Does group affiliation affect the interbank market exposure?

Evidence from the main European banking groups*

by

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Abstract

The interbank market represents a possible opportunity for investment and a source of capital for the entire banking system, and the usefulness of the market depends on the characteristics of the bank and the credit market price dynamics.

The banking group affiliation could also affect both the asset and liability side of the interbank exposure of the bank because of the strict relationship between all of the group's members.

Considering a representative sample of all of the main European banks, we study the relationship between the asset side, the liability side and the net exposure of these groups with respect to the bank characteristics, the market dynamics and the group structure characteristics. The results demonstrate that the group features significantly affect the interbank exposure, even if some of the group characteristics increase or lose their relevance during the financial crisis.

JEL classification: G21, G15, G32

Keywords: Banking group, Interbank market, Intragroup relationship

1. Introduction

To overcome liquidity shocks, banks rely on relationships (Cocco et al., 2007): they can diversify away liquidity shocks by developing bilateral lending relationships with other banks

(Upper and Worms, 2004), while corporate relationships arising from takeovers among banks are intended to diversify away liquidity shocks inside the banking group (Focarelli et al., 2002).

The interbank market depends on financial contracts among banks: the banks' role and strategies to satisfy liquidity needs in the interbank market can be affected by the firm characteristics, such as the control, the market segment and the size (Cajueiro and Tabak, 2008). For banks affiliated with banking groups, the liquidity management is virtually centralized (Schinasi and Teixera, 2006), and lacking regulatory constraints, it can be considered fungible inside the banking group (Cumming and Hirtle, 2001). The liquidity needs of a group member are a function of the correlation between the cash flows of the group entities (D'Souza and Lai, 2006). Therefore, the liquidity needs of the group are affected by the possible synergies existing among its members (Vander Vennet, 2002).

In light of the relevance of the interbank transmission of liquidity among banking groups (Cabral et al., 2002) and the impact of asset size on interbank market lending (European Central Bank, 2010), this paper studies the interbank market exposure of the main European banking groups for the 2005–2010 time frame. At the aggregate group level, the paper tests a hypothesis about the role of banking group features in explaining the interbank exposure of the banking groups. For each banking group, we examine the credit both offered and obtained in the interbank market in each year, and we study their relationship with the balance sheet indexes, the credit market dinamycs and the group features. The results demonstrate that the interbank exposure is significantly affected by the group characteristics, and during a financial crisis, the role of the bank features changes because of the different strategies adopted by banking groups to overcome the effect of the crisis.

In this paper we present a literature review about the firm-specific factors that affect access to the interbank market by banks and we discuss the rationale of group structure relevance in using the interbank market to overcome liquidity shocks (section 2). After a brief description of the sample (section 3.1), we present a methodology for testing the relevance of group features, market dynamics and bank characteristics in accessing the interbank market (section 3.2). Results about the lending activity, the borrowing activity and the net interbank position are presented separately with respect to the determinants of their value (section 3.3). The last section summarizes the conclusions and the implication of the results (section 4).

2. Literature review

Banks access the interbank market to satisfy their liquidity needs because of the risk of liquidity shortages arising from the uncertainty both in the location (Freixas et al., 2000) and the time of consumption (Allen and Gale, 2000). Banks can diversify away liquidity shocks by developing bilateral lending relationships with other banks (Upper and Worms, 2004), while takeovers among banks are intended to diversify away liquidity shocks inside the banking group (Focarelli et al., 2002).

Both market and firm-specific factors influence the liquidity risk exposure (Bangia et al., 1999) and the price of liquidity (Fecht et al., 2010): the banks' roles and strategies to satisfy liquidity needs in the interbank market can be affected by the firm characteristics, such as the control, the market segment and the size (Cajueiro and Tabak, 2008).

For privately controlled firms, access to the interbank market to adjust the liquidity position is affected by the type of firm ownership: the liquidity needs of the group member are affected by the correlation between the cash flows of the group entities (D'Souza and Lai, 2006). In fact, the

structure of a group enables it to operate in different sectors by flexibly exploiting the possible synergies existing among its members (Vander Vennet, 2002), even though this advantage is countered for large groups by a potential increase in the risk level because of the increase in the leverage and the decrease in the capital ratios (Demsetz and Strahan, 1997). Lacking regulatory constraints, liquidity can be considered fungible inside the banking group (Cumming and Hirtle, 2001); therefore, the liquidity management is virtually centralized for the firm as a whole (Schinasi and Teixera, 2006), and resources are allocated to the business units through a system of internal transfer rates (Matz and Neu, 2007). The centralization of the liquidity risk management is motivated by the fostering of efficiency through the reduction of funding costs, the opportunity of funding diversification and the feasibility of moving collateral and funds among the business units (Joint Forum, 2006). To overcome the disadvantages in accessing liquidity due to their limited size (Ehrmann and Worms, 2004), savings and cooperative banks can create group networks, in which a head institution or more second-level institutions hold liquidity reserves and coordinate the reallocation of liquidity among the members (Mazzillis and Schena, 2001). Nevertheless, cross-border issues encourage the management of liquidity at the local level, even though the group must centrally oversee the liquidity management, irrespective of the level of decentralization implemented (Institute of International Finance, 2006).

