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The Effect of Banking Market Competition on Bank Liquidity Creation and The Moderating Role of Bank Income Diversification: Evidence from European Countries

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ABSTRACT

This study examines the effect of banking market competition on bank liquidity creation and investigates how this effect potentially varies with the degree of bank income diversification. The empirical evidence is based on an international quantitative analysis that used data on 81 European commercial banks from 2006 to 2015. The results show that banks' aggregate on- and off-balance-sheet liquidity creation increases when banking market competition rises. This positive effect diminishes with high levels of bank income diversification. If we believe that the level of liquidity risk in the European market is already excessive, diversification can be considered a "buffer" against the harmful effects of competition. In a highly competitive banking market, bank managers should place more emphasis on the diversification of banking income to avoid competition-induced excess liquidity creation, which can increase the likelihood of failures.

JEL Classifications: G21

Keywords: bank liquidity creation, banking market competition, bank income diversification

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I. INTRODUCTION

Liquidity creation constitutes one of the most pivotal functions that banks perform in the economy. The analytical approach to understanding banks' role in liquidity creation—and, subsequently, in stimulating economic growth—is part of a longstanding tradition dating back to the foundational work of Adam Smith in 1776. Modern theoretical frameworks propose that banks create liquidity both on and off the balance sheet. As posited by Bryant (1980) and Diamond and Dybvig (1983), banks create liquidity "on the balance sheet" by financing long-term illiquid assets with relatively short-term liquid liabilities. Furthermore, Holmström and Tirole (1998) and Kashyap et al. (2002) argued that banks also create liquidity "off-balance-sheet by offering loan commitments and generating similar claims to liquid funds." Berger and Sedunov (2017) showed that bank liquidity creation stimulates economic growth. However, Berger et al. (2019) found that excessive liquidity creation could have a negative effect on the economy and the financial market. Indeed, the creation of liquidity generates a liquidity risk that can become excessive, thus weakening the bank, especially during periods of economic uncertainty, and increasing systemic risk.

Parallel to this discourse on liquidity creation, the role of competition within the banking sector has been foregrounded as a crucial determinant of social welfare. As Cetorelli (2001) suggested, competitive dynamics can potentially reduce prices (i.e., interest rates) and improve services for enterprises and consumers. Moreover, Boyd and De Nicolo (2005) argued that a competitive banking market can yield broader societal benefits, such as superior quality and more affordable financial products. On the other hand, competition can push banks to take excessive risks to generate good performance, which weakens the banking system.

In the context of the dynamism of a globalized financial system and competitive banking environment, it will be useful to estimate the impact of banking market competition on bank liquidity creation. There is limited research on this relationship despite the abundance of studies on the effects of competition in the banking market.

In addition to liquidity creation and banking market competition, we included bank income diversification as a moderating variable in our analysis. As bank income diversification has an impact on bank risk (Lepetit et al., 2008) and performance (Sanya and Wolfe, 2011), it can influence the level of a bank's liquidity creation in the highly competitive banking market (Toh et al., 2020). Income diversification encompasses all non-interest income (Baele et al., 2007), which is a heterogeneous class that contains many different activities. It is divided into four principal elements: "fiduciary income," "service charges," "trading revenue," and "fees and other income" (Stiroh, 2004a; Elsas et al., 2010). Noninterest income comes from non-traditional bank activities, such as securities trading, foreign exchange activity, commissions, fees, and all other revenue aside from interest. A large body of research has discussed the impact of bank income diversification on bank risk (Lepetit et al., 2008) and performance (Sanya and Wolfe, 2011). Well-founded results have confirmed that diversification improves banking efficiency by expanding investment opportunities and reducing idiosyncratic risk. However, other studies have found negative effects of diversification and explained these effects by the dispersion of managerial resources.

We assumed that banks with well-diversified portfolios are less exposed to excessive competition-induced liquidity risk-taking since they can generate profits from

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activities other than interest income. We expected to find that the impact of competition on bank liquidity creation is alleviated when banks have a diversified income portfolio.

The choice of the European context is motivated by its distinctive characteristics—in particular, overbanking and the heterogeneity of its banking concentration. Some countries (Finland, Spain, and the Netherlands) have "national champion" banks with a dominant position, whereas in other countries, notably Germany and Luxembourg, the banking system is characterized by greater fragmentation. Compared to the American system, the European banking system is fragmented, preventing leading banks from competing with their American counterparts.

According to Fernandez-Bollo et al. (2021), the consolidation of banking in the euro area is still slow despite persistent weak bank profitability. For European banks to compete with American ones, authorities must encourage the cross-border integration of banking groups. Unlike domestic consolidation, cross-border integration reaps benefits through improved geographic diversification (Enria and Fernandez-Bollo, 2020).

The remainder of this paper is organized as follows. Section 2 presents a description of the characteristics of European Banks, reviews the related literature, and develops the hypotheses. Section 3 describes the research methods and data. Section 4 presents the main results and robustness tests, and Section 5 concludes the paper.

