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Bank profitability over different business cycles regimes: evidence from panel threshold models

Abstract

The goal of this study is to identify whether bank profitability in the Greek banking system is affected by business cycle conditions through the methodology of panel multiple-threshold models. The empirical findings display that there exists a procyclical relationship between bank profitability and business cycles, with the booming phases to exert a stronger impact on bank profitability vis-à-vis the effect emanating from the contractionary phases. Finally, it is shown that interest rate spreads could be a very good explanation for this asymmetric behavior in profitability.

Keywords: bank profitability, business cycles, panel threshold models, Greece.
JEL Classification: C23, E32, G21.

Introduction

Several studies have attempted to identify the determinants of bank profitability either on a single country or on a panel of countries basis. In particular, Berger (1995a), Neeley and Wheelock (1997) and Angbazo (1997) for US banks document that bank's profitability is positively affected by default risk, the opportunity cost of non-interest bearing reserves, leverage and management efficiency. By contrast, for the case of emerging markets, Barajas et al. (1999), Ben Naceur and Goaied (2001), Afanasieff et al. (2002), and Guru et al. (2002) document significant effects of financial liberalization, labor and capital profitability, the ratio of deposit accounts to bank assets, liquidity, expenses management, ownership, bank size and a set of macroeconomic variables, such as expected inflation and cyclical output, on bank profitability.

Another group of research has focused on the determinants of bank profitability for European banking institutions through panel country methodologies. In particular, Molyneux and Thornton (1992), Demerguc-Kunt and Huizingha (1999, 2001), Bashir (2000) and Abreu and Mendes (2002) find an association between bank profitability and certain factors, such as the level of interest rates, the unemployment rate, bank concentration, type of ownership, leverage, loans to asset ratios, taxation, financial structure and development, legal indicators and stock market developments.

Theory argues that the profitability of banking institutions depends substantially on the phase of business cycle the economy operates while banks tend to smooth out income over the business cycle in an attempt to reduce the volatility of their profits. There are also provided certain explanations that this occurs through: the hypothesis of signalling device (Wahlen, 1994; Ahmed et al., 1999), the moral hazard and the agency theory (Lambert, 1984; Fudemberg and Tirole, 1995), the hypothesis of bankruptcy concerns (Trueman and Titman, 1988), and the impact of tax codes on profitability (Rozycki, 1997). Recessionary phases tend to jeopardize the performance of banking loan portfolios, leading to credit losses and, thus, to lower banking profits. It is also crucial for regulators to fully comprehend the nexus between banks' profitability and different business cycle regimes because in this manner they become capable of detecting the stability and soundness of the banking and financial sector and forecast accurately any upcoming financial crisis (Demirguc-Kunt and Detragiache, 1999; Kaminsky, 1999; Logan, 2000; Borio, 2003; Albertazzi and Gambacorta, 2006). In addition, the comprehension of the above nexus is crucial for explaining the importance of capital adequacy hypothesis for the banking sector. Due to the presence of agency costs and tax-adverse conditions, recessionary phases of the business cycle tend to exacerbate the negative impact of business cycle on bank profitability as well as on consumption, investment and aggregate demand (Cornett and Tehranian, 1994; Calomiris and Hubbard, 1995; Neely and Wheelock, 1997; Stein, 1998; Barajas et al., 1999; Demirguc-Kunt and Huizinga, 2001; Bikker and Hu, 2002; Van den Heuvel, 2003; Goddard et al., 2004).

Moreover, the literature that covers these issues with respect to the Greek banking system is virtually negligible. A handful of papers dealing with the structure of the Greek banking system as well as with the association between profitability and business cycles are those of Alexakis et al. (1995), Eichengreen and Gibson (2001), Gibson (2005), and Athanasoglou et al. (2008). The above studies, however, have not considered the presence of any asymmetric effects in profitability, i.e. the possibility that the impact on banks' profitability could be different over various business cycle regimes, and have used instead linear models to investigate the

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impact of the business cycle effect on bank profitability. Athanasoglou et al. (2008) consider this relationship to be asymmetric by distinguishing the operation of the economy above or below trend. However, business cycles phases are more than that. The economy could operate below or above trend, but a single phase could, in turn, be characterized by sub-phases in which economic conditions (e.g., the macroeconomic environment) are different. In other words, business cycle phases have their own unique characteristics and cannot be treated uniformly.

Therefore, the goal and the novelty of this study is to move further ahead by identifying explicitly how business cycle phases can affect bank profitability through the methodology of panel threshold models that allow for regime shifts (Enders and Granger, 1998; Hansen, 1999). The characteristic of these models is that they identify endogenously the thresholds at which the system switches from one regime to the other. Another novelty of this study is that it makes use of some of the Albertazzi and Gambacorta (2006) and Perez et al. (2006) alternative definitions-components of bank profitability, i.e. interest income, non-interest income, profits (or net income) before taxes calculated as the sum of interest and non-interest income net of operating costs, and gross income defined as the sum of interest income and non-interest income. Splitting those definitions into their components provides a better picture for the operations of the banking sector regarding how bank profitability handles business cycles shocks. Finally, this approach allows a researcher to obtain new insights on certain aspects associated with those components, especially, the manner bank profitability reacts to business cycle phases.

