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The Impact of Recapitalisations and Bank Competition on Greek Bank Net Interest Margins.

E C Mamatzakis[1]

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Abstract

Purpose
This study investigates the reasons behind the very high net interest margins in the Greek banking industry compared to the euro-area, focusing on the association between bank competition and recapitalisations.
Design/methodology/approach
We conduct a dynamic panel analysis covering the period from the early 2000s to 2021, that controls for possible endogeneity and treats for heterogeneity. We also employ local projections impulse response functions that control for structural changes in Greek banking.
Findings
We find that low bank competition has contributed to high net interest margins in Greece. Interestingly, the impact of recapitalisations conditional to low bank competition has had a significant further impact on increasing net interest margins, which is a noteworthy case due to several Greek bank recapitalisations in the last ten years. Our findings are supported by local projections impulse response functions.
Originality
To mitigate distortions in bank competition, we argue to accelerate steps toward the direction of the banking union and a common bank regulation framework in the euro-area.

Keywords: Bank competition, recapitalisations, net interest rate margin, dynamic panel analysis, local projections.

JEL Classifications: G21; E43; E52; D4; L1.

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[a]Professor of Finance, Birkbeck Business School, Birkbeck College, University of London, Malet St, London WC1E 7HX, UK. E-mail: e.mamatzakis@bbk.ac.uk.

1. Introduction

Bank recapitalisations can impact net interest margins in various ways. Recapitalisations involve injecting new capital into a bank, which can strengthen its balance sheet and increase its capacity to lend. This, in turn, can lead to an increase in the volume of loans and potentially a reduction in interest rates, which could lower net interest margins (Beccalli et al., 2018). On the other hand, bank recapitalisations can also lead to an increase in the cost of funding, as new investors may require a higher rate of return to compensate for the increased risk they are taking on (Aliu, et al. 2016 and Krasniqi et al. 2023). This higher cost of funding may result in banks charging higher interest rates on loans, which could increase net interest margins. Additionally, the impact of bank recapitalisations on net interest margins may also depend on the specific circumstances of the bank and the broader economic environment. For example, if a bank is undercapitalised and is experiencing financial distress, the recapitalisation may lead to a reduction in its perceived risk and an increase in investor confidence, which could result in lower borrowing costs and higher net interest margins. In addition, Cruz Garcia and de Guevara (2020) show evidence that higher capital requirements and deposit insurance premiums would increase banks' interest rates. It is worth noting that the literature to date has been focusing on net interest rate margins while the interest rates are low, even negative in the case of Euro-area. For example, Hanzlik and Teply (2020) provide evidence that shows capital requirements assert a positive impact on net interest margins in a low interest rate environment though there is heterogeneity across US, UK and European banks. Present et al. (2023) also argue that banks in a low interest rate environment with a business model that relies on net interest income increase they would increase their lending margins and will charge higher fees and

commissions to compensate for any reduction in net interest income. Therefore, the impact of bank recapitalisations on net interest margins can be rather complex, in particular in a high interest rate environment as in the current conjecture.

In this paper, we argue that recapitalisation impact on net interest margin should be examined in relation to the underlying bank competition. The dynamics of how recapitalisation would affect net interest margins are intricately linked to the competitive conditions within the banking industry. Factors related to market structure like bank concentration, the number of banks, and the degree of competitiveness among banks would play a pivotal role in shaping the outcomes of recapitalisations. Therefore, examining the impact of recapitalisations on net interest margins in isolation may not provide a comprehensive understanding of its effects. Instead, an informed assessment that considers the bank market structure would enable a more accurate investigation. This approach allows for insights into how recapitalisations interact with the bank market structure, shedding light on the relationships between financial stability, bank competition, and net interest margins.

There is a long list of studies that suggest that greater bank competition among banks can lead to a decrease in net interest margins (Ho and Saunders 1981; Ho and Stoll, 1980; Maudos and de Guevara 2004; Carbo and Rodriguez 2007). However, other studies suggest that the impact might be positive (Saunders and Schumacher 2000). We identify the impact of bank competition on net interest margins and examine the impact of recapitalisations conditional to bank competition on the Greek banking sector. To the best of our knowledge this is the first study that closely links recapitalisations with competition in Greece.

The case of Greece is of interest because three main recapitalisations took place in the previous decade while bank market power was high. Moreover, the banking crisis that unfolded in

Greece following the sovereign debt crisis was marked by elevated levels of non-performing loans, diminishing asset quality, and a decline in financial stability. To address the solvency challenges faced by the four major Greek banks, three rounds of recapitalisations were conducted between 2013 and 2015. The first two recapitalisations were necessitated by the Private Sector Involvement (PSI) program, which entailed a significant haircut of Greek sovereign bonds, resulting in unsustainable losses for the banks. A substantial capital injection of €65 billion was required to bail out the four systemic Greek banks—National Bank of Greece (NBG), Alpha Bank, Eurobank, and Piraeus. Consequently, capital injections became imperative, ultimately leading to the nationalisation of the Greek banking industry. The third recapitalisation took place in 2015 when capital controls were also introduced, and the Greek economy was at risk of exiting the Euro-area. The repercussions of the banking crisis echoed throughout the Greek economy, manifesting in a prolonged recession, heightened unemployment, and political instability. This study focuses on the distinctive case of the Greek banking system because of the unique market structure and successive recapitalisations. There are four major Greek banks—NBG, Alpha Bank, Eurobank, and Piraeus—alongside the smaller Attica Bank. It is noteworthy that these four systemic banks held approximately 95.7% of the Greek banking market share in 2020, while Attica Bank, with a considerably smaller size, contributes to the broader banking landscape.

In addition, recent data show that the net interest rate margin (NIM thereafter) for savings accounts and loans in Greece was at 4.83% in November 2022. This is more than double the NIM for corporate loans and mortgages in the euro-area, which stood at 2.4% and 2.8%, respectively. Such a large divergence in NIM between the Greek banking and the euro-area is hard to explain within a common currency area and it, therefore, provides an opportunity to study Greek banking as a special case. Clearly, high NIM can boost short-term profitability

and get the Greek banking industry on a sustainable path considering facing losses for years since the Greek crisis in 2012. However, the diverging NIM in Greece from the euro-area may also lead to inefficiencies that impede effective financial intermediation.

It is worth mentioning that our sample selection includes four major Greek banks, that is National Bank of Greece (NBG), Alpha Bank, Eurobank, and Piraeus, plus the smaller Attica bank, because they provide a unique sample of banks that have been repeatedly recapitalised using public funds so as to stay solvent during the Greek financial crisis. Roughly €65 billion in capital infusions were necessary to rescue those banks from financial distress. The initial two rounds of recapitalization were triggered in large part by the Private Sector Involvement (PSI) program. In February 2012, the Greek government formally unveiled the PSI that was a bond exchange initiative garnered substantial participation from creditors, resulting in approximately €197 billion out of €205 billion worth of eligible bonds being swapped for new Greek bonds. These new bonds included extended maturities and reduced coupon payments that resulted to a significant nominal haircut of 53.5%. The PSI led to a reduction of Greece's debt by around €127 billion. This program had far-reaching consequences for domestic banks, as they held substantial amounts of Greek government bonds. The PSI initiative entailed substantial reductions in the value of Greek sovereign bonds, leading to unsustainable financial setbacks for Greek banks. This, in turn, triggered a series of subsequent capital injections, effectively culminating in the government taking control of the banking sector. Given the above the Greek banking industry and the four main Greek commercial banks provide a unique sample to study the impact of recapitalisations on NIM.

According to Brock and Rojas-Suarez (2000), high NIM are linked to bank-specific inefficiencies that have a negative effect on credit growth and investment. Barajas et al. (1998)

note that high operational expenses, a lack of competition, inflation rates, and high taxation can lead to high NIM. The high NIMs in Greek banks discourage potential depositors with low saving rates, limiting funds available for investment. High loan rates increase borrowers' interest burden and reduce potential and existing borrowers' consumption expenditure and investment. Ultimately, hindered credit expansion leads to lower economic growth and longer-run bank profitability.