II. LITERATURE REVIEW

A. Characteristics of European Banks

The characteristics of banks in European countries vary significantly based on the ownership structures. We can divide our sample into two groups: the first consists of France, Germany, Italy, and Spain, and is characterized by the presence of foreign-owned banks and global systemically important banks, which play a prominent role in these countries. This group has more mature and developed banking markets characterized by higher levels of competition. In addition, in Group 1 countries, there are large banks with an international presence that are exposed to increased competition, notably from large American banks.

The second group, which includes Bulgaria, Estonia, Latvia, Lithuania, the Slovak Republic, and Slovenia, has smaller banking sectors and fewer major players compared to the larger European economies. This group experienced a higher degree of foreign bank penetration in the 1990s, thus improving competition. In these countries, a handful of dominant banks control a significant portion of the local market but do not have as extensive an international footprint as those in Group 1.

Even before the financial crisis of 2007–2008, large European countries exhibited a significant movement towards the concentration of their banking sectors. For example, Germany and Spain experienced increases of 60% and 70%, respectively, between 2007 and 2022, as we can observe in Figure 1. This figure represents the evolution of the shares of five major banks within the total active (CR5). Thanks to domestic merger operations, the number of banks has continued to decrease, while their sizes to increased. The consolidation of the European banking sector in recent years can be partly explained by the financial crisis. For example, in Spain, a small number of large banks, including Santander and BBVA, still dominate the market, but competition has intensified with the rise of digital banking and the arrival of new players.

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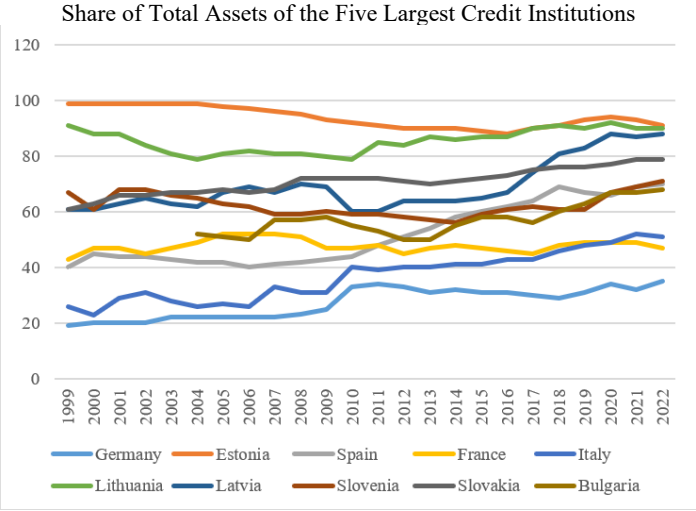
Figure 1
Share of Total Assets of the Five Largest Credit Institutions

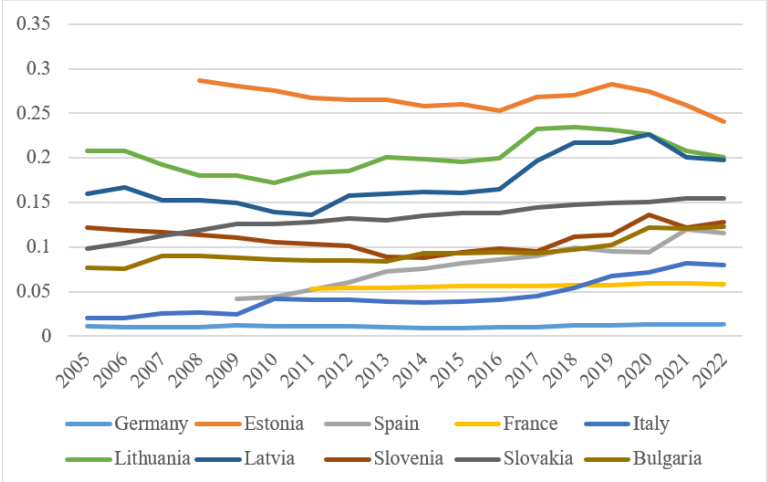


Source: European Central Bank

We note that banking consolidation affected all countries in Group 1 but remained less significant compared to Group 2, which is characterized by a heterogeneous trend. For example, Latvia's CR5 increased, while Estonia's decreased.

Furthermore, we see a certain convergence among all countries. This convergence is affirmed by Figure 2, which presents the Herfindahl (H) index for total credit for the entire sample. We still see a higher concentration for the countries in Group 2, although in most of these countries, the H index has decreased. Germany remains the country with the most fragmented banking system.

