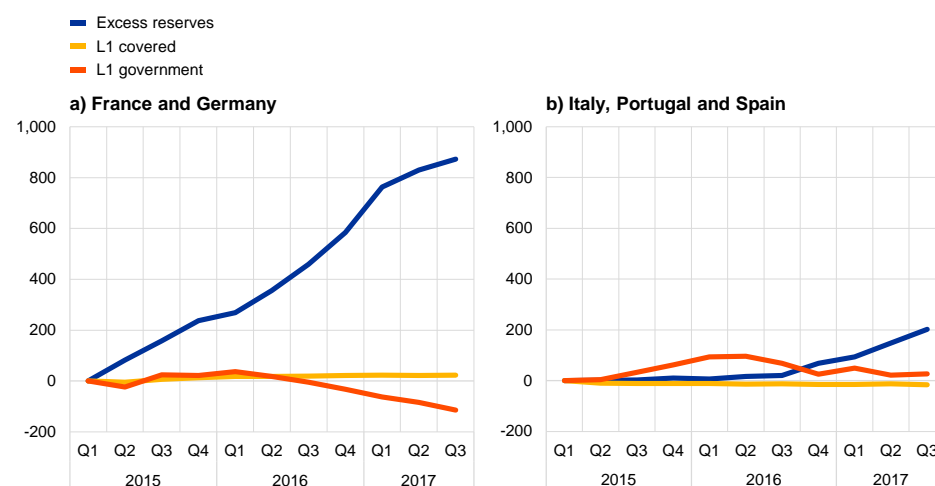
Chart 8 shows the evolution in sub-components of L1 HQLA holdings of the banking sector in some euro area jurisdictions. In particular, in the time span covered in this study, the amount of excess reserves accumulated in higher-rated jurisdictions (e.g. cumulative increase of €873 billion in France and Germany)²⁰ is higher than in lower-rated jurisdictions (e.g. cumulative increase of €202 billion in Italy, Spain and Portugal). In France and Germany, this development is mirrored, albeit to a lesser extent, by a cumulative decline in government bond holdings of €117 billion, while government bond holdings in Italy, Spain and Portugal increased by €26 billion. These findings seem to suggest that a sizeable accumulation of excess reserves moderately incentivise banks to gradually decrease their holdings of government bonds. This would be in line with economic theory suggesting that banks start reducing other HQLA asset holdings once HQLA buffers turn uneconomically large due to excess reserves.

²⁰ These numbers are biased upwards given that excess reserves held by branches of non-EA banks (such as UK banks) are also included.

Chart 8

Evolution of HQLA holdings of banks in France and Germany (a) and in Italy, Portugal and Spain (b)

(EUR billions; from Q1 2015 to Q3 2017)



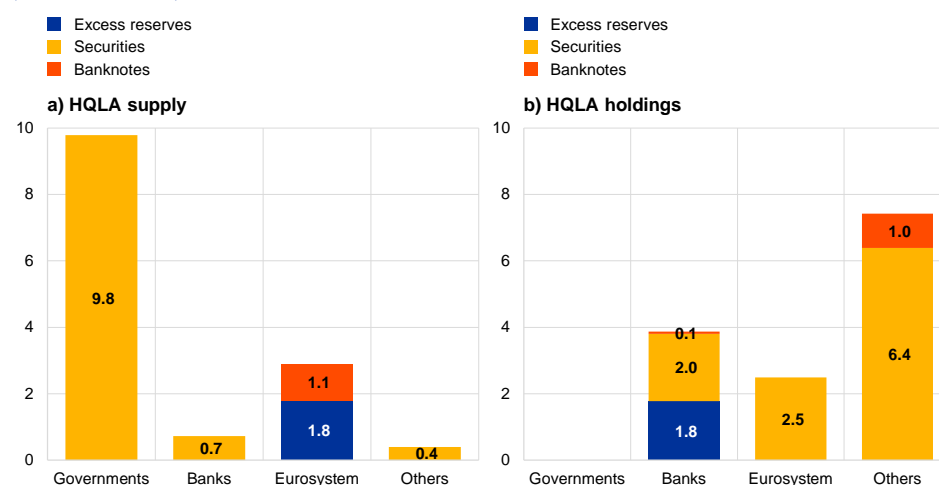
Sources and notes: See Charts 5 and 7.

Chart 9 provides an overview of the HQLA supply and holdings of four categories of economic agents: governments, banks, the Eurosystem and other agents based on evidence reported so far. In particular: (i) Section 2 focused on the supply of HQLA by governments and private entities and here too, HQLA issuance is split between banks and other agents; (ii) Section 3 introduced the role of the Eurosystem, which, from the viewpoint of other economic agents, both absorbs and provides HQLA; (iii) this section showed the holdings of HQLA for different economic agents.

Chart 9

Overview of supply (a) and holdings (b) of HQLA of different economic agents

(EUR billions; Q3 2017)



Notes: (a) the amount of Eurosystem holdings of HQLA herein reported includes securities under both the APP (€2.0 trillion) and the non-monetary policy portfolio (€0.5 trillion); by contrast, the amount of HQLA effectively encumbered through refinancing operations is not taken into account (€137 billion); (b) for simplicity, it is assumed that government holdings of marketable HQLA are negligible; (c) the amount of banknotes held by the banking sector is the amount of vault cash reported in their balance sheets (Eurosystem SDW source).