While liquidity risk depends primarily on retail deposits (Ho and Saunders, 1985) because depositors are enabled to withdraw at low cost (Diamond and Rajan, 2001), the market segment affects the liquidity creation by banks (Berger and Bouwman, 2009). Retail banks that take on demand deposits and that offer loan commitments more frequently access the unsecured interbank market to hold higher liquid buffers that can be mitigated if a less-than-perfect

correlation holds (Kashyap et al., 2002). For banks focused on investment activity, short-term collateralized borrowing is more relevant to satisfy their liquidity needs (Adrian and Shin, 2008). The size affects the attitude of the bank toward wholesale funding, including the access opportunity (Allen et al., 1989) and the price of the funds obtained (Nyborget al., 2002). The size matters because of economy of scope and scale: as it concerns the liquidity, a large bank has better access to the interbank markets, for example, because it has a larger network of regular counterparties, particularly in the case of banks labeled “too big to fail”, or because it has a wider range of collateral to satisfy liquidity needs through the secured market (Fecht et al., 2010).

3. Empirical analysis

3.1 Sample

We consider the top 500 banking groups worldwide on the basis of total assets, and we focus our attention only on those that are based in the enlarged European Union because they are more homogeneous under the definition of EU legislation. From this sample, we exclude all the groups for which the solo balance sheet is not available or is incomplete or the details of the structure and ownership are not provided (the final number of banking groups is 49). The full list of groups considered is presented in table 1.

Table 1. Sample description

HSBC Holdings Plc	Raiffeisen Landesbanken Holding GmbH
BNP Paribas	Skandinaviska Enskilda Banken AB
Banco Santander SA	Caja Madrid-Caja de Ahorros y Monte de Piedad de Madrid
Barclays Plc	Dexia
UniCredit SpA	Deutsche Zentral-Genossenschaftsbank-DZ Bank AG
Genossenschaftlicher FinanzVerbund	Swedbank AB
Lloyds Banking Group Plc	Landesbank Baden-Wuerttemberg
Intesa Sanpaolo	Svenska Handelsbanken
Société Générale	Banco Popular Espanol SA
Deutsche Bank AG	European Financial Group EFG (Luxembourg) SA
Rabobank Group-Rabobank Nederland	Ageas
Banco Bilbao Vizcaya Argentaria SA	Banco Espirito Santo SA
Credit Mutuel – IFRS	Espirito Santo Financial Group S.A.
BPCE SA	Millennium bcp-Banco Comercial Português, SA
Standard Chartered Plc	Nationwide Building Society
Commerzbank AG	Mediobanca SpA
Nordea Bank AB (publ)	EFG Eurobank Ergasias SA
LA CAIXA-Caja de Ahorros y Pensiones de Barcelona	Caja de Ahorros de Valencia Castellon y Alicante BANCAJA
KBC Group-KBC Groep NV/ KBC Groupe SA	Norddeutsche Landesbank Girozentrale NORD/LB
NRW.BANK	Banco de Sabadell SA
Gruppo Monte dei Paschi di Siena	Allied Irish Banks plc
Erste Group Bank AG	DekaBank Deutsche Girozentrale
Danske Bank A/S	WestLB AG
UBI Banca-Unione di Banche Italiane Scpa	Landwirtschaftliche Rentenbank
Banco Popolare	

Source: Bankscope data processed by the authors

Because of the availability of data, we consider the time horizon from 2005 to 2010, and we collect only yearly data from the income statement and the balance sheet of each banking group. On the basis of the data available in Bankscope and following the approach proposed by Upper and Worms (2004), we construct our proxy of the liquidity risk considering the loan to banks and the deposits to banks and the difference between the two proxies. Following the literature available, we identify and construct indexes and proxies useful in explaining the liquidity exposure of each banking group.

To consider the role of the group characteristics in explaining the liquidity risk exposure, we also collect information about the rating of the group (our proxy is the Fitch support rating, which measures the quality of the banking groups on the basis of the characteristics of the holding and the other group members), and we analyze the ownership of each group member, the type of subsidiaries and holdings (bank vs. other), the country of each groups' members and the role of controlled subsidiaries with respect to others. For group structure and ownership, Bankscope provides only the last available data and so we use information available in the solo balance sheet of each banking group in order to reconstruct all the changes happened in the six year time horizon.

A preliminary analysis of sample composition, based on some summary statistics, demonstrates that the groups are quite heterogeneous on the basis of these features (Table 2).

Table 2. Groups characteristics

Mean number of countries for each group		Cooperative banks	Not cooperative banks
Only one country	4	5	44
From 2 to 10	23	Public ownership*	Not public ownership*
From 11 to 20	12	7	42
Over than 20	10	Holding bank	Other type of Holding
Ratio controlled subsidiaries / Overall		36	13
Mean	35.46%	Ratio banks controlled / Overall controlled	
Median	27.05%	Mean	18.14%
Min	0.00%	Median	13.85%
Max	100.00%	Min	1.33%
		Max	62.86%
Note: * We do not consider the effect of the nazionalization during the financial crisis			

Source: Bankscope data processed by the authors

Considering the reference country for each group member, less than the 20% of the groups considered operate in only one country, and only 10% operate in more than 20 countries. The groups considered are prevalently not cooperative banks (only 10%) and not public owned (only

14%), and the reference entity (holding) is normally a bank or a financial institution (more than 73%).