The remainder of the paper is organized as follows. Section 1 provides an overview of the model as well as the methodology of panel threshold models, while section 2 discusses the data used. Section 3 reports the empirical findings and discusses the results, while the final section concludes the paper and provides suggestions for further research.

1. Methodology: models with a single threshold variable and threshold models with multiple business cycle turning points

1.1. A no threshold model. A simple panel model that relates bank profitability and macroeconomic conditions, i.e. proxied by a macroeconomic variable, such as the output gap, with no threshold and one regime yields:

$$profit_{jt} = a \times GAP_{(t-1)} + \sum_{j=1}^{k} \beta_j \times X_{jt} + \delta \times profit_{j,t-i} + \mu_j + e_{jt} \quad (1)$$

with μ_j representing individual fixed effects, j representing the number of j banks (k), t is the time dimension, and $profit_{j,t-1}$ is the one-period lagged profits that account for persistence, possibly due to the presence of impediments to market competition, the lack of informational transparency and, possibly, to serial correlation of macroeconomic shocks (Berger et al., 1999). The persistence coefficient δ takes values between 0 and 1. The closer to 0 its value is, the more competitive the banking industry is and vice versa. Finally, X_{jt} represents a set of control variables that, according to the relevant literature, are classified as bank-specific, industry-specific and macroeconomic-specific factors. The control variables that serve the goal of the investigation are: size (SIZE or SIZE2-squared), credit risk (CRR), productivity growth (PROD), operating expenses management (OPER), industry concentration (CONC), the ownership status of banks ($DUMMY_{own}$), the output gap (GAP) and expected inflation (INFL) (Athanasoglou et al., 2008).

Size is a variable that measures the presence of economies or diseconomies of scale in the industry. In most of the finance literature, the total assets of the banks (along with their squared value) are used as a proxy for bank size. Credit risk is considered to be a significant determinant of profitability since it is related to the presence of bank failures. Jimenez and Saurina (2006) argue that bank's lending hazards are much higher during the boom phase of a cycle than in the midst of a recessionary period. For them, a possible solution is the provision of certain prudential tools that curtails hazardous lending, especially during the boom phase of the cycle, such as capital requirements based on the tests provided by the second pillar of solutions package of Basel II. The relevant literature offers a bunch of explanations for such behavior, i.e. the principal agency problem through which managers aim at growth objectives instead of profitability targets (Mester, 1989), strong competitive conditions between banking and other financial institutions, which leads to narrower spreads. As a result, bank managers opt for higher loan growth and lower the quality loan standards (Jimenez and Saurina, 2006). In addition, the herd behavior hypothesis supports that bad loan mistakes cannot judged accordingly if the majority (if not all) of bank managers commit them (Rajan, 1994). The institutional memory hypothesis also argues that in the long run loan officers become less skilled or experienced to offer loans to high-risk borrowers (Berger and Udell, 2004). Operating expenses also seem to play a substantial role as a determinant of bank profitability. Bourke (1989) and Molyneux and Thornton (1992) provide evidence in favor of a positive relationship between the two variables. The market power evidence argues that a higher (lower)

level of concentration leads to more (less) monopolistic-type of profits, although higher (lower) concentration in the banking sector is associated with less efficient capital markets and, accordingly, with a slower reallocation of capital and, thus, with slower growth (Cetorelli and Strahan, 2006). This finding is a piece of evidence in favor of the collusion hypothesis, according to which, the degree of bank concentration is a significant determinant of profits (Molyneux and Forbes, 1995; Berger, 1995b; Maudos, 1998). Finally, the macroeconomic environment should also be taken into consideration since this type of macro-prudential analysis is a highly significant tool for regulators. This analysis supports micro-prudential supervision through the evaluation of the strength of the macroeconomic environment and how this emits signals of an upcoming financial distress (Logan, 2000; Borio, 2003). Within this context, expected inflation seems to play a crucial role in bank profitability since it acts as a proxy for the impact of bank's wages and other operating expenses on profitability. In addition, expected inflation is associated with loan interest rates and, therefore, profitability. Molyneux and Thornton (1992) and Perry (1992) argue in favor of a positive relationship between inflation and profitability. However, if inflation is not anticipated and banks are sluggish in adjusting their interest rates, then it is very likely that bank costs may increase faster than bank revenues and in this way bank profitability is adversely affected.