We contribute by extending the seminal model of Ho and Saunders (1981) and Maudos and de Guevara (2004) to examine the impact of recapitalisations conditional to bank competition on the Greek banking sector. We employ dynamic panel data analysis that uses a GMM estimator that also controls for endogeneity concerns that could bias results. Applying correct identification to reveal the association between bank recapitalisations, bank competition and NIM does not come without challenges. To this end, we also employ local projections framework (see Jordà and Taylor 2016), that a useful identification for examining the effects of structural changes, like major recapitalisations, on bank NIM. Our findings show that successive recapitalisations assisted by collusive behaviour across banks have resulted in the determination of high interest rates margins, leading to the earning of monopoly rents. To mitigate distortions in bank competition, we recommend strengthening the banking union and common bank regulation framework in the euro-area to promote greater bank competition. By doing so the credit expansion of the economy will increase, which is a necessary precondition to growth in the medium term.

In what follows, Section 2 provides the theoretical model, and Section 3 discusses the data. In Section 4 we report the empirical results and provide policy implications while the last Section concludes.

2. The theoretical model of bank net interest margin

2.1 The Ho and Saunders bank net interest margin model

We opt for the model developed by Ho and Saunders (1981) that shows that the bank sets loan, R_L, and deposit rates, R_D, as follows: $R_D = r - a$; and $R_L = r + b$ where r is market interest rate, a and b are risk premia charged to compensate for the transaction risk involved in financial intermediation. Therefore, the net interest margin (*NIM* thereafter) equals to the sum of the two mark-ups:

$$NIM = R_L - R_D = a + b \quad (1)$$

Ho and Saunders (1981) show that the optimal *NIM* is a function of the competition, risk aversion, volatility, and size:

$$NIM_{i,t} = \alpha_{i,t} + \beta_{i,t} = \frac{\alpha_{i,t}}{\beta_{i,t}} + \frac{1}{2} RA_{i,t} \sigma_{i,t}^2 Q_{i,t} \quad (2)$$

where the first term or $\frac{\alpha_{i,t}}{\beta_{i,t}}$ is the ratio of the intercept (α) and slope (β) of the symmetric deposit and loan functions and measures the bank's risk-neutral *NIM* given its monopoly power for bank i in period t. In effect the ratio $\frac{\alpha_{i,t}}{\beta_{i,t}}$ is a measure of market power and thereby competition.

Thus, the *NIM* depends on four factors: (i) *RA*, the bank's management risk aversion; (ii) σ_i^2 , the interest rate volatility capturing risk; (iii) Q, the average transaction size, and (iv) the degree of competition. Based on Ho and Saunders (1981) increased competition or lower market power, that is lower ratio α/β, would lower net interest margin (see also Ho and Stoll, 1980). This is because increased competition would reduce banks' market power and their ability to charge higher interest rates.

The degree of risk aversion determines the size of the risk premium charged. Furthermore, the level of risk aversion among banks plays an important role in determining the size of the risk premium charged. When banks are more risk-averse, they charge a higher risk premium to compensate for the potential losses. On the other hand, if banks are less risk-averse, they charge a smaller risk premium, which would result in lower net interest margins.

Additionally, changes in interest rate volatility and transaction size can also affect net interest margins. When interest rate volatility increases or transaction size decreases, banks may need to charge higher margin rates to compensate for the increased risk (Saunders and Schumacher 2000).

Therefore, competition, risk aversion, interest rate volatility, and transaction size, can all affect the level of net interest margin in the banking sector.

Carbo and Rodriguez (2007) extended the Ho and Saunders model by incorporating additional factors such as operating expenses, and credit risk. Their extended model provides a more comprehensive understanding of the factors that affect net interest margin in the banking sector. Operating expenses are an important factor in determining net interest margin because they directly affect banks' profitability. Banks with higher operating expenses will need to charge higher interest rates to maintain their profitability, which would result in higher net interest margins. On the other hand, banks with lower operating expenses would be able to charge lower interest rates, which would lead to lower net interest margins. Credit risk is another important factor that affects net interest margin. Banks that have higher levels of credit risk would need to charge higher interest rates to compensate for the increased risk of default. As a result, banks with higher credit risk would have higher net interest margins. By incorporating these additional factors, Carbo and Rodriguez (2007) provide a more comprehensive

framework for understanding the factors that affect net interest margin in the banking sector. In addition, Maudos and de Guevara (2004) extended the Ho and Saunders model by incorporating the Lerner index, which is a direct measure of competition level. The Lerner index measures the extent to which banks have market power and can set prices above marginal cost. By including the Lerner index in the model, Maudos and de Guevara were able to directly assess the impact of competition on net interest margins. They found that a higher level of competition, as measured by a lower Lerner index, was associated with lower net interest margins. Their study also found that other factors, such as risk aversion and credit risk, had significant effects on net interest margins. However, the impact of these factors was not as strong as the impact of competition. Overall, the inclusion of the Lerner index in the Ho and Saunders model provides a more direct measure of competition and allows for a more accurate assessment of the impact of competition on net interest margins in the banking sector.

Following from this literature, our identification is specified as follows:

$$NIM_{i,t} = \rho_1 NIM_{i,t-1} + \beta_2 X_{i,t} + \beta_3 Z_{i,t} + \beta_4 \Phi_{i,t} + \alpha_{i,t} + v_{i,t} \quad (3)$$

where NIM_{it} is the net interest margin measured as the interest rate income minus the interest rate expenses divided by total earning assets, X_{it} includes the main endogenous variable, like bank competition (Lerner index or Boone indicator). Z_{it} is a vector of control variables that are bank specific like operation efficiency; risk aversion; credit risk; the ratio of non-interest income to total assets; the ratio of cash plus balances with central banks to total assets. Φ_{it} captures macroeconomic factors (Carbo and Rodriguez 2007; Maudos and de Guevara 2004) such as the consumer price index; the policy rate which is the marginal lending facility rate at the central bank and GDP growth. α_i the group-specific error component (that count for bank and time-fixed effects), and v_{it} the idiosyncratic error component.

Moreover, because our focus is on the impact of recapitalisations conditional to bank competition, we extend the Ho and Saunders model of Equation (3) by adding interaction terms between the recapitalisations and bank competition. Recapitalisation is an important factor that affects net interest margins in the banking sector. When banks are recapitalised, they are able to improve their financial position and reduce their risk of default. This can lead to a decrease in the risk premium charged by banks, which would result in lower net interest margins. However, the impact of recapitalisation on net interest margins may depend on the level of competition in the banking sector as we argue here. If banks have a high degree of market power, they may use recapitalisation to increase their market share and maintain higher net interest margins. In contrast, if competition is high, banks may use recapitalisation to improve their financial position and compete more effectively on price, leading to lower net interest margins. By adding interaction terms between recapitalisation and competition, it is possible to identify the impact of recapitalisation on net interest margins conditional on the level of competition. This can provide insights into how recapitalisation affects net interest margins in different competitive environments.

Therefore, to identify the impact of recapitalisations conditional to bank competition, we develop further Equation (3) to:

$$NIM_{it} = \rho_1 NIM_{it-1} + \beta_2 X_{it} + \beta_3 Z_{it} + \beta_4 \Phi_{it} + \beta_5 yearRECAP_{it} + \beta_6 yearRECAP_{it} * Lerner_{it} + \alpha_{it} + v_{it} \quad (4)$$

where $yearRECAP_{it}$ captures the year of recapitalisation for bank i (which is a dummy variable taking the value of 1 if recapitalisation takes place). β_5 represents the average difference in *NIM* between banks that recapitalised vis a vis the previous years, while β_6 captures the impact of

interaction between bank competition and recapitalisation. This parameter β_6 is of main interest in the current analysis as it provides a way to identify whether the impact of bank competition on *NIM* is amplified by recapitalisations.