5 Demand for HQLA due to the LCR and other factors

This section first estimates banks' demand for HQLA due to the LCR. Second, it analyses two other important structural changes in the last decade that increased demand for HQLA in the euro area. These are the OTC derivatives reform and the stronger role of the secured segment in euro area money markets (driven by both regulation and higher risk aversion).²¹

5.1 HQLA demand from the banking sector due to the LCR

Estimating the amount of HQLA needed by the euro area banking system in order to be LCR-compliant is challenging for three reasons: (i) no detailed supervisory data are publicly available for all banks; (ii) banks tend to be over-compliant and the desired level of over-compliance is unknown; (iii) banks can improve their LCR by altering their funding profile instead of increasing their holdings of HQLA.

Given the above-mentioned challenges, the results from a recent EBA study²² have been used to estimate the demand for HQLA due to the LCR. Based on a representative sample of European Economic Area (EEA) banks, the EBA estimates that the aggregated LCR ratios of banks in the EEA was 139% as of the end of Q4 2016, corresponding to HQLA of 14% as a share of total assets.²³ Hence, taking an aggregate perspective, it seems that no additional demand for HQLA should be expected to cover LCR shortfalls. As reported in Section 4, our estimates show that euro area banks held about €3.4 trillion of HQLA (including central bank excess reserves) as of the end of Q4 2016 (see Chart 8). If we consider 139% a reliable estimate of the aggregated LCR²⁴, HQLA holdings of the euro area banking sector of around €2.5 trillion would correspond to an aggregated LCR of 100%.²⁵ In practice, however, banks tend to target an LCR ratio higher than 100% to account for volatility of

²¹ The purpose of this section is not to include an exhaustive list of factors driving HQLA demand from banks and other economic agents, but simply to provide some examples that are generally deemed relevant in this respect.

²² [EBA report](#) on liquidity measures under Article 509(1) of the CRR (18 December 2017).

²³ No UK banks were included in the sample, and all banks except one were LCR-compliant (shortfall of €0.12 billion).

²⁴ While the EBA study also includes data from non-EA banks, a (very) large portion of assets reflect activities in the euro area (since UK banks are not included either). The aggregated LCR from the sample can therefore serve as a proxy for the aggregated banking sector in the euro area. The EBA sample covers both large and small institutions and, in terms of total assets, accounts for 61% of the EU banking sector. 21 of the 134 banks are non-EA banks. Most of the large non-EA banks in the sample are banks incorporated in Sweden and Norway, the assets of which partly relate to activities in the EA. The other non-EA banks (e.g. from the Czech Republic, Hungary and Poland) are small and have a limited impact on the aggregated figures. Furthermore, an LCR ratio of 139% as of Q4 2016 seems broadly consistent with the numbers [published](#) by the SSM on LCR ratios for SIs.

²⁵ €3.4 trillion divided by 1.39. A proxy based on HQLA as a share of total assets from the EBA study (14%) and total assets of the banking system (approx. €26 trillion) results in almost the same estimate of €2.6 trillion.

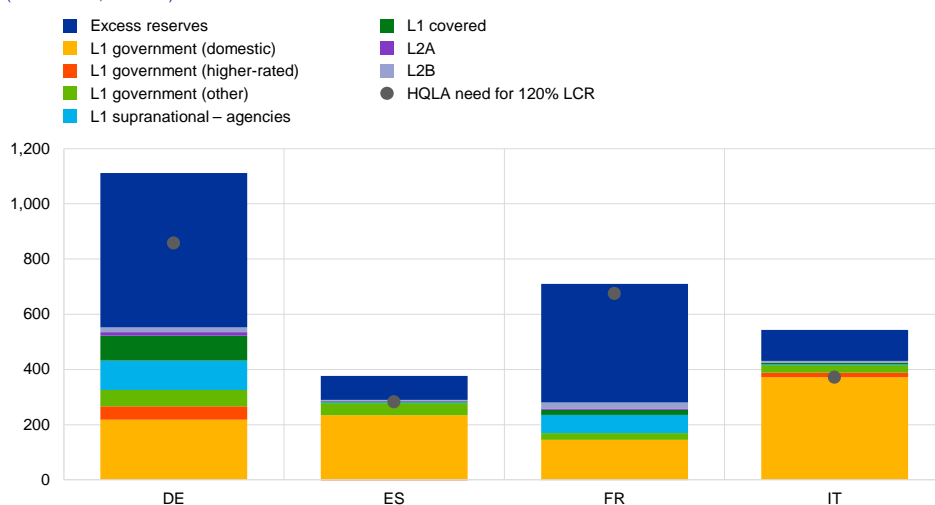
liquidity outflows and to build in a safety buffer to avoid being non-compliant on reporting days.²⁶ In order to cater for over-compliance, we estimate that the holdings correspond to an aggregated LCR of 120% or just under €3 trillion.

In addition, the evolution of the LCR ratio is also determined by banks' net liquidity outflows, the market value of HQLA and several other factors, including monetary operations of the Eurosystem. The EBA report on the LCR as of the end of 2017²⁷ shows that banks have mainly improved their LCR in recent years by increasing their HQLA as a share of total assets. Thus, we can reasonably assume that outflows stayed largely unchanged in 2017. Against this backdrop, we can estimate the LCR ratio of the aggregated euro area banking system as of the end of Q3 2017 as the ratio of HQLA held by the banking sector (€3.8 trillion minus €137 billion of HQLA encumbered through refinancing operations) to net outflows (€2.5 trillion), resulting in an LCR of just under 150%.²⁸ This level is consistent with LCR figures for significant institutions provided by ECB Banking Supervision, which reported an aggregated LCR of about 144% in Q4 2017, in particular if smaller banks are added since they tend to have higher LCR ratios than larger banks.²⁹

Chart 10

HQLA holdings of banks in France, Germany, Italy and Spain, and estimated HQLA needs for a 120% LCR level

(EUR billions; Q3 2017)



Sources: SHS-S dataset for amounts of securities holdings. EADB and CSDB for classification and grouping. SNL Financial for LCR levels.

