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INTERDEPENDENCE BETWEEN ASSETS AND LIABILITIES IN THE BANKING SYSTEM: CHANGES IN THE LAST TWO DECADES

by Valentina Michelangeli* and Fabio Massimo Piersanti*

Abstract

Asset and liability management deals with the joint evaluation of assets and liabilities in a bank's balance sheet; it is a traditional tool used by intermediaries to limit financial risks. Building on a measure of the extent of asset-liability management practices, which we name *interdependence index*, we show that the intensity of asset-liability linkages decreased between the beginning of the century and the onset of the COVID-19 pandemic for all three main classes of Italian banks (larger, smaller, and BCCs). The monetary policy operations introduced in the wake of the sovereign debt crisis, the 2012 reform of the tax treatment of bank bond yields and the protracted low interest rate environment meant there was less need for banks to closely link assets and liabilities in their balance sheets, thus fostering greater independence between investing and financing decisions.

JEL Classification: G21, G32.
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Contents

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1. Introduction[1]

Banks traditionally engage in maturity transformation activities, as they accept deposits with short maturities and grant long-term loans; these activities can expose financial intermediaries to interest rate and liquidity risks (Segura and Suarez, 2017; Bologna, 2018; Schmitt, 2018; Acharya, 2009; Mendoza and Quadrini, 2010; Huang et al., 2012; Bessler and Kurmann, 2014; Chen, 2022).

The ability to limit these risks is critical for financial stability. Asset–liability management (ALM) is the traditional tool used by financial intermediaries for this purpose and consists in the conjoint evaluation of risks and benefits for assets and liabilities (DeYoung and Yom, 2008; Romanyuk, 2010; Memmel and Schertler, 2012; Paul and Zhu, 2020). Banks' exposure to financial risks can be inferred from items included in the two sides of the balance sheet: if a bank's assets are closely matched with its liabilities, the issues associated with maturity term and liquidity transformation are very limited. In its most simple form, ALM requires banks to select a liability structure that matches the expected maturity or duration of their existing assets, thus immunizing banks' earnings from interest rate movements. The benefits of ALM are rather clear, including: an understanding of a bank's overall position with respect to its obligations; a quantification of risks; and gains in efficiency and performance from the integration of asset and liability management. The challenges associated with the adoption of an ALM framework relate to its implementation. For instance, each bank has its own objectives, risk tolerances, and regulatory constraints, which can vary over time and require adjustments in the balance sheet.

Over the past twenty years, many developments have occurred - such as changes in the monetary policy stance, especially after the Great Financial Crisis, a change in the taxation of bank bonds in 2012 in Italy, and the emergence of financial innovation - which may have fundamentally affected banks' on-balance sheet maturity term and liquidity transformation. The recent literature has been mostly silent on the subsequent ALM dynamics. Our contribution is to provide an assessment of how the relationship between the two sides of banks' balance sheets has evolved between the beginning of this century and the end of 2020, in correspondence with the onset of the COVID-19 crisis. We construct and decompose an indicator that can be used to monitor the changes over time in asset-liability linkages. This indicator is particularly relevant for policymakers when increases in interest

[1] We thank Paolo Angelini, Francesco Columba, Alessio de Vincenzo and Francesco Palazzo for their useful comments.

rates or policy reforms occur, since it enables them to quickly identify variations in the structure of banks' balance sheets and, as a result, it could raise their ability to anticipate and counteract risks associated with maturity mismatches.

More in detail, using supervisory data on Individual Balance Sheets for Italian banks (IBSI) from January 2003 to December 2020 and relying on the existing literature, we construct and improve a measure of asset-liability interdependence: the *interdependence index*. This measure imposes no structure on the data and makes no assumptions about the causal direction between asset and liability positions. This flexibility is essential for our analysis as different banks may adopt different policies, i.e. some banks may have a large deposit base and search for profitable lending opportunities, while others may have a large portfolio of loans and search for cheap sources of funding. The *interdependence index* is computed as the sum of all (squared) pairwise correlations between assets and liabilities weighed by the average share of the balance sheet items in the bank portfolio. High values of this measure indicate a strong link between assets and liabilities, i.e. banks conjointly choosing items on both sides of the balance sheet to mitigate the risks; low values instead indicate that the asset-liability interdependence is limited and thus banks have more leeway in structuring their positions. We also developed a simple approach to identify the most relevant asset-liability positions in driving the interdependence index's dynamics.

We consider three groups of banks - larger, smaller and cooperative credit banks (BCCs) - which allows us to capture the main differences in business models and regulatory requirements.

We find that the asset-liability interdependence declines over time for all three groups of banks. In particular, the *interdependence index* initially has the largest value for BCCs, due to the strong correlation between a few large asset and liability items (in particular, between bonds in portfolio and deposits), and it falls abruptly after 2011. Since then, the indicator has the highest value for larger banks, suggesting that these banks are overall more inclined to practice on-balance sheet asset-liability management than the others. This likely reflects their lower use of deposits, their lower capital ratios and their lower income from commissions relatively-speaking. In this respect, their business model is similar to that of large US banks (Laeven et al., 2014).

The *interdependence index* is also very useful for identifying periods of time or specific episodes when asset-liability interconnections in the banking system changed. In 2011, the Long-Term Refinancing Operations (LTROs) by the European Central Bank and subsequent monetary policy measures (such as the Targeted Long-Term Refinancing Operations, TLTROs) as well as a fiscal reform in Italy in 2012[2] made bank bonds relatively more expensive and also affected the advantageousness of interbank lending, leading to an increased substitution of bank bonds with central bank loans and retail deposits from households and firms. These latter sources of funding reduced the need to strictly link asset and liability positions and thus contributed to the decline in the interdependence indicators. At the end of 2020, the *interdependence indexes* for the three bank categories were at the lowest levels observed in over twenty years.

In our exercise, we also identify the most common asset-liability relationships driving the dynamics of the *interdependence indexes* for the three bank groups, i.e. the relationship between long term loans to households and firms other than residential mortgages (in our taxonomy, *Long term loans*) and both *M3 deposit*s and *Bonds issued*. At the beginning of the century, the correlation between *Long term loans* and *M3 deposits* was strongly negative, whereas that between *Long term loans* and *Bonds issued* was mainly positive. This suggests that banks initially structured their balance sheet in such a way as to limit risks associated with maturity mismatch, i.e. they were not using a short term liability, such as sight deposits, to finance risky long term assets. Indeed, these assets, which usually have high yields because they carry a sizeable degree of credit risk and are mostly priced at floating interest rates, were often matched with longer term and costlier liabilities such as bank bonds, with a varying remuneration scheme according to debt seniority. This limited the banks' problems associated with maturity mismatch. However, in a low interest rate environment the advantage of funding long term loans with bank bonds fell drastically: banks became less prone to match risky long term assets with bank bonds. Given the abundance of deposits, banks began to link these liabilities relatively more with *Long term loans*.

Instead we do find that the link, at least for larger banks, between *Residential mortgages* and *M3 Deposits* is strong, positive and persistent. Despite the fact that these two positions have different maturities, this evidence is in line with the findings by Drechsler et al. (2021), who claim that banks fund their investments in long term fixed rate assets with deposits, which effectively are behaving as long term liabilities. Hanson et al. (2015) show that traditional banks act as patient investors holding illiquid fixed-income assets with little risk of interruption before maturity.[3]

[2] Since 2012, the preferential tax treatment of bank bonds has ceased. The interest on deposits and bonds were subjected to the same rate of 20 percent, increased to 26 percent from 1 July 2014, introducing a tax advantage for public securities (whose taxation remained at 12.5 per cent).

[3] Deposits can be considered a stable source of funding that can be used to finance banks' long term assets. From a prudential perspective, the net stable funding ratio is a measure used to promote resilience over a 12-months horizon by creating incentives for banks to finance their activities with more stable sources of funding on an ongoing basis. The factor that applies to retail deposits is 95 per cent, indicating that the funding is expected to be almost fully available after one year (BIS, 2018). Moreover, corporate projects often require long term investment and they can result in significant

The remainder of the paper proceeds as follows. Section 2 presents the asset-liability interdependence measure. Section 3 describes the data. Section 4 shows the results. Section 5 concludes.

2. Description of the *interdependence index*

Building on the work of Memmel and Schertler (2012), we present the *interdependence index*, which is our measure for calculating the extent of the relationships between banks' assets and liabilities in each year of the sample.[4]

Our *interdependence index* has yearly frequency but, given the higher granularity of our data, exploits information from all monthly bank balance sheet positions. Let us consider the set of asset and liability positions over total assets, $S^A = [S_1^A, S_2^A, \dots, S_{n_a}^A]$ and $S^L = [S_1^L, S_2^L, \dots, S_{n_l}^L]$, where n_a and n_l are the total number of asset and liability positions. Let $S_i^{A,z,m}$ ($S_j^{L,z,m}$) be the generic asset (liability) position taken by bank z in month m and $\rho_{ij} = corr(S_i^{A,z,m}, S_j^{L,z,m})$ be the correlation between the specific asset-liability positions across banks and months in a given year. The annual asset *i* (liability *j*) position is computed as an average over twelve months across banks, i.e. $\bar{X}_h = \frac{1}{n_z}\sum_z^{n_z}\frac{1}{12}\sum_m^{12} X_h^{z,m}$, with $X \in [S^A, S^L]$, $h \in [i, j]$, and n_z the number of banks in a given category. Therefore, for each bank category in a given year *y*, the *interdependence index* ω_y is given by the weighted sum of all pairwise correlations

$$\omega_y = \frac{\sum_{i=1}^{n_a}\sum_{j=1}^{n_l}\overline{S_i^A}\ \overline{S_j^L}\ \rho_{i,j}^2}{\sum_{i=1}^{n_a}\sum_{j=1}^{n_l}\overline{S_i^A}\ \overline{S_j^L}} \tag{1}$$

By definition, the *interdependence index* for each year belongs to the interval between 0 and 1.

