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Dimitrios P. Louzis
Angelos T. Vouldis

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BANK OF GREECE
Economic Analysis and Research Department – Special Studies Division
21, E. Venizelos Avenue
GR-102 50 Athens
Tel: +30210-320 3610
Fax: +30210-320 2432

www.bankofgreece.gr

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PROFITABILITY IN THE GREEK BANKING SYSTEM: A DUAL INVESTIGATION OF NET INTEREST AND NON-INTEREST INCOME

Dimitrios P. Louzis
Bank of Greece

Angelos T. Vouldis
Bank of Greece and European Central Bank

Abstract

This study examines in parallel the determinants of interest and non-interest income in the Greek banking system aiming to understand the primary drivers of overall profitability for Greek banks. Using dynamic panel data techniques and a unique data set, including supervisory data, covering the whole Greek commercial banking system from 2004 to 2011, we find that net interest income is primarily affected by the banks' market power, their operating costs and their strategic choice to diversify their income sources by enhancing non-interest income. On the other hand, non-interest income is more persistent than net interest income, with the more efficient banks, possessing a strong deposit base, having greater leverage in boosting their non-interest income. Aggregate demand conditions and inflation can also affect both income components. Moreover, interest- and non-interest income are found to be substitutes rather than complements, with non-interest income used as an indirect competition instrument by efficient banks, instead of competing directly with their peers through prices in loans and deposits.

Keywords: Profitability; Non interest income; Dynamic Panel data; Greek banking system.

JEL Classifications: G21, C23

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Correspondence:
Bank of Greece,
Financial Stability Department,
3 Amerikis Str., 10564,
Athens, Greece.
Phone: +30 210 3205169
Fax: +30 210 3205419
Email: dlouzis@aueb.gr ; dlouzis@bankofgreece.gr

1. Introduction

Banks perform the core economic function of financial intermediation between savers and borrowers. In the textbook business model, profits are derived from the interest spread between lending and borrowing rates. In reality, however, the source of banks' profits is more diversified including fees and commissions charged for the provision of financial services. In addition, banks are also involved in other activities such as trading securities, further diversifying their income sources.

The multi-output framework of analysis may be necessary in order to interpret paradoxical empirical phenomena e.g. of coexistence of decreasing interest margins and market power (Maudos and de Guevara 2004). For example, a bank may use its dominance in the market to increase the non-interest share of income through higher fees and commissions while keeping lending rates relatively low.

The present paper presents an integrated analysis of banks' profitability for the Greek banking sector. A salient feature of our analysis is that it differentiates between income components. Given the reliance of banks on sources of income beyond the interest spread, this type of analysis is necessary in order to gain insights into the determinants of performance in the banking sector. In addition, given the dearth of studies dealing with profitability determinants in Greece, the paper aims to present an integrated view of underlying causes by splitting income into its components, rather than focusing on aggregate profits. [1]

The period under examination (2004-2011) includes both the phase of boom and quick credit expansion along with the subsequent crisis that engulfed the Greek economy and, therefore, can be considered as a representative period including a full business cycle. In addition, we use individual bank data for a sample of 19 banks covering the whole Greek banking system (above 95%, as a share of assets) enhancing the reliability of the results and enabling a robust examination of size effects. In addition, supervisory data on the credit risk, reflected in the NPL ratio, are used, along with publicly available data.

The class of theoretical models stemming from the seminal paper by Ho and Saunders (1981) provides the guiding principle for selecting the explanatory variables

[1] Given the rapidly changing, post-PSI (2012) landscape of the Greek banking system, this type of analysis is especially relevant for policy as a means to understanding the dynamics of the sector.

to be investigated for the net interest income (NII) econometric model. This approach emphasizes the "dealership"/intermediation function of the banks, linking depositors and borrowers. In a nutshell, banks' profits are interpreted in that model by the risks that the bank undertakes while performing this intermediation function. Given the "traditional" business model followed by the Greek banks (i.e. limited use of structured products, securitization etc) this theoretical approach seems to be suitable for guiding the selection of potential determinants of profitability. However, given that it is a microeconomic model[2] we investigate also the impact of the business cycle and economy-wide effects on the banks' profitability.

As regards non-interest income, we formulate a number of hypotheses taken from the literature, which link the non-interest income (Non-II) to bank-specific variables and the macroeconomic environment. Our focus is on the relationship between the business model characterizing a bank and its reliance on Non-II.

A significant element of this study is the emphasis on the relationship between the net interest income and non-interest income as manifestations of the profit strategy followed by the banks. A bank may use Non-II to enhance its competitiveness on the prices of loans and deposits, thereby using to Non-II to cross-subsidize the NII[3,4]. In this case, the two types of incomes can be considered as substitutes rather than as complements. In addition, a negative relationship between Non-II and NII implies positive diversification effects and a smoothing of profitability effected by reliance also on Non-II. These two dimensions of using Non-II as an alternative source of income (i.e. substitutability with respect to NII and diversification of profit sources) are driven by different considerations (gaining market share and smoothing profits, respectively) but in the context of an econometric model, both considerations will be reflected in the same way as negative relationship between NII and Non-II. Alternatively, NII and Non-II can be chosen by a bank as complements i.e. trying to maximise both at the same time rather than subsidizing the one source of income with the other. A positive relationship between NII and Non-II would also imply relatively low diversification benefits. We consider the empirical investigation of this aspect of banks' behavior as a crucial one with respect to understanding how their profitability is affected by the presence of different sources of income.

[2] However, the model also hints at the influence of the market structure on profits.
[3] Potentially, also, distorting risk pricing.
[4] This possibility implies the existence of barriers to entry in the non-interest-income earning activities.

Finally, investigation of the Greek banking system represents a "clean" prototype case, as banks operate within a liberalized institutional environment, in the context of a relatively advanced and closed economy which was growing rapidly, until the outbreak of the crisis, and whereby banks followed a traditional business model involving mainly deposit-taking and loan-granting. Therefore, the results are not affected by additional factors which may be present in other jurisdictions, such as banks being highly involved in the originate-to-distribute activities, or swings in international trade or exchange rates affecting the macroeconomic environment, or, finally, issues of financial underdevelopment impacting on the evolution of banks' profitability.

The structure of the rest of the paper is as follows. Section 2 presents a literature review on determinants of interest and non-interest income while also reviewing existing work on the Greek banking sector. Section 3 presents the selection of variables for both income components along with the econometric methodology. In Section 4 the results are presented and discussed. Finally, Section 5 concludes.

2. Literature review

2.1. Literature for interest and non-interest income

In Ho and Saunders (1981), the bank is modeled as a "dealer" between depositors and borrowers, and the spread between lending and deposit rates is explained as the price for providing the intermediation function in the face of uncertainty of deposit supplies and loan demands. The interest spread is found to be dependent on the following factors: i) elasticity of the demand and supply curves for loans and deposits, respectively (assumed to be symmetric in the model), reflecting market structure[5]; ii) risk aversion (higher risk aversion leads to higher spreads); iii) size of transactions (positively related to interest spread since it magnifies the risk of intermediation in the face of uncertainty in deposit supply and loan demand); and iv) variance of the interest rate on deposits and loans (increases interest spread).

[5] That is, the more inelastic are the demand and supply functions, the higher the interest margin as the bank is able to exercise monopoly power.

Allen (1988) enriches the dealership model by including a variety of loan types and finds that portfolio effects may reduce the interest spread. In Carbo and Rodriguez (2007) the introduction of non-traditional activities similarly reduces the interest margin, however, gross margins, which include fees for non-traditional activities, are by definition higher compared to the interest margin. Angbazo (1997) introduce management quality and argue that it is a factor enhancing interest spreads.

There is a significant strand of literature which examines empirically the determinants of interest income. Maudos and de Guevara (2004) use a dataset of individual banks from the largest European sectors (Germany, France, the United Kingdom, Italy and Spain), spanning the period 1993-2000. They focus on bank-specific variables, which are selected based on the class of theoretical models originating from Ho and Saunders (1981). They find that market power, operating costs and efficiency represent the most statistically significant explanatory variables. The methodology followed in that paper for the selection of the explanatory variables is close to the one followed here as regards the class of theoretical models from which the variables under investigation are chosen and the addition of additional variables which capture possible effects missing from abstract models (e.g. agency effects). However, the results in that paper are not conditioned on the macroeconomic environment and, therefore, the impact of cyclical macroeconomic effects is not investigated. Valverde and Fernández (2007) study the determinants of interest rate margins for a sample of European banks in the period 1994-2001. They investigate both theoretical and accounting margins and find that relationships between diversification and interest margins can only be observed using the Lerner index, rather than accounting margins. In a study which includes consideration of non-interest income activities, Lepetit et al. (2008) examine a sample of European banks, andfind evidence of cross-selling of interest and non-interest products. [6]

Moreover, Stiroh (2004) examines the diversification benefits of non-interest income on banks' profitability. Empirical evidence using data from the U.S. banking industry spanning the period 1978-2000, suggests that it is unclear whether noninterest income provides significant diversification benefits given the high

[6] Other empirical studies for the determinants of interest income include Saunders and Schumacher (2000) for the US banking system and six European countries. Brock and Rojas (2000), Martinez and Mody (2004), and Gelos (2006) examine determinants of profitability for Latin American banking systems.

volatility of trading income. On the other hand, he notes that for a third of the banks in the sample examined, a negative correlation between net interest income and non-interest income growth is found i.e. diversification benefits are present for these banks. In addition, there is a caveat for these results, namely that the specific period is a transitory phase in which banks started relying to a significant extent on non-interest income and, therefore, not reaping the full benefits of this expansion of income sources. In fact, Nguyen (2012) investigates a large sample of banks across 28 countries, for the period 1997-2004, and finds that the relation between the two components of income has evolved over time, from a phase of subsidization between interest and non-interest income, throughout the period 1997–2002, to a phase of complementarity, throughout the period 2003-2004. Finally, Baele et al. (2007) focus on European banks and provide empirical evidence of market perceptions of higher profitability for more diversified banks. Therefore, the overall evidence is rather inconclusive as regards the existence of diversification benefits from non-interest income.[7]

Köhler (2013) provides empirical evidence that the relationship between reliance of a bank on non-interest income and its risk profile of banks is not monotonic. It is rather dictated by diversification effects, meaning that there is some optimal level of reliance on non-interest income which if it is surpassed it will make the bank more risky. It could be inferred, therefore, that the risk profile of a bank is related to its reliance on non-interest income and that interest- and non-interest income can be both complements and substitutes, depending on the share of non-interest income in total profits. On the other hand, Baele et al. (2007) finds that larger and more diversified banks have higher systematic risk because their market betas are higher.