1.2. A multiple threshold model. In case now that a certain number of thresholds is present, extending the Enders and Granger (1998) and Hansen (1999) models, which permit multiple regimes identified by the same threshold variable, in this paper we allow for a four-regime model with two different threshold variables, one related to profitability and one related to the business cycle. With this format banks are divided into less profitable and more profitable in both booming and recessionary conditions. In other words, banks' profitability is investigated over different phases of the business cycle, while each regime is characterized by different slopes, i.e. α, and to identify those slopes we require that those regressors as well as are the thresholds are not time invariant. The four regimes considered are: Low profitability-recession, low profitability-boom, high profitability-recession, and high profitability-boom. Thus, the model to be estimated yields:

$$\begin{aligned} profit_{jt} = {} & \alpha_1 GAP_{(t-1)}\, I\,(profit_{jt} \le \gamma_1)\, I\,(GAP_{t-1} \le \gamma_2) + \\ & \alpha_2\, GAP_{(t-1)}\, I\,(profit_{jt} \le \gamma_1)\, I\,(GAP_{t-1} > \gamma_2) + \\ & + \alpha_3\, GAP_{(t-1)}\, I\,(\gamma_1 < profit_{jt})\, I\,(GAP_{t-1} \le \gamma_2) + \\ & + \alpha_4\, GAP_{(t-1)}\, I\,(\gamma_1 < profit_{jt})\, I\,(GAP_{t-1} > \gamma_2) + \\ & + \sum_{j=1}^{k} \beta_j X_{jt} + \delta \cdot profit_{j,t-i} + \mu_j + e_{jt}, \qquad (2) \end{aligned}$$

where $I(.)$ is the indicator function and $\gamma = (\gamma_1, \gamma_2)'$ is the threshold parameter vector pending to be estimated. The model estimates the parameters in vector γ through an endogenous manner in a sense that these γs are the threshold parameters that characterize the turning point business cycle conditions (boom or recession). We make use of a Fixed Effects transformation and Least Squares (LS). The error terms (e) are assumed to follow an *iid* process with zero mean and finite variance.

Hansen (1999) recommends estimation of γs by conditional LS minimizing the concentrated sum of squared errors $S(\gamma) = \hat{e}(\gamma)'\, \hat{e}(\gamma)$, i.e. $\gamma = arg\ min\ S(\gamma)$. The estimated γs must be sought among the actually realized values of the corresponding threshold variables, after trimming the initial and final tail of the distribution for identification purposes. In addition, we wish to avoid estimating a threshold that it sorts a small number of observations in one regime. We can avoid this by restricting the above minimization to values of the threshold such that a minimal percentage of observations (e.g., 1% or 5%) lie in each regime.

1.3. Testing for one threshold. The null hypothesis of no threshold is H_0: $\alpha_1=\alpha_2=\alpha_3=\alpha_4$. Under H_0 the thresholds γ_1 and γ_2 are not identified. To test for one threshold we employ a Likelihood Ratio (LR) test of H_0 against the alternative of a profitability threshold, which is based on:

$$F_{11} = [S_0 - S_1(\gamma_1)] / \sigma^2.$$

where $S_0 = \hat{e}_{it}'\, \hat{e}_{it}$ and $\sigma^2 = [n(T-1)]^{-1}\, S_1(\gamma_1)$, with T being the number of time periods and n being the number of banks. Similarly, the LR test of H_0 against the alternative of a business threshold is based on:

$$F_{12} = [S_0 - S_1(\gamma_2)] / \sigma^2.$$

If F_{11} rejects the null of thresholds, then another test is employed that discriminates between one profitability threshold and the alternative of both a profitability one and a business cycles one. The corresponding LR test is based on:

$$F_{21} = [S_1(\gamma_1) - S_2(\gamma_1,\gamma_2)] / \sigma^2.$$

This time σ^2 is defined as: $\sigma^2 = [n(T-1)]^{-1}\, S_2(\gamma_1, \gamma_2)$. In this case the null of one profitability threshold is rejected in favor of two thresholds if F_{21} is large.

2. Data

Data on real GDP, obtained from OECD Main Economic Indicators database along with four alternative income measurements, i.e. i) the ratio of net interest income to total assets (INT) (an item that includes income on interest-bearing assets, fee income related to lending operations, dividend

income on shares and participations, and income on bonds calculated as the difference between the book value and the redemption value of bonds), ii) the ratio of non-interest income to total assets (NOINT) (an item includes interest paid on liabilities, fee expenses related to borrowing operations, and income that does not represent ordinary and regular banking business), iii) the ratio of gross profits defined as the sum of interest and non-interest income to total assets (PROF), and, finally, iv) the ratio of net income defined as gross income minus operating expenses, including property costs to total assets (NPROF) for a panel of 20 Greek banks (covering the 92% of total operating income in the Greek banking system) were obtained from Bloomberg spanning over the period of 1990-2006. All data are on a quarterly basis. The analysis is restricted to banks continued operating throughout the entire period under investigation, implying that a balanced panel sample has been used. All four definitions of profitability are normalized by the total assets to avoid spurious size effects in the explanation of profitability.