A nice feature of this measure is that (squared) unconditional correlations among asset and liabilities are weighted by the relative size of each item. Thus, large correlations between small balance sheet positions are unlikely to drive the results.[5]

We also develop a simple approach to identify the most important relationships (from both sides of

economic losses in case of liquidation before completion. In the past, a decline (or expectation of decline) in the value of the assets held by banks induced depositors to withdraw their funds (Gorton, 1988; Jacklin and Bhattacharya, 1988; Allen and Gale, 2000). Diamond and Dybvig (1983) emphasize that deposit insurance is a source of stability that keeps depositors "sleepy" and prevents runs. Indeed, the introduction of deposit insurance implied that also in distress, depositors do no longer have incentives to run and thus the bank does not need to liquidate long-term assets, remaining solvent.

[4] In Section A of the Appendix we describe other measures of interdependence between assets and liabilities used in the literature.

[5] The possibility that small balance sheet positions could drive the results was the main limitation of the canonical correlation (see Section A of the Appendix).

the balance sheet) driving the dynamics over time of the *interdependence index*.

We decompose equation (1) as the sum of the individual *interdependence indexes*:

$$\omega_y = \sum_{\varepsilon=1}^{n_a \bullet n_l} \bar{Q}_{i,j}\, \rho_{i,j}^2 \text{ with } \bar{Q}_{i,j} = \frac{\overline{S_i^A}\,\overline{S_j^L}}{\sum_{i=1}^{n_a} \sum_{j=1}^{n_l} \overline{S_i^A}\,\overline{S_j^L}} \tag{2}$$

For the sake of simplicity, we can refer to $\bar{Q}_{i,j}\rho_{i,j}^2$ as the *interdependence index* specific to the *i-th* asset and the *j-th* liability position. In order to identify the most relevant asset-liability interconnections, we compute the *interdependence share*, defined as the ratio between the individual and total *interdependence indexes*, $\theta_{i,j} = \frac{\bar{Q}_{i,j}\rho_{i,j}^2}{\omega_y}$, whose time average is defined as $\bar{\theta}_{i,j}$. Finally, we sum the average *interdependence shares* for each asset (liability) item across all liability (asset) positions and define the asset (liability) specific contribution to the *interdependence index* as follows

$$\underbrace{\bar{\theta}^i = \Sigma_{j=1}^{n_l} \bar{\theta}_{i,j}}_{\textbf{Asset } \boldsymbol{i} \textbf{ specific contribution}} \quad \text{and} \quad \underbrace{\bar{\theta}^j = \Sigma_{i=1}^{n_a} \bar{\theta}_{i,j}}_{\textbf{Liability } \boldsymbol{j} \textbf{ specific contribution}} \tag{3}$$

Equation (3) gives the total contribution of each asset *i* and liability *j* position to explain the average composition of *interdependence index*.

3. Data

We analyse asset-liability relationships for Italian banks between 2003 and 2020 by exploiting monthly data from individual bank's balance sheets available from Bank of Italy supervisory reports. Our sample consists of an average of 520 banks each year; the number of banks has declined over time, from around 580in 2003 to about 350[6] in 2020, following consolidation through mergers and acquisitions in the sector. We focus on all Italian banks and we sub-consolidate at the holding group level when a bank is neither a stand-alone nor a BCC (see footnote 6).

Each bank is assigned to one of three groups: larger banks whose total assets are above the median of the sample (excluding BCC), smaller banks whose total assets are below the median of the sample, and BCCs.[7] The three groups are quite different. Larger banks include all SIs and the largest LSIs, which usually also adopt an internal ratings-based approach (IRB) and cover the entire national

[6] BCCs are considered as single entities even when part of a banking group, i.e. after the 2019 reform. More in detail, in the first quarter of 2019, a process of reforming the cooperative banking sector through consolidation was concluded. ICCREA and Cassa Centrale Banca became the parent companies of two banking groups, to which 143 and 84 cooperative credit banks respectively belong. After the reform, the Cassa Centrale Banca group was classified as significant, while ICCREA was already classified as significant prior to the reform (Bank of Italy, 2019). This choice is necessary in order to evaluate BCCs as a separate category of banks within our empirical exercise.

[7] For banks that are neither stand-alone nor part of a BCC banking group, we consider the sub-consolidated value of total asset at the holding group level.

territory.[8] Smaller banks include all the LSIs not part of the previous group. BCCs are local cooperative and mutual banks. They are subject to special criteria for the allocation of profits (for example, mutual banks must allocate at least 70 per cent to reserves) and they often provide credit to shareholders (principle of mutuality). BCCs differ from commercial banks and other financial institutions since only their members, who are also owners, can have an account. Given the different areas of operation (local vs national/international), missions (community-oriented vs profit-oriented), and accounting and regulatory criteria, BCCs are analysed as a separate group.

Based on data structure and availability, Table 1 presents our classification of bank balance sheet items:

Table 1. Bank balance sheet

Assets	**Liabilities**
Cash	
Deposits at CB (deposits at the central bank)	*CB loans* (loans from the central bank)
Claims towards OMFI (claims towards monetary financial institutions in the euro area)	*Debt towards OMFI (*liabilities towards other monetary financial institutions)
Loans:	Deposits:
Short term loans towards NFCs and HHs	*M3 deposits* (less than two years)
Residential mortgages (long term)	*Long term deposits* (more than two years)
Long term loans (more than one year)	
Bonds held (issued by governments, private sector or the rest of the world)	*Bonds issued*
Stocks held (issued by governments, private sector or the rest of the world)	*Other liabilities* (minor residual items)
Other assets (minor residual items)	*Total equity (*capital and reserves)

Exploiting this decomposition of the asset and liability sides of the balance sheet, which relies on available information on the maturity of each position, we can differentiate accounts by their implicit liquidity and maturity. On the one hand, *Cash*, *Claims towards OMFI*, *Short term loans*, *Stocks held,*[9] and *Debts towards OMFI* tend to have shorter maturities and are less exposed to interest rate

[8] The sample including only SI banks is too small to carry out our empirical exercises. Moreover, the definition of SI/LSI banks was firstly introduced in 2014, while our exercise starts in 2003.
[9] We include *Stocks held* among assets with short maturity as they can be sold by the owner to her liking.

fluctuations. On the other hand, *Deposits at CB, CB loans* (especially after 2011), *Residential mortgages, Bonds held*[10] *and issued, Long term deposits, Long term loans*[11] and *Total equity* tend to have longer maturities and are more exposed to interest rate fluctuations. Despite their short contractual maturity, *M3 deposits*[12] tend to remain in the bank portfolio for long periods.

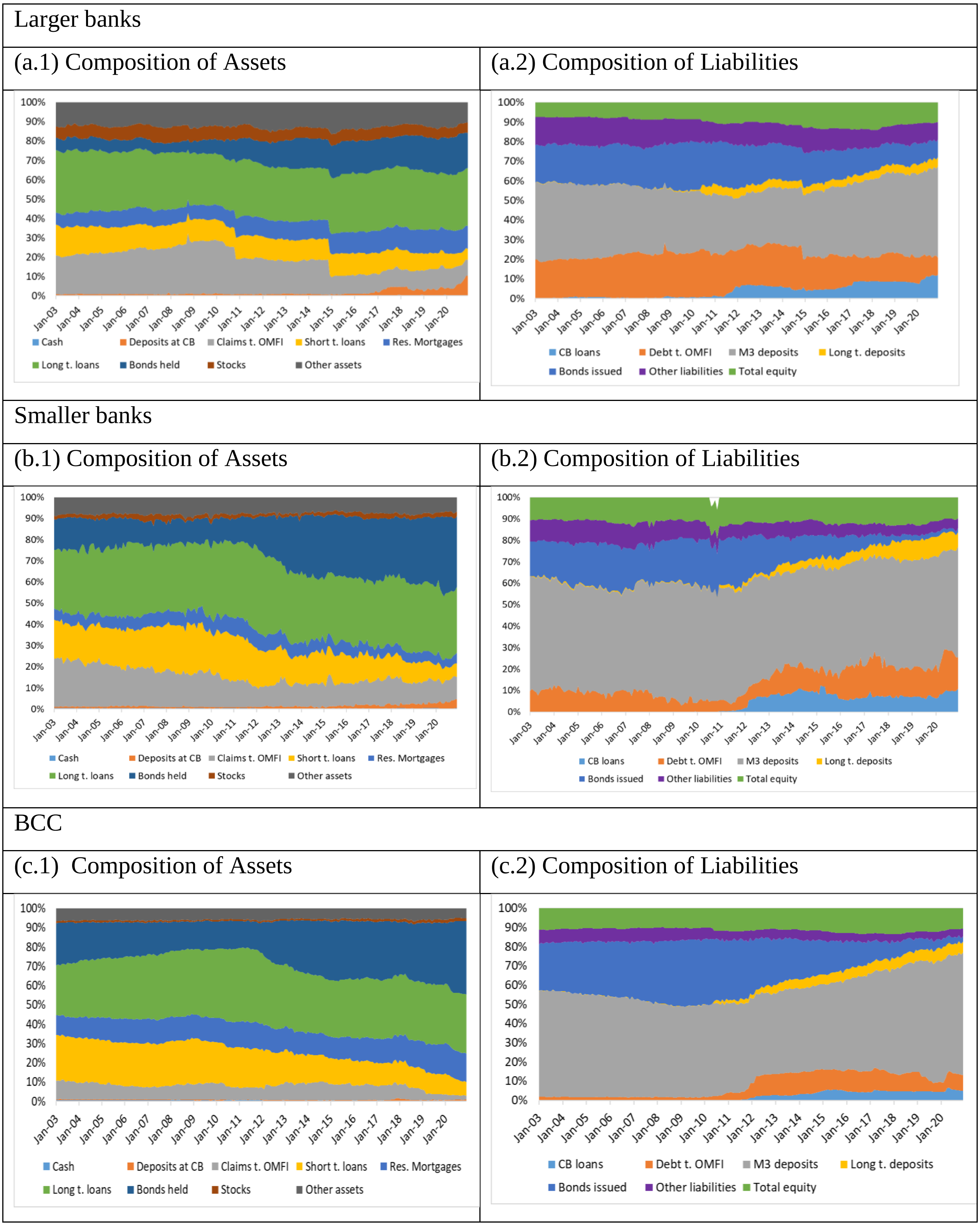
Figure 1 shows how asset and liability positions have evolved between the beginning of the 2000s and December 2020. We observe an increase over time in the overall shares of *Bonds held* and a decrease in the shares of *Short term loans* and *Claims towards OMFI*. On the asset side, some changes in composition occurred with the introduction of special monetary policy operations. During the sovereign debt crisis, between December 2011 and February 2012, the ECB launched two rounds of longer-term refinancing operations (LTROs). These measures were extraordinary for two reasons. First, the total amount was sizable and equal to around €500 billion of additional finance for the Euro-area banking system. Second, the maturity was long, i.e. three years. During a period of money market freeze due to low confidence and high risk aversion of participants in the financial markets, the goal of these measures was to provide the banking system with the needed liquidity by lowering the cost of funding (Garcia-Posada and Marchetti, 2016; Andrade et al, 2019; Carpinelli and Crosignani, 2021). According to 2012 November data, in the previous months Italian banks' recourse to eurosystem credit held steady at about €280 billion; the two three-year LTROs accounted for 92 per cent of the total (Bank of Italy, 2012). These operations also contributed, at least to some extent, to a lengthening of asset maturities and, in fact, the share of *Short term loans* decreased. Moreover, some of this cheaper liquidity was also used to expand the share of *Bonds held* in the portfolio (Crosignani et al., 2020).