Figure 2
Herfindahl Index for Total Credit



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Source: European Central Bank

B. Banking Market Competition and Liquidity Creation

As noted above, banks create liquidity on the balance sheet typically by using liquid deposits to fund illiquid loans (e.g., Bryant, 1980; Diamond and Dybvig, 1983) and off the balance sheet through similar claims to liquid funds and loan commitments (e.g., Boot et al., 1993; Holmström and Tirole, 1998; Kashyap et al., 2002). However, most studies analyzing the link between competition and the creation of liquidity have focused on balance sheet liquidity. For example, Cyrnak and Hannan (1999) and Heitfield and Prager (2004) found that loan rates and deposit interest rates, respectively, are influenced by banking market concentration. Kick (2022) found that when monopolistic firms exercise their pricing power in the context of bank competition and liquidity creation, it leads to a reduction in liquidity creation by banks, implying that these firms tend to provide insufficient supply to the market. The presence of high bank–individual pricing power significantly limits the impact of positive interest rate shocks on banks' liquidity creation. Based on the theoretical literature, there are two opposing effects of banking market competition on bank liquidity creation. On the one hand, the "fragility channel" view suggests that increased competition increases banks' fragility by decreasing bank profits, which reduces the capital that normally operates as a "buffer" to face "adverse shocks" (Horvath et al., 2016). Thus, banks tend to decrease liquidity creation by accepting fewer deposits and issuing fewer loans to diminish the threat of bank runs. According to this view, when competition increases, banks tend to reduce their lending activity (Ali et al., 2022).

In the Czech banking sector, Horvath et al. (2016) observed that increased competition among banks has been linked to a reduction in the creation of liquidity by financial institutions, possibly due to the impact of competition on banks' financial robustness, resulting in reduced lending and deposit activities. Greater competition within the banking sector may lead to a heightened emphasis on profitability and risk mitigation, prompting banks to exercise more prudence in their lending and deposit functions, consequently diminishing liquidity creation.

Many authors' results confirm that competition reduces liquidity creation through bank fragility (Horvath et al., 2016; Ali et al., 2019; Jiang et al., 2019, 2022). This is likely to harm banks' profitability and increase their vulnerability to shocks. Jiang et al. (2019) found that liquidity creation is reduced by regulatory-induced competition in such a way that this reduction is more effective with banks that have less risk-absorbing capacity.

On the other hand, there are two views according to which increased banking market competition positively affects bank liquidity creation. The first is the "price channel" view, which proposes that increased competition affects banking price policies, leading to increased deposit rates and decreased loan rates (Horvath et al., 2016). This consequently increases the demand for deposits and loans, which, in turn, leads banks to provide more liquidity creation. Hannan (1991), Carbo-Valverde et al. (2009), and Rice and Strahan (2010) showed that competition reduces loan rates. Beck et al. (2004) found that banking competition reduces financial obstacles, whereas Hainz et al. (2013) showed that competition reduces collateral requirements. Berger and Hanna (1989) presented empirical evidence that banks operating in concentrated markets and banks with high

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market power set prices that are not beneficial to depositors, diminishing the supply of deposits and reducing bank liquidity creation.

The second view is based on the "efficiency channel" and suggests that competition forces banks to boost efficiency, invest in financial innovation, and, in this way, create more liquidity (Boot and Thakor, 2000; Black and Strahan, 2002; Laeven et al., 2015). Based on these two sets of views, we propose that market competition has a positive effect on bank liquidity creation. Thus, we formulate our first hypothesis as follows:

H1: There is a positive relationship between banking market competition and bank liquidity creation.

C. Banking Market Competition and Liquidity Creation

Laeven and Levine (2007) studied the benefit of the diversity of activities conducted by financial institutions and found a discount premium, unlike other studies, which have detected a diversification premium. Thus, the benefit of diversification in the banking sector remains uncertain and dependent on the context and the characteristics of the bank. Empirically, several studies have demonstrated a mixed effect of bank income diversification on bank risk and performance. On the one hand, Saunders et al. (2016) found that US banks with a high ratio of noninterest income to interest income have high profitability. Using a large sample of banks around the world, Demirgüç-Kunt and Huizinga (2010) showed that income diversification increases bank returns. In addition, Lee et al. (2014) found that non-interest activities diminish risk and increase the performance of banks in Asian countries. Using bank data from 11 emerging economies, Sanya and Wolfe (2011) showed that bank income diversification increases bank profitability. They argued that diversified income portfolios decrease operating expenses arising from banks' operating synergies and ameliorate banks' income-producing ability. They also found that income diversification diminishes insolvency risk since noninterest income is less sensitive to macroeconomic volatility.

On the other hand, Stiroh (2006), Stiroh and Rumble (2006), and DeYoung and Roland (2001) argued that an increase in noninterest income has a negative impact on bank stability in the US context. Using data on European banks, De Jonghe (2010) showed that income diversification decreases bank stability. Githaiga (2020) showed that diversification has a negative effect on bank performance. Williams (2016) found that noninterest income is positively related to bank risk at Australian banks. Moreover, Mercieca et al. (2007) and Maudos (2017) reported a negative impact of income diversification on bank profitability for European banks, as non-interest activities require additional experience and expertise to manage. Similarly, Stiroh (2004b) identified a negative relationship between diversification and profitability at US community banks.