2.2. Specifically for Greece

The determinants of profitability in the Greek banking sector have been investigated in a number of studies which are briefly discussed below.

[7] Further research on this theme can be found in Acharya et al. (2002), Lepetit et al. (2008) and Smith et al., (2003).

In particular, Eichengreen and Gibson (2001) are amongst the first that systematically examine the profitability in the Greek banking system.[8] The authors use a panel of commercial and non-commercial banks covering the 1993-1998 period in order to examine the determinants of ROA and ROE. They examine both bank- and market-specific determinants and conclude that the latter (specifically variables such as concentration ratios and market shares) have positive but insignificant effect on profitability, while the size variable presents a non-linear relation with profitability. From the bank-specific variables, staff costs, leverage and liquidity are significant determinants of profitability. The authors also introduce the notion of profitability persistence as a measure of competitiveness in the market.[9] They find a negative persistence probably due to the structural changes in the banking sector caused by the financial liberalization. In the same line with Eichengreen and Gibson (2001), Mamatzakis and Remoundos (2003) study the Greek banking profitability using a panel of 17 banks for the 1989-2000 period and find that profitability is primarily determined by variables that proxy management decisions (bank-specific variables)

In Gibson (2005), the author repeats the analysis of Eichengreen and Gibson (2001) using an updated sample which spans from 1993 to 2003. Among the main findings of the study are: (a) profitability persistence is now positive and in some cases significant, indicating reduced competition in the Greek banking system, (b) profitability is less sensitive to bank size compared to the results in Eichengreen and Gibson (2001) and (c) the differences between publicly- and privately-owned banks tend to be immaterial.

Another important contribution in the field is Athanasoglou et al. (2008) who examine the effect of internal and external variables on profitability. External determinants are those not affected by managerial actions and include both macroeconomic and industry-specific variables. The study uses an unbalanced panel of Greek commercial banks spanning the period 1985-2001. The authors find that a

[8] Earlier attempts include Staikouras and Steliaros (1999) that examine the determinants of ROA and ROE using a panel of 17 commercial banks during the 1991–1998 period. They find that the profitability of the Greek banks is primarily affected by the inflation rate, the propriety regime and the bank leverage (debt-to-assets ratio). Moreover, Hondrogianis et al (1999) also notes that banks revenues are significantly affected by their monopolistic power during the1993 – 1995 period.

[9] In a competitive market we expect that a shock to profits will die out quickly meaning that the coefficient of the lagged dependent variable (that is ROA or ROE in *t*-1) will not be close to unity. A negative coefficient of the lagged dependent variable means that "profits revert to normal in a oscillating manner" indicating a period of rapid change in banking system structure which results in highly volatile profits (Gibson, 2005).

stronger capital position is conducive to profitability while the opposite is the case with credit risk (proxied as loan loss provisions-to-loans ratio). On the other hand, bank size does not appear to be a statistically significant determinant. The authors also show a positive relation between profitability and business cycles. In the same vein, Kosmidou (2008) examines the profitability of the Greek banking sector during the period EU financial integration (1990-2002) using data from 23 banks. Her empirical findings are in line with Athanasoglou et al. (2008), as she documents a positive relation between capital level and ROA while the effect of size seems to be ambiguous. The author also finds that efficiency and economic growth boosts profitability.

Alexiou and Sofoklis (2009) investigate the determinants of profitability (ROE and ROA) using quarterly data over the period 2000-2007 and a sample of the six largest Greek banks. This paper provides evidence of economies of scale in the Greek banking sector (positive relationship between size and profitability), a negative effect of credit risk (proxied by the ratio of loss provisions over total loans), a positive effect of efficiency and a trade-off between liquidity (proxied by the loan-to-deposits ratio) and profitability. Finally, Drakos (2002) finds that default, interest rate and liquidity risks are the primary determinants of the net interest margin for the Greek banking system.

From the abovementioned extant literature it is clear enough that the majority of the studies focus on aggregate measures of profitability, such as ROE/ROA, whilst only one concentrates on the interest income component (Drakos, 2002). Moreover, with the exception of Alexiou and Sofoklis (2009) the rest of the studies use data from the pre-Eurozone era. To our knowledge there is no previous work examining specifically the non-interest component or using a sample that covers almost the full period under the Euro currency regime including the current twin sovereign-debt and banking crisis (Gibson et al., 2014).

3. Methodology

3.1. Determinants of the net interest income

Table 1 lists the variables explored as determinants of the net interest income (NIM). The first set consists of bank-specific variables which are chosen based on the class of models originating from Ho and Saunders' (1981) seminal model ("pure-spread determinants"). Given that such stylized models abstract from additional elements that may be relevant, some further bank-specific variables are also examined based on assumptions about the banks' strategy and management incentives. Finally, macroeconomic variables are also included, based on the literature that links the macroeconomic environment to banks profitability.

3.1.1. Pure-spread determinants

In this section, the hypotheses which originate from the stylized "dealer" model of a bank (originating from Ho and Saunders (1981)) are presented.

(A1) *"Market power" hypothesis: Market power enables bank to earn more NIM.*

The "dealer" model assumes absence of perfect competition in the loan market, therefore market power boosts the bank's profits. We use the Lerner index as a measure of market power.[10] It is defned as $Lerner = (p_i - mc_i)/p_i$, where p_i is the price a bank *i* can charge for its products and mc_i is the marginal cost. The price p_i is proxied by the ratio of bank revenues (financial + other operating) to total assets. Marginal cost is estimated using the common approach of a translog cost function with one output (assets) and three inputs (labor, physical assets, lendable funds):

[10] Valverde and Rodriguez Fernández (2007) argue in favour of using the Lerner index, compared to accounting interest rate margins, to identify the determinants of bank margins. In addition, Delis (2012) conducts a direct comparison with alternative indicators, such as that proposed in Boone (2008), and finds that the Lerner index is a valuable measure of market power.

$$\ln tc_{it} = a_0 + \sum_{k=1}^{3} a_k \ln w_{it}^k + \frac{1}{2}\sum_{j=1}^{3}\sum_{k=1}^{3} a_{jk} \ln w_{it}^j \ln w_{it}^k$$
$$+ \beta_1 \ln ta_{it} + \frac{1}{2}\beta_2 (\ln ta_{it})^2 + \sum_{k=1}^{3} \beta_{3k} \ln ta_{it} \ln w_{it}^k$$
$$+ \gamma_1 trend + \frac{1}{2}\gamma_2 trend^2 + \sum_{k=1}^{3} \gamma_{3k} trend \ln w_{it}^k + \gamma_4 trend \ln ta_{it} + \mu_i + u_{it}$$

where *tc* is the total cost (both financial and operating) and *ta* are the total assets. The prices of production factor are proxied by:

w^1 = price of labor: personnel costs / number of workers

w^2 = price of physical capital: operating expenses (except personnel costs) / fixed assets

w^3 = price of deposits: financial costs / deposits

Fixed effects are captured by μ_i and *trend* is used so as to capture the effect of technical change.

(A2) *"Risk aversion" hypothesis: More risk averse banks earn more NIM.*

According to the "dealer model", bank margins are driven by the preferences of the bank's management and specifically from the degree of risk aversion. Given the risks that the bank is exposed to when undertaking the intermediation function, an increase in bank margins would take place if the management is more risk-averse. The risk profile of the bank is proxied using the ratio of equity to assets (ETA).

(A3) *"Credit risk" hypothesis: Higher credit risk leads banks to charge higher margins.*

Credit risk is not addressed explicitly in the original "dealer" model, but it is clearly shown that uncertainty of income streams is priced into the bank's margins. The derived hypothesis is that in equilibrium banks charge higher interest rates when loans are riskier, therefore, a positive relationship of credit risk with NIM is expected.

In contrast to previous studies, non-performing loans (NPLs) are used to represent credit risk, rather than loan loss provisions. The latter option is usually chosen due to lack of data, but the caveat is that the writing of provisions is to some extent a strategic choice of the bank and there may be a time distance between actual increase of credit risk and the appearance of this risk on the balance sheet through provisioning. [11]

(A4) *"Funding risk" hypothesis: Higher funding risk leads the bank to charge higher margins.*

The variability of interest rate on deposits is a factor which increases the riskiness of the intermediation function and leads the bank to charge higher margins. Banks' funding risk is reflected in their retail cost of funding (defined here as the ratio of interest expenses to deposits) compared to some benchmark rate, such as Euribor.

(A5) *"Risk interactions" hypothesis: Interaction between market and credit risk leads to a non-linear amplification of NIM.*[12]

In crisis periods correlation between different risk factors increases and the effect of each risk factor on profitability may be more pronounced. To allow for such amplifying effects, interaction term between market and credit risk is included, as expressed by the ratio of impairment losses to gross loans on the one hand, and the volatility of 3-month Euribor (annualized standard deviation using weekly data).

(A6) *"Size effect" hypothesis: The larger the size of the transactions, the larger the margins that banks charge.*

The prototype Ho and Saunders (1981) model posits that the volume of loans (here in logarithms) is related to the interest margin since it affects the risk in bank's intermediation function**.** Specifically, the size of transactions interacts with the

[11] We also experimented with the alternative of using loan loss provisions instead of NPLs. The results were not found to be sensitive to the variable used to proxy credit risk. The relevant results are available upon request.
[12] See Maudos and de Guevara (2004) for a modified "dealer" model incorporating such interactions.

management's risk aversion and the variability of interest rates (i.e. with the other variables related to the risk pricing of the margins) and leads, in the equilibrium state, to increased margins.