[10] We consider *Bonds held* as long term assets as we cannot distinguish between the different maturities. Our choice rests on some considerations concerning the composition of this class of assets as well as the accounting portfolio where they are usually allocated in when looking at the banking sector as a whole. Banks' bond holdings are made of public bonds (65 per cent on average between 2003 and 2020) and corporate bonds. Both are mostly evaluated at the amortized cost. This suggests that they can be considered as long term assets.

[11] Among Long term loans we include loans granted to firms and households with maturity over one year and different from residential mortgages.

[12] M3 deposits include also deposits from the rest of the world and from central governments because no further breakdown by liquidity (M3 vs no M3) was available.

Figure 1. Composition of assets and liabilities by group of banks

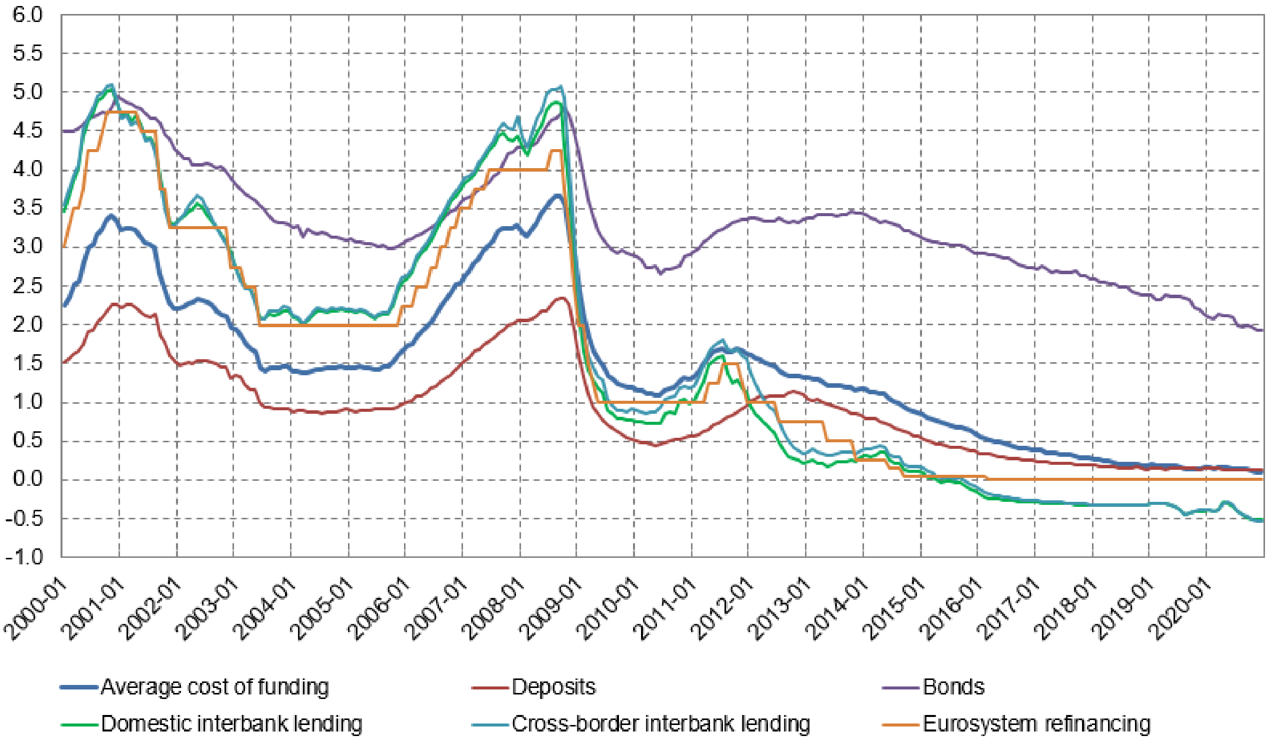


Source: Individual Balance Sheet Items. *Note:* our sample includes all Italian banks operating in Italy either part of an Italian holding group or stand-alone. Foreign branches and subsidiaries are excluded from the sample. Individual banks data are sub-consolidated at the holding group level when the bank is neither a stand-alone nor part of a BCC banking group. BCC banks are considered as single entities when part of a holding group.

On the liability side, we observe over time an increase in the shares of *Deposits (M3 and Long term)* and *CB Loans*, as well as a decrease in the share of *Bonds issued*. The increase in the share of *Deposits* became more pronounced following the sovereign debt crisis. It was likely driven by clients' caution in a period characterized by economic uncertainty (Bayer et al., 2019) and by the low interest rate environment, which drove a reduction in the differential returns between deposits and other riskier or less liquid investments. Deposits provided a very cheap source of funding for banks (Figure 2).

The share of *CB loans* increased for all banks following the 2011 LTROs and the subsequent monetary policy operations, which allowed banks to access funding at very advantageous conditions; (the share grew from an average of 0 per cent in 2003 to about 10 per cent in December 2020). Access to cheaper sources of funding translated into a fall in the share of the more expensive *Bonds issued*: when interest rates are low, the return on bonds is contained and thus households prefer to hold deposits, which are more liquid than bank bonds. Moreover, following the 2012 tax reform which reduced the after-tax returns on bank bonds, households also had less incentive to hold them; this contributed to the decrease in the share of this item in total bank liabilities (Carletti et al., 2021).

Figure 2. Cost of funding (percentage values)



Source: Supervisory reports.

4. Results

This section presents the evolution of the *interdependence index* for the three groups of banks and proposes a decomposition analysis. The *interdependence index* is a quantitative measure that allows us to assess, in an explicit and quick way, the ALM practices adopted by banks.

4.1 *Interdependence index* for the three groups of banks

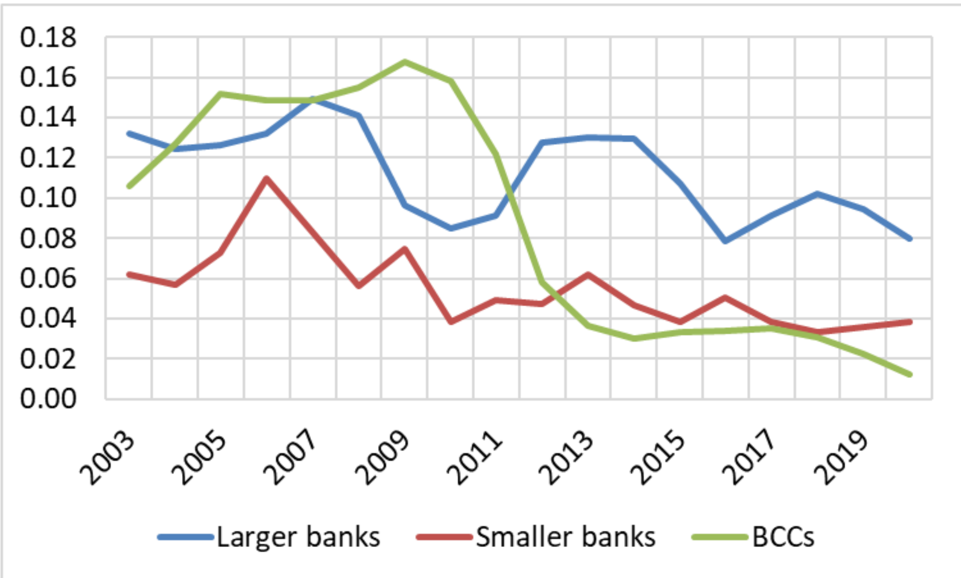
Figure 3 presents the *interdependence index* for the three groups of banks.

For larger banks, the index was high in the early 2000s, indicating a sizable degree of dependence between asset and liability items. After a drop following the financial crisis, the index increased again in response, at least to some extent, to the monetary policy operations adopted to prevent a credit crunch during the sovereign debt crisis. In 2014, with the economy close to the zero lower bound (ZLB) on nominal interest rates, the index decreased even further, remaining at levels lower than those observed at the beginning of the century.

For smaller banks, the *interdependence index* is always below the level for larger banks, but the dynamics are similar. The indicator peaked in 2006, before the financial crisis, after which it declined. It increased moderately following the sovereign debt crisis and then decreased again after 2014.