The ownership of each group member is, on average, less than 36%, therefore for the other members participation does not imply corporate control. In terms of the types of controlled entities, not all of them are banks; the banking group frequently decides to also control other types of firms (not financial ones).

To determine the impact of interest rate market dynamics (e.g., Furfine, 2001), we also collect information about the marginal lending facility amount and the EONIA interbank loan rate directly from the ECB website.

3.2 Methodology

The analysis of the banking groups dynamics is conducted by considering different proxies of the liquidity risk exposure:

$$Asset\ side_{it} = Loans\ \&\ Advances\ to\ Banks_{it} \quad (1)$$

$$Liability\ side_{it} = Deposits\ from\ Banks_{it} \quad (2)$$

$$Net\ exposure_{it} = Liability\ side_{it} - Asset\ side_{it} \quad (3)$$

Formula (1) computes the investment released by a banking group in the lending activity on the interbank market considering the overall exposure at the end of the year t related to loans and advances. The variable constructed considers all of the main investments made by the group on the interbank market (Cocco et al. 2009).

Formula (2) computes the exposure on the interbank market, considering only the deposits obtained by banks. The choice to exclude the secured debt is consistent with other studies

available in the literature that demonstrate that only deposits show dynamics that are not affected by the specific contract characteristics (e.g., Cajueiro and Tabak, 2008).

Formula (3) considers the difference between the liquidity exposure asset side and liability side because the effects of the market conditions on the strategy are determined by the net position (Wong, 1997) of each banking group.

The choice to consider the debt/credit exposure independently with respect to the size of the exposure could be useful because there is evidence that demonstrates the role of specific bank features in explaining the amount of interbank exposure in the interbank market (e.g., Iori et al., 2007). In order to reduce the noise of the data analysed, we transform the explained variables into dummy variables that allow to study the main feature that explain an over-exposure in the interbank market (on both asset and liability side) and the positive net exposure in the market. In formulas:

$$Asset\ side\ Binary_{it} = \begin{cases} 1\ if\ Asset\ Side_{it} \geq Median_t \\ 0\ if\ Asset\ Side_{it} < Median_t \end{cases} \quad (4)$$

$$Liability\ Side\ Binary_{it} = \begin{cases} 1\ if\ Liability\ Side_{it} > Median_t \\ 0\ if\ Liability\ Side_{it} < Median_t \end{cases} \quad (5)$$

$$Net\ exposure\ Binary_{it} = \begin{cases} 1\ if\ Net\ exposure_{it} > 0 \\ 0\ if\ Net\ exposure_{it} < 0 \end{cases} \quad (6)$$

Formulas (4) and (5) are dummy variables that assume value 1 if, respectively, the asset side and liability side exposure are higher than the median value of the sample and zero otherwise.

Formula (6) considers only the sign of the difference between the interbank exposure asset side and liability side and classifies the banking groups that at time t have a net exposure equal or greater than zero as debtors (value 1) and all the others as investors (value 0).

We perform panel regression analysis of the value of liquidity risk exposure (asset side, liability side and net exposure) with respect to some explanatory variables identified in the literature. The following formulas are studied:

$$Asset\ side_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{n} \gamma_{it}^{p} MKT_t \quad (1a)$$

$$Asset\ side_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{m} \gamma_{it}^{p} MKT_t + \sum_{q=1}^{o} \tau_{it}^{q} Group_{it} \quad (1b)$$

$$Asset\ side_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{m} \gamma_{it}^{p} MKT_t + \sum_{q=1}^{o} \tau_{it}^{q} Group_{it} + \vartheta_t FinCrisis_t \quad (1c)$$

$$Liability\ side_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{n} \gamma_{it}^{p} MKT_t \quad (2a)$$

$$Liability\ side_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{m} \gamma_{it}^{p} MKT_t + \sum_{q=1}^{o} \tau_{it}^{q} Group_{it} \quad (2b)$$

$$Liability\ side_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{m} \gamma_{it}^{p} MKT_t + \sum_{q=1}^{o} \tau_{it}^{q} Group_{it} + \theta_t FinCrisis_t \quad (2c)$$

$$Net\ exposure_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{n} \gamma_{it}^{p} MKT_t \quad (3a)$$

$$Net\ exposure_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{m} \gamma_{it}^{p} MKT_t + \sum_{q=1}^{o} \tau_{it}^{q} Group_{it} \quad (3b)$$

$$Net\ exposure_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{m} \gamma_{it}^{p} MKT_t + \sum_{q=1}^{o} \tau_{it}^{q} Group_{it} + \theta_t FinCrisis_t \quad (3c)$$

$$Asset\ Side\ Binary_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{n} \gamma_{it}^{p} MKT_t \quad (4a)$$

$$Asset\ Side\ Binary_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{m} \gamma_{it}^{p} MKT_t + \sum_{q=1}^{o} \tau_{it}^{q} Group_{it} \quad (4b)$$