In addition, data on a set of various control variables were also obtained. In particular: a) credit risk (CRR), measured as the ratio of total loans to total assets, which proxies the risk profile of a bank, b) the ratio of real gross total revenues over the number of employees to proxy the rate of change in labor productivity (PROD), c) the ratio of operating expenses to total assets to measure the variable of operating expenses management (OPER), d) the value of bank assets along with their square value to proxy for size (SIZE and SIZE2, respectively), e) the Herfindahl-Hirschman index, which is equal to the sum of the squares of each bank's market share in total banking industry assets and was constructed to proxy for any potential concentration of the banking industry (CONC), and, finally, f) the 10-year government bond interest rate to proxy for inflation expectations (INFL).

All of these data, except those regarding the number of employees, are obtained from Bloomberg, while the number of employees is obtained from the Bank of Greece. We finally compute the output gap (GAP) from the Hodrick-Prescott (HP) filtering approach. Both RATS (Version 6.3) and GAUSS are used to assist the empirical analysis.

3. Empirical analysis

3.1. Bank profitability trends – an overview of the Greek banking system. The banking system in Greece has played the major role in channeling funds from surplus to deficit units, especially firms, during times where alternative financing means have been virtually negligible. Following specific deregulation guidelines, the Greek banking system, however, has transformed itself over the last 20 years from a highly regulated sector in which interest rates were set by the monetary authorities into a competitive and dynamic sector that constitutes one of the basic pillars for economic growth with its assets increasing more than fourfold. Over the period under study, the Greek banks experience a shift from interest income sources to non-interest income sources (Figure 1), a phenomenon mainly attributed to the establishment of a deregulated banking environment (a process started back in 1987-88), the introduction of new information technologies, intense financial innovation and the necessity to compete with new foreign banking competition, especially after the country's participation in the euroland and the subsequent decline in interest margins. The deregulation process focused mainly on the acceleration of transformation for Greek banks to stand ready to meet the standards of international competition as well as to assist growth in investment flows. Therefore, Greek banks have been forced to develop and search other areas through which they could raise further revenues, such as the stock market, the insurance market, trading operations, and services operations. As a result, the increase in the use of non-interest income has made their profits less sensitive to changes in interest rates. This ability is expected to be augmented if the deregulated European banking environment provides banks with additional rights to bolster their involvement in non-banking activities.

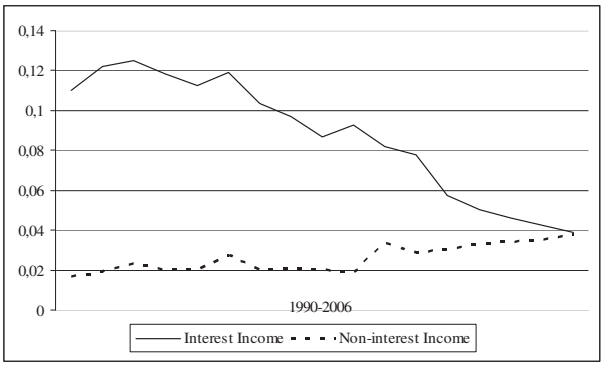

Fig. 1. Sources of income in the Greek banking system: interest vs non-interest income

Nevertheless, the share of interest income to total revenues has remained at high levels, a phenomenon associated with the low development of the stock market, implying that bank lending has retained its role as the primary source of business financing. Finally, Greek banks are largely dependent on cash and make very little use of electronic means of payments, resulting in strengthening the cost expenses both to individuals and to the banks themselves. This is an adverse characteristic that will be, hopefully, faded away through the

introduction of the Single European Payments Area expected to be initiated in 2008. This situation will lead to the reduction of high costs of a cash based banking system while, at the same time, will provide more upgraded electronic fund transfer and direct debit services to their clients.

3.2. Dynamic heterogeneity. An issue that it is of major concern is the heterogeneity of banks included in this data set. Heterogeneity could be explained by the fact that banks are characterized by heterogeneous bank-specific determinants, such as profitability, capital, credit risk, productivity measures, and operating expenses management.

The dynamic heterogeneity across a cross-section of the relevant variables can be investigated as follows. In the first step, an ADF(n) equation for the linear Model (1), which also includes fixed effects, in the panel is estimated; then, the hypothesis of whether regression parameters are equal across these equations is tested. Next, a similar test of parameter equality is performed by estimating an n-order autoregressive model for each of the relationships under investigation. Standard Chow-type F tests under the null of parameter equality across all relationships are also performed. White's tests for group-wise heteroscedasticity are employed to serve this end. The results are reported in Table 1. They indicate that the relationship under investigation is characterized by heterogeneity of dynamics and error variance across groups, supporting the employment of panel analysis.

Table 1. Tests of dynamic heterogeneity across groups

ADF(3)	AR(3)	WHITE'S TEST
12.34*	23.84*	57.62*

Notes: The ADF(3) column reports the parameter equality test (F test) across all relationships in the panel. The AR(3) column reports the F test of parameter equality conducted in a fourth-order autoregressive model of the relationships under study. Finally, the White's test reports White's test of equality of variances across the investigated relationships in the panel. The White's test was computed by regressing the squared residual of the ADF(3) regression on the original regressor(s) and its(their) square(s). The test statistic is (NT) x R^2, which is x^2 distributed with the number of regressors in the second regression as the degrees of freedom. * denotes significance at 1%.