For BCCs, the index remained above larger banks until 2009 reflecting the high correlation between a few large items. It decreased steeply from 2010 to 2013, and then remained relatively flat and below the level for smaller banks until the end of the period considered.

Figure 3. Interdependence indexes for bank groups



Note: our calculations on Individual Balance Sheet Items data.

The dynamics of the banks' *interdependence index* offer a framework for interpreting the main trends observed in their balance sheets over time.

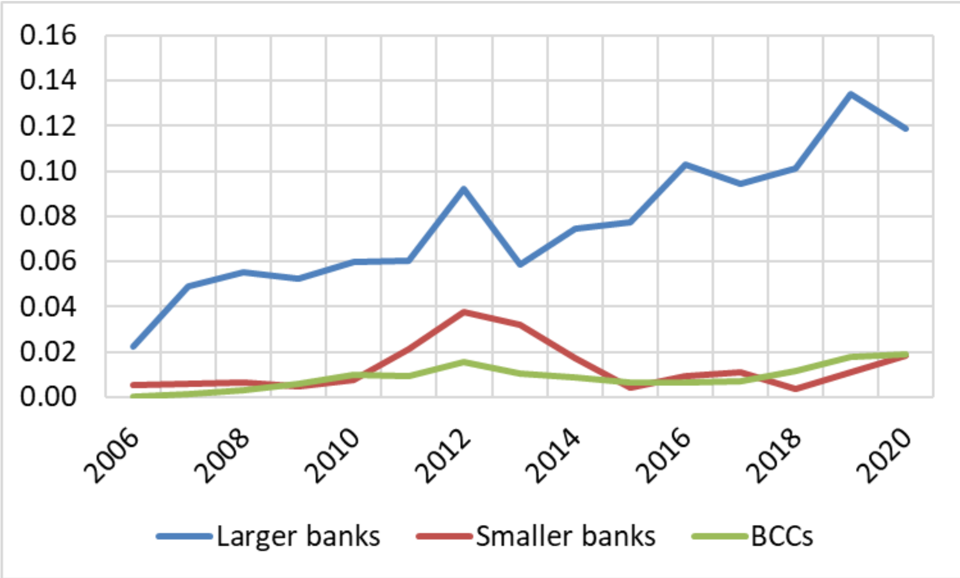
At the beginning of the sample period, in an environment characterized by high interest rates and limited access to the use of derivatives, the *interdependence index* is high for all groups, because banks are trying to limit the risks associated with maturity mismatch by linking items on both sides of the balance sheet. In other words, banks are selecting asset and liability positions similar in terms of some relevant characteristics (maturity, interest rate type, liquidity); the goal is to create on-balance sheet asset-liability dependencies able to reduce the exposure to interest rate and liquidity risks.

Over time, the *interdependence index* for each group declined significantly, suggesting that asset-liability relationships are becoming weaker. This decrease can be associated in part, at least for the larger banks (Figure 4),[13] with a greater use of derivatives[14] within more sophisticated techniques for ALM, in line with DeYoung and Yom (2008) and Memmel and Schertler (2012). The extensive use of these hedging instruments may have contributed to reduce the need to use in-balance sheet adjustments.

[13] Figure 4 shows the derivatives used for hedging purposes at market value; this is the only information available since the early 2000s and offers a historical perspective consistent with the rest of the analysis. The notional value, on the other hand, has only been reported in Finrep reports since 2018. The figure B1 in Section B of the Appendix shows the notional value of hedging derivatives, both economic and accounting, (also providing details on interest rate risk hedging derivatives) on total assets . Overall, the distribution by group of banks appears in line with that of market values: larger banks make more extensive use of these hedging instruments. Finrep reports have some limitations on the derivatives front (most of which can be overcome with the EMIR database, however only available from 2021). Indeed, information on the direction or maturity of these instruments is not available. Different classes of instruments also imply different interpretations of market and notional values. Their possible use therefore requires caution.

[14] In Italy, banks represent the main resident sector that holds both long and short positions in financial and credit derivatives (Infante and Sorvillo, 2019). The bank activity in derivatives has increased since the beginning of the century but it remains relatively modest compared to other countries because Italian intermediaries are mostly specialized in commercial banking (i.e. collection of savings and granting of credit). The sale of derivatives to businesses, households and public entities is limited to a few intermediaries: in 2015 the first five groups carrying out in this activity held 90 per cent of the market share (Signorini, 2015).

Figure 4. Evolution of the on-balance sheet share of hedging derivatives on total assets (percentage values)



Source: Finrep data. The figure shows the market value of hedging derivatives, defined as the sum of derivatives on both the asset and liability side of the balance sheet.

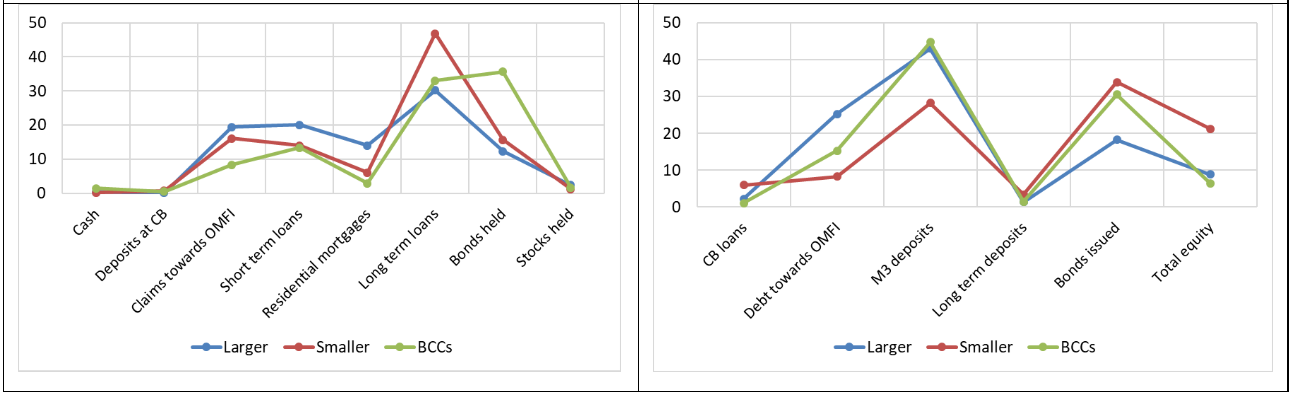
4.2 *Interdependence index* decomposition

In this section, we exploit the decomposition presented in equation (3) and, with the goal of identifying the most relevant interconnections driving the dynamics of the index, we look more closely at links between individual asset and liability positions. Figure 5 displays the average asset (liability) specific contribution to the *interdependence index* for all bank groups over the period 2003-2020.

Considering the asset side of the balance sheet, Figure 5 panel a shows a clear pattern for the three groups of banks. For all of them, *Long term loans* is a key contributor to the *interdependence index*. In particular for smaller banks this item explains on average almost 50 per cent of the index. For larger banks, there are at least two other asset positions that play a relevant role, i.e. *Short term loans* and *Claims towards OMFI*. For BCCs, the main contributor is instead *Bonds held*. Concerning liabilities, panel b shows that *M3 deposits* and *Bonds issued* are the positions that largely contribute to explaining the *interdependence inde*x, and thus the ALM practices, for all groups of banks. For larger banks, *Debt towards OMFI* explains slightly more than *Bonds issued*. For smaller banks, *Total equity* also provides a relevant contribution. Table 2 summarizes our selected asset and liability items.

Figure 5. Contributions to interdependence index over the 2003-2020 period (percentage values)

a) Asset ($\bar{\theta}^i$) | b) Liability ($\bar{\theta}^j$)



Note: our calculations on Individual Balance Sheet Items data.

The left panels in Figure 6 present the dynamics of the *interdependence index* (black line, right axis) and show its decomposition into the individual asset-liability *interdependence indexes* (coloured areas, left axis) that contribute the most to the dynamics over time. The right panels show the evolution of the unconditional dynamic correlations, across banks, between the selected asset and liability items considered in Table 2, i.e. the asset-liability correlations refer only to the relationships that played a larger role in explaining the index.[15]

Table 2. Main contributors to the interdependence index by group of banks

	Asset	**Liability**
Larger banks	*Long term loans* *Short term loans* *Claims towards OMFI* *Residential Mortgages*	*M3 deposits* *Debt towards OMFI* *Bonds issued*
Smaller banks	*Long term loans*	*Bonds issued* *M3 deposits* *Total Equity*
BCCs	*Bonds held* *Long term loans*	*Bonds issued* *M3 deposits*

[15] For simplicity, we have selected only a subset of the most relevant asset-liability relationships for larger banks from Table 2.

The main common feature across bank groups is the role of the two relationships *Long term loans-M3 term deposits* and *Long term loans-Bonds Issued*, which always explain a sizeable share of the *interdependence index* (Figure 6 panels a, c and e).

The correlation between *Long term loans* and *M3 deposits* is strongly negative from the beginning of the sample until the financial crisis (sovereign debt crisis for BCCs), suggesting that banks were not matching this asset class to sight deposits (Figure 6 panels b, d and f), while the correlation between *Long term loans* and *Bonds Issued* is often positive. This reflects banks' choice to minimize maturity mismatch. In an environment characterized by high interest rates, such as the one in place at the beginning of the century, banks likely preferred to link the proceeds from *Long term loans* to similarly state-contingent (even if more expensive) funding sources, mainly long term, such as *Bonds Issued*. The magnitude of the correlation between *Long term loans* and *Bonds Issued* shrinks as time goes by, reflecting a homogenous reduction across banks of bonds as a source of funding. This was due to lower interest rates and to the 2012 tax reform, which lowered the after-tax returns on bank bonds, thus limiting their attractiveness as an investment for households. Moreover, between 2009 and 2014, when the interest rate on deposits started to fall (see Figure 2), the correlation between *Long term loans* and *M3 deposits* approached zero for all bank groups.[16] In a low interest rate environment, *M3 deposits* became abundant and the weak demand for loans led to the diminution of this correlation.