$$Asset\ Side\ Binary_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{m} \gamma_{it}^{p} MKT_t + \sum_{q=1}^{o} \tau_{it}^{q} Group_{it} + \theta_t FinCrisis_t \quad (4c)$$

$$Liability\ Side\ Binary_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{n} \gamma_{it}^{p} MKT_t \quad (5a)$$

$$Liability\ Side\ Binary_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{m} \gamma_{it}^{p} MKT_t + \sum_{q=1}^{o} \tau_{it}^{q} Group_{it} \quad (5b)$$

$$Liability\ Side\ Binary_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{m} \gamma_{it}^{p} MKT_t + \sum_{q=1}^{o} \tau_{it}^{q} Group_{it} + \theta_t FinCrisi \quad (5c)$$

$$Net\ exposure\ Binary_{it} - \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{n} \gamma_{it}^{p} MKT_t \quad (6a)$$

$$Net\ exposure\ Binary_{it} = \alpha_t + \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} + \sum_{p=1}^{m} \gamma_{it}^{p} MKT_t + \sum_{q=1}^{o} \tau_{it}^{q} Group_{it} \quad (6b)$$

$$Net\ exposure\ Binary_{it} - \alpha_t \ | \sum_{k=1}^{n} \beta_{it}^{k} Firm_{it} \ | \sum_{p=1}^{m} \gamma_{it}^{p} MKT_t \ | \sum_{q=1}^{o} \tau_{it}^{q} Group_{it} \ | \theta_t FinCrisi \quad (6c)$$

For the firm characteristics, we consider the following *n* items:

$Size_{it}$ = Natural logarithm of the market value of the group i at time t. It represents a proxy for the size of the group. Size influences the access to the interbank market for borrowers (Allen et al, 1989), but because relationship borrowing among banks is negatively affected by the size (Cocco et al, 2008), the larger the group, the larger the amount of liquidity transfers internally released among related parties inside the group. Therefore, the correlation of cash flows among group members determines the liquidity needs/excess of the group (D'Souza and Lai, 2006).

NII_{it} = Not Interest Income on Total Assets. Based on the contribution of investment bank activity to the profitability of the group, the variable serves as a proxy for the incidence of investment bank activity (European Central Bank, 2010) because the focus on investment activity indicates a higher recourse to short-term collateralized borrowing than to the interbank market (Adrian and Shin, 2008).

ROA_{it} = Return on Asset for group i at time t. The proxy measures the capability of the group to create, in the long run, the internal financial resources necessary to create short-term invested reserves to liquidate in order to meet the liquidity needs (e.g., Flannery, 1981); because it concerns access to the interbank market, ROA affects the price of interbank market borrowing because it signals the profitability of the assets for the lender (Furfine, 2001).

RWA_{it} = Risk-weighted Assets on Assets for group i at time t. The variable measures the risk-weighted assets according to the prudential regulation on capital requirements in force in the country where the holding of the group resides. It accounts for the risk of the group deriving from different sources and, among them, the risk of interbank loans (Rochet and Tirole, 1996).

$Lending_{it}$ = Loans to customers on Total Assets for group i at time t. The variable represents the incidence of lending activity that determines the relevance of the investment in assets that can fail to provide liquidity when the firm needs it (Holmstroem and Tirole, 2000).

Impaired loans$_{it}$ = Impaired Loans on gross Loans for group i at time t. The variable accounts for the quality of management of credit risk with reference to the group (Eisenbeis et al., 1999; Casu and Girardone, 2004), and it affects the access to the interbank market, both in terms of the price (Allen and Saunders, 1986) and the amount (Cocco et al., 2009).

Fixed asset$_{it}$= Fixed Assets on Total Assets for group i at time t. The variable accounts for the relevance of the fixed assets; therefore, it affects the opportunity to invest in the interbank market; moreover, it is an indicator of the branches in place in the group (Cyree et al., 2000).

Deposits$_{it}$= Retail Deposits on Total Assets for group i at time t. Because liquidity risk depends primarily on retail deposits (Ho and Saunders, 1985), the variable accounts for the relevance of such deposits in financing the assets.

Securities$_{it}$= Securities on Total Assets for group i at time t. The range of collateral affects the opportunity to raise liquidity through the interbank market (Fecht et al., 2010); therefore, the variables serve as proxies for the collateral offered to satisfy liquidity needs.

For market dynamics, we consider the following m items:

Eonia$_t$ =European Overnight Interest Average. The variable serves as a proxy for the cost and the return involved in accessing the interbank market (Prati et al., 2003).

MargL$_t$= Marginal lending facility volumes. The variable measures the amount of liquidity sources offered by the Central Bank that, because the Central Bank is normally the less costly financing source, could negatively affect the number of transactions completed in the interbank market.

For group characteristics, we consider the following o items:

Controlled/All$_{it}$ = Number of controlled subsidiaries with respect to the number of total subsidiaries for group i in year t. Because groups are able to raise funds from internal markets to

overcome liquidity shocks (Cetorelli et al., 2008), the variable serves as a proxy for the relevance of affiliates for which the commitment to transfer liquidity is higher because of the corporate control of the group.