Few studies have considered diversification as a moderating variable to explain the creation of liquidity. Hu and Gong (2019), Dang (2022), and Dang and Huynh (2022), studied the relationship between uncertainty (monetary policy shocks), liquidity creation, and the moderating effect of diversification. Toh et al. (2020) and Grover and Sinha (2021) analyzed the moderating effect of income diversification on the link between competition and liquidity creation. Dang (2022) showed that resource dispersion due to diversification can negatively influence liquidity creation. However, diversification

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could have a different effect on how uncertainty influences liquidity creation. Banks could reduce the effect of uncertainty on liquidity creation through diversification, allowing them to increase their noninterest income and prepare to reduce lending rates and interest margins to attract more customers.

Dang (2022) recommended encouraging revenue diversification to limit the injurious impacts of uncertainty on bank output. Dan and Huynh (2022) found that banks that are less dependent on customer deposits or that have more diversified funding models may be less affected by monetary policy shocks while creating liquidity. However, Hu and Gong (2019) analyzed the moderate effect of asset diversification on the relationship between uncertainty and bank lending and found that diversification reinforces the negative effect of economic policy uncertainty on credit growth. Using a sample of Malaysian banks, Toh et al. (2020) found that competition reduces the effect on liquidity creation, and this negative relation diminishes or disappears due to diversification. The impact of competition on a bank's ability to generate liquidity might be influenced by the degree of diversification within its portfolio. The authors consider diversification to be a "buffer" that allows banks to create liquidity in a competitive environment by generating new sources of income and improving their tolerance to the compression of intermediation margins.

Toh et al. (2020) showed that highly diversified banks are less affected by the negative impact of banking competition on the creation of liquidity, as diversification helps cushion the compression of profit margins resulting from increased competition, thus supporting their role in the creation of liquidity. Grover and Sinha (2021) concluded that diversification has not moderated the adverse impact of competition on liquidity creation in the Indian context; on the contrary, the deterioration of liquidity caused by competition has intensified among highly diversified banks, especially private ones.

Hence, following the analysis presented above, we formulate two opposing hypotheses as follows:

H2a: Bank income diversification enhances the effect of banking market competition on bank liquidity creation.

H2b: Bank income diversification reduces the effect of banking market competition on bank liquidity creation.

III. RESEARCH METHOD

A. Sample

Our sample was a dataset of 81 European commercial banks from 2006 to 2015 (810-year observations). We eliminated banks with missing data. Thus, our sample did not include all European countries. Table 1 provides the sample distribution by country. The variables' definitions and sources are shown in Table 2.

Table 1
The Sample Distributions by Country

	Country	Number of banks
1	France	14
2	Germany	13

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3	Italy	27
4	Spain	2
5	Bulgaria	1
6	Estonia	2
7	Latvia	10
8	Lithuania	4
9	Slovak republic	5
10	Slovenia	3
	Total	**81**

Table 2
Variable Definitions

	Variable Description	Sources
Dependent Variables		
CLcat/ TA	Total bank liquidity creation on and off-balance sheet, normalized by corresponding total assets.	BankScope and the authors' calculation
CLcatn/ TA	Total bank liquidity creation on-balance sheet normalized by corresponding total assets.	Same as above
Independent Variables		
Hstatistic	H-statistic (Panzar and Rosse, 1987) is a measure of the degree of competition in the banking market. It measures the elasticity of banks' revenues relative to input prices. High values of H-statistics denote a more competitive market. The values of H-statistics range from -∞ to	The Global Financial Development database
Moderating variable		
NON	The NON ratio is a measure of income diversification. It is calculated as the ratio of non-interest income to total operating income. High values indicate a high level of income diversification. Following Stiroh (2004a), Elsas et al. (2010), we segment non-interest income into four elements: "fiduciary income", "trading income", "service charges", and "fee and other non-interest income shares". The Appendix gives a more details account of the revenue items included in each category.	BankScope and the authors' calculation
Control variables		
Bank characteristics		
BSize	We use the natural logarithm of total bank assets as a measure of bank size.	BankScope
ROAA	We use return on average assets as a measure of bank	
Equity_to_TA	performance. It is calculated as the ratio of net income	

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Country characteristics		
Zscore	The Z-score is used to measure the probability of default of a country's banking system. It is measured as (ROA+ (equity/assets)/sd (ROA); sd (ROA) is the standard deviation of ROA. ROA, equity, and assets are country-level aggregate figures measured from underlying bank-by-bank.	The Global Financial Development database
GE	Government effectiveness. This measure is defined by Kaufmann et al. (2011) as: "capturing perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies." Higher values indicate strong governance performance.	The Worldwide Governance Indicators database

B. Variables

We constructed two measures of liquidity creation (scaled by total assets) introduced by Berger and Bouwman (2009): "cat fat" and "cat nonfat." Due to data limitations, we only used this classification based on the "category" of items. Following Berger and Bouwman (2009), we employed "cat fat" (scaled by total assets) as our preferred measure in all regressions, while "cat nonfat" was used in robustness checks. Following Berger and Bouwman's (2009) methodology, we calculated "cat fat" using a three-step procedure. As shown in Table 3, we first arranged all bank activities other than loans as liquid, semi-liquid, or illiquid by combining information on product "category" and "maturity." In addition, we classified loans as liquid, semi-liquid, or illiquid only by category. Second, we attributed weights to all the bank activities arranged in Step 1. Finally, we combined bank activities as arranged in Step 1 and as weighted in Step 2 to construct the "cat fat" measure.