(A7) *"Operations costs" hypothesis: Operating costs erode the NIM.*

On the cost side, operating expenses, expressed as a percentage of total assets are expected to erode profitability.[13] This is intuitive, because if one takes into account that the exercise of monopoly power by the bank when setting margins has been already taken into account, the pass-through effects, which one encounters often in empirical discussions, reflect the combination of these two effects (market power and operations costs), rather than any one of them in isolation.

We would like to investigate the relationship between alternative sources of income, therefore, the net non-interest income, normalized using the total assets is included as an explanatory variable**.** A more specific measure of alternative income source is the fees and commissions income (again expressed as a percentage of total assets). Two alternative hypotheses can be made with regard to the relationship between NII and the alternative sources of income:

(A8) *Substitutability hypothesis: Interest and non-interest income are substitutes.*

A negative sign implies that banks use interest income to diversify from non-interest income business meaning that the two sources of income represent substitutes.

(A9) *Complementarity hypothesis: Interest and non-interest income are complements.*

If non-interest income enhances net interest profitability, then the two sources of income are supplementary.

[13] Maudos and de Guevara (2004) extend the original Ho and Saunders (1981) model by incorporating production costs.

3.1.2. Other bank-specific determinants

Given the stylized nature characterizing theoretical models of banking, it was deemed preferable to include also variables that may not appear explicitly in such models but intuition and economic reasoning would imply that they may influence interest income. Consequently, we formulate additional hypotheses and include the corresponding variables in our estimated model:

(A10) *"Efficiency" hypothesis: More efficient banks are able to earn higher NIM.*

Quality of management is represented by the cost-to-income-ratio. It is expected to be negatively related with profitability since inefficiency leads to non-optimal allocation of assets and funding structures.

(A11) *"Traditional business model" hypothesis: Banks following a traditional business model (i.e. primarily taking deposits and granting loans) have lower margins.*

It may be argued that banks focusing on traditional intermediation activities should have lower interest margins given specialization and the presence of economies of scale. Loans to assets and deposits to assets have been interpreted as specialization variables (Carbo and Rodriguez 2007).[14]

3.1.3. Macroeconomic determinants

We include macroeconomic determinants in order to capture cyclical effects to banks' profitability. In our view, bank-specific determinants do not cover the full spectrum of factors which determine the banks' profits as the macroeconomic environment could exert significant influence through the demand for loans and price developments. Previous studies have focused solely on microeconomic (i.e. bank-

[14] Finally, we have also tried the implicit interest payments and the opportunity cost of keeping reserves as explanatory variables. Implicit interest payments are defined as the difference between operating expenses minus total non-interest income, divided by total assets. Given that this effectively raises the interest rate paid, a positive relationship is expected, since the bank will try to compensate for this additional cost by raising the margin. Moreover, given that cash reserves do not earn income, it is expected that the bank will pass this opportunity cost to the borrowers and therefore, a positive sign with respect to the opportunity cost is expected. This variable is proxied by cash as a percentage of assets.

specific) explanatory variables but we propose to combine macro- and micro-economic factors and estimate a comprehensive specification, in order to avoid having our results distorted due to endogeneity. Therefore, we formulate two additional hypotheses:

(A12) *"NIM procyclicality" hypothesis: NIM moves in the same direction with economic activity.*

Procyclicality in NIM during a boom can be explained by demand effects, which enable banks to boost their profits by increasing their spreads.[15] Empirical evidence in favour of this hypothesis has been provided in Dietrich and Wanzenried (2011). In the case of Greece, it is expected that due to excess credit demand over supply during most of the examined period[16], there would be a positive relationship between NIM and GDP (see also Athanasoglou et al. 2008).

(A13) *"NIM nominal pass-through" hypothesis: NIM increases during periods of elevated inflation.*

Changes in the level of price affect profitability, although in an ambiguous way since it is not a priori clear whether the price of revenue or cost items will be more affected. In general, since inflation is primarily associated with a booming environment, banks should be able to pass-through the costs of inflation to their clients.[17] Moreover, the banks' ability to anticipate inflation and reprice accordingly their products determines the overall effect of inflation on profitability. We use the growth rate of harmonized consumer price index (HCPI) as the inflation measure.

3.2. Determinants of non-interest income

In this section, we present the bank-specific and macroeconomic determinants of non-interest income based on the hypotheses formulated in the literature.

[15] There is also empirical evidence for a negative relationship between GDP and margins (e.g. in Valverde and Fernández 2007).
[16] For a quantification of demand and supply effects in the Greek credit market, see Vouldis (2014).
[17] The composition of the banks' portfolio between floating- and fixed-rate loans is an important element in this respect.

(B1) *"Sophistication" hypothesis: Larger banks rely more on Non-II compared to their smaller peers.*

The size of a bank is commonly used as a control variable in non-interest income literature (e.g. Rogers and Sinkey 1999; DeYoung and Rice 2004; Hahm 2008; Nguyen 2012). Rogers and Sinkey (1999) explain that non-traditional banking activities involve a certain level of specialization on the part of the banks. The authors state that big-sized banks have greater opportunities to employ specialized employees or equipment and exploit the resulting productivity gains, implying a positive link between the size of a bank and the level of the non-interest income. Moreover, large banks operate in a highly competitive environment forcing them to earn low interest margins.[18] Therefore, large financial institutions tend to depend more heavily on non-interest income in order to increase their profits (DeYoung and Rice 2004). The size of a bank is proxied by the logarithm of its assets as in DeYoung and Rice (2004), Hahm (2008), and Nguyen (2012).

(B2) *"Depositors as customers" hypothesis: Deposit-based funding structure enhances Non-II through earning possibilities offered via relationship banking.*

Banks with high level of deposits tend to rely more on activities which involve person-to-person contacts and this is expected to have a positive impact on non-interest income. DeYoung and Rice (2004) explain that banks can profit from this personalized relationship by selling fee-based products to customers who have already visited their branches ("ready customers") and by charging higher prices for these products, taking advantage of the inelastic depositor demand.

(B3) *"Non traditional business model" hypothesis: Banks with alternative sources of funding rely more on Non-II than banks where deposits is the main funding source.*

On the other hand, non-traditional activities usually require less balance-sheet funding (e.g. deposits), implying that banks with low level of deposits and alternative sources

[18] According to DeYoung and Rice (2004) large banks' products are characterized as "financial commodities" which are sold in highly competitive markets.

of funding (e.g. money market) tend to produce more non-interest income (Rogers and Sinkey 1999).

(B4) *"Risk aversion I" hypothesis: A more conservative business model entails diversification of income through increasing fees.*

Rogers and Sinkey (1999) formulate the hypothesis that risk-averse banks engage in non-traditional activities since this reduces their bankruptcy risk through diversification of income sources. Therefore, we expect a positive relation between non-interest income and risk aversion.

(B5) *"Risk aversion II" hypothesis: Banks use Non-II to diversify income and reduce bankruptcy risk.*

The previous hypothesis could also be used to link non-interest income with the risks that bank undertakes.is Given that managers try to reduce bankruptcy risk (and improve bank's market valuation) through the diversification of their income cashflows, a negative link between risk (credit, funding and liquidity risk) and non-interest income is expected.

(B6) *"Pass through" hypothesis: Banks are able to pass their operating costs to customers through non-interest activities.*
If a bank can pass on a portion of its operating costs to their depositors and lenders, then we expect that higher level of operating costs would lead to a higher level of non-interest margins implying a positive relation between operating costs and non-interest income (Claessens et al. 2001).[19]

(B7) *"Efficiency" hypothesis: More efficient banks are able to earn more Non-II.*

DeYoung and Rice (2004) place emphasis on the role of efficiency and the quality of bank management in generating non-interest income. The authors argue that '*ceteris paribus*' an efficient bank management is able to boost fee-based products sales to a

[19] Operating costs have been used as a control variable for the non-interest margins e.g. in Claessens et al. (2001) and Nguyen (2012).

larger percentage of its core costumer base compared to an inefficient bank management, fully taking advantage of its assets (branches, information systems etc), internal processes and personnel expertise. Here, we use the cost-to-income ratio to proxy (in)efficiency (Louzis et al. 2012; Hahm 2008) ; high (low) values of this ratio indicate low (high) levels of efficiency and thus, we expect a negative relation with non interest income.

As regards the relation between profits from traditional activities (as proxied by the NIM) and the non interest income, both signs are possible (Rogers and Sinkey 1999; Nguyen 2012):

(B8) *"Substitutability" hypothesis: Interest and non-interest income are substitutes.*

A negative sign implies that banks are engaged in non-traditional activities in order to counterbalance shrinking interest margins meaning that non-traditional activities are used as substitutes to the traditional ones.

(B9) *"Complementarity" hypothesis (B9): Interest and non-interest income are complements.*

If non-interest income enhances net interest profitability, then non-traditional activities are considered to be supplementary to the traditional ones.

The impact of business cycles and macroeconomic environment on non-interest income has not been extensively studied in the literature. Regarding the impact of inflation on Non-II, both directions of effect could be assumed:

(B10) *"Nominal value dependence" hypothesis: Non-II increases within an inflationary environment.*

Albertazzi and Gambacorta (2009) report a positive link between inflation and non-interest income and give two possible explanations for their findings: (a) fees are correlated with the nominal values of assets under management and, thus, during high

inflation periods non-interest income increases and (b) banks intensify their efforts to earn more non-interest income during periods of high inflation.[20]

(B11) *"Diversification within deflation" hypothesis: Non-II decreases within an inflationary environment.*

Hahm (2008) finds a negative relation between inflation and non-interest income and argues that a high inflation environment may discourage agents to invest in long-term financial assets. Weaker investment demand then leads to less non-interest income via reduced "fees from fund sales, asset-backed securitization, and trading of securities and derivatives" (Hahm 2008, p. 16). In addition, income from fees may increase in an environment of low inflation as banks may strategically chose to focus on their profit opportunities from the non-interest component, to compensate from weaker profitability from traditional business. The latter mechanism is closely related to the "Substitutability" hypothesis (B8) and could be considered as a variant of it.