HH Overall$_{it}$ = Herfindahl index of the affiliates classified for the country of origin in year t for group i. The correlation between the cash flows of the group entities that work in the same country can affect the liquidity position of the group (D'Souza and Lai, 2006).

HHbanks$_{it}$ = Herfindahl index of the banks classified for the country of origin in year t for group i. Differences in the regulations on minimum liquidity reserve requirements and the support provided to affiliates by the group (Joint Forum, 2006) can affect the liquidity strategy of the group, while the correlation between the cash flows of the group entities can affect the liquidity position of the group (D'Souza and Lai, 2006).

Banks/All$_{it}$ = Number of controlled bank subsidiaries divided by the total number of controlled subsidiaries. Because banks offer long-term assets and take retail deposits that affect the liquidity risk (Kashyap et al., 2002), the variable serves as a proxy for the relevance of the banking activity on controlled members of the group.

Cooperatives$_{it}$ = Dummy variable that assumes a value of 1 if the banking group is a cooperative banking group in year t. Banks can form relationship networks to adjust liquidity when friction exists both in the wholesale and retail markets (Freixas et al., 2000) because they are more exposed to monetary policy shocks in their lending activities (Kashyap and Stein, 2000). Because savings and cooperative banks belong to networks in which a head institution or more second-level institutions hold liquidity reserves and coordinate the reallocation of liquidity among the members (Mazzillis and Schena, 2001), they can overcome the disadvantages in accessing liquidity caused by their limited size (Ehrmann and Worms, 2004).

Public owner$_{it}$ = Dummy variable that assumes a value of 1 if the owner of the group is public in year t. The analysis of the public ownership is relevant because the public shareholder could normally affect the lending and investment policy of the banking group (Cajueiro and Tabak, 2008).

Rating$_{it}$ = Support rating defined by Fitch that measures the quality of the banking groups based on the characteristics of the holding and the other group members that provides a judgment on a scale that varies from 1 (lowest-risk groups) to 6 (highest-risk groups) (Fitch, 2004).

Holding bank$_{it}$ = Dummy variable that assumes a value of 1 if the owner of the group is a bank in year t. When the holding is a bank, liquidity management is defined by a high level of centralization (Joint Forum, 2006), which affects the access to external sources to satisfy liquidity shocks.

The last variable added is a financial crisis dummy variable that assumes a value of 1 from 2007 to the present. The inclusion of this variable makes it possible to test, as supposed in the literature (European Central Bank, 2010), that the main financial groups changed their interbank exposure during the last several years in order to overcome the problems related with the new financial and macroeconomic scenario.

The summary statistics (number of observation, mean, min and max) of the variables selected are presented in table 3.

Table 3. Summary statistics

	Obs	Mean	St.Dev.	Min	Max
Asset side	273	0.11	0.10	0.01	0.7
Liability side	278	0.13	0.09	0.00	0.46
Net exposure	278	0.02	0.10	-0.64	0.32
Asset Side - Binary	273	0.56	0.50	0.00	1.00
Liability Side - Binary	278	0.45	0.50	0.00	1.00
Net exposure - Binary	278	0.67	0.47	0.00	1.00
ROA	280	0.00	0.01	-0.06	0.04
Size	278	12.74	1.13	10.7	15.08
NIC/TA	278	0.73	0.84	-1.11	7.03
RWA	273	0.52	0.23	0.14	1.00
Lending	278	0.53	0.20	0.00	0.80
Impaired loans	278	0.03	0.03	0.00	0.13
Fixed assets	280	0.01	0.01	0.00	0.04
Deposits	280	0.36	0.28	0.00	1.00
Securities	278	0.63	0.30	0.08	1.00
Eonia	300	0.02	0.01	0.00	0.04
Deposit facility (mln €)	300	20.80	23.80	0.05	53.20
Controlled	300	0.35	0.25	0.00	1.00
HH Overall	300	0.47	0.28	0.05	1.00
HH banks	300	0.43	0.32	0.05	1.00
Ratio banks	300	0.18	0.14	0.01	0.63
Cooperatives	300	0.10	0.30	0.00	1.00
Public owner	300	0.14	0.35	0.00	1.00
Holding bank	300	0.74	0.44	0.00	1.00
Rating	300	1.56	1.07	1.00	5.00
Fin crisis	300	0.50	0.50	0.00	1.00

Source: Bankscope data processed by the authors

Some of the group dummy variables considered are invariant over time for each financial groups (like the Holding bank, Cooperative and the Public) and so the inclusion of these variables implies the choice of the random effects regression models[1].

[1] The Hausman specification test confirms that the choice is also statistical reasonable on the basis of the sample characteristics. Results of the test are not presented in the paper but they will be available upon request.

3.3 Results

To test the different roles of the banking group features, we perform a panel linear regression with random effects to test their role in explaining the liquidity exposure (Table 4).