3.3. The no thresholds case. Table 2 reports the results where changes in the regime do not exist. Our no threshold model was estimated with one lag for the output gap (higher lags were shown to be statistically insignificant). The no threshold model (1) is treated as a dynamic panel and it is estimated through the Arellano and Bond (1991) General Method of Moments (GMM) methodology. Their estimation approach, to avoid possible bias due to endogeneity, makes use of lagged values of the dependent variable as well as of lags of the exogenous regressors as instruments. In particular, we use two lagged values of profits and the output GAP and one lag for each of the control variables. The model also contains a dummy variable ($DUMMY_{2001}$) pertaining to the year 2001 that indicates the participation of the country in the euroland. Finally, the model uses an additional dummy variable that differentiates between state banks (STATE BANK=1) and private banks (PRIVATE BANK=0). It is believed that publicly owned banks usually pursue political objectives, e.g. lending to politically associated corporations, a fact rendering them as an obstacle for the efficient allocation of capital in the economy (Sapienza, 2004) as well as for the development of financial and capital markets (La Porta et al., 2002).

Table 2. Estimates with no threshold and fixed effects

$profitjt = \alpha 1\ GAP(t-1) + \beta 1\ CRRjt + \beta 2\ PRODjt + \beta 3\ OPERjt + \beta 4\ CONCjt + + \beta 5\ INFLt + \beta 6\ SIZEjt\ (SIZE2jt) + \beta 7\ DUMMY2001 + \beta 8\ DUMMYown + + \delta\ profitj(t-1) + \varepsilon jt$				
Definition of profitability:	INT	NOINT	PROF	NPROF
α_1 =	0.0164	0.0119	0.0126	0.0129
	(4.24)*	(1.23)	(3.86)*	(4.13)*
β_1 =	-0.1238	-0.1162	-0.0856	-0.0977
	(-4.47)*	(-3.39)*	(-2.72)**	(-3.29)*
β_2 =	0.0348	0.0285	0.0318	0.0286
	(3.84)*	(3.22)*	(3.54)*	(4.04)*
β_3 =	-0.0124	-0.0115	-0.0125	-0.0131
	(-4.45)*	(-3.76)*	(-3.83)*	(-3.94)*
β_4 =	-0.037	-0.026	-0.024	-0.019
	(1.14)	(1.09)	(1.23)	(1.12)
β_5 =	0.048	0.053	0.039	0.047
	(4.57)*	(4.31)*	(4.22)*	(4.58)*
	(4.57)*	(4.31)*	(4.22)*	(4.58)*
β_6 =	0.236	0.219	0.198	0.207
	(4.73)*	(4.20)*	(4.28)*	(4.50)*
	0.032	0.029	0.027	0.034
	(4.18)*	(4.39)*	(3.96)*	(4.16)*
β_7 =	1.246	1.162	1.234	1.218
	(4.68)*	(4.14)*	(4.69)*	(4.33)*
β_8 =	0.027	0.018	0.023	0.020
	(1.25)	(1.17)	(1.20)	(0.85)
δ =	0.358	0.369	0.353	0.382
	(3.78)*	(4.14)*	(4.07)*	(4.38)*
Diagnostics				
LM =	[0.14]	[0.17]	[0.09]	[0.13]
RESET =	[0.40]	[0.48]	[0.33]	[0.28]
HE =	[0.27]	[0.20]	[0.25]	[0.21]
Sargan test	[0.38]	[0.43]	[0.32]	[0.35]

Notes: LM is a serial correlation test, RESET is a functional form test, and HE is a heteroskedasticity test. Figures in parentheses denote t-statistics, while those in brackets denote p-values. The Sargan statistic tests for over-identifying restrictions in our GMM dynamic model. * statistically significant at 1%. ** denotes statistical significance at 5%.

The empirical findings display that the theoretical arguments are in favor of a positive relationship between bank profitability and output gap (bank profits are procyclical). In other words, improvements (declines) in the economy lead to higher (lower) demand lending by the banking sector and in better (worse) financial conditions for the borrowers with positive (negative) effects on bank profitability. However, this is not the case for one out of the alternative profit definitions, i.e. that of non-interest income. In particular, this positive relationship turns out to be statistically insignificant for this case, implying that this source of income is not (yet) correlated with business cycle phases. This class of income is mostly related to trends in financial markets. In quantitative terms, when the GAP increases by 1 percent, net interest income, the sum of interest and non-interest income and the net income increase, in the first year, by 1.6, 1.3 and 1.3 percent, respectively. Due to the persistence of profits, the long-run effect of cyclical output on profits is even greater. In other words, the upward phase of the cycle tends to lead to higher lending to the private sector with favorable effects on bank profitability and vice versa.