We follow Berger et al. (2019), and our approach differs somewhat from that of Berger and Bouwman (2009). In their liquidity creation calculations, they counted the gross fair values of derivatives with a negative weight. However, we eliminated derivatives from the liquidity creation calculations. This elimination is doubtlessly extremely small, as Berger and Bouwman (2009) found that derivatives account for less than 1% of US off-balance-sheet liquidity creation.

In the robustness check, we used the "cat nonfat" measure by excluding off-balance sheet activities in the third step. Like Berger and Bouwman (2009), we normalized all liquidity creation measures by total assets to permit significant comparisons between liquidity creation across banks and to avoid granting undue weight to large banks.

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Table 3

Bank Liquidity Creation Construction

Step 1: We classify all bank activities into liquid, semiliquid, or illiquid categories. Step 2: We assign weights to the activities classified in step 1		
Assets		
Liquid Assets (weight = -1/2)	Semiliquid Assets (weight = 0)	Illiquid Assets (weight = 1/2)
Other Mortgage Loans Corporate and Commercial Loans Other Loans Investment in Property Other Earning Assets Foreclosed Real Estate Fixed Assets Goodwill Other Intangibles Current Tax Assets Deferred Tax Assets Discontinued Operations Other Assets	Residential Mortgage Loans Other Consumer/Retail Loan Loans and Advances to Banks	Reserve Repos and Cash Collateral Trading Securities and at FV through Income Available for Sale Securities Held to Maturity Securities At-equity Investment in Associates Other Securities Cash and Due from other Banks Insurance Assets
Liabilities and Equity		
Illiquid Liability and Equity (weight = -1/2)	Semiliquid Liabilities (weight = 0)	Liquid Liabilities (weight = 1/2)
		Senior Debt Maturing after 1 Year Subordinated Borrowing Other Funding Fair Value Portion of Debt Credit Impairment Reserves Reserves for Pensions and Other Current Tax Liabilities Deferred Tax Liabilities Other Deferred Liabilities Discontinued Operations Insurance Liabilities Other Liabilities Pref. Shares and Hybrid Capital accounted for as Debt Pref. Shares and Hybrid Capital accounted for as Equity Common Equity Non-controlling Interest Securities Revaluation Reserves Foreign Exchange Revaluation Reserves Fixed Assets Revaluation and other Accumulated OCI
Customer Deposits Deposits from Banks Repos and Cash Collateral Trading Liabilities	Other Deposits and Short-Term Borrowing	
Off-balance Sheet		

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Liquid Guarantees (weight=-1/2)	Semiliquid Guarantees (weight = 0)	Illiquid Guarantees (weight = 1/2)
Guarrantees Acceptances and Documentary Credits Reported Off-Balance Sheet Committed Credit Lines Other Contingent Liabilities	Other Off-Balance Sheet Exposure to Securitizations	
Step 3: We combine banks activities as classified in step 1 and as weighted in step 2 to construct a liquidity creation measure cat ¨ fat¨		
Cat fat=	+1/2* illiquid assets +0* Semiliquid assets +1/2* illiquid liabilities +0* Semiliquid liabilities +1/2* illiquid guarantees +0* Semiliquid guarantees	-1/2* liquid assets -1/2* liquid liabilities -1/2*equity -1/2* liquid guarantees

C. Empirical Model

Initially, we examined the effect of banking market competition on bank liquidity creation in order to test hypothesis H1 via the following generalized least squares regressions:

$$\frac{CLcat_{i,t}}{TA_{i,t}} = \alpha_0 + \alpha_1 Hstatistic_{i,t} + \alpha_2 BSize_{i,t} + \alpha_3 ROAA_{i,t} + \alpha_4 Equity\_to\_TA_{i,t} + \alpha_5 Zscore_{i,t} + \alpha_6 GE_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where CLcat/TA is one of the normalized bank liquidity creation measures, Hstatistic is the level of banking market competition, BSize is the log of total assets bank size, ROAA is the ratio of return on average assets, Equity_to_TA is the ratio of equity to total assets, Zscore is the probability of default of a country's banking system, and GE is government effectiveness. We then added the bank income diversification levels to test their impact on the relationship between banking market competition and bank liquidity creation. This allowed us to test hypothesis H2 via the following least squares regressions:

$$\frac{CLcat_{i,t}}{TA_{i,t}} = \alpha_0 + \alpha_1 Hstatistic_{i,t} + \alpha_2 BSize_{i,t} + \alpha_3 ROAA_{i,t} + \alpha_4 Equity\_to\_TA_{i,t} + \alpha_5 Zscore_{i,t} + \alpha_6 GE_{i,t} + \alpha_7 NON_{i,t} + \alpha_8 Hstatistic * NON_{i,t} + \varepsilon_{i,t} \quad (2)$$