(B12) *"Non-II procyclicality" hypothesis: Non-II moves in the same direction with economic activity.*

The impact of the phase of business cycle on non interest income can also be ambiguous in its direction. During the boom phase of the business cycle increased economic activity may lead to increased demand for a variety of services (financial transactions, cash management, safe-keeping, investment services etc) boosting up non interest income.[21]

(B13) *"Non-II anticyclicality" hypothesis: Non-II moves in the opposite direction with economic activity.*

The empirical findings of Hahm (2008) support a negative relation between GDP growth and non-interest income. According to the author, a slowdown in the economy creates incentives for banks to diversify their income cashflows and move towards

[20] The authors note that high inflation penalizes lenders.
[21] Nevertheless, Albertazzi and Gambacorta (2009) argue that this kind of services is more likely to be correlated with the trends in the financial markets than with GDP growth and monetary policy.

non-traditional, fee-based activities. Specifically, during recession periods bank lending market becomes highly competitive and banks risk profile is deteriorated due to increased credit risk.[22] Accordingly, banks seek alternative income cashflow streams in order to offset their decreasing interest margins and improve their expected return-risk profile.

3.3. Econometric method

In this section we describe the econometric techniques used in the analysis of the (non) interest income determinants. In particular, Carbo and Rodriguez (2007) argue that current values of bank margins may be affected by its past values and explain that banks need to match the random deposit supply function and the random demand function of lending funds and non-traditional activities across periods. Therefore banks have to use both beginning-of-period and end-of-period information in order to maximize their wealth. Consequently, we adopt a dynamic panel data approach in order to account for the time persistence of the (non) interest income proxies which has also been documented in recent empirical studies (e.g. see Maudos and Solis 2009; Carbo and Rodriguez 2007; Albertazzi and Gambacorta 2009).[23] In general, a dynamic panel data specification is given by:

$$y_{it} = ay_{it-1} + \beta(L)X_{it} + \eta_i + \varepsilon_{it},\ |a| < 1,\ i = 1,\ldots,N,\ t = 1,\ldots,T \qquad (1)$$

where the subscripts *i* and *t* denote the cross sectional and time dimension of the panel sample respectively, y_{it} is the interest and non-interest income proxies, $\beta(L)$ is the $1 \times k$ lag polynomial vector, X_{it} is the $k \times 1$ vector of explanatory (pure spread, bank specific and macroeconomic) variables other than y_{it-1}, η_i are the unobserved individual (bank specific) effects and ε_{it} is the error term.

We apply the *two-step system Generalized Method of Moments* (GMM) estimator, which uses both differences and levels of Eq. (1) in a system, in order to consistently estimate its parameters (Arellano and Bond 1991; Arellano and Bover 1995; Blundell and Bond 1998). The first-differenced Eq. (1), which is written as

[22] See Louzis et al. (2012) for a study of Greek NPLs and business cycles.
[23] In the Appendix we also present Fixed Effects regressions which account for the unobserved heterogeneity of the different banks.

$\Delta y_{it} = a\Delta y_{it-1} + \beta(L)\Delta X_{it} + \Delta\varepsilon_{it}$, eliminates the bank specific effects, but, does not eliminate the estimation bias caused by the inherent correlation between the lagged depended variable, Δy_{it-1} and the error term, $\Delta\varepsilon_{it}$. Nonetheless, y_{it-2}, which is expected to be correlated with Δy_{it-1} and not correlated with $\Delta\varepsilon_{it}$ for $t = 3,...,T$, can be used as an instrument in the estimation of the differenced equation, given that ε_{it} are not serially correlated. This suggests that lags of order two, and more, of the dependent variable satisfy the following moment conditions:

$$E\left[y_{it-s}\Delta\varepsilon_{it}\right] = 0 \text{ for } t = 3,...,T \text{ and } s \geq 2 \tag{3}$$

A second source of bias stems from the possible endogeneity of the explanatory variables and the resulting correlation with the error term. In the case of strictly exogenous variables, all past and future values of the explanatory variable are uncorrelated with the error term, implying the following moment conditions:

$$E\left[X_{it-s}\Delta\varepsilon_{it}\right] = 0 \;\; t = 3,...,T \text{ and for all } s. \tag{4}$$

The assumption of strict exogeneity is restrictive and invalid in the presence of reverse causality i.e. when $E\left[X_{is}\varepsilon_{it}\right] \neq 0$ for $t < s$. For a set of weakly exogenous or predetermined explanatory variables, only current and lagged values of X_{it} are valid instruments and the following moment conditions can be used:

$$E\left[X_{it-s}\Delta\varepsilon_{it}\right] = 0 \;\; t = 3,...,T \text{ and for } s \geq 2. \tag{5}$$

Blundell and Bond (1998) show that there are substantial efficiency gains, especially for small *T*, when the orthogonality assumptions presented in Eqs (3)-(5) are augmented with additional ones based on the levels of Eq. (1). Henceforth, assuming that Δy_{it} and ΔX_{it} are endogenous but uncorrelated with η_i, we can use the following moment conditions for the levels equation:

$$E\left[\Delta Y_{it-1}(\eta_i + \varepsilon_{it})\right] = 0 \;\; t = 3,...,T \tag{6}$$

$$E\left[\Delta X_{it-1}(\eta_i + \varepsilon_{it})\right] = 0 \;\; t = 3,...,T \tag{7}$$

System GMM estimation combines the orthogonality restrictions described in Eqs. (3) – (7) and under a two-step procedure produces consistent parameter estimates.[24] Moreover, we test the overall validity of the instruments by implementing the Sargan specification test, which, under the null hypothesis of valid moment conditions, is asymptotically distributed as chi-square (Arellano and Bond 1991; Arellano and Bover 1995; Blundel and Bond 1998). Furthermore, we assess the fundamental assumption of serially uncorrelated errors, ε_{it}, by testing the hypothesis that $\Delta\varepsilon_{it}$ are not second order autocorrelated. Rejection of the null hypothesis of no second order autocorrelation of the differenced errors implies serial correlation for the level error term and thus inconsistency of the GMM estimates.

4. Empirical results

4.1. The data set

The data set is an unbalanced panel consisting of nineteen (19) Greek banks over the period 2004-2011 on an annual basis. The majority of the variables are obtained from banks balance sheets with the exception of the NPL ratio which is obtained from the supervisory database of Bank of Greece. Table 1 summarizes the definition of the variables, the sign of impact on interest and non interest income according to the theory presented in Section 3 and the descriptive statistics of the variables used in the study along with the number of observations for each of the variables. In addition, Figure 1 presents the evolution of the cross section average for all variables. Overall, almost all interest and non-interest income proxies show a downward trend throughout the period with the exception of Spread2 and Markup proxies. Another striking feature is the sharp increase of credit and market risk, especially after 2008, and the on-going deleveraging of the Greek economy as shown in the diagrams of the logarithm of loans and assets.

[24] The one-step procedure assumes independent and homoscedastic residuals (both cross sectional and over time) and uses a weighting matrix in the estimation procedure which reflects these properties. The two-step procedure uses the estimated residuals from the first step in order to construct a consistent variance-covariance matrix of the moment conditions and use it as a weighting matrix in the estimation procedure. Two-step estimates are likely to be more efficient when we use system GMM estimation (as opposed to the differenced GMM estimation) especially for large samples (Bond 2002).

[Insert **Table 1** about here]

[Insert **Figure 1** about here]

4.2. Interest income determinants

This section presents the empirical results based on the following baseline model for the interest income proxies:

$$INT_{it} = c + aINT_{it-1} + \sum_{k=1}^{K} \beta_k PS_{it}^k + \gamma_1 GDP_t + \gamma_2 Inflation_t + \eta_i + \varepsilon_{it} \quad (8)$$

where INT_{it} is the interest income proxy (NII or alternative measures), PS_{it}^k are the "pure spreads" determinants of interest income as proposed in the theoretical model of Maudos and Solis (2009), while the equation is augmented by introducing two macroeconomic variables, the GDP growth and the inflation rate.[25] In order to account for the endogeneity of the bank-specific variables, which is caused by the reverse causality between the bank-specific and the dependent variables, we instrument all *PS* determinants according to Eq. (5), while the macroeconomic variables are considered strictly exogenous and are instrumented according to Eq. (4). Moreover, the number of cross section units (banks) poses limitations on the number of instruments which can be used in the estimation of Eq. (8). In particular, when the number of instruments is greater or equal to the number of cross sectional units, then both standard errors and Sagan test can be downward biased. To circumvent this issue we use a "restricted" GMM approach (Judson and Owen 1999), where by only a limited number of lags of the explanatory variables in Eq. (4) is used as instruments. In addition, we reduce the need for extra instruments by controlling for the number of explanatory variables used in addition to the baseline model of Eq. (8). In particular, we add just one of the other bank-specific determinants (i.e. implicit interest payments, liquidity risk, efficiency and banking specialization variables) at a time in order to test the corresponding hypothesis, ensuring that the total number of instruments does not exceed the number of cross sectional units. Therefore, the extended model becomes:

[25] According to Maudos and Solis (2009) "pure spread" determinants for the interest income proxies are market power (Lerner index), operating costs, risk aversion, interest rate risk, credit risk, interaction between market and credit risk, transaction size and non-interest income.

$$INT_{it} = c + aINT_{it-1} + \sum_{k=1}^{K} \beta_k PS_{it}^{k} + \delta X_{it} + \gamma_1 GDP_t + \gamma_2 Inflation_t + \eta_i + \varepsilon_{it} \quad (9)$$

where X = *implicit interest payments*, *liquidity risk*, *efficiency*, *loans-to-assets*, *deposits-to-assets* and *other earning assets to assets*.