2.2 Local projections of the Ho and Saunders bank net interest margin model

Identification is key to reveal the association between bank recapitalisations, bank competition and *NIM*. The local projections (LP) framework, as proposed by Jordà and Taylor (2016), can be a useful tool for examining the effects of structural changes, such as major recapitalisations, on bank net interest margins (NIM). The LP framework is a method of estimating impulse response functions in a local projection setting. This involves estimating a set of regressions of the dependent variable (in this case, NIM) on the independent variables of interest (such as recapitalisation and competition), along with a set of lags and other control variables. The estimated coefficients from these regressions can then be used to calculate the impulse response function, which shows how the dependent variable responds to a change in the independent variable over time. The LP framework is particularly useful for examining the effects of structural changes because it allows for a more flexible specification of the model, and it does not assume that the effects of the shock are constant over time. This can be important when examining the effects of major recapitalisations, which can have long-lasting effects on the banking sector.

Overall, the LP framework can be a useful tool for examining the effects of structural changes, such as major recapitalisations, on bank net interest margins. By estimating impulse response functions in a local projection setting, we can gain insights into how these changes affect NIM over time, and how the effects may differ depending on the level of competition in the banking sector.

One of the strengths of the LP framework is its ability to accommodate panel data, which is particularly useful when studying the effects of structural changes. The local projections framework is useful in our context because it allows for the estimation of dynamic causal effects in a variety of settings of the Greek banking, for example the various recapitalisations that took place in the period 2013 to 2015. Compared to panel VAR models, the LP framework does not impose any restrictions on the shape of the impulse response functions, which means that it can accommodate a wide range of dynamic responses to shocks (Jordà and Taylor 2016). This makes the approach less sensitive to misspecification and allows for more flexible modeling of the underlying data-generating process.

Our *LP* model for different horizons h = 0, 1,2,3, … in years takes the following form:

$$NIM_{it+h} - NIM_{it-1} = \alpha_{i,h} + \gamma_{t,h} + \beta_{1,h}D_{i,t} + \delta_{1,h}X_{it} + \delta_{2,h}Z_{i,t} + \delta_{3,h}\Phi_{i,t} + \varepsilon_{i,t+h} \text{ , (5)}$$

where $NIM_{i,t+h}$ - $NIM_{i,t}$ notes the change in *NIM* from, $D_{i,t}$ notes the racapitalisation year; and h denotes the time horizon considered which is set to three years given the annual frequency of our sample. $X_{i,t}$ includes bank competition (Lerner index). $Z_{i,t}$ is a vector of bank specific control variables, and Φ_{it} includes macroeconomic variables. The specification also includes bank ($\alpha_{i,h}$) and time ($\gamma_{t,h}$) fixed effects to capture time-invariant bank features and shocks that are common across banks (such as the volatility in ECB marginal lending facility, for example).

Following from the *LP* model of Equation (5), we extend by identifying the effects of recapitalisations on *NIM* using state dependency in the Lerner index. As such, we build a *LP* specification that the NIM's response is conditional on specific scenarios, such as that the recapitalisation took place in periods of low bank competition (high Lerner index).

In particular, the state-dependent *LP* specification takes the following form:

$$NIM_{i,t+h} - NIM_{i,t-1} = S_{i,t-1}\left[\alpha_{i,h} + \gamma_{t,h} + \beta_{1,h}D_{i,t} + \delta_{1,h}X_{it} + \delta_{2,h}Z_{i,t} + \delta_{3,h}\Phi_{i,t}\right] + (1 - S_{i,t-1})\left[\alpha_{i,h} + \gamma_{t,h} + \beta_{1,h}D_{i,t} + \delta_{1,h}X_{it} + \delta_{2,h}Z_{i,t} + \delta_{3,h}\Phi_{i,t}\right] + \varepsilon_{i,t+h} \quad (6)$$

where the indicator $S_{i,t-1}$ takes the value of 0 or 1 depending on the state dependency being considered.

In the empirical application, we consider the state dependency to be conditional on the level of bank competition. In detail, we consider the Lerner index being above the 75th percentile of sample distribution, showing low bank competition. We use local projections (LP) to estimate impulse responses due to a shock in recapitalisation considering bank competition as the state dependency. From Equation (6) we estimated impulse responses based on the estimated $\beta_{.,h}$ coefficients at each horizon. We also estimate confidence bands that are based on the estimated standard errors (Jordà and Taylor 2016).

3. The data set of the Greek banking industry

Despite financial liberalisation efforts early in 2000s aimed at increasing financial integration with the EU and joining the Euro-Area, the Greek banking industry has responded ever since through mergers and acquisitions, increasing the relative size of few banks, and reducing competition. In addition, Greece faced a sovereign debt crisis from 2010 to 2017, resulting in multiple costly bank recapitalisations that could have further amplified the impact of bank competition on interest rate margins. Greek banks have significantly increased loan interest rates since recapitalisations as they gained greater market share (see Karadima and Louri 2021; Hardouvelis and Vayanos, 2023). In 2008, the year of the global financial crisis, the Greek government attempted to intervene by making up to €28 billion accessible to the banking system to promote loan expansion and reduce interest rate pressure. Alas, the global financial crisis eventually caught up with the Greek economy in 2010 in terms of a fully-fledged

sovereign debt crisis unpresented for a member state of the euro-area. The banking crisis that followed the sovereign debt crisis in Greece was characterised by high levels of non-performing loans, declining asset quality, and deteriorating financial stability. As a result, three rounds of recapitalisations were necessary between 2013 and 2015 to address the solvency of the four major Greek banks. The recapitalisations were partly due to the Private Sector Involvement (PSI) program, which involved a significant haircut of Greek sovereign bonds and resulted in unsustainable losses for Greek banks. This, in turn, necessitated capital injections and ultimately led to the nationalisation of the banking industry. The banking crisis had a profound impact on the Greek economy, leading to a prolonged recession, high unemployment, and political instability.

Approximately €65 billion in capital injections were required to bail out the four systemic Greek banks (NBG, Alpha Bank, Eurobank, and Piraeus), with the first two recapitalisations partially due to the Private Sector Involvement (PSI) program, which had an impact on local banking institutions that held Greek government bonds. The PSI involved significant haircuts of Greek sovereign bonds that led to unsustainable losses for Greek banks, necessitating successive rounds of capital injections that effectively resulted in the nationalization of the banking industry.

In this study, given the unique case of the Greek banking, we select the four major Greek banks, that is National Bank of Greece (NBG), Alpha Bank, Eurobank, and Piraeus, plus the smaller Attica bank. Note that those four systemic banks hold about 95.7% of the Greek banking market share in 2020, while Attica has much smaller size. We collect data from the Greek annual balance sheets for each bank in the sample and the statistical Annexes of Bank of Greece. In detail, the Hellenic Bank Association, which represents all systemic Greek banks and foreign credit institutions operating in Greece, publishes balance sheet data of Greek banks (see

https://www.hba.gr/En). The Bank of Greece publishes data on bank deposits and credit, as well as on the key monetary aggregates (see https://www.bankofgreece.gr/en/statistics/monetary-and-banking-statistics). Greek banks are required to provide to the Bank of Greece balance sheet data.

Table 1 reports descriptive statistics for the variables of our identification. The average NIM of the Greek banking industry over the sample period from 1999 to 2022 is at 2.8 compared to 1.8 in the Euro Area. The Lerner index is measured as the percentage markup of price above marginal cost. To assist the exposition, assume that if the bank market is perfectly competitive then P = MC so that the Lerner index is equal to 0. Of course, this case of perfect competition is observed in the banking industry where the number of banks does not tend to infinitive. As a rule of thumb note that the closer a market is to a monopoly, the higher the Lerner index and the lower the bank competition.[1] The Single Supervisory Mechanism (SSM) and ECB should monitor such indexes and intervene if the banking market structure deviates from a competitive one. For example, a banking market with a Lerner index of less than 0.1 is a competitive market. However, if the banking market has a high Lerner index like the case of Greece at around 0.2 over the sample period would indicate a highly concentrated market and antitrust concerns should be raised. The values of Boone indicator at -0.017 show a very low degree of competition (like the Lerner index). Also note that the growth rate of new loans (*lLoan*) is negative over the period, suggesting low credit expansion.