Table 4. Liquidity risk exposure determinants – OLS panel random effect regression

Panels 1a, 1b and 1c use as explained variable the overall investment released by a banking group in the lending activity on the interbank market, panels 2a, 2a and 2c considers all the deposits obtained by other banks while panels 3a, 3b and 3c study the difference between the liability and the asset side exposure.
The set of explanatory variables includes group performance and risk exposure (ROA, size, NIC/TA, RWA, Lending, Impaired loans, Fixed assets, Deposits and Securities), interbank market dynamics (EONIA and Deposit facility), group features (Controlled, HH Overall), HH Banks, Ratio Banks, Cooperative, Public, Holding Bank and Rating) and a time dummy (fin crisis). For further details and summary statistics see section 3.2.

	Asset side			Liability side			Net exposure		
	(1a)	(1b)	(1c)	(2a)	(2b)	(2c)	(3a)	(3b)	(3c)
ROA	-0.68*	-0.37	-0.33	-2.00**	-1.9**	-1.88**	-1.35**	-1.55**	-1.54**
Size	-0.03**	-0.01*	-0.01	-0.01	-0.01	0.00	0.02**	0.00	0.00
NIC/TA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RWA	-0.01	0.00	-0.01	0.00	0.01	0.00	0.01	0.01	0.01
Lending	-0.16**	-0.11**	-0.11**	-0.05	-0.01	-0.01	0.09**	0.08*	0.08*
Impaired loans	-0.69**	-0.54**	-0.28*	-0.53**	-0.41*	-0.08	0.15	0.13	0.17
Fixed assets	-1.53*	-0.25	-0.86	0.57	1.16	0.41	2.23*	1.63	1.50
Deposits	0.00	-0.01	0.01	-0.08**	-0.07**	-0.05*	-0.08**	-0.07**	-0.06**
Securities	-0.07**	-0.08**	-0.10**	0.00	0.02	0.00	0.08**	0.11**	0.10**
Eonia	-0.33	-0.30	0.27	0.18	0.17	0.89**	0.51*	0.49*	0.59*
Deposit facility	0.98**	1.00**	-0.59	0.95**	0.97**	-1.03*	-0.08	-0.11	-0.39
Controlled		-0.01	-0.02*		0.03**	0.02*		0.04**	0.04**
HH Overall		0.02	0.03		-0.04	-0.03		-0.06	-0.06
HH banks		0.01	0.00		0.02	0.01		0.02	0.01
Ratio banks		0.12**	0.12**		0.07	0.06		-0.02	-0.02
Cooperatives		-0.04	-0.02		-0.06*	-0.05		-0.03	-0.03
Public owner		0.16**	0.18**		0.10**	0.11**		-0.07*	-0.07*
Holding bank		0.02	0.01		0.01	0.01		0.00	0.00
Rating		-0.01**	-0.01**		-0.01*	-0.01*		0.00	0.00
Fin crisis			-0.04**			-0.05**			-0.01
Constant	0.63**	0.34**	0.30**	0.27**	0.19	0.18	-0.35**	-0.10	-0.12
R^2 within	0.34	0.42	0.50	0.22	0.26	0.32	0.19	0.24	0.24
R^2 between	0.40	0.65	0.64	0.14	0.41	0.47	0.04	0.14	0.15
R^2 overall	0.40	0.64	0.64	0.17	0.39	0.46	0.07	0.15	0.16
Observations	273	273	273	273	273	273	273	273	273
Groups	49	49	49	49	49	49	49	49	49

Source: Bankscope data processed by the authors

The choice to include the banking group features makes it possible to duplicate at least the overall R^2 of the regression model. Therefore, to explain the liquidity policy of the main banking groups, it is necessary to explicitly consider the main group features. The analysis of the asset side of the interbank exposure is normally easy to model, while the analysis of the liability side and the net exposure is less explainable.

The performance measure of the banking groups (measured by ROA) negatively affects the interbank exposure. For the liability side, the negative effect can be explained by the low dependence of the group with respect to the rest of the market because of the opportunity for self-financing. For the asset side, the relationship is negative because of the low profitability of the interbank lending with respect to the other investment opportunities, which implies that these types of investments are less relevant with respect to other investment opportunities (Wong, 1997). Excluding models 1b and 1c, the ROA variable does not increase the statistical fitness of the model.

Normally, larger groups are less active in the interbank markets because of the opportunities that they have to use internally generated financial resources to meet liquidity needs. This relationship is clear for both the asset side, while for the liability side, there is no clear statistical relationship. The lack of relevance for the liability side could be explained by the existence of a residual (and marginal) financing policy in the interbank market for the larger groups that exist to meet unexpected liquidity needs. The relevance of the size on the net exposure can imply potential systemic effects of the interbank market activity.

The investments released in the interbank market are negatively affected by the relevance of the lending offered in the interbank market because the bank is more worried about creating the reserves necessary to address unexpected losses related to the lending activity. For the liability

side, the lending activity negatively affects the liquidity exposure only for the characteristics of the banking group. The effect on the net exposure is strictly linked to the asset side position.

The role of impaired loans negatively affects the interbank activity (both the asset and the liability side) because of the lower reputation of the banking groups in the market when the number of defaults increases (Allen and Saunders, 1986).

The amount of fixed assets negatively affects the interbank investments because banks that are more exposed in their long-term investments because of the higher need for money to support growth invest less in the interbank market (Cjree, Wansley and Boehm, 2000). When including the banking group structure variables, the fixed assets investment variables lose their statistical significance.