Notes: Domestic government bonds include bonds issued (or guaranteed) by the central or regional government of the country where the bank is resident. "Higher-rated" government bonds include bonds issued by euro area governments with an S&P long-term rating higher than or equal to AA. Excess reserves refer to the average in the maintenance period up to the end of Q3 2017. Holdings by jurisdiction also include excess reserves held by branches with a non-euro area parent. Country-level LCRs in 2017 are computed as a weighted average of individual LCR levels weighted by banks' total assets. LCR ratios are based on consolidated data (and hence also include assets from foreign subsidiaries).

²⁶ These internal targets for the preferred level of over-compliance are rarely disclosed, and market analysts do not appear to have a minimum LCR ratio in mind. However, there is a certain consensus that banks aim for some over-compliance.

²⁷ EBA report on liquidity measures under Article 509(1) of the CRR (18 December 2017).

²⁸ This is consistent with the increase in the LCR for significant institutions between 2016 and 2017 as published by the SSM (ECB Annual Report on supervisory activities, 2017, Chapter 8).

²⁹ See, for example, EBA March 2018 for details on LCR levels differentiated by size, where the groups of banks with Tier 1 capital below or equal to €3 billion show higher LCR levels than the aggregated level.

LCR ratios at country level differ slightly from the euro area aggregate. Applying the methodology described above, we compare the holdings of HQLA of the banking system of a specific jurisdiction with the HQLA needs corresponding to an LCR compliance level of 120%. Chart 10 shows that in the four largest jurisdictions of the euro area, the aggregated LCR ratio is above 120%. Estimates for German and French banks, which hold large shares of excess reserves, show that in an environment with less sizeable excess reserves, these banks may need to hold more marketable HQLA or decrease net outflows in order to obtain an LCR ratio equal to or higher than 120%.

5.2 HQLA demand from the financial system due to the EMIR

The EMIR implements the 2009 G20 commitment to improve transparency, prevent market abuse and reduce counterparty and systemic risks in the OTC derivatives market in the EU.³⁰ Key elements of this regulatory reform include promoting the central clearing of standardised OTC derivatives contracts and new margin requirements for OTC contracts that continue to be cleared non-centrally. This section estimates the impact of the EMIR on demand for collateral, i.e. the amount of assets absorbed due to collateralisation of OTC derivative transactions, with a focus on those assets qualifying as HQLA when possible.

To estimate how much collateral is currently absorbed by the euro area OTC derivatives market³¹, we used public information from the Bank for International Settlements (BIS), International Swaps and Derivatives Association (ISDA) and European Securities and Markets Authority (ESMA) as of the beginning of 2017. According to our estimates (see Annex and Chart 11):

- the maximum amount of collateral potentially needed for hedging the counterparty risk embedded in all OTC derivatives positions in the euro area is equal to €930 billion;
- the effective amount of collateral absorbed by the euro area OTC derivatives market is around €701 billion: most collateral is exchanged in bilateral transactions and relates to variation margins; the estimate neglects the possibility of collateral re-use and re-hypothecation.³²

³⁰ See [Regulation \(EU\) No 648/2012](#). At the 26 September 2009 summit in Pittsburgh, G20 leaders agreed that all standardised OTC derivative contracts should be cleared through a CCP by the end of 2012 and that OTC derivatives contracts should be reported to trade repositories.

³¹ Regrettably, data availability did not allow for determining the share of the banking sector in the total demand for collateral.

³² Through re-hypothecation of client assets and collateral re-use, securities can in principle be used multiple times to collateralise different derivatives (and, in general, securities financing) transactions, increasing the effective supply of collateral assets for a given stock of securities. Re-hypothecation and collateral re-use can therefore increase the availability of securities collateral and thereby mitigate both transitory and longer-term pressures on collateral supply. While collateral pledged for variation margins may be used multiple times, many initial margins will not be permitted for re-hypothecation (initial margins are only allowed to be re-hypothecated once for non-cleared derivatives transactions).

To provide an overview of the type of collateral needs stemming from the OTC derivatives market in the euro area, we will focus on the role of initial and variation margins. The rationale behind the preference for using a certain type of collateral for initial or variation margins depends on the regulation for these requirements. Initial margins are required to be bankruptcy-remote, and securities prove to be adequate for this purpose. Conversely, cash is a more flexible instrument to cover daily mark-to-market movements and, as such, is the primary form of collateral used for variation margins.

According to an ISDA survey on bilaterally margined transactions, on aggregate, about 73% of the total margin consists of cash and 22% of government securities. As for cleared transactions, evidence on collateral type pledged at CCPs was taken from balance sheet data of LCH Group only³³: they show that cash margins represent 48% of the total margin pledged at this CCP. In this light, assuming that the proportion of the non-cash margin is the same for both cleared and non-cleared transactions, we estimate the amount of cash and government bonds used for EMIR compliance purposes. As the share of HQLA cannot be separated from the total margins needed for collateralising CCPs or bilateral positions, we assume that the minimum amount of HQLA required for EMIR compliance purposes is composed of government bonds pledged to cover initial margins (€93 billion) and variation margins (€101 billion) due on cleared and non-cleared OTC derivatives transactions. This stands at €194 billion (lower part of Chart 11) and represents a realistic lower limit of HQLA demand absorbed by this market segment. The maximum amount of HQLA needed as collateral, assuming that only HQLA will be used as collateral, would be equivalent to the effective amount of collateral used in the euro area OTC derivatives market (€701 billion).