After 2014, when the first round of TLTRO was launched, such correlation became more negative for both larger and smaller banks and positive for BCCs. Indeed, *Long term loans* (i.e. mainly business loans) were the target of the TLTRO, thus larger and smaller banks financed this class of loans with funds from central banks (*CB loans*). In fact, since 2015 the correlation between *Long term loans* and *CB loans* turned positive (see Figure 7 panel a), especially for smaller banks.[17]

For larger banks, we can identify other asset-liability relations that display high and stable links over time. For instance, there is a strongly positive correlation between *M3 deposits* and *Residential mortgages* and between M3 *deposits* and *Short term loans* (Figure 6 panel b). On the one hand, this is in line with the findings of Hoffmann et al. (2019) and Dreschler et al. (2021) who argue that banks hedge against interest rate risk by funding long term fixed-rate assets with stable *M3 deposits*, whose rates are also typically low and insensitive to market interest rates. On the other hand, *M3 deposits* are an abundant funding source and banks use them to fund *Short term loans*, which carry relatively low interest rate, credit and liquidity risks. Adopting a wider view on larger banks' ALM practices, a

[16] By construction, when the correlation approaches to zero, also the contribution to the *interdependence index* approaches to zero as it is a positive function of the squared correlation.

[17] Our claim holds also if the net balance vs Central Bank, i.e. *Deposits at CB – CB Loans*, is considered. See Figure C1 panel a in Appendix C.

reasonable hypothesis is that prudential regulation contributed to some extent to the increase in the weight of the relationship between M3 *deposits* and other classes of bank loans after 2015. Indeed, to enhance short-term resilience to liquidity shocks at internationally active banks, the Basel Committee on Banking Supervision (BCBS) introduced the Liquidity Coverage Ratio (LCR) as part of the Basel III post-crisis reforms.[18] This requirement is designed to ensure that banks hold a sufficient reserve of high-quality liquid assets to withstand a 30-day stress test scenario in the form of a severe net cash outflow. The LCR became a minimum requirement for BCBS member countries on 1 January 2015, with the requirement set at 60 per cent and rising by 10 percentage points annually to reach 100 per cent on 1 January 2019. The Net Stable Funding Ratio (NSFR) supplements the LCR with the aim of providing a sustainable maturity structure of assets and liabilities.[19] The NSFR is calibrated under the assumption that short-term (maturing in less than one year) deposits provided by retail customers and funding provided by small business customers are behaviourally more stable than wholesale funding of the same maturity from other counterparties; the NSFR became a minimum standard on 1 January 2018. Even though we cannot identify exactly the variables entering in the LCR and the NSFR, we observe that after the introduction of these two minimum standards banks began to assign more weight to the relationship between *M3 deposits* and different classes of loans. Finally, interbank assets (*Claims towards OMFI*) and liabilities (*Debts towards OMFI*) appear strongly correlated, given their extremely short maturity.

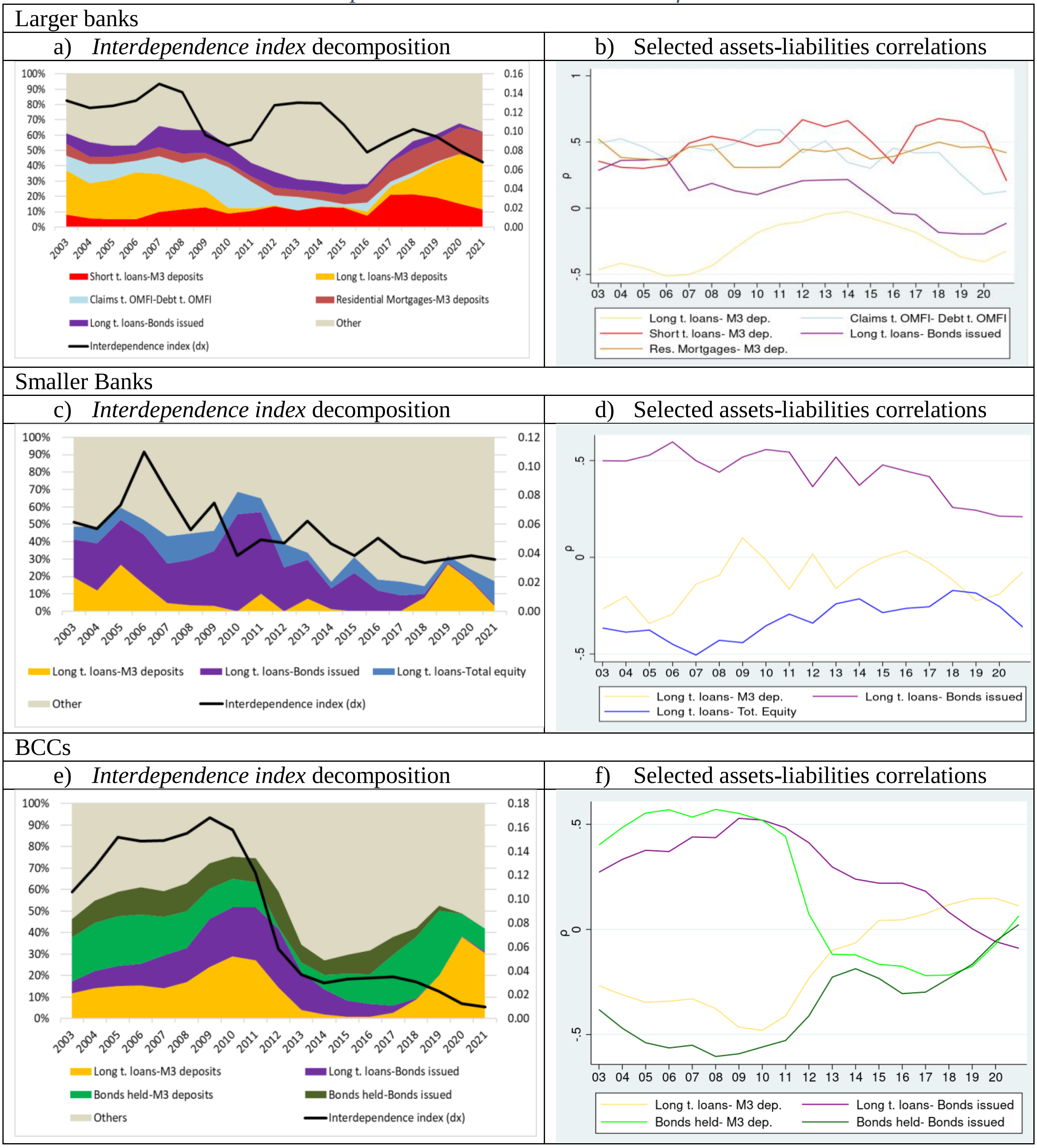
Focusing on smaller banks, we find that until 2018 the relationship *Long term loans-Bonds issued* was the largest contributor to the interdependence index (Figure 6 panel c). Looking at Figure 6 panel d, we find a strongly positive correlation over the whole time span. As before, we can infer that typically high yield *Long term loans* are more likely funded with costlier long run debt obligations (with probably different degrees of seniority) rather than sight deposits. The correlation between the two items remains positive, although declining, over the whole time span of our sample. Finally, there is a relatively stable and negative correlation between *Long term loans* and *Total equity.*

For BBCs, we can draw conclusions similar to those for smaller banks regarding the relationship *Long term loans-Bonds issued.* Moreover, we also find a strong explanatory power for

[18] Basel Committee on Banking Supervision, *Basel III: The Liquidity Coverage Ratio and Liquidity Risk Monitoring Tools*, January 2013.
[19] Basel Committee on Banking Supervision, *Basel III: The Net Stable Funding Ratio,* October 2014. See also Section A.2 in the Appendix for a hint on the role of macro-prudential regulation of the relationship between bank capital and all asset positions.

Bonds held (mainly government bonds) both linked to *M3 deposits* and *Bonds issued* (Figure 6, panel e).

Figure 6. Most relevant asset-liability relationships: contribution to interdependence index and evolution of correlations over time



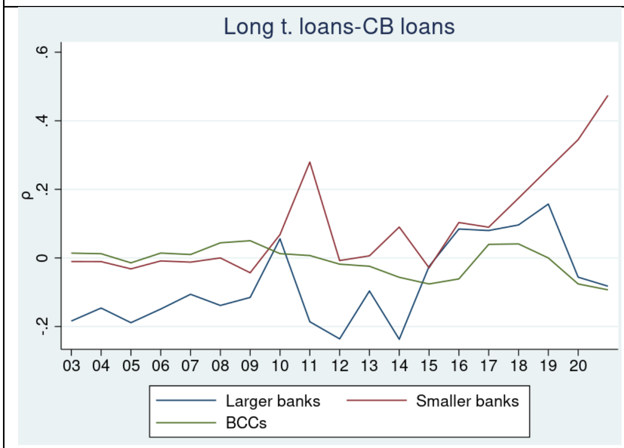
Note: our calculations on Individual Balance Sheet Items.

Until 2011, *Bonds held* was strongly positively correlated with *M3 deposits* and strongly negatively correlated with *Bonds issued*. This, again, is coherent with Hoffmann et al. (2019) and Dreschler et al. (2021) as banks fund their investment in long-term fixed rate assets with sight deposits. In this way, they hedge interest rate risk. However, in 2012, the correlation between *Bonds held* and *M3* *deposits* suddenly dropped and remained for a few years flat at a negative value similar to that of *Bonds held-Bonds issued*, whose profile also flattened. The decrease in the *Bonds held-M3 deposits* correlation is largely responsible for the sudden decline in the BCCs' *interdependence index*. Besides the fall in interest rates and the change in the tax regime for bank bonds, a role is likely played by the implementation of the first round of LTROs at the end of 2011. BCCs did not directly access these open market operations, but they indirectly benefitted from them through the interbank market. Indeed, since 2011, the correlation between *Bonds held* and *Debt towards OMFI* starkly increased (as it did for all other groups, in line with Crosignani et al., 2020), declining only towards the end of the sample, as reported in Figure 7 panel b.[20] Therefore, BCCs seem to have funded their bond acquisitions with debt financing on the interbank market.