As mentioned above, the coefficient of the lagged profits is statistically significant in all four alternative definitions of profits, confirming the results by Athanasoglou et al. (2008) about the dynamic character of the model specification, albeit the coefficient never exceeds 0.40, indicating a moderate persistence of lagged profits and supporting a relatively satisfactory competitive character of the banking industry. Next, the coefficient of the credit risk is negative (and statistically significant) in all specifications, indicating that Greek banks follow a risk-averse approach for screening and monitoring credit risk. Productivity is displayed to exert a positive (and statistically significant) impact on all definitions of bank profitability, reflecting the fact that higher productivity (either in terms of improved human capital or a lower number of employees) leads to higher income, which is translated into profits. Operating expenses are shown to exert a negative (and statistically significant) effect on bank profitability, reflecting that the Greek banking system is characterized by a deficit in the techniques of expenses management, which leads to higher costs. The effect of the bank size on profitability is shown to be positive (and statistically significant), displaying that larger banks experience higher profitability. Both the coefficient of concentration and that of ownership are statistically insignificant and they will be ignored from the remaining part of the empirical analysis.

In terms now of the macroeconomic environment, expected inflation has a positive and statistically significant impact on bank profitability, indicating that banks can successfully adjust interest rates in inflationary periods in such a way that profits are maintained. In addition, this positive effect reflects either the inadequacy of bank customers to successfully anticipate expected inflation, which is due probably to asymmetric information effects between them and bank management or that in inflationary periods bank customers seem to carry out more transactions (Demirguc-Kunt and Huizinga, 1999).

The $DUMMY_{2001}$ variable is positive and statistically significant, indicating that the participation of the country in the euroland has a major positive impact on banks' profits. The $DUMMY_{own}$ variable is shown to be positive but statistically insignificant in all cases, supporting that the ownership status of the bank does not seem to affect its profitability (it will also be ignored from now and onwards). Finally, diagnostic tests indicate that the alternative models perform satisfactorily since they do not 'suffer' from serial correlation (LM test), functional form misspecification (Hausman test), and heteroskedasticity (HE). Moreover, there is no evidence for over-identifying restrictions (Sargan's test).

However, the disadvantage of the above analysis is that it does not take explicitly into consideration that over the period under investigation the trend is not uniform. In case of such an asymmetric business cycles environment we believe that the impact of business cycles on bank profitability should be more pluralistic and it could be investigated through the multiple thresholds modeling approach, in which we turn into.

3.4. A four-regime threshold model. The four-regime threshold model (2) is again treated as a dynamic panel and it is estimated through the Caner and Hansen (2004) methodology to avoid possible bias due to endogeneity. Their methodology makes use of instrumental variables. The system of equations was estimated sequentially. In particular, each equation, except the profits equation (2), was estimated using Least Squares (LS), then the predicted values of the endogenous variables substituted the corresponding variables in (2). Next, the threshold parameters γ_1 and γ_2 were estimated, using LS, and finally, the slopes were estimated using GMM on the split samples. The instrumental variables used are credit risk, productivity, operational expenses and inflation (all in a 2-lagged form).

Table 3 reports the results in which both bank profitability and business cycles are considered to be the thresholds. The empirical findings suggest that

bank profitability is procyclical, indicating that there is a positive relationship between bank profitability and the business cycle, while this positive cyclicality remains robust in all phases of the business cycle.

Table 3. Estimates for threshold regression panel data models

profitjt=α1GAP(t-1) I (profitjt£γ1) I (GAPt-1£γ2) + α2 GAP(t-1) I (profitjt£γ1) I /(GAPt-1>γ2) + α3 GAP(t-1) I (γ1<profitjt) I (GAPt-1£γ2) + α4 GAP(t-1) I /(γ1<profitjt) I (GAPt-1>γ2) + β1 CRRjt + β2 PRODjt + β3 OPERjt + + β4 SIZEjt (SIZE2jt) + β5 INFLt + β6 DUMMY2001 + δ profitj(t-1) + μj + ejt				
Definition of profitability:	INT	NOINT	PROF	NPROF
α_1 = (less profitable bank/ recession)	0.0352 (3.19)*	0.0279 (1.47)	0.0215 (3.08)*	0.0208 (3.28)*
α_2 = (less profitable bank/ boom)	0.0573 (3.96)*	0.0366 (1.24)	0.0348 (3.30)*	0.0362 (3.75)*
α_3 = (more profitable bank/ recession)	0.0196 (4.35)*	0.0185 (1.24)	0.0153 (3.27)*	0.0132 (3.46)*
α_4 = (more profitable bank/ boom)	0.0465 (3.62)*	0.0338 (1.04)	0.0431 (3.10)*	0.0462 (3.50)*
β_1 =	-0.0884 (-3.12)*	-0.0672 (-3.45)*	-0.0551 (-3.22)*	-0.0518 (-3.83)*
β_2 =	0.0258 (3.41)*	0.0177 (3.26)*	0.0259 (3.19)*	0.0268 (3.44)*
β_3 =	-0.0107 (-4.07)*	-0.0086 (-3.84)*	-0.0120 (-3.72)*	-0.0128 (-4.15)*
β_4 =	0.245 (3.88)* 0.038 (4.17)*	0.164 (4.26)* 0.034 (4.37)*	0.257 (4.59)* 0.032 (4.26)*	0.249 (4.25)* -0.041 (4.21)*
β_5 =	0.065 (4.13)*	0.073 (4.38)*	0.046 (3.96)*	0.058 (4.33)*
β_6 =	1.336 (3.51)*	1.682 (3.76)*	1.184 (3.49)*	1.193 (4.07)*
δ =	0.377 (4.10)*	0.382 (4.51)*	0.369 (4.42)*	0.399 (4.68)*
γ_1 =	44.29	17.85	29.16	12.14
γ_2 =	-0.103	-0.106	-0.102	-0.105
N bootstrap	1000	1000	1000	1000
Z: p-value = 0.00				
LR (for a 4-regime model against a 5-regime model):			p-value=0.47	
LR (for a 3-regime model against a 4-regime model):			p-value=0.00	
LR (for a 2-regime model against a 3-regime model):			p-value=0.00	
LR (for a 1-regime model against a 2-regime model):			p-value=0.00	