[1] It is worth noting that we could opt for the Herfindahl-Hirschman Index (HHI) that measures market concertation. Given that the banking industry includes few players we opt for the Lerner Index that assess market bank market power, respectively. Moreover, the HHI index is based on the distribution of market shares among banks, while the Lerner index refers to duality theory to derive marginal cost. Therefore, the Lerner index is chosen in the present analysis to reflect the underlying bank optimisation.

In addition, we include operation efficiency (*OE*) measured by operating expenses to total assets which is low at 0.03, indicating low efficiency. Risk aversion (*RA*) exhibits bank managers' behaviour and it can be approximated by the ratio of equity to total assets. The credit risk (CR) is the ratio of loan loss provisions to gross loans, and it is relatively low at 19.7 percent. *NII* measures the ratio of non-interest income to total assets while the *RES* captures the ratio of cash plus balances with central banks to total assets.

Table 1: Descriptive Bank Statistics

	No of Obs.	Mean	S.D.	Min	Max
NIM	120	2.805	1.086	0.203	6.359
Lerner	120	0.196	0.0543	0.1096	0.313
Boone	120	-0.018	0.140	-0.142	0.416
OE	120	0.037	0.028	0.010	0.192
RA	120	0.038	0.076	0.002	0.619
RA1	120	0.039	0.035	0.004	0.165
CR	120	19.697	1.481	16.585	22.169
lLoan	120	23.730	1.287	20.812	25.116
NII	120	0.0111	0.0076	0.0008	0.0588
RES	120	.00867	.0172	.00008	.0715
MLF	120	1.705	1.331	0.25	3.75
σ^2_{MLF}	120	0.831	0.459	0.224	1.632
CPI	120	1.589	2.008	-1.735	4.712
GDP	120	-0.084	4.949	-10.149	8.434

Source: The Bank of Greece (monetary and banking statistics: https://www.bankofgreece.gr/en/statistics/monetary-and-banking-statistics) and the Hellenic Bank Association (Greek banking system financial data: https://www.hba.gr/En/Statistics/List?type=GreeceBrief_EN).
Authors' estimations. Our sample includes the four systemic banks, National Bank of Greece, Alpha Bank, Eurobank, Piraeus Bank, plus Attica Bank.

The NIM is net interest margin; Lerner index; Boone indicator; OE is operation efficiency measured by operating expenses to total assets; RA is the risk aversion measured by equity to total assets; CR is credit risk which is loan loss provisions to gross loans; lLoan is the logarithm of loans; NII is the ratio of non-interest income to total assets; RES is the ratio of cash plus balances with central banks to total assets. CPI is the inflation; GDP is the GDP growth. MLF is the marginal lending facility and σ^2_{MLF} its volatility.

4. Results

4.1 Dynamic Panel Results of the impact of bank competition

As the first step in our identification strategy, we employ a dynamic panel regression analysis of Equation (3) to control for any endogeneity issues. To accomplish this, we use the Arellano and Bover (1995) GMM estimator, which is a system estimator that employs moment conditions and controls for possible endogeneity. In this method, lagged differences are employed as instruments for the level equation, in addition to the moment conditions of lagged levels as instruments for the differenced equation. It is important to note that the validity of the additional moment conditions is dependent on the validity of the initial condition. Table 2 reports results with various specification tests, such as Sargan test, and AR test. We employ Stata 17 for all estimations. The Sargan test confirms the validity of overidentifying restrictions in instrumental variables and shows good fitness. The AR(2) show no issues with serial correlation. We also use time dummy in our dynamic model.

Our results, as shown in Table 2, indicate that an increase in the measure of competition, whether it is the Lerner index or the Boone index, leads to an increase in NIM. Note that the higher the Lerner or the Boone index the lower bank competition and therefore the higher monopoly power. For instance, in Model 3 of Table 2, results show that an increase of one percent in bank competition, as measured by the Lerner index, leads to a 0.163% increase in the *NIM*. The parameter estimate for Boone indicator is lower at 0.025% (see Model 4, Table 2), but the sign is positive and statistically significant at 1%. These results agree with prior findings in the literature (Maudos and de Guevara 2004; Carbo and Rodriguez 2007).

Regarding operating efficiency, banks that are less efficient often experience higher operating costs, which can result in the need for higher margins. Our results show a positive coefficient

for *OE* as expected. A higher ratio the risk aversion (*RA*) implies greater risk aversion. Thus, banks with high levels of risk aversion tend to be more financially viable, which could reduce funding costs and increase *NIM* as reported in Table 2. It is worth noting that when banks are more risk-averse, they could also charge a higher risk premium to compensate for the potential losses (Ho and Saunders 1981; Ho and Stoll, 1980; Maudos and de Guevara 2004). On the other hand, if banks are less risk-averse, they could charge a smaller risk premium, which would result in lower net interest margins.

Table 2: Dynamic Panel Regression Analysis

Dependent variable *NIM*				
	(1)	(2)	(3)	(4)
NIM_{t-1}	0.646***	0.586***	0.628***	0.541***
	(0.0351)	(0.0441)	(0.0920)	(0.0940)
Lerner	0.0785***	0.0517***	0.163***	
	(0.0127)	(0.0193)	(0.0183)	
OE		0.0784***	0.0938***	0.295***
		(0.0206)	(0.0266)	(0.0570)
RA		0.0541*	0.0554***	0.149***
		(0.0289)	(0.0145)	(0.0371)
CR		0.0344**	0.0116***	0.00170
		(0.0134)	(0.00337)	(0.00740)
lLoan		0.00381***	0.00155	0.00241**
		(0.00115)	(0.00144)	(0.000982)
NII		-0.215**	-0.0837	-0.383***
		(0.0905)	(0.0969)	(0.0569)
RES			-0.199	-0.965
			(0.534)	(1.137)
CPI			0.00162**	0.00148
			(0.000739)	(0.00117)
GDP			0.000111	-0.000679***
			(0.000175)	(0.000215)
σ^2_{MLF}			0.0192***	0.00345
			(0.00336)	(0.0109)
Boone				0.0251***
				(0.0101)
Constant	-0.0121***	-0.176***	-0.171***	-0.333***
	(0.00247)	(0.0457)	(0.0549)	(0.0267)
Time Dummy	Yes	Yes	Yes	Yes
Observations	100	100	100	100
Number of Instru.	10	10	10	10
Sargan test p-val	0.342	0.411	0.420	0.490
AR(1) test p-val	0.113	0.057	0.067	0.121

AR(2) test p-val	0.2523	0.260	0.311	0.252

Source Authors' estimations. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. We implement the estimations with a GMM procedure that follows Arellano and Bover (1995). We use the first lag of left had side variables as instruments. Sargan provides over-identifying test for the validity of identification. Serial correlation is tested using Arellano-Bond AR(2) second-order and AR(1) first order serial correlation tests. NIM: net interest margin; Lerner index; Boone indicator; OE: operation efficiency measured by operating expenses to total assets; RA: the risk aversion measured by equity to total assets; CR: credit risk which is loan loss provisions to gross loans; lLoan: the logarithm of loans; NII: the ratio of non-interest income to total assets; RES: the ratio of cash plus balances with central banks to total assets. CPI: the inflation; GDP: the GDP growth. MLF: the marginal lending facility and σ^2MLF the volatility of MLF.