We use the contemporaneous values for all pure spread and bank specific variables with the exception of the credit risk measure (i.e. NPLs), which is expected to have an impact on interest income with one year lag (see also Carbo and Fernandez 2007). For the macroeconomic determinants we follow a *general-to-specific* exercise using up to one lag for each of the macro indicators, i.e. the models are estimated using GDP_{t-i} and $Inflation_{t-i}$ with $i \in [0,1]$, which results in retaining the contemporaneous values for both of them.

The empirical results for the dynamic specifications of Eqs (7) and (8) and the net interest margin (NIM) as dependent variable are presented in Table 3 along with the Sargan and the AR(2) test for the second order autocorrelation. In the first column of the Table, we present the empirical results for the baseline model, while in columns (1) - (6) we present the results for the models with the bank-specific variables. A first point to note is that the lagged dependent variable is positive and statistically significant across the various specifications (the only exception is the model in column 6), indicating that net-interest margin is positively related with its past values. The autoregressive coefficient ranges from 0.21 to 0.34 implying non-negligible persistence for the net interest margin and justifying the choice for the dynamic structure of the model. Next, we comment on the control variables that are statistically significant across the different models presented in Table 3. In addition, the results of our hypothesis testing for the NIM are summarized in Table 3.

[Insert **Table 3** about here]

[Insert **Table 3** about here]

The Lerner Index, which measures banks' market power, is positively related to the net-interest margin, as expected, and it is highly significant for the majority of the models estimated in the study. These results indicate that banks with greater market

power can charge higher interest margins in the Greek banking system, providing empirical support to the "Market power" hypothesis. In particular, if the market power of a bank increases by 100 basis points (b.p.) in terms of the Lerner index, then we expect an increase by 4.2 b.p. for the net interest margin given the estimates in the baseline model. In general, the estimated coefficient of the Lerner index is on average 0.037, across the various specifications, and it is very close to the estimates reported in Maudos and Fernandez de Guevara (2004) for the banking sector in European Union, which range from 0.031 to 0.034.[26]

The coefficient for the operating costs variable is also positive and statistically significant for all specifications presented in Table 3. The results, which are in accordance with several previous studies (e.g. see Dermiguc-Kunt and Huizigna 1999; Maudos and Fernandez de Guevara 2004; Maudos and Solis 2009; Nguyen 2012) point out that Greek banks can pass on a percentage of their operating costs to depositors and lenders (Dermiguc-Kunt and Huizigna 1999). Specifically, the average estimated coefficient of the operating costs across the different specifications is 0.59, which according to Dermiguc-Kunt and Huizigna (1999) implies that Greek banks can pass on the 60% of their operating costs to their depositors and lenders. The findings are also in line with theoretical models of Maudos and Fernandez de Guevara (2004) and Maudos and Solis (2009), which predict that banks with higher operating costs operate with wider interest margins.

Non-interest income is another pure spread variable for which the empirical evidence suggests that it has a statistically significant and negative effect on net interest margin. As in Maudos and Solis (2009) the results indicate that an increase (decrease) in income from non-traditional activities leads to a decrease (increase) in net interest income implying that the two income sources are substitutes rather than complements. These findings support the idea that Greek banks which are engaged in non-traditional activities, and subsequently have more diversified streams of income, tend to operate with narrower interest margins. This finding can be interpreted as a strategic choice by banks to diversify their income sources (Köhler 2013). In addition, the pricing of non-traditional activities (e.g. securities underwriting) may have an impact on the pricing lending activities due to cross-subsidization strategy followed by the banks e.g. increase non-interest revenue streams and simultaneously be more

[26] Maudos and Fernandez (2007) use data from Germany, France, United Kingdom, Italy and Spain spanning the period from 1993 to 2000.

price-competitive on the loan products (Carbo and Rodriguez 2007; Lepetit et al. 2008).

As regards the macroeconomic determinants, it turns out that there is evidence of a positive relationship between inflation and net interest margin. Given that the Greek economy during the examined period (even after the sovereign debt crisis broke out) was characterized by relatively high, compared to the Eurozone average, rates of inflation (Pelagidis and Moutsopoulos 2011), it seems that banks were able to price in future inflation in their contracts (or adjust existing contracts to inflation developments). Moreover, the coefficient of GDP growth is positive, as expected, illustrating the procyclicality of net interest income.

Regarding the remaining bank-specific variables, the liquidity risk proxy is the only variable for which a statistically significant relationship is detected. The positive coefficient is expected as it reflects the opportunity cost faced by banks when they hold liquid reserves.

In Table 4, the estimations using alternative interest income margins are presented. In particular, we estimate the same core equations (i.e. containing the "pure spreads" determinants) as before employing alternative left-hand side variables. Specifically,[27] we investigate the results using two spread variables ("Spread 1" and "Spread2"), which differ with regard to the definition of the cost of funds (cost of deposits and 3 month Euribor, respectively), a "Markup" metric (over marginal cost), and gross income. The alternative estimation are done for two reasons: i) to investigate the robustness of our previous conclusions; and ii) to dig deeper into the underlying mechanisms of effects from the explanatory variables to the NII, and, specifically, to investigate whether the previously identified statistically significant relationships between the NII and different explanatory variables work mainly through volumes or prices.

As it is expected, the coefficient of the autoregressive term varies substantially among these alternative profit measures, reflecting different degrees of persistence. The Spread1 measure is the more persistent, higher than in the case of the net interest margin, implying that banks are able to adjust their volumes of lending and borrowing more swiftly compared to the adjustment of the corresponding rates.

[27] All variables are defined in Table 1.

The Lerner index remains statistically significant for the markup and gross measures of income but not for the two spreads. These results may be interpreted as showing that market power enhances profitability primarily by allowing banks to optimize their asset and funding structure rather than through higher interest spreads. Similarly, the effect of operating costs is statistically significant for the gross income but not for the spreads and the markup measure, which can again be interpreted as an effect of efficiency reflected mostly in asset allocation and funding structure.

[Insert **Table 4** about here]

Additionally, it is intuitive that inflation remains statistically significant for the spread measure which relates lending rate and funding cost, consistently with the above-mentioned explanation of banks being able to price and re-price their contracts while factoring in inflation expectations and evolution, respectively.[28]

4.3. Non-interest income determinants

In this section, we investigate the determinants of the Non-II and its components, i.e. net income of fees and commissions and other non-interest income, based on the following specification:

$$NII_{it} = c + aNII_{it-1} + \sum_{k=1}^{K} \beta_k X_{it}^{k} + \gamma_1 GDP_t + \gamma_2 Inflation_t + \eta_i + \varepsilon_{it} \quad (10)$$

where *NII* is the *total non-interest income*, *fees* and *other non-interest income* as defined in Table 1 and X^k are the bank specific determinants presented in Section 3.2. Regarding banks risks we include interest rate, credit and liquidity risk as well as the *equity-to-assets* ratio, which is used as a measure of bank risk because it quantifies the ability of bank to shield against insolvency using its own capital to absorb losses (Rogers and Sinkey 1999). Eq. (10) also includes real GDP growth and inflation rate as explanatory variables in order to control for the impact of macroeconomic

[28] Finally, it is noted that the coefficients for the Non-II margin are statistically significant and positive for both the "Markup" and "Gross" metrics but this does not contradict the results of Table 3, given that both of these alternative profit metrics contain the non-interest income by their construction.

environment on non-interest income. Again, we use the contemporaneous values of all bank specific variables, while the *general-to-specific* approach for the macroeconomic variables leads to the use of the contemporaneous and lagged values for Inflation and GDP growth respectively. Moreover, we use lagged values of bank-specific variables as instruments while macroeconomic variables are considered strictly exogenous and are instrumented accordingly (see the discussion in Section 4.3).[29]

Table 6 presents the empirical results for the determinants of non-interest income and its sub-components. In the first two columns the dependent variable is the non-interest income, and the equations differ only inasmuch as the inclusion of NIM as a dependent variable is concerned. The next two columns present the estimations for the fees and commissions income and the remaining part of the non-interest income (trading income or one-off business actions e.g. selling participations), respectively. The Sargan and the AR(2) test for the residuals presented at the bottom of the Table 6 reveal the validity of the instruments used and the rejection of the hypothesis of second order autocorrelation for the error terms. In addition, the results of our hypothesis testing for the Non-II are summarized in Table 6.

[Insert **Table 6** about here]

[Insert **Table 6** about here]

The autoregressive coefficient for the lagged dependent variable is positive and highly significant for the total non-interest income and the fees and commissions income. Therefore, we show that Non-II exhibits higher time persistence compared to the NII, since the autoregressive coefficient is estimated to be approximately equal to 0.41. This result is driven by the "Fees" component of Non-II which is characterized by very high persistence, equal to 0.78, while, on the contrary, the "Other Non-II" component has a low and not statistically significant persistence coefficient, reflecting the volatility of trading income and the one-off character of actions such as selling participations. In fact, the median value of the share of the "Fees" income in the total Non-II within our sample is 0.63, therefore, the behaviour of Non-II is dominated by

[29] A "restricted" GMM approach is also followed for the estimation of the model (see discussion in Section 4.2)

the behaviour of the "Fees" component. The results are similar to the findings of Albertazzi and Gambacorta (2009) who report strong persistence for the non-interest income, using a sample from Euro area and U.S. banks. This result also implies that Greek banks are able to smooth their total income streams by expanding their sources of revenue beyond interest income.

The most striking feature of Table 6 is the results for the (in)efficiency index, which show a negative and statistically significant relation with total non-interest income and its components. In other words, more efficient banks, i.e. banks with low *cost-to-income* ratio, tend to produce more non-interest income, both in the form of fees and commissions or in the form of other non-interest income. This finding is in alignment with the argument of DeYoung and Rice (2004) that an efficient bank management can fully exploit its core customer base and, hence, it is able to expand the sales of its fee-based products. It also seems that efficient banks are able to earn a larger portion of income through non-interest sources. Interestingly, the coefficient for efficiency is not statistically significant for the interest income. Therefore, efficiency is primarily reflected in the non-interest component of income.