The number of deposits positively affects all types of investments and negatively affects the need for funding to overcome the liquidity needs. The variable is statistically relevant only for the liability side and the net exposure and is driven by the asset side because of the high relevance of the deposit funding for the interbank investment.

The availability of securities negatively and significantly affects the investment and net exposure on the interbank market. The results could be explained by the preference of these types of banks for collateralized borrowing over the interbank market (Adrian and Shin, 2008).

The EONIA interest rate seems to significantly affect both the asset side and the liability side of the banking group's exposure in the interbank market. The relationship is not consistent with the literature and is not verified when the financial crisis dummy variable is considered. The relationship identified is not related to the market dynamics; it is only affected by the change in the EONIA market trend during the crisis (Brunnemeier, 2009).

The analysis of the amount of credit offered to the financial system negatively affects the interbank activity because, normally, the higher the amount offered by the Central Bank, the lower the need to collect money through the interbank market and the lower the interest rate of these types of investments (Freixas et al. 2000).

Considering the banking group characteristics, only the degree of control, the type of group (public or private) and the rating affect the liquidity exposure.

The higher the number of controlled entities in the group, the lower the investment in the interbank market is, especially before the most recent financial crisis. The effect on the net exposure is clearer and statistically significant and is significantly driven by the asset side that imposes a highly centralized group that invests primarily in intragroup lending instead of interbank investments (Cetorelli and Goldberg, 2008).

Publicly owned banking groups do not invest in the interbank sector during a financial crisis because during a crisis, the Government agrees to provide the amount of capital necessary only if the banking group significantly modifies (reduces) its risk exposure (Cajueiro and Tabak, 2008). Normally, they frequently resort to interbank lending while the net exposure in the interbank market in not clearly affected by public ownership.

Normally, less risky banking groups (lower rating assigned by Fitch) have a lower exposure in the interbank market, and they are also able to increase the lending obtained in the interbank market because of the high reputation they have in the credit market. The net effect is not clear because the relevance of the asset side and the relevance of the liability side are comparable.

The financial crisis dummy variable negatively affects all types of interbank exposure because of the lack confidence of all of the banks in the interbank transactions during a period of crisis (European Central Bank, 2008). The relationship is statistically significant only for the liability

side, so the net exposure is driven by the effect on the liability side (even if it is not statistically significant).

The analysis of the binary variables constructed on the asset side, liability side and net exposure allows identifying some interesting differences respect the exposure amount analysis (Table 5).

Logit regression models perform worse with respect to the ordinary least squares models when only the asset side or the liability side are considered (the Pseudo R^2 is less than an half of the R^2 overall of the OLS models). While when the net exposure is taken into account, the logit regression fits better with the data.

In terms of the explanatory variables, the choice of the logit regression models modifies significantly the role of the firm specific and the market explanatory variables. In fact, even if there is no change in the sign of almost all relationships identified, the statistical relevance of fixed assets and deposits disappears and no market variable (Eonia and Deposit facility) contributes positively to the explanatory power of the model. So all these variables play a role in defining the amount of exposure (both credit and debit ones) but they seems to be less relevant in defining the groups' choice to be net lender or net debtor in the interbank market (models 6a, 6b and 6c) or the strategy to be one of the more exposed financial group in the interbank market (models 4a, 4b, and 4c for the asset side and models 5a, 5b and 5c for the liability side).

Table 5. Liquidity risk exposure determinants – Logit panel regression random effect

Panels 4a, 4b and 4c use as explained variable a dummy variable that assumes value one if the overall investment released by a banking group in the lending activity on the interbank market by the group I at time t is higher respect the median value of the sample in the same year.
Panels 2a, 2a and 2c consider as regressor a dummy variable that assumes value 1 if all the deposits obtained by other banks for the group I at time t is higher respect to the median value of the sample in the same year.
Panels 3a, 3b and 3c study a dummy variable that assume value one if the liability side is higher than the asset side exposure and zero otherwise.
The set of explanatory variables includes group performance and risk exposure (ROA, size, NIC/TA, RWA, Lending, Impaired loans, Fixed assets, Deposits and Securities), interbank market dynamics (EONIA and Deposit facility), group features (Controlled, HH Overall), HH Banks, Ratio Banks, Cooperative, Public, Holding Bank and Rating) and a time dummy (fin crisis). For further details and summary statistics see section 3.2.