A higher ratio of credit risk (*CR*) is linked with lower credit quality and banks would increase NIM to offset the risk of funding riskier projects and to maintain sufficient loan reserves, see Table 2. The positive parameter estimates of *CR* are in line with Poghosyan (2012). Also, note that banks at higher levels of credit risk would need to charge higher interest rates to compensate for the increased risk of default. As a result, banks with higher credit risk would have higher net interest margins. The logarithm of loans (*lLoan*) is used to approximate the size of bank operations. Large size could be associated with greater potential losses, resulting in a positive correlation between *lLoan* and net interest spreads. Table 2 confirms this expectation. On the other hand, a diversified bank is expected to offer lower spreads to attract new customers and compensate for the opportunity cost through higher fees and commissions. Our results shows that the *NII* asserts a negative impact on *NIM*. The reserve requirements and regulatory costs (*RES*) appear not have any statistically significant impact on *NIM*. Macroeconomic factors such as inflation (*CPI)* and growth are also included in our model, with the *CPI* variable approximating year-end change in consumer price index and carries a positive sign as expected. The parameter estimate of GDP growth is statistically negative when Boone indicator (see last column, Table 2) but very low in magnitude. Lastly, the volatility of the marginal lending facility (for controlling for ECB policy rate) carries a positive sign in line with our expectations that higher volatility in ECB rate would increase *NIM* to compensate for the increased risk (Saunders and Schumacher 2000).

4.2 Identifying the impact of recapitalisations.

Next, we bring into the forefront the impact of recapitalisations. In Table 3 we estimate Equation (4) that captures the impact of recapitalisations of Greek banks. Our findings reveal that all interactions between Lerner and recapitalisations have a positive and statistically significant impact on *NIM*, suggesting that successive capital injections amplify the positive effect of low bank competition on *NIM*.

Table 3: Dynamic Panel Data Analysis, impact of recapitalisations.

Dependent variable *NIM*	(1)	(2)	(3)	(4)
NIM_{t-1}	0.686***	0.685***	0.809***	0.936***
	(0.0310)	(0.0425)	(0.0870)	(0.0504)
Lerner	0.165***	0.111***	0.166***	
	(0.0199)	(0.00883)	(0.0236)	
OE	0.0843**	0.0878***	0.0694***	0.302***
	(0.0360)	(0.0305)	(0.0269)	(0.0529)
RA	0.0323**	0.0350**	0.0454***	0.0539
	(0.0151)	(0.0148)	(0.0130)	(0.0628)
CR	0.00877	0.00723	0.0110**	-0.00103
	(0.00623)	(0.00661)	(0.00511)	(0.0108)
lLoan	0.00183	0.00136	0.00159	0.00209
	(0.00119)	(0.00151)	(0.00140)	(0.00153)
NII	-0.00529	0.0834	-0.0326	-0.389***
	(0.103)	(0.128)	(0.0841)	(0.0841)
RES	-0.292	-0.517	-0.513	-0.183
	(0.446)	(0.571)	(0.583)	(1.263)
CPI	0.000784**	0.00106**	0.00199***	0.00204*
	(0.000352)	(0.000536)	(0.000575)	(0.00117)
GDP	-0.000205	-1.58e-05	0.000220	-0.000515*
	(0.000189)	(0.000157)	(0.000168)	(0.000281)
σ^2_{MLF}	0.0148***	0.0188***	0.0223***	0.0119
	(0.00259)	(0.00215)	(0.00232)	(0.0121)
yr2013	0.0174***			0.0142**
	(0.0411)			(0.00686)
*yr13*Lerner*	0.122***			
	(0.0231)			
yr2014		0.00971***		
		(0.00257)		
*yr14*Lerner*		0.0544***		
		(0.0102)		
yr2015			0.000197	
			(0.000857)	
*yr15*Lerner*			0.0201***	

			(0.00748)	
Boone				0.0121***
				(0.0018)
*yr13*Boone*				0.343***
				(0.099)
Constant	-0.138*	-0.156***	-0.151***	-0.346***
	(0.0806)	(0.0602)	(0.0504)	(0.0403)
Observations	100	100	100	100
Number of Instru.	10	10	10	10
Sargan test p-val	0.512	0.445	0.380	0.378
AR(1) test p-val	0.031	0.051	0.057	0.092
AR(2) test p-val	0.342	0.361	0.487	0.480

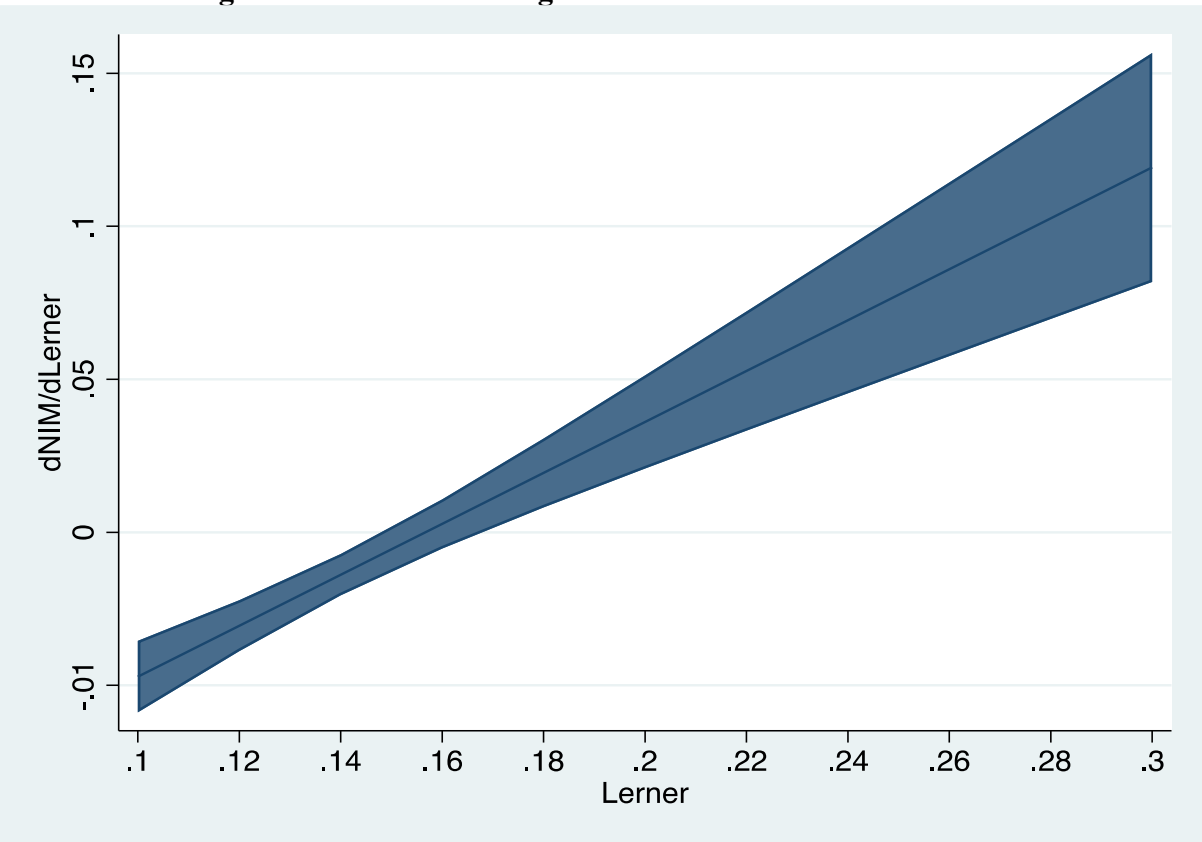
Source Authors' estimations. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. We implement the estimations with a GMM procedure that follows Arellano and Bover (1995). We use the first lag of left had side variables as instruments. Sargan provides over-identifying test for the validity of identification. Serial correlation is tested using Arellano-Bond AR(2) second-order and AR(1) first order serial correlation tests. NIM: net interest margin; Lerner index; Boone indicator; OE: operation efficiency measured by operating expenses to total assets; RA: the risk aversion measured by equity to total assets; CR: credit risk which is loan loss provisions to gross loans; lLoan: the logarithm of loans; NII: the ratio of non-interest income to total assets; RES: the ratio of cash plus balances with central banks to total assets. CPI: the inflation; GDP: the GDP growth. MLF: the marginal lending facility and σ^2MLF the volatility of MLF.