The banks' liability structure is also found to have an impact on non-interest income. In particular, the results in Table 6 give evidence of a positive relationship between a funding structure based more on deposits and the total (other) non-interest income at a 10% significance level. These findings align with DeYoung and Rice (2004) notion that a relatively broad deposit base facilitates personal relations with depositors, which in turn can also enhance the sales of non-lending bank products. Anecdotal evidence is consistent with the idea that in the Greek economy personal relationships play an important role, given a relatively low level of financial sophistication on the part of households and SMEs.

In addition, risk aversion (as proxied by the leverage ratio) is found to be positively associated with increasing revenues from fees. This is also consistent with the notion that a more conservative business model entails diversification of income through increasing fees. Regarding the impact of macroeconomic environment on non-interest income, the results show that, overall, during high inflation periods the Non-II shrinks. In addition, the Non-II increases during the boom phase of the business cycle due to stronger demand for loans. For both macroeconomic variables there is a statistical significant relation at a 10% for two out of the four specifications. Therefore, empirical evidence for the "Diversification within deflation" hypothesis is

offered, which is very much consistent with the hypothesis of NII and Non-II being substitutes, for which we have already found empirical support. Moreover, the positive impact of economic growth on non-interest income implies a non-interest income procyclicality.

Interestingly, the size variable turns out to be statistically insignificant across models, therefore there is no empirical evidence supporting the "sophistication" hypothesis for the Greek banking system. On the contrary, the sign of the coefficient is negative across model (although statistically insignificant). This result reflects the traditional character of the larger and older Greek banks and the fact that the new and smaller players in the industry have expanded relatively more in non-traditional business.

Finally, it is worth noting that, in general, the above mentioned results are also confirmed by the Fixed Effects regressions presented in Table A.3 in the Appendix. Nonetheless, due to high persistence of the dependent variable, at least for the *Nonii* and *Fees*, our empirical analysis is based on the results obtained with the dynamic model.

5. Conclusions

The parallel empirical investigation of the determinants for net interest income and non-interest income provide us with a motivation to think deeper about the interaction of these two income components, in contrast to the usual tendency of examining the revenue sources separately. Conjectures regarding the interrelation between these income sources derived from this study could be further pursued both in theoretical and empirical work.

In the first place, the empirical evidence shows that in the Greek banking system interest- and non-interest income are substitutes rather than complements. It can also be inferred that non-interest income is used as a strategic instrument from more efficient banks to maximize their revenues, compared to less efficient ones, rather than competing with their peers directly on the prices of loans and deposits. Therefore, it is not straightforward that an increase in competition will erode banks' profits or that an increase in efficiency will lower margins. It would be interesting to examine if this result holds for other jurisdictions as well.

In addition, our results provide empirical evidence that non-interest income may be used for diversification, aiming to smooth profits. First, it is found that non-interest income exhibits a higher degree of persistence, thus providing a buffer for adverse external shocks. In addition, the coefficient of inflation on non-interest income has the opposite sign (negative) compared to net interest income, therefore non-interest income may be suitable for "hedging" against adverse macroeconomic developments.

Further decomposing non-interest income, e.g. into fees and trading income would be especially relevant since these sub-components are expected to exhibit different type of behavior and their underlying determinants may differ.

Overall, it can be argued that the conception of the bank as a multi-output firm seems to be a preferable way of analyzing the financial system allowing for much richer strategic behavior and possible explanations for observed patterns which cannot be dealt with satisfactorily in a single-output framework.

Table 1: Definition of variables, sign of impact on Nim and Nonii and descriptive statistics (in %)

		Expected sign							
Name	Definition	Interest margins	Non interest margins	Mean	Median	Max	Min	St.dev.	Obs.
Lerner index		(+)	(+)	21,07	19,36	78,12	-40,12	16,97	145
Operating costs	Total operating expenses [(1)] / Total Assets	(+)	(+)	2,29	2,05	13,59	0,68	1,33	144
Risk aversion	Total Equity / Total Assets	(+)		9,53	6,86	80,93	-16,95	10,96	145
Credit risk	Non-performing loans / Gross Loans	(+)	(?)	8,01	6,65	35,37	0,00	6,11	139
	Impairment losses / Gross loans		(?)	2,75	0,93	38,88	0,00	5,37	138
Funding risk	(Funding cost [(2)] – 3 month Euribor)	(+)	(?)	1,60	1,12	10,73	-2,37	2,27	145
Liquidity risk	Liquid reserves (Cash and Balances with central banks) / Total Assets	(+)	(?)	2,63	2,36	10,15	0,00	1,67	145
	Loans / Total Assets		(?)	65,75	68,55	92,78	18,73	13,99	144
Interaction credit - market risk	(Impairment losses / Gross loans) × 3 month Euribor volatility [(3)]			38,68	11,93	573,49	0,00	79,98	138
Transaction size	Logarithm of Loans	(+)		15,05	14,92	17,88	10,57	1,81	145
Size	Logarithm of Assets		(+)	5,73	1,44	29,76	0,05	7,39	157
Efficiency	Total Operating Expenses / Total Operating Income [(4)]	(-)	(-)	75,40	68,22	667,13	17,16	58,96	144
Liability structure	Deposits / Total Assets		(?)	64,18	65,29	95,21	15,63	16,70	145
	Deposits / Loans		(?)	103,09	97,71	453,87	25,36	45,58	145
Other Earning Assets	(Total assets – Loans) / Total Assets	(-)		34,46	31,49	81,27	7,22	14,17	145

Table 2:(continued)

Implicit interest payments	(Operating expenses – Total non interest income) / Total assets			1,12	1,32	13,59	-11,72	2,26	144
Net interest margin (Nim)	(Interest income – Interest expenses) / average(Total Assets)		(-)	2,36	2,37	6,32	0,24	0,77	143
Spread1	(Lending rate [5] – Funding cost)								
Spread2	(Lending rate – 3 month Euribor)								
Markup	Price [6] – marginal cost			1,45	1,09	18,71	-12,22	2,66	145
Gross	(Net interest income + Total non interest income) / average((Total Assets)			3,39	3,13	13,88	0,31	1,83	145
Non interest income (Nonii)	Total non interest income / average(Total Assets)	(-)		1,31	0,82	15,69	-0,46	2,24	145
Fees	(Fees and commission income – Fees and commission expenses) / average(Total Assets)	(-)		0,88	0,50	14,13	0,00	1,65	145
Other non interest income	(Dividend income + net trading income + other operating income) / average(Total Assets)			0,43	0,22	11,97	-1,54	1,15	144
GDP	Growth rate of constant prices 2005 GDP	(?)	(?)	0,04	1,03	5,51	-7,10	4,37	
Inflation	Growth rate of harmonized consumer price index (HCPI)	(?)	(?)	3,28	3,22	4,70	1,35	0,93	

Notes:

(1) Total operating expenses = Staff costs + Administrative expenses + Depreciations and amortization expenses + Other expenses.
(2) Funding cost = Interest expenses / Deposits.
(3) 3 month Euribor volatility is estimated as the annualized standard deviation using weekly data.
(4) Total operating income = Net interest income + Total non interest income.
(5) Lending rate = Interest income / Loans
(6) Bank revenues (financial and other operating ones) / Total assets

Table 3: Bank-specific and macroeconomic determinants of the net interest margin (NIM) using Dynamic Panel Data

	Baseline	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-5.106	0.184	-0.050	-0.001	0.005	0.009	-1.844
	(-0.848)	(0.616)	(0.102)	(0.956)	(0.836)	(0.582)	(0.733)
NIM(-1)	0.248*	0.218*	0.213*	0.338***	0.322*	0.284*	0.403
	(1.660)	(1.670)	(1.960)	(4.610)	(1.840)	(1.720)	(1.330)
Lerner index	0.042***	0.035***	0.050***	0.032**	0.033***	0.041***	0.032*
	(3.630)	(3.070)	(3.440)	(2.220)	(4.370)	(3.280)	(1.930)
Operating Costs / Total assets	0.688**	0.498*	0.569***	0.547***	0.602**	0.682**	0.602*
	(2.300)	(1.850)	(4.730)	(3.580)	(2.220)	(2.220)	(1.690)
Equity / Total assets	-0.022	-0.043	-0.029	-0.019	-0.024	-0.041	-0.022
	(-0.410)	(-0.884)	(-1.230)	(-0.561)	(-0.648)	(-1.440)	(-1.110)
Interest rate risk	0.002	0.087	0.024	0.066	0.084	0.067	0.066
	(0.020)	(0.422)	(1.380)	(0.651)	(0.911)	(0.455)	(0.505)
NPLs(-1)	-0.029	-0.014	-0.015	-0.018	-0.002	-0.033	-0.032
	(-0.916)	(-0.509)	(-2.190)	(-0.740)	(-0.050)	(-0.790)	(-0.739)
Impairement loss*3m Euribor volatility	0.001	0.000	0.000	0.000	-0.001	-0.001	0.000
	(0.433)	(-0.172)	(-0.270)	(0.300)	(-0.393)	(-0.310)	(0.432)
log(Loans)	0.322	0.147	0.052	0.061	0.065	0.001	0.065
	(0.885)	(0.311)	(1.190)	(0.184)	(0.193)	(0.004)	(0.192)
Non-interest income	-0.249***	-0.083	-0.195*	-0.088***	-0.188*	-0.199	-
	(-2.700)	(-0.353)	(-1.810)	(-3.524)	(-1.780)	(-1.430)	
Implicit interest rate	-	0.184	-	-	-	-	-
		(0.539)					
Liquidity risk	-	-	-0.050	-	-	-	-
			(-1.650)				
Efiiciency	-	-	-	-0.001	-	-	-
				(0.956)			
Deposits / Assets	-	-	-	-	0.005	-	-
					(0.836)		

Table 2: (continued)

Loans / Assets	-	-	-	-	-	0.009	-
						(0.582)	
Other Earning Assets / Assets	-	-	-	-	-	-	0.007
							(0.756)
HCPI	0.052*	0.042	0.030	0.064**	0.040	0.043	0.089**
	(1.660)	(1.510)	(1.090)	(1.990)	(1.510)	(0.991)	(2.890)
GDP	0.054*	0.070	0.068*	0.037*	0.047**	0.045*	0.028
	(1.800)	(1.430)	(1.920)	(1.810)	(2.030)	(1.760)	(0.312)
No of observations	118	118	118	118	118	118	118
Sargan test	10.1	9.798	5.232	5.165	7.206	8.23	7.615
[p-value]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]
AR(2) test	-0.03261	-0.1904	-0.656	0.2069	-0.2716	0.2462	0.06736
[p-value]	[0.974]	[0.849]	[0.512]	[0.836]	[0.786]	[0.806]	[0.946]

Notes

The table reports the two-step System GMM estimation results. Robust t-statistics are reported in parenthesis. The standard errors are computed using the finite-sample correction of Windmeijer (2005). *,** and *** indicate statistical significance at 10%, 5% and 1% respectively.