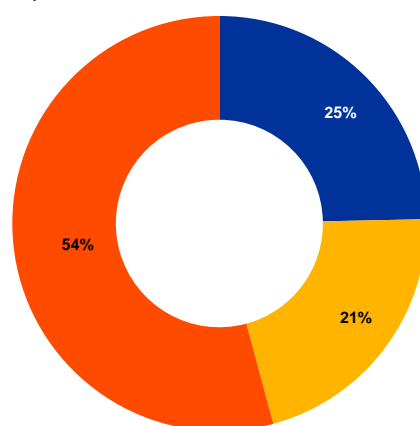
³³ LCH Group includes both LCH SA and LCH Ltd; both CCPs are authorised by the ESMA to clear OTC derivatives transactions under the EMIR. LCH is the leading CCP worldwide in clearing IRS transactions; as such, LCH balance sheet data can be considered representative for this OTC derivatives class.

Chart 11

Maximum collateral needs (a) and effective collateral absorption (b) in the euro area OTC derivatives market

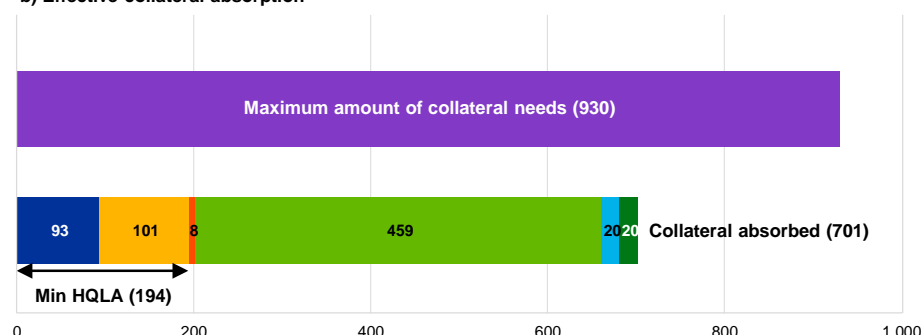
(EUR billions)

a) Maximum collateral needs



Govies IM
 Govies VM
 Cash IM
 Cash VM
 Other IM
 Other VM

b) Effective collateral absorption



OTC derivatives – collateralized vs non-collateralized	
Non-collateralised	229
Collateralised	701
o/w through CCP	197
- initial margin	78
- variation margin	118
o/w bilaterally	504
- initial margin	43
- variation margin	461
Maximum collateral needs	504

Sources: Estimates based on: (i) BIS semi-annual statistics for global OTC derivatives market as of the first half of 2017; (ii) ISDA margin survey 2017; (iii) ESMA report on EU derivatives markets, a first time overview, 2017; (iv) GDP data as of the end of 2016 from Eurostat. Note: See Annex for the methodology.

Consequently, the effective demand for assets that qualify as HQLA due to derivative transactions ranges from €194 billion to €701 billion.

In February 2016, the phasing-in period for the implementation of EMIR provisions relating to the clearing obligation and margin requirements began. The clearing obligation for OTC derivatives transactions with non-financial counterparties became fully operational in December 2018, while the initial margin requirements for non-cleared transactions will be phased in completely as of September 2020. In this light, the additional amount of collateral absorbed by the OTC derivatives market in the next couple of years is expected to increase, but only to a limited extent since most of the EMIR requirements have already been implemented.

An additional factor that could have a material impact on collateral needs for derivative transactions is pension funds, which are currently exempt from central clearing

obligations. This exemption has been extended to at least 2020.³⁴ CCPs currently require market participants to pledge collateral in cash (especially for variation margins), which pension funds do not tend to hold because of their low liquidity needs and long-term investment horizon. As pledging cash as collateral for centrally cleared derivative transactions could have a substantial negative impact on their returns, pension funds are currently exempt from this requirement. It has been proposed that pension funds could also pledge assets instead of cash as collateral. Should this proposal become operational, the demand for HQLA from pension funds could increase.

5.3 Effects of secured money market activity on HQLA demand

A structural feature of the financial crisis has been an increase in risk aversion, which, in the euro area money markets, has caused volumes in the unsecured segment to dry up and the repo market to become progressively more important. The [ICMA European Repo Market Survey published in October 2017](#) shows that almost 98% of collateral used in the secured market qualifies as HQLA, mainly (around 90%) general government bonds and supranational bonds.

In the secured money market segment, two main drivers of repo transactions can be distinguished, which originate *cash-driven* or *collateral-driven* transactions. Through *cash-driven* repo operations, cash lenders can collateralise their exposure and thereby mitigate the counterparty risk of the borrower, allowing cash borrowers to borrow at lower rates. However, the repo market is also a place for transactions such as securities lending or collateral swaps, which qualify as *collateral-driven* transactions. High excess liquidity, a lower free float of APP-eligible securities and potentially higher demand for collateral fostered by regulation have pushed *collateral-driven* transactions towards a predominant role in the repo market, through which market participants look for specific securities. The effect of repo transactions on the availability of HQLA for the broader financial system and, more specifically, for the banking sector depends on the type of asset exchanged in the transaction, on counterparties involved and on margins and haircuts applied to the transaction.³⁵

For collateral versus collateral transactions, i.e. two offsetting repo transactions conducted at the same time, there is no impact on the overall availability of HQLA if HQLA securities are exchanged. If the transaction instead involves an exchange of HQLA with non-HQLA, the impact on the total availability of HQLA for the financial system remains unchanged while, from the banking system perspective, it increases/decreases when a bank lends/borrows HQLA through a transaction with a non-bank.