Notes: Figures in parentheses denote t-statistics, while figures in brackets denote standard deviations. Z is the bispectral test and LR is the likelihood ratio test. The instrumental variables used are credit risk, productivity, operational expenses and inflation (all with 2 lags). * denotes significance at 1%.

Moreover, this positive relationship remains robust across the alternative profit definitions, although it turns out to be statistically insignificant for the case of non-interest income. The findings also indicate that over different phases of the business cycle the impact of output gap is much higher on bank profitability than in the case of the linear model. In addition, the heterogeneity of the coefficient estimates across regimes is also evident. This reinforces the argument that the various business cycles phases exert a heterogeneous impact on bank profitability. In particular, the findings suggest that in booms the impact of the business cycle on bank profitability is higher than in recessions. The coefficients α_2 and α_4 that correspond to booming conditions lie from 0.0348 to 0.0573 and from 0.0338 to 0.0465, respectively, for the definitions of bank profitability as interest income, profits and net income. By contrast, the coefficients α_1 and α_3 that correspond to recessionary periods lie from 0.0208 to 0.0352 and from 0.0132 to 0.0196, respectively, for the alternative bank profitability definitions. In other words, during the booming conditions banks' profitability is shown to be more cyclical than during recessionary phases, regardless of the profitability character. A possible explanation lies in the argument that Greek banks have found certain protective activities to insulate as much as possible their profitability during the downturn of the business cycle. This argument receives support from the display of Figure 1, which shows the attempt of the Greek banking institutions to replace business cycle sensitive activities with less sensitive ones. In other words, the rise of non-interest income seems to represent technological advances, expansion of low-risk activities and the banks' exposure to international competition. Furthermore, banks may realize that during recessions borrowers could find other nonbank lenders to offset any potential shortfall in bank lending and, thus, are reluctant to follow a fully negative loan supply shock policy attributed to high risk premiums due to adverse selection and moral hazard problems.

The control variables retain their expected theoretical sign. With a grid search method (changing by 1% every time) the results show that the γs remain practically the same across profit definitions. The bispectral Z test, recommended by Ashley and Patterson (1989), examines the superiority of the threshold model over its linear version. Its value is equal to 5.12 (with a zero p-value), indicating that the null hypothesis of a linear bank profitability expression is clearly rejected and threshold effects are present. The likelihood ratio LR test, recommended by Hansen (1996), investigates whether a one regime model is valid against a model with more regimes. The reported results display that the null hypothesis of a single regime is rejected and that the accepted number of regimes is four. Their p-values are calculated using a bootstrap experiment with 1000 simulation replications. This experiment generates the bootstrap samples by holding both the regressors and thresholds fixed in repeated bootstrap samples.

3.5. Robustness tests: different output cyclicality measures. This section explores the impact of the output gap cyclicality on bank profitability by making use of measurements of cyclical output paths through alternative methodological approaches, since the H-P filter has been criticized on the grounds that although imposes smoothness it does not erase determinism on the trend. The employed techniques include time series filtering, such as Beveridge-Nelson (BN) decomposition (Beveridge and Nelson, 1981) that models first differences as an ARMA model with the trend being modeled as a long-horizon forecast that is a random walk, the frequency domain approach represented through the help of a so-called exact band-pass (BP) filter developed by Baxter and King (1999) that defines the cycle as having spectral power, the production function (PF) approach that emphasizes the concept of the non-accelerating wage inflation rate of unemployment in conjunction with a Kalman filtering process (Kuttner, 1994), and, finally, the forward-looking Phillips curve setting (FLPC), developed by Basistha and Nelson (2007) that incorporates the output gap into a forward-looking New Keynesian Phillips curve and performs a statistical decomposition approach. Table 4, to economize on space, reports only the association between bank profitability and the alternative measurements of the output gap. As we can notice, the results remain robust. In other words, bank profitability is positively (again) and significantly affected by the pattern of the business cycle.