Note that results for Boone indicator (see last column in Table 3) pertain to the first recapitalisation in 2013, which was the major one (similar results were observed for the remaining recapitalisations, available upon request). Overall, across all Models in Table, the dominant result relates to the positive effect of low bank competition on *NIM* that it is amplified across all specifications by recapitalisations. We find that because Greek banks have a high degree of market power, low degree of bank competition, they use recapitalisation to increase further their market share and maintain ever higher net interest margins. To reverse this trend of persistent high interest rate margins, bank competition should increase, for example through changes in regulations and supervision framework of the market. Remaining parameter estimates are in line with Table 2 findings, including specification tests, such as Sargan test, and AR test. The Sargan test confirms the validity of overidentifying restrictions in

instrumental variables and shows good fitness. The AR(2) show no issues with serial correlation. We also use time dummy in our dynamic model.

Following the above estimations, we report in Figure 1 the change in *NIM* due to a change in the Lerner index. It is interesting to note the positive relationship between the Lerner and *NIM* exists when the Lerner is high (above 0.16). If the Lerner is from 0 to 0.1, the *NIM* falls by about 0.01 basis points, but if the Lerner changes from 0.17% and above, the *NIM* increases by up to 0.15 basis points. The estimated impact persists over time, and lower competition would increase banks' *NIM*.

Figure 1: Effect of a change in the Lerner index on the NIM.



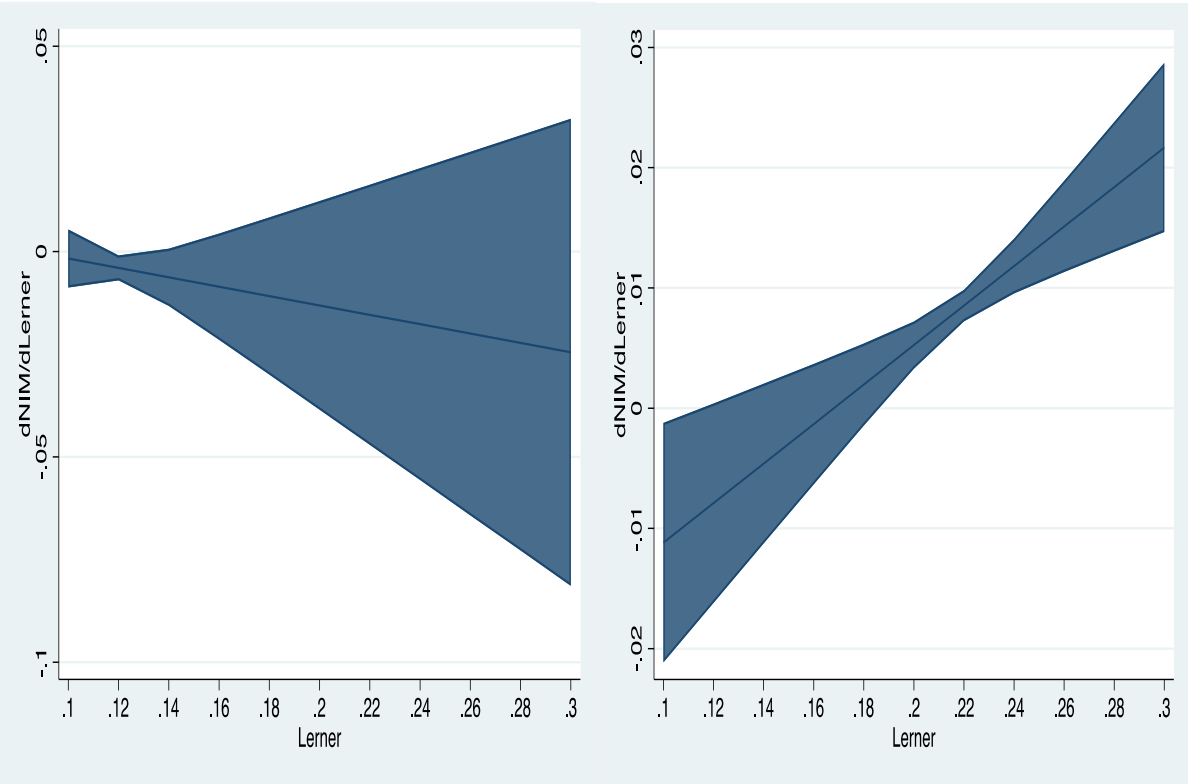
Source: Authors' estimations. Shaded area presents 95% confidence bands.

To demonstrate the impact of recapitalisation on *NIM*, Figure 2 shows the change in *NIM* due to the change in the Lerner index before recapitalisation in 2013 and thereafter. Note that during

the post-recapitalisation period, there is a notable positive association between the Lerner index and net interest margin (*NIM*). Interestingly, it is worth noticing that before this period, the association between the two variables displayed a downward slope.

Figure 2: Effects of a change in the Lerner index on the NIM, prior and after recapitalisations.

2001 to 2012 **2013 to 2021**



Note: Authors' estimations. Shaded area presents 95% confidence bands.

Over the past decade, the Greek banking sector has undergone significant structural changes because of the sovereign debt crises that have impacted financial markets (Karadima and Louri 2021; Hardouvelis and Vayanos, 2023). Our results, as displayed in Table 3 and in Figures 2, reveal that recapitalisations impede further bank competition, resulting in even higher levels of

NIM. In 2020, the National Bank of Greece (NBG), Piraeus Bank, Alpha Bank, and Eurobank, along with Attica Bank, controlled over 95% of the Greek banking market. In this regard, low bank competition insinuates that there is collusive behaviour in setting saving and loan interest rates to enhance interest earnings.

It is worth noting that National Bank of Greece (NBG), Piraeus Bank, Alpha Bank, and Eurobank are the four main systemic Greek banks. The Greek government holds ownership in those banks through the Hellenic Financial Stability Fund (HFSF). The HFSF was created in 2010 with the primary objective of contributing to maintaining the financial stability of the Greek banking system. Since its inception, the HFSF has actively supported the recapitalisation of those four systemically important banks. By 2013 the HFSF provided a total of €50 billion in funding to the Greek banks. Of this amount, €25 billion was provided in the form of bonds that could be converted into shares of the banks, financing the funding gap of banks. In 2014, the recapitalisation process for Greek banks was continued as part of the second bailout program for Greece. Under the second bailout program, the HFSF provided additional funding of €8.3 billion to the Greek banks. This funding was used to strengthen the capital positions of the banks and improve their ability to withstand potential losses. In 2015, Greek banks underwent another round of recapitalisation as part of the third bailout program for Greece. The recapitalisation was carried out by the European Stability Mechanism (ESM), which is the euro-area's bailout fund. Under the third bailout program, the ESM provided a total of €25 billion in funding to the Greek banks.

After the third recapitalisation in 2015 the HFSF retains the following ownership of the four systemic banks: 40.39% of NBG, 26.42% of Piraeus Bank, 11.01% of Alpha Bank, and 2.38% of Eurobank. To unravel Greek banks' ownership structure is rather challenging. Although all

banks are publicly traded there is no comprehensive information about their ownership. Institutional investors, pension funds, and hedge funds, as well as individual investors appear to own the four systemic Greek banks, but no details are disclosed about their shares. Recent data for NBG shows that the largest shareholder was the HFSF in 2021, which held a stake of approximately 29.7% in the bank. Other significant shareholders included the Qatar Investment Authority, but its share percentage is not disclosed. Interestingly the Qatar Investment Authority also appears to hold a main shareholding in Alpha Bank. The Fairfax Financial Holdings appears to be a significant shareholder of Eurobank, while the HFSF increased its ownership in 2021 to 35.42%. Clearly the ownership structure is of importance, but data availability issues restrict a detailed investigation.