Where CLcat/TA is one of the normalized bank liquidity creation measures, Hstatistic is the level of banking market competition, BSize is the log of total assets bank size, ROAA is the ratio of return on average assets, Equity_to_TA is the ratio of equity to total assets, Zscore is the probability of default of a country's banking system, and GE is government effectiveness. NON is the ratio of noninterest income to total operating income. Hstatistic*NON is the variable that represents the interaction between banking market competition and bank income diversification.

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IV. RESULTS

A. Descriptive Analysis

Table 4 provides the descriptive statistics for the variables used in the empirical analysis. We found that the dependent variable—bank liquidity creation as measured by CLcat/TA—had a mean of .4813. This figure is consistent with the research of Berger et al. (2019), who found that the mean of CLcat/TA was .509 for conventional banks.

The independent variable—banking market competition as measured by the H-Statistic—had a mean of .15037, with a maximum of .4452 and a minimum of -0.0669. This result implies that there was not a perfect market competition structure in our sample because there was a monopoly and a collusive oligopoly. The moderator variable—bank revenue diversification as measured by NON—had a mean of .4328. This means that, on average, less than half of the revenue came from noninterest business.

To test the absence of multicollinearity between the variables, we used the correlation matrix shown in Table 5. According to Gujarati (2021), there is no issue with multicollinearity if the correlation coefficient between two variables is not above .8. Thus, this correlation matrix shows that there is no multicollinearity problem, as the maximum correlation value is .3375, which is between GE and the Z-score. According to Neter et al. (1989), if the mean VIF is not above 10, there is no problem of multicollinearity. For our regressions, the VIF statistics calculated indicate the absence of multicollinearity among the variables included in the model.

Table 4
Descriptive Statistics

Variables	Obs	Mean	Std Dev.	Min	Max
CLcat/TA	810	0.4813	0.2533	-0.4278	1.7624
HStatistic	810	0.1503	0.10426	-0.0669	0.4452
NON	810	0.4328	0.4955	-3.3297	10.3170
BSize	810	9.3125	2.2576	4.5207	14.6050
ROAA	810	2.7547	13.0101	-29.255	83.81
Equity_to_TA	810	8.1539	13.5148	-250.623	71.398
Zscore	810	12.7296	5.1107	-0.2411	23.0851
GE	810	0.9123	0.5001	-0.0573	1.7368

Table 5
Correlation Matrix

	CLcat/TA	HStatistic	NON	BSize	ROAA
CLcat/TA	1				
HStatistic	0.0390	1			
NON	-0.1005	-0.0268	1		
BSize	-0.2519	-0.3947	0.0610	1	
ROAA	0.0078	0.0172	0.0248	-0.1656	1
Equity_to_TA	-0.0343	0.1051	0.0125	-0.1976	0.1893
Zscore	-0.1504	-0.3032	0.0256	0.3900	0.1209
GE	-0.0695	-0.0585	-0.0026	0.3573	-0.1146

B. Banking Market Competition and Bank Liquidity Creation: Baseline Results

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As a preliminary check, we tested the impact of banking market competition on the liquidity creation of banks, regardless of their income diversification levels, to determine whether banks suffer or benefit from increased banking market competition. Table 6 shows the estimation results for Equation (1). The residuals do not verify the ordinary least squares (OLS) hypotheses; they are heteroscedastic and autocorrelated. Thus, we estimated Model 1 using the generalized least squares method (GLS).

Our results show that the estimated coefficient on the H-statistic is positive and significant (at a level of 5%), indicating that the aggregate, on- and off-balance-sheet liquidity creation of banks increases with market competition. This shows that increased banking market competition encourages banks to create more liquidity. Our results support the "price channel" and "efficiency channel" views, suggesting that higher competition is related to increased liquidity creation. Therefore, H1 is verified: there is a positive relationship between banking market competition and bank liquidity creation.

Turning to the control variables, GE evinces a significant positive impact on bank liquidity creation. Thus, strong governance performance encourages banks to create liquidity. We can conclude that competition pushes banks to take increased liquidity risks to improve their performance. Thus, competition can weaken the banking system if banks' risk-taking ever becomes excessive.