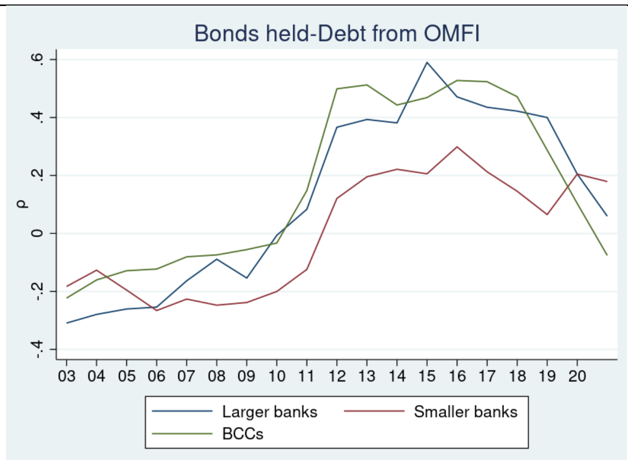
We also find that, in a low interest rate environment, BBCs gradually have become keener to fund *Long term loans* (mainly business loans) via *M3 deposits*, benefiting also from the abundant availability of this type of liability (see Figure 6 panel f).

Figure 7. Correlation of specific items over time

a)



b)



5. Conclusions

Asset-liability management techniques are the traditional way to mitigate risks associated with maturity mismatch. In this work, we present a measure of the evolution of the interdependence between asset and liability items in bank balance sheets over the past twenty years, with the goal of highlighting how changes in economic conditions and monetary policy are associated with modifications in the interconnections between them. As far as we know, the related literature has been

[20] Our claim holds even if considering the net interbank position, see Figure C1 panel b in Section C of the Appendix.

silent on the topic, and we aim at filling this gap.

More in detail, we construct an *interdependence index* and provide a decomposition of it that can be closely monitored to quickly identify changes in bank asset-liability interconnections. We find evidence that: i) the degree of asset-liability interdependence has significantly decreased over time for all three main groups of banks (larger, smaller and BCC) and reached the lowest levels in 2020 during the COVID-19 crisis; ii) in a low interest rate environment, following the unconventional monetary policy operations by central banks and the 2012 reform of the taxation on bank bond returns, banks increased their reliance on less costly deposits and central bank loans to fund long term lending to firms, in turn reducing the need to strictly connect the two sides of the balance sheet; and iii) the two main relationships driving the dynamics of the interdependence index are *Long term loans-M3 Deposits* and *Long term loans-Bonds Issued*.

Our indicator and its decomposition may enrich the conventional monitoring tools of policymakers, especially in the light of recent increases in interest rates and the related possible changes in bank funding and lending policies.

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Appendix

A. Robustness

The related literature on ALM has usually relied on a set of indicators based on different way to measure the extent of the asset-liability interdependence. In this section, we confront our findings with those obtained from other indicators usually employed in the field.

A.1 Canonical correlations

Canonical correlations (CC), firstly introduced by Hotelling (1935, 1936) and exploited by De Young and Yom (2008) with an application to the banking sector, offer a way of inferring information from cross-covariance matrices. In particular, given two vectors of the shares of single asset or liability items over total bank assets, $S^A = [S_1^A, S_2^A, \dots, S_{n_a}^A]$ and $S^L = [S_1^L, S_2^L, \dots, S_{n_l}^L]$, the canonical-correlation analysis allows to find the linear combinations of S^A and S^L which have maximum correlation with each other. In a nutshell, for each year CC derives from

$$CC = \max_{\eta^A, \eta^L} corr\left(\eta^{A'} S^A, \eta^{L'} S^L\right) \qquad (1)$$

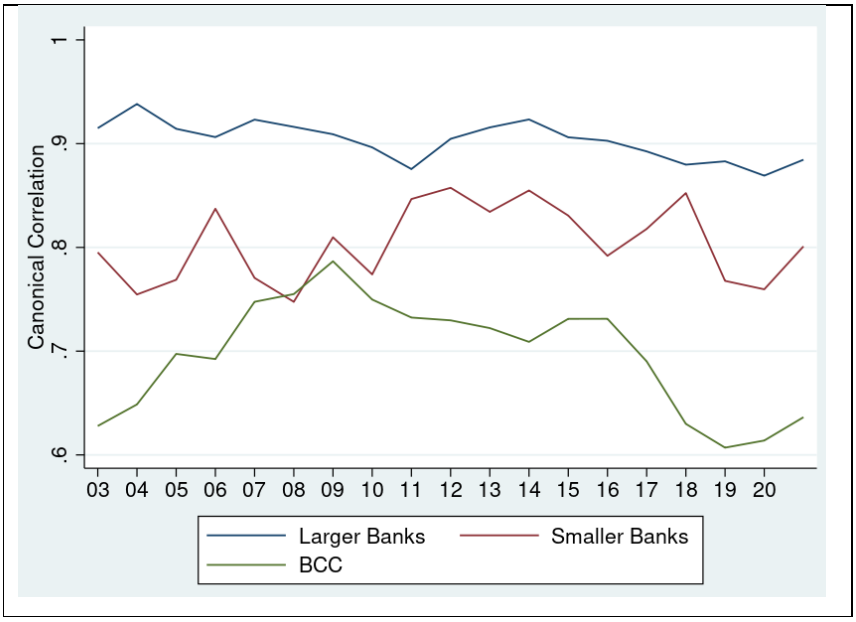
Where η^A and η^L are (canonical) coefficient vectors of the same size as S^A and S^L, which are selected such that the correlation is maximized (note that one asset and liability position must be omitted in order to avoid multi-collinearity). The solution to the problem involves an iterative procedure that stops when a maximum is found.

The analysis relies on the idea that the size and the strength of the canonical correlations are at the basis of the identification of relationships between specific asset and liability accounts. In particular, if we find that a liability variable (such as *M3 deposits*) is strongly correlated with the constructed canonical variable $A = \eta^{A'} S^A$ and we also observe that an asset variable (such as *Long term loans*) is strongly correlated with the constructed canonical variable $L = \eta^{L'} S^L$, we can infer that banks with a high share of *M3 deposits* also tends to have large amounts of *Long term loans*. The drawback of the CC is that just a single correlation could drive the results irrespective of the true relevance, in terms of balance sheet size, of the variables involved; this could be the case, for instance, of a high correlation between *Stock holdings* and *Short term loans*, i.e. items which typically account for only a small part of banks' balance sheet.

The *canonical correlations*, calculated for each year and bank category, are displayed in Figure A.1. Overall asset and liability variables exhibit a relatively high degree of collective dependence, but we observe some differences across groups. The *canonical correlation* takes larger values for larger banks (in line with the findings by DeYoung and Yom, 2008), equal on average to 90 per cent and only moderately declining over time. For these banks, the higher value of the *canonical correlation* with respect to the other groups reflects the more market-based and less stable funding structure. Indeed, the sum of the shares of *Debt towards OMFI* and *Bonds issued* was well above those for the other bank categories and that of *Deposits* well below. In other words, banks that rely more on market based funding need to constrain more the composition of assets in their balance sheet so as to limit the risks associated with maturity mismatch.

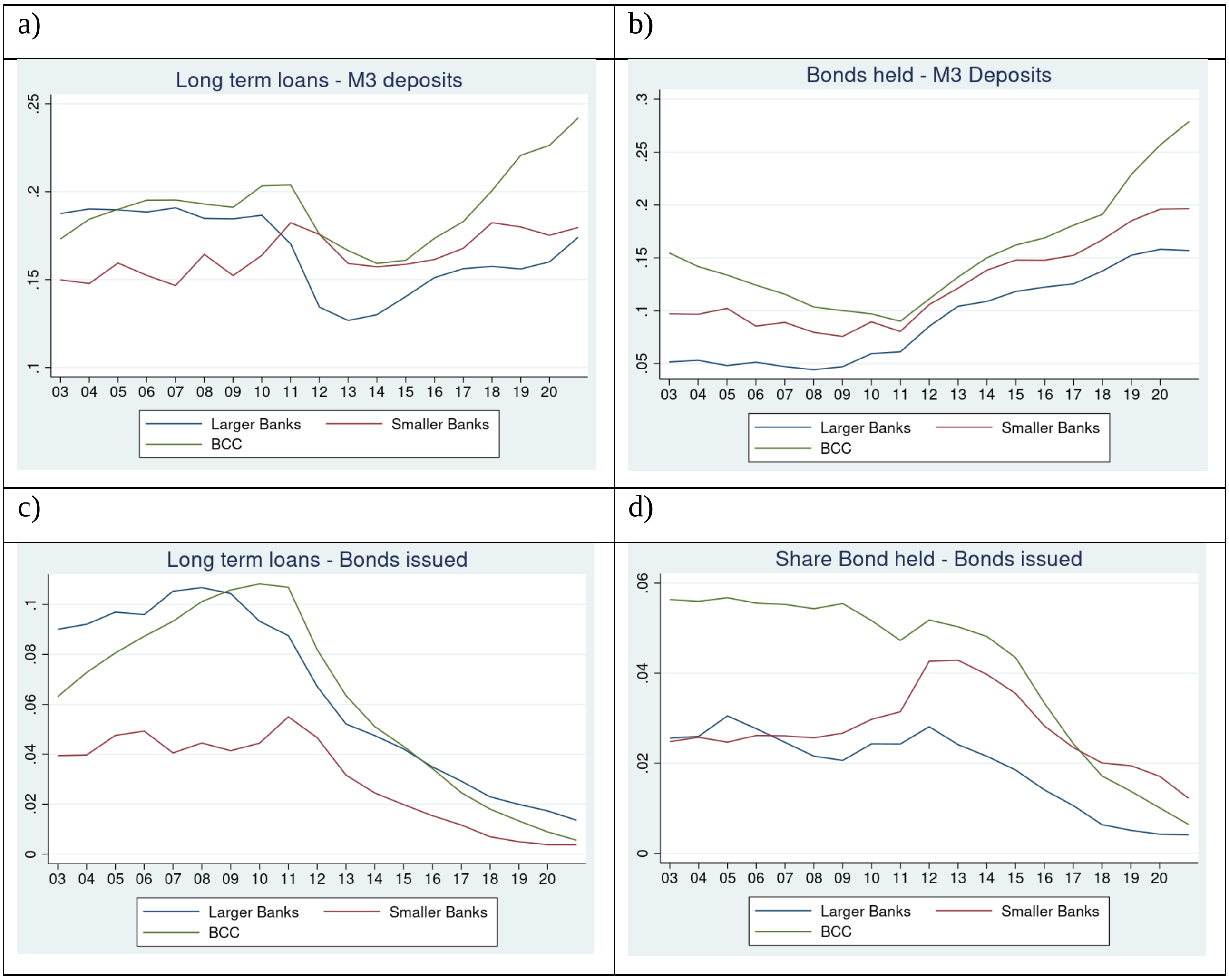
For smaller banks, the average *canonical correlation* over the period 2003-21 equalled 80 per cent, reaching a peak in 2012 after the introduction of the LTROs. For the BCCs, the *canonical correlation* displayed always the lowest value among the three banking categories, highlighting the different business model. With respect to larger banks, the smaller ones and the BCCs detain a larger share of deposits, which represents a cheap source of funding that limit the need for banks to strongly link assets and liability positions. Indeed, as claimed by Drechsler et al. (2021) these items have contractually a short maturity, but in practice sight deposits remain in banks' balance sheet for long time, and thus can be used to fund long term loans and other assets with longer maturity without incurring in a significant interest rate risk.