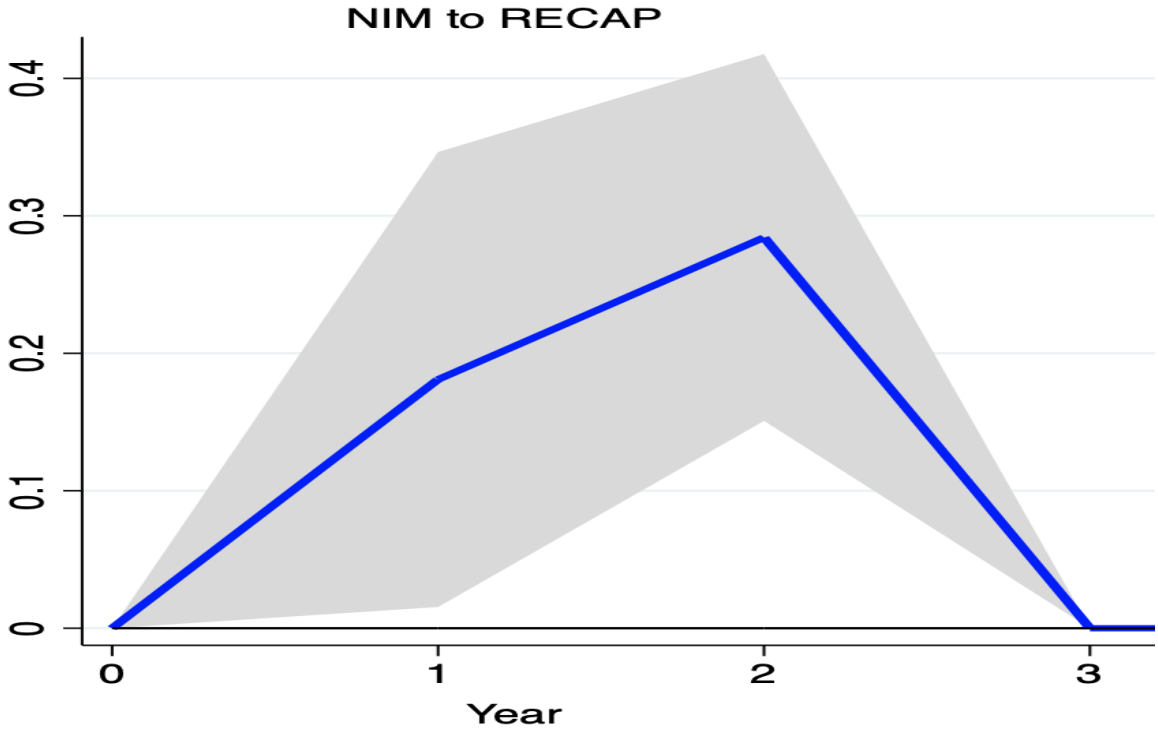
4.2. Local projections (LPs) findings

We turn next to the local projections (*LP*) analysis to examine any shift in the direction of adjustment in *NIM* brought about by the shocks in recapitalisations. The *LPs* by enabling to trace the response of *NIM* to unexpected changes in the underlying market conditions give an insight into the dynamics of *NIM* and its path towards a steady state.

Figure 3 shows impulse response functions (IRFs) of *LPs* of Equation (6), suggesting that once the recapitalisation is implemented, conditional to the Lerner index being above the 75th percentile of sample distribution showing low bank competition, the *NIM* increases by an average of close to 0.2 percent within the first year of recapitalisation and it will continue to rise up till 0.3 percent by year two, converging to steady state thereafter. The confidence interval for this increase varies but it shows 90% significance for the first year. This finding suggests that the Greek banks would react positively to recapitalisations, leading to increases in *NIM* to boost their profitability. Higher *NIM* could positively signal to investors to invest in banks, which in turn can lead to lower borrowing costs and a stronger profit performance

overall. It is important to note, however, that higher *NIM* could undermine credit expansion and growth rate in general.

Figure 3: LP response of NIM to a shock in Recapitalisation (RECAP).

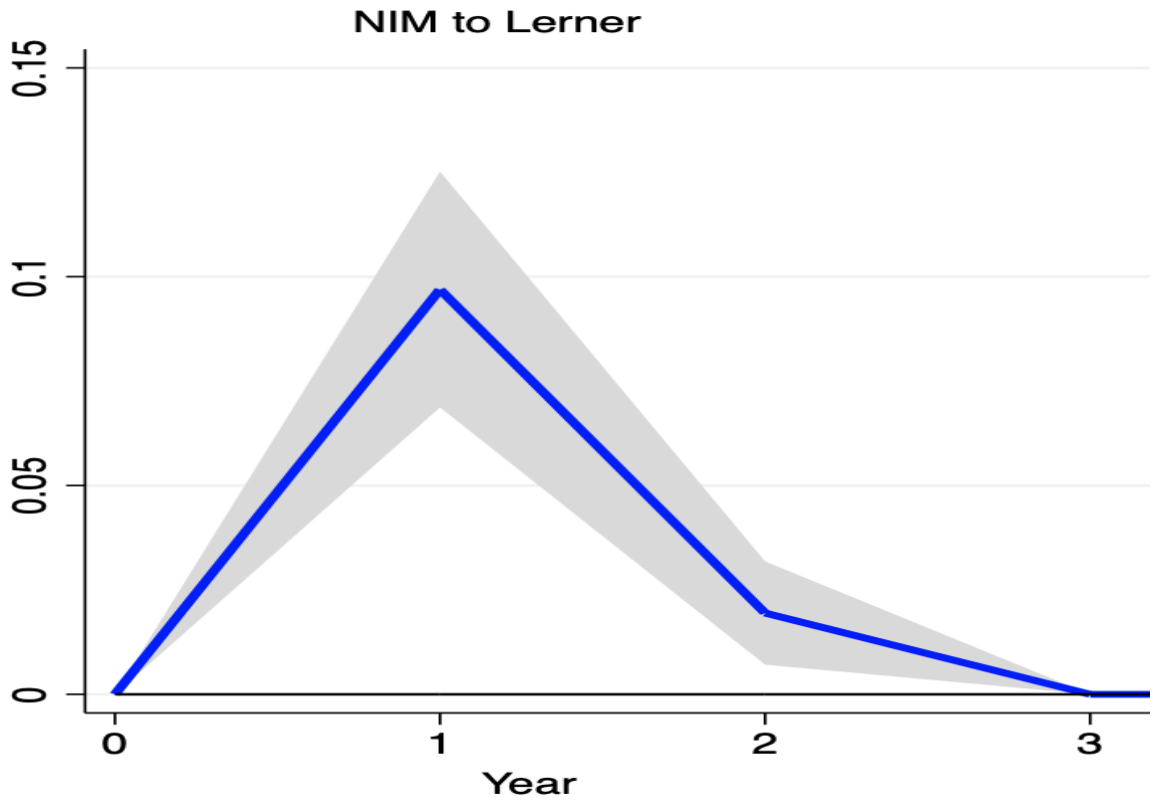


Note: Authors' estimations. RECAP captures the announcement of recapitalisation.

Recapitalisations can amplify further their positive effects on *NIM* through the impact of bank competition. To test this hypothesis, we examine the response of *NIM* to a shock in the Lerner index conditional that recapitalisation has taken place (see Figure 4). The IRF suggests that lower perceived bank competition as denoted by higher levels of the Lerner index is associated with higher levels of *NIM* by 0.1% following a recapitalisation. In fact, Figure 4 shows that the response of *NIM* is highly statistically significant. Therefore, bank competition is a significant

factor in increasing *NIM* following the recapitalisations. Our results demonstrate that low bank competition will increase *NIM* if recapitalisation takes place that is acting as amplifier for even higher *NIM*.