Table 6
Effect of Banking Market Competition and Bank Liquidity Creation

Variables	Coef	Stdr. Err	P>|t|
Hstatistic	0.4186	0.1876	0.026**
BSize	0.0005	0.0389	0.989
ROAA	0.0014	0.0031	0.648
Equity_to_TA	0.0009	0.0015	0.534
Zscore	-0.0075	0.0051	0.142
GE	0.1473	0.0692	0.033**
_cons	0.3797	0.3843	0.323

Notes: This table illustrates the regression result on panel data for model (1) by the GLS method. Cat fat: measure of liquidity creation scaled by total assets, Hstatistic: measure of banking market competition, BSize: the natural logarithm of total bank assets, ROAA: ratio of return on average assets, Equity_to_TA: ratio equity to total assets, Zscore: the probability of default of a country's banking system, GE: Government effectiveness, cons: the constant variable.
*** indicates statistical significance at the level of 5%..*

C. Influence of Bank Income Diversification Levels

We next investigate whether the effect of banking market competition on bank liquidity creation is affected by the bank's income diversification level. Table 7 reports the estimation results of Equation (2), using the ratio of noninterest income to total operating income as a measure of banks' income diversification levels. The residuals do not verify the ordinary least squares (OLS) hypotheses; they are heteroscedastic and autocorrelated. Thus, we estimated Model 2 using the method of generalized least squares (GLS).

Table 7 confirms our baseline result, namely that an increase in banking market competition exerts a positive effect on bank liquidity creation, as the coefficient α_1 on H-statistic is significant and positive. We note that the coefficient α_8 on $\mathrm{Hstatistic} * \mathrm{NON}$ is negative and significant, indicating that the positive effect of banking market

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competition on bank liquidity creation is less evident for banks with highly diversified income than for those with less diversified income. Hypothesis 2b is thus supported.

Turning to the control variables, the BSize variable is significantly negatively related to liquidity creation. This result means that small banks create more liquidity than large ones. Moreover, ROAA was positively and significantly related to CLcat/TA. Thus, banks with stronger performance create more liquidity. In addition, bank income diversification is positively and statistically significantly (at the level of 5%) associated with bank liquidity creation.

We conclude that the effect of competition on liquidity risk taking is less pronounced for well-diversified banks, i.e., competition pushes less diversified banks more to assume higher liquidity risk.

Table 7
Effect of Bank Competition on Bank Liquidity Creation by Income Diversification Level

Variables	Coef	Stdr. Err	P>|t|
Hstatistic	0.8590	0.3598	0.017**
NON	0.2189	0.0932	0.019**
Hstatistic*NON	-0.8929	0.4273	0.037**
BSize	-0.0536	0.0238	0.024**
ROAA	0.0022	0.0012	0.070*
Equity_to_TA	0.0010	0.0012	0.379
Zscore	-0.0045	0.0052	0.381
GE	0.1180	0.0860	0.170
_cons	0.6950	0.2271	0.002***

Notes: This table illustrates the regression result on panel data for model (2) by the GLS method. Cat fat: measure of liquidity creation scaled by total assets, Hstatistic: measure of banking market competition, NON: ratio of non-interest income to total assets, BSize: the natural logarithm of total bank assets, ROAA: ratio of return on average assets, Equity_to_TA: ratio equity to total assets, Zscore: the probability of default of a country's banking system, GE: Government effectiveness, cons: the constant variable.
****, ** and * represent statistical significance at the 1%, 5% and 10% levels respectively.*

D. Robustness Tests

We tested for the robustness of our results by using Berger and Bouwman's (2009) "cat nonfat" measure (scaled by total assets) as a measure of liquidity creation. Table 8 indicates that banking market competition is positively and significantly related to bank liquidity creation, as in our previous findings. Table 9 presents the results of the influence of income diversification on the effect of banking market competition on liquidity creation. We found that the results were qualitatively unchanged. Banking market competition is positively and statistically significantly (at a level of 1%) related to bank liquidity creation. Moreover, the interaction variable Hstatistic*NON is negatively and statistically significantly (at a level of 1%) associated with bank liquidity creation.

Table 8
Effect of Bank Competition on Bank Liquidity Creation

Variables	Coef	Std.Err	P>|t|
Hstatistic	0.5523	0.2344	0.018**
BSize	-0.0276	0.0291	0.343
ROAA	0.0018	0.0012	0.153
Equity_to_TA	-0.0001	0.0015	0.913

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Zscore	-0.0040	0.0062	0.511
GE	0.0192	0.0932	0.837
_cons	0.5447	0.2664	0.041**

Notes: This table illustrates the regression result on panel data with an alternative measure of Liquidity creation for model (1) by the GLS method. Cat nonfat: measure of liquidity creation scaled by total assets, Hstatistic: measure of banking market competition, BSize: the natural logarithm of total bank assets, ROAA: ratio of return on average assets, Equity_to_TA: ratio equity to total assets, Zscore: the probability of default of a country's banking system, GE: Government effectiveness, cons: the constant variable.
*** represent statistical significance at the 5%.*

Table 9
Effect of Bank Competition on Bank Liquidity Creation by Income Diversification Level