Figure A1. Canonical correlations



The difference between the *canonical correlation* and *interdependence index* dynamics are due to the differences in the relative weights of each asset-liability relationship. Indeed, they are homogeneous in the former, while reflects the true relative weight of each asset-liability couple in the latter. Therefore, the fact that the *interdependence index* for BCCs is above the one larger banks before 2012 reflects the highest relative weight of some specific components (*Long term loans-M3 Deposits*, *Bonds held-M3 deposits, Long-term loans-Bonds issued, Bonds held-Bonds issued*) due to a less diversified balance sheet structure, as reported in Figure A2.

Figure A2. Evolution of selected relative shares



A.2 Coefficient of determination

A shortcoming of the *interdependence index* is that it just considers unconditional correlations among asset and liability items therefore abstracting from a potential omitted variable bias. In this respect, we complement our analysis with *coefficients of determination* (R^2) computed from a set of regressions. In particular, we regressed in any year each asset (liability) variable on all liability (asset) variables of the opposite side of the balance sheet to obtain an estimate of the explained variance.[21] Table A1 presents the averages proportion of variance of any asset (liability) position explained by all the variables on the other side of the balance sheet, calculated separately for each group of banks.

[21] Similarly to *interdependence index* computation, we consider all monthly asset and liability positions of all banks within each group in a given year when running equations to compute R^2s.

Table A1. Average proportion of explained variance for asset and liability variables (percentage values)

	Larger banks	**Smaller Banks**	**BCCs**
Asset variance explained by liability variables	34.8	20.2	16.5
Liability variance explained by asset variables	37.7	28.2	20.0

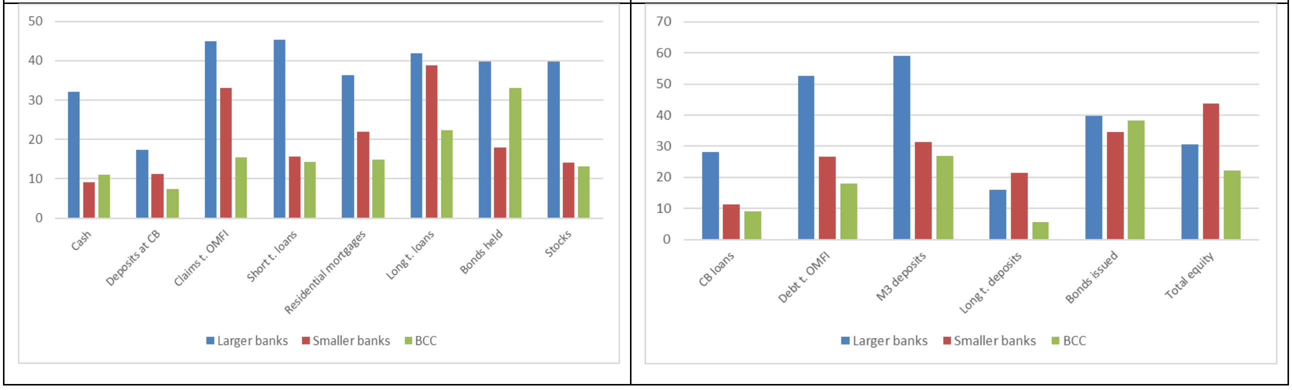
Note: our calculation on Individual Balance Sheet Items.

Larger banks display, on average, the highest *coefficients of determination* for both asset and liability positions, while BCCs have the lowest. Moreover, for each group, the average proportion of the variance of bank liabilities explained by asset variables exceeds the proportion of the variance of bank assets explained by liability variables. We draw three inferences from these findings. First, as already documented, larger banks are more inclined to practice ALM. Second, the correlation runs more strongly from assets to liabilities (i.e. banks find investment opportunities and shape funding structure accordingly) than the other way round (i.e. banks gather sources of funding and then look for investment opportunities), in line with results by Hanson et al. (2015). Third, the average proportions of the variance explained by the variables on the other side of the balance sheet are relatively small in size, indicating that the *interdependence indexes* (i.e. the correlations among variables) can be driven by a small number of relationships among individual asset and liability accounts, as already shown in the previous section.

We next consider the balance sheet positions that play a larger role in explaining the above results. Table A2 reports for each year the R^2 for a regression of each position on all the items in the opposite side of the balance sheet, which is useful to identify period-by-period changes; Figure A3 summarizes the content of Table A2 plotting the average R^2, computed over the entire period, for each asset and liability position as dependent variable.

Figure A3. Average R^2 by single item in bank balance sheet (percentage values)

(a) Asset positions average R^2 | (b) Liability positions average R^2



Note: our calculation on Individual Balance Sheet Items.

Figure A3 reports results similar to Figure 5. Indeed, larger banks appear to be more incline to undertake ALM practices as average *coefficients of determination* on both sides of the balance sheet are usually higher than other groups.

Table A2 allows to identify some interesting patterns that occurred in correspondence of some episodes.

The funding obtained from the Eurosystem began to be used to sustain banks' activities. For larger and smaller banks, in 2011 and 2012 the R^2 of the regression of *Claims towards OMFI* over all liability positions increased significantly: these banks fuelled some of the cheap liquidity obtained by the central banks towards other institutions (Darracq-Paries et al, 2015; Andrade et al., 2019). For all banks also the R^2 of the regression of *Bonds held* over all liability positions increased, confirming that banks, with the aim of exploiting the spread between the return on these bonds and the cost of funding at the central banks, augmented their holdings of government bonds (Crosignani et al., 2020; Carpinelli and Crosignani, 2021).

For smaller banks and BCCs the R^2 of the regression of *Bond issued* over all asset positions was high at the beginning of the sample period, suggesting that these banks tied bond issuance to investment opportunities. Since 2014, it progressively decreased: the tax reform of 2012 and the ample access to cheap liquidity from deposits translated into a lower need to match expensive bank bonds with asset positions.

Another interesting pattern concerns the evolution of the link between *Total equity* and total assets (measured by the R^2 of a regression of *Total equity* on all assets). For larger and smaller banks it raised significantly after 2013-2014, reflecting to some extent prudential regulation. The global financial crisis showed that a stronger capital base is necessary to improve the ability of the banking system to withstand severe economic shocks.[22] The increase in the R^2 of the regression of *Total equity* on all assets indicates that banks have strengthened the link between their assets and equity (Galardo and Vacca, 2022). The BCCs were less affected by the regulatory framework described in Basel III. The increase in the share of capital was smaller than for the other banks and the R^2 of *Total equity* on all assets variables was not affected at the time of the reform.

[22] Basel III was then introduced with the aim of improving the quality and quantity of bank capital. The final document with the main aspects of the reform was approved by the end of 2010 (BIS, 2010). One important change with respect to the previous regulation was the increase in the minimum Tier 1 capital requirement (from 4 to 6 percent of risk-weighted assets). Moreover, the Basel Committee strengthened the rules underlying counterparty risk. The entry date for the Basel III framework in Italy was January 2014 and by June 2015 all large internationally active banks have met Basel III minimum capital requirement (BCBS 2016).