³⁴ The European Parliament has agreed to extend the temporary derogation from the mandatory clearing of derivatives for a further two years for a large majority of pension scheme arrangements (which could be extended by a further year) and for three years for small pension scheme arrangements (which could be extended by two further years). See [press release](#) for further details.

³⁵ In this paper we focus only on first-round effects, i.e. price effects are neglected.

Conversely, in a security versus cash transaction, the effect on the stock of marketable HQLA held by the banking sector depends on the counterparty involved in the transaction (i.e. a bank or non-bank). If a repo (or reverse repo) transaction is conducted between two banks or two non-banks, the net impact on the total availability of HQLA for the banking or non-banking sector is zero, as the cash leg generates offsetting changes in reserve accounts of banks at the central bank (i.e. the total amount of central bank reserves is unchanged), and the security leg simply transfers the security from one counterparty to the other, thus leaving the overall amount of marketable HQLA unchanged. By contrast, when a repo (or a reverse repo) transaction is initiated by a bank with a non-bank, the security leg results in a reduction (increase) of marketable HQLA in the banking sector, while the cash received will be deducted from the reserve account balance of another bank where the non-bank has the account, i.e. the cash leg has no impact. From the perspective of the broader financial system, the total amount of HQLA outstanding stays unchanged, i.e. the repo market merely redistributes HQLA. However, since on aggregate the banking sector tends to be a net receiver of cash in secured short-term funding, banks have a net demand for securities to provide collateral to their non-banking counterparties.

Collateral re-use is permitted in the European repo market, meaning that HQLA used in a secured transaction are not locked up in the agent's portfolio but can potentially be used again in the market. However, according to EU Regulation 2365/2015 (Article 15), minimum transparency conditions apply when collateral is re-used, such as disclosure of the risks and the obligation to acquire prior consent. Such requirements together with evidence reported in recent studies³⁶ appear to suggest that the effective share of collateral re-use is not substantial in the secured market.

A complete picture of the repo market and its implications for HQLA availability requires mentioning the role of margins and haircuts. Margins and haircuts are applied in bilateral and centrally cleared secured transactions and are designed to cover counterparty credit and market risks.³⁷ When involving cash or HQLA, they *de facto* erode the amount of HQLA that is available in the market; this effect is amplified (i.e. the erosion of collateral increases) when collateral is re-used.

An additional aspect to take into account is that, generally speaking, higher activity in the repo market requires a higher stock of marketable HQLA for the repo market to function properly. To better understand this, we consider two theoretical scenarios:

- money market activity is fully concentrated in the unsecured segment: in this case, banks and non-banks have no need for marketable HQLA for their borrowing and lending; thus, the amount of marketable HQLA available is irrelevant for money market functioning;

³⁶ A recent report by the Financial Stability Board on collateral re-use (2017) shows that the share of collateral re-use for a sample of major international global banks roughly amounts to only 20% of total assets (having dropped from 30% in the wake of the global financial crisis). M.L. Fuhrer et al. (2016) carried out an analysis on the Swiss repo market showing that less than 5% of transaction volumes involve re-used securities and highlighting that this share tends to increase with the scarcity of collateral.

³⁷ Prior to the sovereign debt crisis, for example, CCP collateral haircuts on bonds issued by different jurisdictions in the euro area applied by LCH SA stood at roughly 5% (see ESMA/2016/1415 report on Securities Financing Transactions and leverage in the EU for historical data); in 2018 they ranged from 0.5% to 6.0% depending on the issuer rating (see LCH SA website).

- money market activity is fully concentrated in the secured segment: in this case, both banks and non-banks would need to rely on a certain stock of marketable HQLA for their borrowing and lending; therefore, a reduction in the supply of marketable HQLA would have an impact on money market activity if the overall supply is below the aggregate stock of securities needed for repo market transactions.

To sum up, the use of marketable HQLA in repo transactions requires some *stock of marketable HQLA* to be available for the secured market to function properly, also given the limited re-use of collateral. Additionally, demand for HQLA increases because of margins and haircuts, which tend to erode the amount of HQLA in the financial system. However, if we ignore the effect of margins and haircuts, the overall amount of HQLA in net terms in the financial system is not affected by repo activity in the sense that secured transactions mobilise both securities and cash. In this respect, the secured money market segment is important for facilitating the circulation of collateral within the financial market. This conclusion sheds a different light on demand for HQLA due to repo transactions than previous studies³⁸, which suggest that repo transactions create substantial demand for HQLA and imply that these securities are subsequently “absorbed”, thus neglecting the importance of collateral mobilisation of the repo market.

Nonetheless, from the banking system perspective, the availability of HQLA could crucially change if repo transactions are conducted with a non-bank entity. This could exacerbate collateral scarcity in a context where most of the transactions are collateral-driven and banks tend to be net receivers of cash.

³⁸ See, for example, Capel and Levels (2012).

6 HQLA availability in an environment with less sizeable excess reserves

A closer look at the balance sheet of the Eurosystem (Section 3) shows that central banks' operations can have a profound impact on the availability of HQLA in the financial system. Consequently, the design of the Eurosystem's MPI framework influences the composition and, to a certain extent, the size of HQLA portfolios of different economic agents and, in particular, of banks.