Table 4: Hypothesis-testing for the net interest income – synopsis of results

Hypothesis	Variable(s)	Sign	Rationale	Empirical result
A1. "Market power"	Market power	(+)	Absence of perfect competition in the credit market	√
A2. "Risk aversion"	Equity-to-assets	(+)	Higher bank margins compensation higher risk aversion from banks' management	X
A3. "Credit risk"	NPLs,	(+)	Higher credit risk leads the bank to charge higher margins	X
A4. "Funding risk"	Spread over euribor	(+)	Higher funding risk leads the bank to charge higher margins	X
A5. "Risk interactions"	Credit risk * Funding risk	(+)	Interaction of credit with funding risk amplifies non-linearly banks' margins	X
A6. "Size effect"	Loans	(+)	Size of transactions increases the risk and margins	X
A7. "Operations costs"	Operating cost	(-)	Operating costs erode banks' margins	√
A8. "Substitutability" hypothesis	Non-interest income / Assets	(-)	Non-interest income is used to diversify profits	√
A9. "Complementarity" hypothesis	Non-interest income / Assets	(+)	Non-interest income	X
A10. "Efficiency" hypothesis	Cost-to-income-ratio	(-)	Efficient management leads to higher NIM	X
A11. "Traditional business model" hypothesis	Deposits/Assets Loans/Assets	(-)	Traditional banks could be more competitive as regards their prices	X
A12."NIM procyclicality" hypothesis	GDP growth	(+)	Profits from interest margins are higher during booms	√
A13. "NIM nominal pass-through" hypothesis	Inflation	(+)	Banks are able to pass the costs of inflation to their clients	√

Table 5: Bank-specific and macroeconomic determinants of alternative interest income margins.

	Spread1	Spread2	Markup	Gross
Constant	8.016	-11.858	-2.433	-0.257
	(0.223)	(0.411)	(0.706)	(0.973)
Dependent variable(-1)	0.697***	0.203	0.090	0.047
	(3.150)	(0.652)	(0.649)	(0.319)
Lerner index	0.010	-0.016	0.046***	0.038**
	(0.368)	(-0.223)	(3.670)	(2.370)
Operating Costs / Total assets	-0.209	0.487	0.149	0.920***
	(-0.414)	(0.590)	(0.488)	(4.480)
Equity / Total assets	-0.138**	0.046	-0.025	-0.030
	(-2.410)	(0.292)	(-0.545)	(-0.541)
Interest rate risk	0.730**	0.207	0.021	0.066
	(2.170)	(0.343)	(0.184)	(0.410)
NPLs(-1)	0.118	-0.144	-0.030	-0.032
	(0.706)	(-0.983)	(-0.541)	(-1.040)
Impairement loss*3m Euribor volatility	-0.004	0.002	0.001	0.001
	(-1.290)	(0.284)	(0.537)	(0.255)
log(Loans)	-0.549	0.993	0.138	0.006
	(-1.210)	(1.060)	(0.325)	(0.013)
Non-interest income	0.270	-0.103	0.586***	0.539***
	(1.18)	(-0.212)	(2.750)	(2.650)
HCPI	0.180*	0.002	0.032	0.048
	(1.770)	(0.017)	(0.549)	(1.030)
GDP	0.179*	-0.095	0.027	0.021
	(1.850)	(-1.040)	(0.675)	(0.631)
No of observations	119	119	119	119
Sargan test	6.073	13.94	7.624	8.342
[p-values]	[1.000]	[1.000]	[1.000]	[1.000]
AR(2) test	-0.2453	-1.105	-1.086	0.059
[p-values]	[0.806]	[0.269]	[0.277]	[0.953]

Notes

The table reports the two-step System GMM estimation results. Robust t-statistics are reported in parenthesis. The standard errors are computed using the finite-sample correction of Windmeijer (2005). *,** and *** indicate statistical significance at 10%, 5% and 1% respectively. For the definition of Spread1, Spread2, Markup and Gross see Table 1.

Table 6: Bank-specific and macroeconomic determinants of non interest income (Non-II) margins.

	Non-II	Non-II	Fees	Other Non-II
Constant	6.190	15.588	4.844	3.114
	(0.607)	(0.956)	(1.540)	0.432)
Dependent variable (-1)	0.410***	0.407**	0.776**	0.166
	(2.680)	(2.600)	(2.420)	(1.480)
Size	-0.482	-1.034	-0.306	-0.190
	(-0.751)	(-1.000)	(-1.390)	(-0.460)
Deposits	0.023	0.029*	0.005	0.014*
	(1.430)	(1.770)	(0.547)	(1.750)
Risk aversion	-0.001	-0.084	-0.032*	-0.014
	(-0.009)	(-0.514)	(-1.880)	(-0.113)
Market risk	0.278	0.353	0.044	0.183
	(1.050)	(1.010)	(0.302)	(1.030)
Credit risk	0.003	-0.036	-0.006	-0.015
	(0.091)	(-0.384)	(-0.514)	(-0.219)
Liquidity risk	0.265	1.101	0.163	-0.020
	(0.594)	(1.280)	(0.860)	(-0.105)
Operating expenses	0.082	0.022	-0.101	0.654
	(0.141)	(0.020)	(-0.149)	(1.640)
Efficiency	-0.016*	-0.027*	-0.009*	-0.016***
	(-1.770)	(-1.930)	(-1.690)	(-3.210)
NIM		-0.482*	-0.043	-0.547
		(-1.731)	(-0.072)	(-1.050)
HCPI	-0.085*	-0.173	0.047	-0.077*
	(-1.790)	(-1.310)	(0.938)	(-1.680)
GDP(-1)	0.063*	0.019*	-0.005	0.048
	(1.710)	(1.662)	(-0.179)	(1.180)
No of observations	122	122	122	121
Sargan test	5.335	4.306	1.518	4.444
[p-value]	[1.000]	[1.000]	[1.000]	[1.000]
AR(2) test	-0.8065	-1.009	-0.9892	1.128
[p-value]	[0.376]	[0.313]	[0.323]	[0.259]

Notes

The table reports the two-step System GMM estimation results. Robust t-statistics are reported in parenthesis. The standard errors are computed using the finite-sample correction of Windmeijer (2005). *,** and *** indicate statistical significance at 10%, 5% and 1% respectively. For the definitions of Nonii, Fees and Other nonii see Table 1.

Table 7: Hypothesis-testing for the non-interest income – synopsis of results

Hypothesis	Variable(s)	Sign	Rationale	Empirical result
B1. "Sophistication" hypothesis	Assets (logarithm)	(+)	Large and sophisticated banks rely more on Non-II	X
B2. "Depositors as customers" hypothesis	Deposits/Assets	(+)	Banks relying on deposits can use close relationship with their clients to enhance Non-II	√
B3. "Non-traditional business model" hypothesis	Deposits/Assets	(-)	Non-traditional activities usually require less balance-sheet funding	X
B4. "Risk aversion I" hypothesis	Equity/Assets	(+)	A more conservative business model entails diversification of income through increasing fees.	√
B5. "Risk aversion II" hypothesis	Credit risk Funding risk Liquidity risk	(-)	Banks try to reduce bankruptcy risk through the diversification of their profits.	X
B6. "Pass through" hypothesis	Operating cost	(+)	Banks pass their operating costs to their clients through non-interest charges.	X
B7. "Efficiency hypothesis"	Cost-to-income-ratio	(+)	An efficient bank management is able to boost fee-based products sales.	√
B8. "Substitutability" hypothesis	Non-interest income	(-)	Banks are engaged in non-traditional activities in order to counterbalance shrinking interest margins.	X
B9. "Complementarity" hypothesis	Non-interest income	(+)	Non-interest income enhances net interest profitability.	X
B10. "Nominal value dependence" hypothesis	Inflation	(+)	fees are related to the nominal values of assets	X
B11. "Diversification within deflation" hypothesis	Inflation	(-)	Banks increase fees within a deflationary environment	√
B12. "Non-II procyclicality" hypothesis	GDP growth	(+)	Macroeconomic activity enhances non-interest profitability through strong demand.	√
B13. "Non-II anticyclicality" hypothesis	GDP growth	(-)	Slowdown in economic activity pushes banks towards fee-based activities	X