Table A2. R^2 for asset and liability positions over time

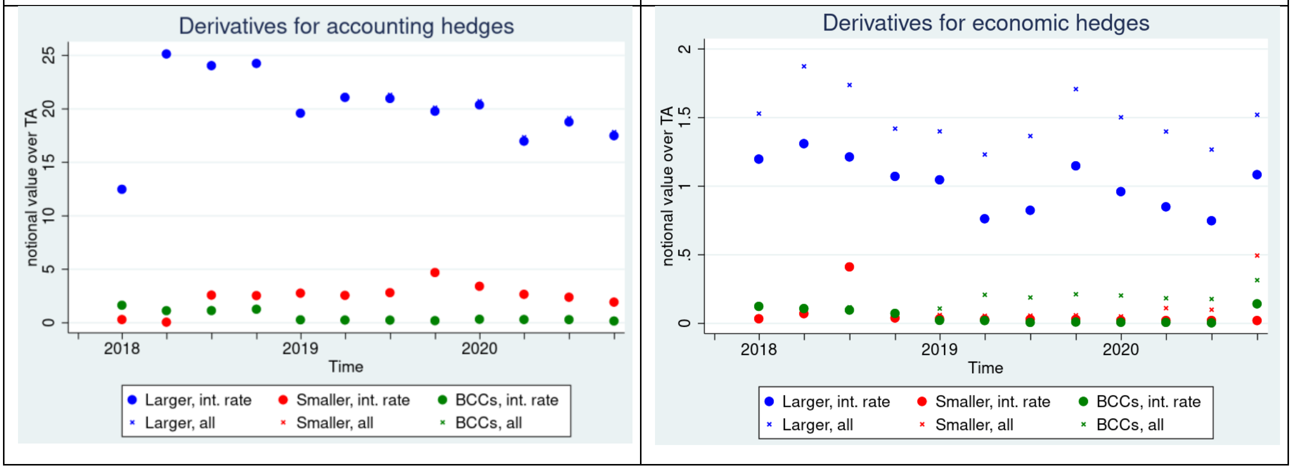
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Larger banks																		
Cash	0.41	0.38	0.44	0.46	0.39	0.43	0.35	0.30	0.34	0.42	0.36	0.40	0.35	0.18	0.12	0.10	0.10	0.29
Deposits at CB	0.27	0.26	0.18	0.16	0.14	0.12	0.20	0.19	0.12	0.20	0.15	0.06	0.11	0.23	0.18	0.20	0.04	0.31
Claims t. OMFI	0.49	0.53	0.54	0.39	0.39	0.30	0.30	0.51	0.64	0.67	0.70	0.62	0.49	0.38	0.36	0.41	0.32	0.22
Short t. loans	0.35	0.40	0.45	0.47	0.45	0.49	0.37	0.33	0.41	0.59	0.49	0.54	0.44	0.54	0.48	0.53	0.47	0.37
Res. mortgages	0.46	0.40	0.40	0.38	0.37	0.37	0.18	0.27	0.36	0.39	0.37	0.42	0.38	0.35	0.43	0.39	0.33	0.29
Long t. loans	0.47	0.48	0.47	0.44	0.44	0.44	0.31	0.28	0.32	0.50	0.57	0.55	0.40	0.27	0.38	0.41	0.44	0.38
Bonds held	0.32	0.34	0.32	0.34	0.26	0.23	0.21	0.18	0.25	0.50	0.57	0.49	0.55	0.60	0.52	0.57	0.54	0.37
Stocks	0.02	0.03	0.03	0.08	0.15	0.23	0.19	0.24	0.30	0.28	0.37	0.38	0.43	0.20	0.08	0.14	0.20	0.17
CB loans	0.23	0.18	0.22	0.13	0.07	0.09	0.36	0.11	0.25	0.53	0.48	0.64	0.44	0.23	0.23	0.23	0.18	0.51
Debt t. OMFI	0.64	0.60	0.59	0.62	0.61	0.58	0.55	0.55	0.50	0.46	0.58	0.49	0.55	0.51	0.49	0.51	0.41	0.23
M3 deposits	0.70	0.67	0.66	0.68	0.72	0.71	0.55	0.45	0.44	0.61	0.54	0.56	0.39	0.35	0.59	0.72	0.69	0.61
Long t. deposits	0.07	0.05	0.04	0.23	0.15	0.11	0.02	0.12	0.20	0.23	0.23	0.16	0.17	0.17	0.17	0.21	0.27	0.27
Bonds issued	0.31	0.38	0.41	0.41	0.36	0.36	0.29	0.29	0.32	0.38	0.43	0.49	0.49	0.44	0.43	0.48	0.47	0.44
Total Equity	0.25	0.29	0.31	0.28	0.21	0.36	0.32	0.20	0.23	0.38	0.44	0.50	0.34	0.40	0.28	0.18	0.26	0.27
Smaller banks																		
Cash	0.18	0.18	0.17	0.19	0.07	0.07	0.08	0.08	0.10	0.05	0.04	0.09	0.02	0.05	0.05	0.04	0.08	0.09
Deposits at CB	0.05	0.18	0.14	0.20	0.13	0.03	0.05	0.06	0.04	0.05	0.11	0.18	0.13	0.08	0.07	0.09	0.17	0.26
Claims t. OMFI	0.27	0.23	0.25	0.44	0.38	0.40	0.39	0.26	0.44	0.63	0.53	0.39	0.21	0.27	0.23	0.15	0.23	0.27
Short t. loans	0.14	0.18	0.14	0.15	0.10	0.08	0.16	0.14	0.15	0.13	0.23	0.18	0.07	0.18	0.20	0.23	0.20	0.16
Res. mortgages	0.22	0.16	0.26	0.28	0.28	0.27	0.23	0.20	0.15	0.18	0.18	0.31	0.26	0.26	0.26	0.21	0.13	0.12
Long t. loans	0.48	0.44	0.51	0.65	0.51	0.43	0.39	0.39	0.57	0.39	0.38	0.20	0.40	0.35	0.23	0.15	0.25	0.27
Bonds held	0.11	0.09	0.11	0.21	0.15	0.10	0.13	0.07	0.04	0.20	0.31	0.34	0.26	0.34	0.24	0.20	0.19	0.13
Stocks	0.09	0.07	0.12	0.10	0.13	0.09	0.11	0.17	0.15	0.06	0.18	0.32	0.28	0.15	0.13	0.25	0.08	0.06
CB loans	0.02	0.04	0.07	0.00	0.02	0.00	0.02	0.01	0.12	0.24	0.25	0.31	0.15	0.12	0.15	0.14	0.13	0.23
Debt t. OMFI	0.21	0.23	0.33	0.46	0.39	0.32	0.16	0.16	0.21	0.29	0.46	0.51	0.11	0.20	0.24	0.20	0.14	0.19
M3 deposits	0.35	0.39	0.33	0.40	0.23	0.19	0.29	0.10	0.19	0.14	0.38	0.28	0.14	0.35	0.45	0.52	0.49	0.41
Long t. deposits	0.31	0.24	0.26	0.34	0.04	0.20	0.17	0.09	0.27	0.31	0.18	0.07	0.22	0.23	0.12	0.24	0.29	0.29
Bonds issued	0.43	0.38	0.40	0.47	0.44	0.38	0.40	0.46	0.39	0.29	0.34	0.39	0.38	0.35	0.31	0.22	0.14	0.10
Total Equity	0.47	0.30	0.38	0.47	0.44	0.27	0.36	0.19	0.20	0.32	0.46	0.54	0.66	0.57	0.62	0.69	0.53	0.41
BCC																		
Cash	0.04	0.05	0.05	0.06	0.09	0.11	0.09	0.12	0.14	0.14	0.13	0.12	0.12	0.12	0.13	0.18	0.18	0.18
Deposits at CB	0.03	0.03	0.09	0.07	0.12	0.03	0.02	0.05	0.14	0.14	0.19	0.06	0.02	0.02	0.02	0.04	0.07	0.18
Claims t. OMFI	0.20	0.21	0.20	0.19	0.34	0.20	0.17	0.13	0.16	0.15	0.15	0.14	0.17	0.11	0.06	0.07	0.07	0.08
Short t. loans	0.22	0.20	0.21	0.20	0.21	0.15	0.11	0.10	0.08	0.15	0.17	0.17	0.15	0.13	0.10	0.09	0.09	0.05
Res. mortgages	0.18	0.15	0.15	0.14	0.13	0.13	0.13	0.12	0.13	0.14	0.14	0.15	0.20	0.21	0.21	0.19	0.11	0.08
Long t. loans	0.13	0.16	0.21	0.19	0.28	0.26	0.31	0.31	0.26	0.22	0.23	0.25	0.31	0.27	0.22	0.15	0.14	0.12
Bonds held	0.18	0.25	0.32	0.34	0.32	0.38	0.37	0.33	0.30	0.41	0.39	0.39	0.47	0.49	0.42	0.34	0.18	0.06
Stocks	0.10	0.11	0.11	0.10	0.06	0.09	0.11	0.13	0.12	0.10	0.11	0.10	0.11	0.11	0.13	0.23	0.25	0.29
CB loans	0.01	0.00	0.00	0.00	0.00	0.01	0.02	0.05	0.14	0.16	0.22	0.13	0.13	0.10	0.10	0.14	0.15	0.26
Debt t. OMFI	0.13	0.08	0.14	0.10	0.12	0.06	0.05	0.04	0.08	0.30	0.35	0.26	0.28	0.32	0.32	0.32	0.19	0.10
M3 deposits	0.34	0.37	0.43	0.42	0.38	0.44	0.46	0.45	0.37	0.21	0.17	0.12	0.10	0.08	0.15	0.14	0.11	0.11
Long t. deposits	0.05	0.04	0.05	0.05	0.05	0.04	0.03	0.03	0.03	0.03	0.05	0.07	0.09	0.10	0.10	0.08	0.06	0.04
Bonds issued	0.38	0.41	0.47	0.47	0.51	0.54	0.58	0.53	0.51	0.44	0.34	0.29	0.27	0.28	0.28	0.25	0.21	0.16
Total Equity	0.16	0.19	0.20	0.19	0.37	0.31	0.26	0.21	0.23	0.21	0.20	0.20	0.22	0.18	0.12	0.20	0.30	0.28

Note: our calculation on Individual Balance Sheet Items.

B. Derivatives

Figure B1. Derivatives on total assets (percentage values)

a) b)



Note: Finrep data. The circles show, in each quarter, the notional value of derivatives hedging against interest rate risk on total assets; the crosses show the total value of the derivatives referring to all risks (interest rate, equity, exchange rate and gold, commodities, credit risk and other) on total assets. It should be noted that for accounting hedges, the derivatives against interest rate risk almost always coincide with the total.

C. Net interbank position

Figure C1. Correlations over time between specific items

c) d)