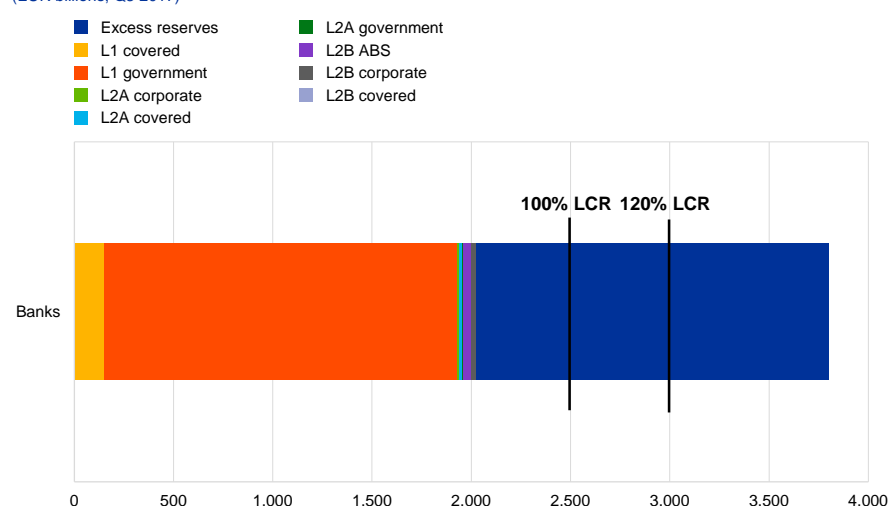
Against this backdrop, and based on the quantitative analyses in Sections 2, 3 and 4, this section provides some food for thought with respect to possible implications for HQLA holdings of euro area banks in an environment with less sizeable excess reserves.

As shown in Section 4 and in Chart 12 below, almost 50% of the HQLA held by euro area banks currently consist of excess reserves. These reserves are partially exogenous for the banking sector, i.e. supply-driven through the APP. If the amount of excess reserves (comprising non-marketable HQLA available only to banks) decreases, banks will have to compete more with non-banks for marketable HQLA in order to obtain HQLA in sufficient amounts to fulfil the required (100%) or desirable (e.g. 120%) LCR level. Consequently, the level of excess reserves could have an impact on the relative cost of holding a liquidity buffer for banks.

Chart 12

HQLA holdings of the euro area banking system and estimated HQLA needs for a 100% and 120% LCR level

(EUR billions; Q3 2017)



Source: See Chart 5 for sources of HQLA holdings and securities classification.

Note: HQLA need to satisfy the LCR estimated according to the methodology outlined in Section 5.1 (authors' calculations based on data from the EBA report).

As described in Section 2, when analysing the (perceived) availability of HQLA, it is not only the aggregated amount of HQLA outstanding that is relevant. Risk attitude could also impact the perceived availability of HQLA. In a stressed environment with *flight-to-quality* phenomena or, more generally, in a euro area financial market characterised by a certain degree of fragmentation along national borders, the difference between HQLA as defined in the Delegated Regulation and the common concept of safe assets may become relevant. For certain banks, the perceived availability of HQLA could therefore be relatively low. This may apply in particular in a *flight-to-quality* context where, for instance, highly rated assets are accepted at more favourable conditions in repo transactions or by CCPs. Price considerations are important too, as a scarcity of certain higher-rated HQLA make them expensive and will lead to them being substituted with other HQLA assets, such as excess reserves or lower-rated HQLA.

These considerations may be relevant when assessing HQLA availability in an environment with a lower level of excess reserves. As shown in Chart 6 (Section 4) and Chart 10 (Section 5), banks in several jurisdictions including Germany (approximately €560 billion) and France (approximately €430 billion) hold a considerable amount of excess reserves. Hence, in a context of less sizeable excess reserves, these banks would potentially need to acquire marketable HQLA to maintain their current LCR ratio and compete for such assets with other economic agents. If there is a *safe asset premium* on the preferred marketable HQLA (e.g. on highly rated government bonds), banks requiring these assets might need to pay a higher price compared with the current situation to hold a liquidity buffer of the same size.³⁹

However, an environment with less sizeable excess reserves does not necessarily imply that the overall stock of HQLA outstanding decreases substantially. Excess reserves may be lower due to less sizeable monetary policy operations, which as illustrated in Section 3 most likely implies that less marketable HQLA are absorbed by the Eurosystem, or liquidity in excess of the banking system's needs could be absorbed via other central bank liabilities. In the former case, the stock of marketable HQLA previously absorbed through monetary policy operations (e.g. refinancing operations, outright operations) is made available again in the market to all economic agents. As illustrated in Section 3, the Eurosystem currently absorbs a substantial amount of HQLA (€2.6 trillion as of Q3 2017), mostly on the back of the APP. In the latter case, HQLA could in theory be provided in the form of debt certificates, term deposits or reverse repos, for instance. This illustrates that a reduction in excess reserves does not necessarily imply that the overall stock of HQLA decreases substantially.