Variables	Coef	Str.Err	P>|t|
Hstatistic	1,2660	0.3128	0.000***
NON	0,2064	0.1065	0.053*
Hstatistic*NON	-1,7317	0.4770	0.000***
BSize	-0,0407	0.0267	0.128
ROAA	0,0011	0.0012	0.334
Equity_to_TA	0,0010	0.0015	0.505
Zscore	-0,0039	0.0059	0.511
GE	0,0215	0.0880	0.806
_cons	0,5763	0.2483	0.020**

Notes: This table illustrates the regression result on panel data with an alternative measure of Liquidity creation for model (2) by the GLS method. Cat nonfat: measure of liquidity creation scaled by total assets, Hstatistic: measure of banking market competition, NON: ratio of non-interest income to total assets, BSize: the natural logarithm of total bank assets, ROAA: ratio of return on average assets, Equity_to_TA: ratio equity to total assets, Zscore: the probability of default of a country's banking system, GE: Government effectiveness, cons: the constant variable.
*****, ** and * represent statistical significance at the 1%, 5% and 10% levels respectively.*

V. CONCLUSION

This study empirically investigated the effect of banking market competition on bank liquidity creation and the moderating role of bank income diversification, focusing on commercial banks in European countries from 2006 to 2015. The results are based on a regression on panel data and the use of the GLS method.

Our preliminary results show that commercial banks in highly competitive markets create more liquidity on- and off-balance-sheet. This result is consistent with the "price channel" and "efficiency channel" views. However, it should not be forgotten that the creation of liquidity is associated with an increase in liquidity risk at banks. Thus, the question arises of systematic risk, which can result in excessive risk-taking by banks without adequate cover. We found that income diversification attenuates the effect of banking market competition on bank liquidity creation. Thus, the most successfully diversified banks create less liquidity and are therefore less exposed to competition-induced liquidity risk-taking. The benefits or harms of diversification must be judged by the balance between liquidity creation and liquidity risk. If the level of risk is tolerable, diversification will destroy the liquidity induced by competition, but if the risk is excessive, diversification can be considered a "buffer" against the harmful effects of competition. In the robustness test, we found the same results.

This research has important implications for bank managers. Amid growing banking market competition, bank managers should put more accentuation on bank

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income diversification to avoid excess liquidity creation, which may raise the likelihood of bank failures. This idea is discussed by Grover and Sinha (2021), who suggest that "excessive liquidity creation has serious repercussions at the micro as well as macro level." Also, Berger and Bouwman (2017) suggest that "liquidity creation of US banks tends to be high prior to financial crises. It has incremental explanatory power in predicting crises."

We conclude that promoting the integration of the European banking market, particularly the cross-border integration of banking groups, can improve the benefits of diversification. The authorities must supervise banks by assuming liquidity risk, especially in highly competitive markets, and especially by raising liquidity ratios.

We investigated only income diversification. Asset diversification could have shed more light on the moderating effect of diversification, as Laeven and Levine (2007) affirm that these two kinds of diversification capture different perspectives on banking activities.

We believe that our conclusions can be validly extended to other countries or regions, provided that the degree of competition is at a level similar to that in Europe. However, this belief requires empirical validation, especially if the context changes in terms of the quality of institutions and the mechanisms of banking and competition controls.

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APPENDIX

The sources of non-interest income: The Federal Reserve Board (www.federalreserve.gov).

Fiduciary activities: "It includes gross income from services rendered by the bank's trust department or by any of its consolidated subsidiaries acting in any fiduciary capacity, such as commissions and fees on the sale of annuities by these entities."
Service charges on deposit accounts: "It includes charges for the maintenance of deposit accounts, failure to maintain specified minimum deposit balances, writing excessive checks, withdrawals from non-transaction accounts, closing of savings accounts, dormant accounts, use of ATM or remote service units, processing of checks with insufficient funds, and other fees."
Trading revenue: "It includes the net gain or loss from trading cash instruments and off-balance sheet derivative contracts (including commodity contracts). It also includes revaluation adjustments to the carrying value of assets and liabilities resulting from the periodic marking to market, revaluation adjustments from the periodic marking to market of interest rate, foreign exchange rate, commodity, and equity derivative contracts, and incidental income and expense related to the purchase and sale of cash instruments reportable in trading assets and liabilities."
Other non-interest income: "It includes fees, commissions, and all other service charges that cannot properly be included elsewhere. The sources of other non-interest income include rental of safe deposit boxes; safekeeping of securities; sale of bank drafts, money orders, and travelers' checks; collection of utility bills, redemption of savings bonds; handling of food stamps; execution of acceptances and issuance of letters of credit; notarizing of forms; consulting and advisory services; credit card fees; charges to merchants for handling of credit card; data processing services; loan commitment fees; rental fees; interest on tax refunds; and life insurance proceeds on policies. It also includes net gains (losses) from the sale of branches, transactions of foreign currency, or non-hedging derivative instruments."

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