Table A.1 Bank-specific and macroeconomic determinants of Net interest margin (NIM) using Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	4.438	4.565	4.439	4.099	4.279	6.463	6.463
	(1.220)	(1.260)	(1.230)	(0.947)	(1.120)	(1.820)	(1.820)
Lerner index	0.037***	0.038***	0.037***	0.039***	0.037***	0.037***	0.022***
	(9.590)	(10.200)	(9.300)	(3.880)	(9.500)	(9.250)	(3.370)
Operating Costs / Total assets	0.613***	0.507***	0.613***	0.614***	0.586***	0.526***	0.410***
	(7.610)	(4.650)	(7.680)	(7.610)	(7.980)	(5.870)	(2.870)
Equity / Total assets	-0.032***	-0.032***	-0.032***	-0.032***	-0.030***	-0.037***	-0.037**
	(-4.580)	(-4.580)	(-4.560)	(-4.540)	(-3.300)	(-5.500)	(-2.110)
Interest rate risk	0.047	0.054	0.046	0.050	0.060	0.068*	0.058
	(1.310)	(1.500)	(1.250)	(1.330)	(1.260)	(1.930)	(1.350)
NPLs(-1)	-0.034***	-0.037***	-0.034***	-0.034***	-0.034***	-0.034***	-0.024**
	(-3.280)	(-2.970)	(-3.290)	(-3.350)	(-3.300)	(-3.380)	(-2.460)
Impairement loss*3m Euribor volatility	0.000	0.000	0.000	0.000	0.000	0.000	-0.001
	(0.159)	(0.075)	(0.168)	(0.163)	(0.150)	(-0.793)	(-1.010)
log(Loans)	-0.194	-0.202	-0.193	-0.180	-0.199	-0.338*	-0.320
	(-0.985)	(-1.030)	(-0.982)	(-0.803)	(-1.010)	(-1.700)	(-1.430)
Non-interest income	-0.204***	-0.119**	-0.204***	-0.206***	-0.206***	-0.190***	
	(-6.77)	(-2.440)	(-6.840)	(-6.600)	(-7.360)	(-6.050)	
Implicit interest rate		0.117*					
		(1.840)					
Liquidity risk			-0.008				
			(-0.471)				
Efiiciency				0.001			
				(0.227)			
Deposits / Assets					0.004		
					(0.544)		
Loans / Assets						0.012*	
						(1.750)	

Table A.1 (continued)

Other Erning Assets / Assets							8.626*
							(1.980)
HCPI	0.048***	0.050***	0.049***	0.050***	0.051***	0.044***	0.044**
	(3.290)	(3.390)	(3.260)	(4.520)	(3.220)	(3.150)	(2.540)
GDP	0.065***	0.065***	0.065***	0.067***	0.065***	0.065***	0.050***
	(5.870)	(5.890)	(5.890)	(4.730)	(5.890)	(5.860)	(4.510)
No of observations	120	120	120	120	120	120	120
R-square	0.877	0.879	0.877	0.877	0.878	0.881	0.793

Notes
The table reports the fixed effects estimation results. t-statistics are reported in parenthesis and are computed with robust standard errors. *,** and *** indicate statistical significance at 10%, 5% and 1% respectively.

Table A.2 Bank-specific and macroeconomic determinants of alternative interest income margins using Fixed Effects

	Spread1	Spread2	Markup	Gross
Constant	13.931	11.317	-0.823	2.525
	(0.227)	(0.152)	(0.868)	(0.560)
Lerner index	0.060***	0.029***	0.041***	0.044***
	(6.480)	(2.730)	(4.870)	(6.630)
Operating Costs / Total assets	1.364***	0.988***	-0.001	0.842***
	(4.170)	(5.680)	(-0.008)	(7.940)
Equity / Total assets	-0.137***	-0.120***	-0.061***	-0.024**
	(-6.090)	(-4.760)	(-4.590)	(-2.430)
Interest rate risk	-0.087	0.768***	0.187**	0.137***
	(-0.942)	(5.210)	(2.070)	(2.730)
NPLs(-1)	-0.043	-0.120***	-0.061	-0.060*
	(-1.100)	(-2.910)	(-1.310)	(-1.700)
Impairement loss*3m Euribor volatility	-0.008***	-0.007***	0.000	0.000
	(-8.140)	(-4.940)	(-0.469)	(0.816)
log(Loans)	-0.631	-0.392	0.058	-0.120
	(-1.020)	(-0.916)	(0.222)	(-0.534)
Non-interest income	-0.043	0.003	0.804***	0.509***
	(-0.561)	(0.068)	(16.800)	(30.600)
HCPI	-0.101**	-0.027	0.117*	0.075*
	(-2.090)	(-0.799)	(1.860)	(1.860)
GDP	-0.064	-0.120	0.021	0.037**
	(-1.610)	(-1.650)	(0.949)	(2.570)
No of observations	120	120	120	120
R-square	0.794	0.874	0.961	0.966

Notes

The table reports the fixed effects estimation results. t-statistics are reported in parenthesis and are computed with robust standard errors. *,** and *** indicate statistical significance at 10%, 5% and 1% respectively. For the definition of Spread1, Spread2, Markup and Gross see Table 1.

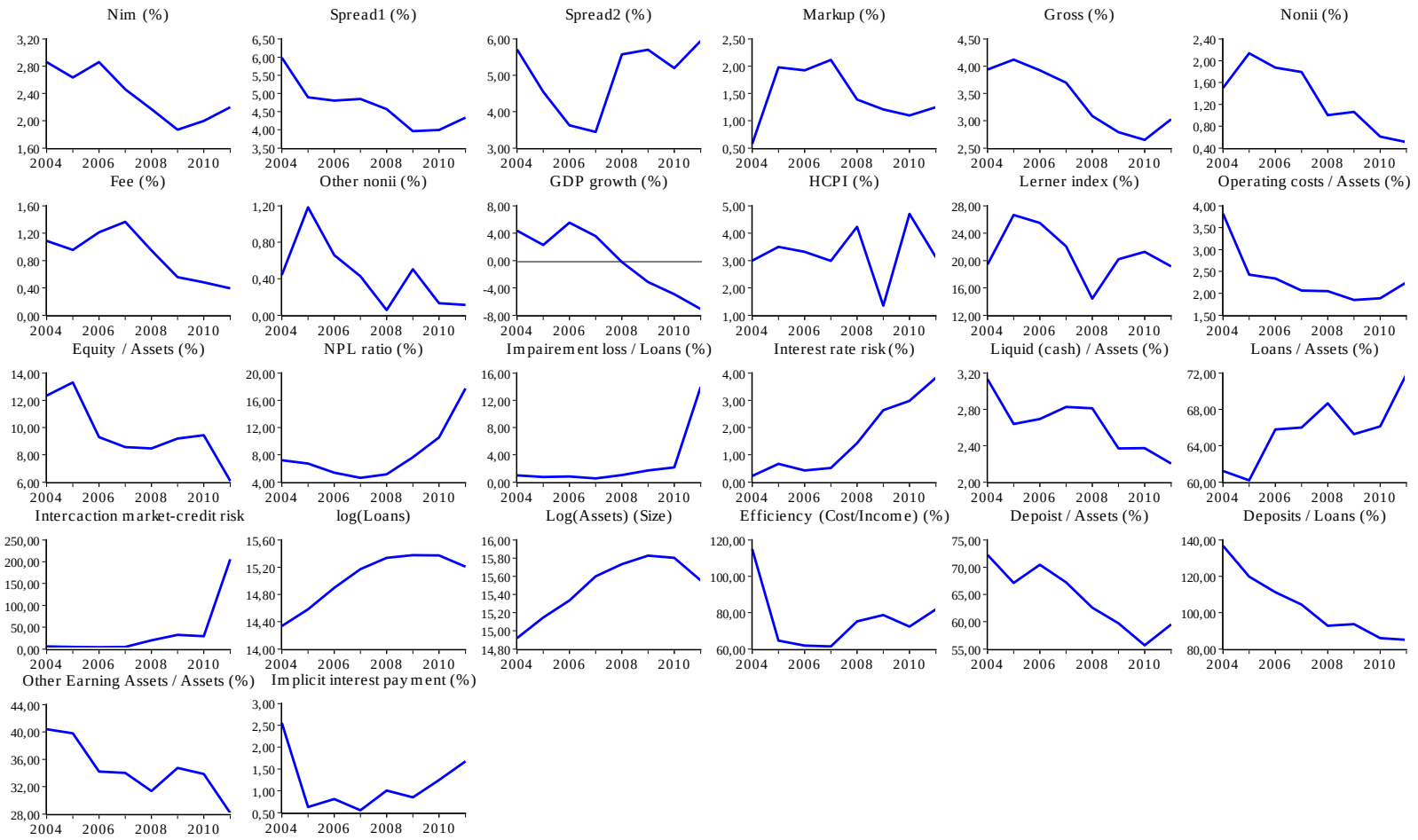
Table A.3 Bank-specific and macroeconomic determinants of non interest income margins using Fixed Effects

	Non-II	Non-II	Fees	Other Non-II
Constant	6.723	22.443**	-0.383	22.826***
	0.721)	(2.080)	(-0.044)	(2.940)
Size	-0.509	-1.159**	-0.005	-1.154***
	(-1.020)	(-2.140)	(-0.012)	(-2.930)
Deposits	0.037*	0.031	0.021	0.010**
	(1.660)	(1.460)	(1.120)	(2.280)
Risk aversion	0.068	0.024	-0.053	0.078**
	(0.843)	(0.383)	(-1.550)	(2.600)
Market risk	0.147	0.052	0.125	-0.073
	(1.010)	(0.420)	(0.955)	(-1.400)
Credit risk	0.037	0.021	-0.006	0.026
	(1.010)	(0.866)	(-0.381)	(1.370)
Liquidity risk	-0.140	-0.131	-0.079	-0.052
	(-1.260)	(-1.240)	(-1.020)	(-1.200)
Operating expenses	-0.167	0.557	0.594*	-0.037
	(-0.452)	(1.210)	(1.970)	(-0.186)
Efficiency	-0.019*	-0.029*	-0.015*	-0.015**
	(-1.750)	(-1.960)	(-1.650)	(-2.290)
NIM		-1.306**	-0.507	-0.799***
		(-2.270)	(-1.550)	(-3.050)
HCPI	-0.038	-0.034	0.065	-0.098***
	(-0.695)	(-0.530)	(0.946)	(-3.170)
GDP				
GDP(-1)	0.088*	0.098*	0.100	-0.002
	(1.670)	(1.760)	(1.540)	(-0.115)
No of observations	125	125	125	125
R-square	0.719	0.772	0.766	0.842

Notes

The table reports the fixed effects estimation results. t-statistics are reported in parenthesis and are computed with robust standard errors. *,** and *** indicate statistical significance at 10%, 5% and 1% respectively. For the definitions of Nonii, Fees and Other nonii see Table 1.

Figure 1: Evolution of interest and non-interest margins and their determinants



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