The extent to which an environment of less sizeable excess reserves affects the size and composition of HQLA buffers of banks and other economic agents also depends on the design features of central bank operations. In the current collateral framework of the Eurosystem, banks can increase their HQLA buffers and improve their LCR by

³⁹ Future demand for HQLA due to the LCR will also depend on the way in which banks decide to address LCR requirement. Banks could, for instance, also address LCR constraints by adjusting their funding profile (raising longer-term or more LCR-friendly funding). Banks with sizeable liquidity buffers (high LCR ratios) could also revert to reducing the size of the liquidity buffer.

participating in *refinancing operations* and pledging non-HQLA collateral (liquidity transformation). As Section 3 also shows, 65% of the collateral pledged in refinancing operations consists of non-HQLA. In general, the ability of banks to obtain central bank reserves depends on the features of monetary policy operations (e.g. price and maturity), which determines their attractiveness compared with market alternatives.

The reflections provided above together with the analyses in previous sections further show that the design of the MPI framework (e.g. the collateral eligible for refinancing operations, the type of counterparties which may have direct or indirect access to the central bank balance sheet and the features of monetary policy operations compared with market alternatives) influences the demand for central bank reserves (liquidity). These considerations are relevant (beyond the scope of this paper) in that, from a monetary policy operational perspective, the central bank should be attentive to demand for HQLA (and possible scarcity phenomena) to the extent that it interferes with the efficiency and efficacy of the MPI framework, i.e. with its ability to ensure that monetary and financial conditions are in line with the central bank's monetary policy stance.

Annex

The [BIS global OTC derivatives semi-annual statistics](#) provide data about this market segment's gross credit exposure (GCE), defined as "*gross market value minus amounts netted with the same counterparty across all risk categories under legally enforceable bilateral netting agreements.*" In other words, GCE provides a measure of exposure to counterparty credit risk without including the effect of CCP clearing, i.e. only counterparty risk embedded in bilateral positions is taken into account. To estimate the total collateral needs in the Eurozone due to the OTC derivatives market:

- we calculated the average share of GCE versus the notional outstanding amount (NOA) for four and a half years of data from semi-annual BIS statistics on the global OTC derivatives market⁴⁰, equal to 0.31%;
- we estimated the size of the euro area derivatives market by applying the GDP share of the Eurozone in the EU (equal to 72.2% according to Eurostat as of 2016) to the NOA of the EU OTC derivatives market resulting from the [ESMA report](#), equal to €278 trillion.

We thus find that the maximum amount of collateral that could be absorbed by the Eurozone OTC derivatives market if all positions were collateralised stands at €930 billion. This estimate is based on the sum of the two following elements:

- €851.5 billion of collateral needs due to non-cleared transactions; it is calculated assuming that the share of GCE/NOA in the euro area is the same as at global level;
- €78.5 billion of collateral needs due to cleared transactions, which is assumed to be equal to the estimated initial margin effectively posted by the CCP.

In order to estimate the total effective collateral absorbed by OTC derivative positions in the Eurozone, due both to the clearing obligation and the margin requirements under EMIR, we again referred to the BIS database and the ISDA margin survey.

The BIS database provides statistics on the amount of cleared transactions, which in 2016 and 2017 stood at around 60% of the notional value of all OTC derivatives transactions (USD 314.0 trillion). Specifically, these stood at 76.4% of interest rate derivatives (USD 308.6 trillion), 1.1% of forex derivatives (USD 0.8 trillion), 0.9% of equity derivatives (USD 0.1 trillion) and 44.0% of credit derivatives (USD 4.5 trillion). Assuming that the share of cleared transactions per instrument are equally applicable to the euro area market as reported by the ESMA, we estimate the amount of cleared transactions in the euro area to be €137.9 trillion in notional terms.

⁴⁰ Please note that: a) the share of GCE over NOA has been relatively stable over the last ten years; b) as GCE includes both derivatives payables and derivatives receivables, the total collateral needs in the global OTC derivatives market are halved with respect to GCE data reported by BIS statistics.

We then referred to data available in the [ISDA margin survey](#), which provides information, at global level, about the collateral:

- pledged with the CCP, distinguishing initial and variation margins (IM/VM) for interest rate swaps and credit default swaps (CDS)⁴¹; this represents almost the total cleared transactions in the derivatives market, as equity and commodities have a residual role;
- used for margining non-centrally cleared positions, distinguishing IM and VM; as data are provided both for collateral delivered and collateral received, we based our estimate on collateral delivered only.

Assuming that the share of IM and VM for cleared and non-cleared transactions is the same at global and Eurozone level, the effective amount of collateral absorbed for cleared and bilateral transactions⁴² is estimated at 75.4% of the total collateral needed, equal to €701 billion.

⁴¹ Initial margins are based on effective data from CCPs; variation margins are estimated by the ISDA, as CCPs do not disclose this information.

⁴² The total collateral pledged for CCPs is estimated at €196.5 billion (€78.5 billion IM and €118.0 billion VM), while for bilateral transactions it stands at €504.1 billion (€42.8 billion IM and €461.3 billion VM).