	Asset side			Liability side			Net exposure		
	(4a)	(4b)	(4c)	(5a)	(5b)	(5c)	(6a)	(6b)	(6c)
ROA	-38.89	-27.56	-28.62	-75.89	-53.33	-54.26	-5.93	-15.41	-15.17
Size	-0.35	0.05	0.12	-0.11	-0.52	-0.58	0.93*	0.95*	0.93*
NIC/TA	-0.41	-0.42	-0.50	-0.28	-0.41	-0.40	-0.01	0.03	0.04
RWA	-0.23	0.62	0.60	-0.17	1.11	1.19	1.13	1.37	1.43
Lending	-9.60**	-9.25**	-9.44**	-5.13	-1.00	-0.99	6.36*	10.59**	10.68**
Impaired loans	-34.66**	-31.08*	-25.45*	-52.06*	-41.36	-43.35	2.61	1.28	-0.72
Fixed assets	-110.33	-41.00	-56.49	-75.6	8.95	10.79	7.04	34.78	40.58
Deposits	-0.37	-1.16	-0.88	-3.05	-2.77	-2.87	-0.36	1.74	1.60
Securities	-4.85**	-5.71**	-6.06**	-0.85	2.76	2.91	2.31	5.18**	5.26**
Eonia	24.84	28.20	41.51*	0.97	7.99	5.04	10.03	5.71	0.44
Deposit facility	-20.39	-23.75	-61.02	-8.27	-19.71	-11.47	-2.97	-0.53	15.13
Controlled		-1.25	-1.24		2.69	2.74		3.11*	3.07*
HH Overall		0.35	0.40		1.55	1.41		-2.22	-2.26
HH banks		-0.24	-0.42		-4.67	-4.61		4.78**	4.86**
Ratio banks		4.16	4.23		-3.25	-3.25		-0.43	-0.43
Cooperatives		-1.78	-1.56		-33.05	-34.25		-5.37**	-5.46**
Public owner		5.13*	5.31*		6.24*	6.28*		0.89	0.85
Holding bank		-0.60	-0.64		0.28	0.31		0.51	0.50
Rating		-0.32	-0.30		-1.05*	-1.07*		-0.38	-0.39
Fin crisis			-1.00			0.24			0.40
Constant	15.41**	10.27	10.96	7.24	8.79	9.21	-16.00**	-22.76**	-23.20**
Pseudo R^2	0.20	0.25	0.25	0.26	0.35	0.35	0.14	0.22	0.22
Wald chi2	0.01	0.12	0.14	0.58	0.72	0.79	0.59	0.16	0.19
Prob > chi2	0.68	0.62	0.62	0.9	0.9	0.91	0.68	0.48	0.48
Observations	273	273	273	273	273	273	273	273	273
Groups	49	49	49	49	49	49	49	49	49

Source: Bankscope data processed by the authors

Looking at the groups characteristic, the asset side (models 4a, 4b, 4c) is driven by the public ownership (positive relationship) while the liability side (models 5a, 5b, 5c) is affected by both the public ownership and the group rating (respectively positive and negative relationship). The analysis of the net exposure (models 6a, 6b and 6c) shows some differences respect to the linear regression results: the main explaining variables are the degree of control, the cooperative status dummy and the geographical concentration of the banks. The cooperative bank status could affect the probability of being a debtor in the interbank market because (on average) this type of bank is normally smaller, so their access to the interbank market to satisfy liquidity needs is lower (Allen et al., 1989). The relationship with the geographical concentration could be related to the higher geographical concentration of the portfolio that positively affects the cash flow correlation (D'Souza and Lai, 2006).

The financial crisis dummy does not increase the explanatory power of the regression model and so during the crisis the interbank exposure of the main financial groups did not change significantly and the manager's choices never changes radically. Results are consistent with the US experience where the crisis does not change the number and type of financial intermediaries that trade actively in interbank market even if the sensitivity to bank specific features and riskiness is significantly increased (Afonso et al., 2011).

4. Conclusions

Consistent with other studies available in the literature, there are some bank features (such as lending and size) and some market trends (interest rate and credit supply) that can affect the interbank activity of banking groups. Banking group features significantly affect the exposure in the interbank market of the overall banking group for both the asset and liability sides. The type

of group, the type of holding, the degree of control and the rating of the group are the most important variables for explaining the interbank exposure.

The role of the banking features in explaining the liquidity exposure of the overall banking group demonstrates the need for a supervisory approach that examines the banking group's exposure instead of analyzing each bank's exposure. The results support the theory proposed by some authors about the effects of a centralized banking supervision process (e.g., Rochet and Tirole, 1996) on the main European banking groups made directly by the ECB or by a macroprudential supervisory authority.

The relevance of the banking group variables in explaining the interbank market exposure demonstrates the need for a supervisory approach to the liquidity market dynamics that uses a macro scenario to evaluate the intragroup bank transfers.

The next step of the research will be to refine some of the explanatory variables (such as the HH) to verify whether the change in the specification of the index can affect the statistical fitness of the model and the variable significance. To measure how much group features affect the liquidity exposure, an event study approach could make it possible to identify how the different changes in the group features could affect the interbank exposure of the banking group.

The current debate about the SFI demonstrates the attention given by supervisors to monitoring the largest European financial groups to mitigate the risk of a future financial crisis (e.g., Masera, 2009). Evidences presented in the paper demonstrate the role of some group features in explain their interbank exposure and could be useful in order to define the new supervisory guidelines for liquidity management. The current regulatory framework highlights the relevance of liquidity risk measurement at group level and points out some legal constraints that have to be considered for evaluating liquidity transfer restrictions (BIS, 2010). Nonetheless, empirical evidences

presented in the paper demonstrate the relevance for the main European groups of features like degree control, ownership, number of banks in the group and group's rating and point out some further development opportunities for the current regulatory framework.

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