Figure 4: LP response of *NIM* to a shock in the Lerner index.



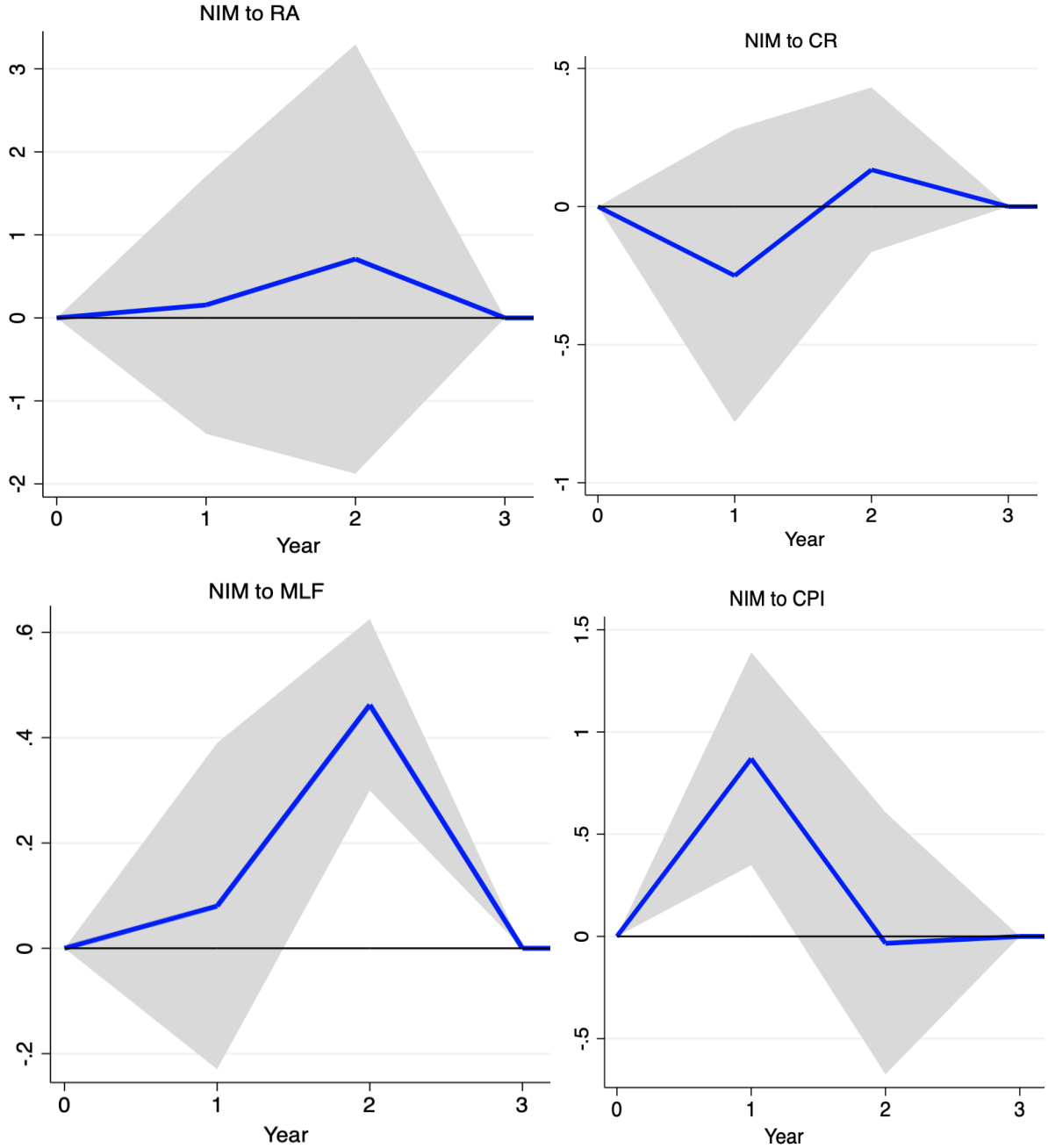
Source: Authors' estimations.

It is no surprise therefore that the *NIM* of Greek banking industry is the highest in the euro-area. This result highlights the importance of having a highly competitive market structure in ensuring lower levels of *NIM*.

Lastly, Figure 5 shows the responses to *NIM* conditional to risk aversion (*RA*), credit risk (*CR*), inflation (*CPI*) and volatility of marginal lending facility (MLF). The IRFs suggest that higher perceived inflation is associated with higher and statistically significant levels of *NIM*. Following a recapitalisations, *NIM* increase by around 0.7% within a year due to higher inflation. This is of interest given the recent episodes of two-digit inflation in 2021. It is also of interest that *NIM* increases by 0.4% in year two conditional to increases in volatility of

marginal lending facility. This result is of particular importance in the current conjecture of high interest rates and inflation. Risk aversion also positively contributes to *NIM* though statistical significance is low. On the other hand, credit risk would reduce *NIM* in the first year before turning positive in year two, but statistical significance is low, and caution is warranted.

Figure 5: LP of response of *NIM* to shocks in RA, CR, MLF, CPI.



Note: Authors' estimations. RA is the risk aversion; CR is credit risk; CPI is inflation; MLF is the volatility of marginal lending facility.

5. Conclusions

The Greek banking sector has been facing significant challenges in recent years, including losses and high levels of non-performing loans. Greece holds the highest non-performing loans ratio in the EU, standing at 31.4% as of December 2021. The stability of the banking system is crucial for the overall health of the economy, but there is no simple solution to improve the profitability of Greek banks. High-interest rate margins are not a panacea for a sound banking industry. High-interest rate margins would lead to increased default risk on bank loans as evidenced by high ratios of non-performing loans and thereby cause financial instability. In addition, the persistence of net interest margins has hindered credit expansion and economic growth. For every year between 2011 and 2020, there was negative credit growth as demand for credit by households and businesses was severely subdued due to high rates. In 2021 the negative credit growth was reversed, but it remained at very low levels compared to the pre-capitalisations period.

One factor contributing to the problem is the lack of competition in the sector, which has led to the highest net interest margin across the euro-area. This study shows that recapitalisations conditional to low competition are key to hikes in net interest rate margins. Our research findings underscore significant policy implications, emphasizing the crucial roles of EU competition laws, the European Central Bank (ECB), and antitrust authorities within the euro-area. To prevent the undue market dominance of a select few Greek banks, it is imperative for EU banking institutions to actively engage in promoting bank competition. The acceleration of the banking union in the euro-area, coupled with enhanced regulatory and supervisory measures, can contribute to maintaining reasonable interest rate margins.

Furthermore, fostering the restructuring of the Greek banking sector towards a greater reliance on non-interest income represents a strategic avenue for banks to potentially reduce interest margins. Diversifying revenue streams beyond traditional interest-based transactions can provide financial institutions with flexibility and resilience in a dynamic market environment.

Lastly, it is worth noting that the Hellenic Financial Stability Fund (HFSF), funded by the Greek government during the sovereign debt crisis in 2010s with the primary purpose of ensuring the stability of the Greek banking system, is in the process of disinvesting its ownership of the four systemic Greek banks. This disinvestment will be concluded by the year-end of 2025. The HFSF's disinvesting is a significant development, and this move holds the potential to impact bank competition and, consequently, net interest margins. The disinvestment process could have far-reaching implications for the Greek banking landscape, making it an area ripe for future research exploration. Future research may investigate the repercussions on market dynamics, competition among banks, and the subsequent effects on NIM. Such research endeavours could contribute valuable insights into the evolving financial landscape in Greece and provide a deeper understanding of the consequences of the HFSF's disinvestment strategy on the banking sector.

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