References

- Baldo, L., Hallinger, B., Helmus, C., Herrala, N., Martins, D., Mohing, F., Petroulakis, F., Resinek, M., Vergote, O., Usciati, B. and Wang, Y. (2017), "The distribution of excess liquidity in the euro area", *Occasional Paper Series*, No 200, ECB, Frankfurt am Main, November.
- Bech, M. and Keister, T. (2017), "Liquidity regulation and the implementation of monetary policy", *Journal of Monetary Economics*, No 92, pp. 64-77.
- Bucalossi, A., Coutinho, C., Junius, K., Luskin, A., Momtsia, A., Rahmouni-Rousseau, I., Sahel, B., Scalia, A., Schmitz, S.W., Soares, R., Schobert, F. and Wedow, M. (2016), "Basel III and recourse to Eurosystem monetary policy", *Occasional Paper Series*, No 171, ECB, Frankfurt am Main, April.
- Capel, J. and Levels, A. (2012), "Is Collateral Becoming Scarce? Evidence for the euro area," *DNB Occasional Studies*, Vol. 10, No 1, Netherlands Central Bank, Research Department, Amsterdam.
- Committee on the Global Financial System and Markets Committee (2015), "Central bank operating frameworks and collateral markets", *CGFS Papers*, No 53, Basel.
- Committee on the Global Financial System (2013), "Asset encumbrance, financial reform and the demand for collateral assets", *CGFS Papers*, No 49, Basel.
- ECB Banking Supervision (2018), *Supervisory Banking Statistics*, Second quarter 2018, Frankfurt am Main.
- ECB Banking Supervision (2018), *Annual Report on supervisory activities 2017*, Frankfurt am Main.
- European Banking Authority (2017), *Report on liquidity measures under Article 509(1) of the CRR*, London, December.
- European Banking Authority (2018), *Report on liquidity measures under Article 509(1) of the CRR*, London, October.
- European Banking Authority (2018), *CRD IV-CRR/BASEL III monitoring exercise – results based on data as of 30 June 2017*, London, March.
- European Securities and Markets Authority (2016), *Report on securities financing transactions and leverage in the EU*, Paris, October.
- Financial Stability Board (2017), *Transforming Shadow Banking into Resilient Market-based Finance*, Basel.
- Fuhrer, L., M., Guggenheim, B. and Schumacher, S. (2015), "Re-use of collateral in the repo market", Working Paper, No 2, Swiss National Bank, Zurich.

Ihrig, J., Kim, E., Kumbhat, A., Vojtech, C. and Weinbach, G. (2017), “How have banks been managing the composition of high-quality liquid assets?”, *Finance and Economics Discussion Series*, 2017-092, Board of Governors of the Federal Reserve System, Washington.

International Capital Market Association (2017), *European Repo Market Survey*, No 33, Zurich, October.

Koijen, R., Koulischer, F., Nguyen, B. and Yogo, M. (2018), “Quantitative Easing in the Euro Area: The Dynamics of Risk Exposures and the Impact on Asset Prices”, *Working Paper Series*, Revised WP No 601, Banque de France, February.

Potter, S. (2018), *The Supply of Money-Like Assets. Remarks for American Economic Association Panel Session: The Balance Sheets of Central Banks and the Shortage of Safe Assets*, Philadelphia.

Acknowledgements

The paper presents research from a network of experts from national central banks in the euro area and the European Central Bank. The editors and contributors would like to thank Sebastiaan Bielen, Ulrich Bindseil, Benjamin Sahel, Michael Wedow (ECB), Dorothee Hellmuth and Daniel Krause (Deutsche Bundesbank) for their input, valuable and helpful comments and constructive discussions. We would also like to thank Gesa Schlossmacher (Deutsche Bundesbank) and Lefkios Geladaris (ECB) for their excellent data analysis support.

Editors:

Roel Grandia

De Nederlandsche Bank, Amsterdam, The Netherlands; email: r.grandia@dnb.nl

Petra Hänling

Deutsche Bundesbank, Frankfurt am Main, Germany; email: petra.haenling@bundesbank.de

Michelina Lo Russo

Banca d'Italia, Rome, Italy; email: michelina.lorusso@bancaditalia.it

Pontus Åberg

European Central Bank, Frankfurt am Main, Germany; email: pontus.aberg@ecb.europa.eu

Contributors:

Luca Baldo

Banca d'Italia, Rome, Italy; email: luca.baldo@bancaditalia.it

Pierre Guerin

Banque de France, Paris, France; email: pierre.guerin2@banque-france.fr

Benoit Hallinger

Banque de France, Paris, France; email: benoit.hallinger@banque-france.fr

Philipp Hanheide

European Central Bank, Frankfurt am Main, Germany; email: philipp.hanheide@ecb.europa.eu

Sophie Mages

Banque de France, Paris, France; email: sophie.mages@banque-france.fr

Jesús Pedro Ibanez Sandoval

Banco de España, Madrid, Spain; email: jesus.ibanez@bde.es

Felix Mohing

Deutsche Bundesbank, Frankfurt am Main, Germany; email: felix.mohing@bundesbank.de

Karol Paludkiewicz

Deutsche Bundesbank, Frankfurt am Main, Germany; email: karol.paludkiewicz@bundesbank.de

Franziska Schobert

Deutsche Bundesbank, Frankfurt am Main, Germany; email: franziska.schobert@bundesbank.de

Fabrizio Zennaro

Banca d'Italia, Rome, Italy; email: fabrizio.zennaro@bancaditalia.it

© European Central Bank, 2019

Postal address 60640 Frankfurt am Main, Germany
Telephone +49 69 1344 0
Website www.ecb.europa.eu

All rights reserved. Any reproduction, publication and reprint in the form of a different publication, whether printed or produced electronically, in whole or in part, is permitted only with the explicit written authorisation of the ECB or the authors.

This paper can be downloaded without charge from the [ECB website](http://www.ecb.europa.eu), from the [Social Science Research Network electronic library](http://www.ssrn.com) or from [RePEc: Research Papers in Economics](http://www.repec.org). Information on all of the papers published in the ECB Occasional Paper Series can be found on the ECB's website.

PDF ISBN 978-92-899-3679-8, ISSN 1725-6534, doi:10.2866/3211, QB-AQ-19-001-EN-N