Table 4. Robustness tests (alternative output GAP measures)

Definition of profitability:	INT	NOINT	PROF	NPROF
Measurement of output gap				
BN				
α_1 =	0.0367	0.0285	0.0234	0.0212
	(3.43)*	(1.26)	(3.27)*	(3.54)*
α_2 =	0.0532	0.0370	0.0361	0.0385
	(3.58)*	(1.15)	(3.69)*	(3.45)*
α_3 =	0.0174	0.0075	0.0127	0.0142
	(3.87)*	(1.06)	(3.53)*	(3.78)*
α_4 =	0.0477	0.0369	0.0471	0.0442
	(3.88)*	(1.13)	(3.57)*	(3.71)*
BP				
α_1 =	0.0384	0.0248	0.0237	0.0217
	(3.36)*	(1.24)	(3.72)*	(3.41)*
α_2 =	0.0541	0.0389	0.0394	0.0353
	(3.62)*	(1.18)	(3.67)*	(3.53)*
α_3 =	0.0141	0.0106	0.0147	0.0139
	(4.12)*	(1.20)	(3.47)*	(3.28)*
α_4 =	0.0448	0.0391	0.0474	0.0479
	(3.27)*	(1.14)	(3.49)*	(3.37)*
PF				
α_1 =	0.0372	0.0262	0.0224	0.0211
	(3.46)*	(1.32)	(3.58)*	(3.34)*
α_2 =	0.0547	0.0358	0.0319	0.0344
	(3.64)*	(1.16)	(3.79)*	(3.47)*
α_3 =	0.0144	0.0106	0.0135	0.0131
	(3.86)*	(1.11)	(3.48)*	(3.21)*
α_4 =	0.0426	0.0357	0.0428	0.0440
	(3.35)*	(1.10)	(3.54)*	(3.37)*
FLPC				
α_1 =	0.0344	0.0251	0.0227	0.0211
	(3.26)*	(1.44)	(3.32)*	(3.07)*
α_2 =	0.0557	0.0363	0.0347	0.0377
	(3.84)*	(1.12)	(3.51)*	(3.47)*
α_3 =	0.0168	0.0102	0.0126	0.0129
	(4.18)*	(1.14)	(3.57)*	(3.26)*
α_4 =	0.0442	0.0376	0.0426	0.0477
	(3.47)*	(1.12)	(3.44)*	(3.23)*

Notes: BN = the Beveridge-Nelson decomposition, BP = the band-pass filter, PF = the production function domain approach, and FLPC = the forward-looking Phillips curve approach. The remains are similar to Table 3.

3.6. The role of interest rate spreads in the profitability asymmetries. Angbazo (1997) argues that interest rate spreads, i.e. lending rates minus deposit rates, affect banks' profitability as well as capital of banks in such a manner that they can be insulated from macroeconomic and other shocks. An important feature of the above asymmetric bank profitability is during downturns (recessions) lending portfolios carry high risk profiles, which yield higher lending rates and/or lower deposit rates and, thus, higher interest rate spreads. However, the above indicated lower sensitivity of bank profitability over recessions, vis-à-vis over booms, which could reflect that banks prefer not to pass through the entire higher lending risk onto their lending rates, implying a lower spread margin and, thus, lower business cycle sensitivity of their lending activities. These findings find support from Dueker (2000) who reports that banks are very reluctant to lower their lending rates fast over recessions due to the higher risk of default.

Several research attempts have provided evidence that banks' interest rate spreads behave asymmetrically. In particular, Levine and Loeb (1989), Hutchison (1995) and Tkacz (2001) show that lending rates are adjusted faster during booms than during recessions, a phenomenon that has critical implications not only for bank profitability but also for documenting any possible asymmetric effect of monetary policy on output. Such asymmetric spread behavior is often explained through the presence of information asymmetries between banks and their customers. Dueker and Thornton (1997), Saunders and Schumacher (2000) and Corvoisier and Gropp (2002) argue that such

spreads display a countercyclical behavior, a fact attributed to a risk-averse and profit-smoothing bank management that adopts a countercyclical markup behavior of lending rates over the cost of funds, while it favors the argument that because of switching costs, banks exert market power over their customers. By contrast, theoretical arguments from the interest rate transmission literature favor that in booms, where interest rate tightening is present, interest rates on bank liabilities are more sluggish than those on assets, which supports that in booming conditions rising spreads are present (Sander and Kleimeier, 2004). Evidence by Neumark and Sharpe (1992) and Angelini and Cetorelli (2003) also provides support to this argument. Therefore, we want to believe that a possible asymmetric behavior of interest rate spreads could be a good predictor of the above indicated asymmetric character of bank profitability. To this end, model (3) is employed to account for any asymmetric pattern of interest rate spread variables over the business cycle:

$$spread_t = \varphi_1 \, GAP_{(t-1)} \, I \, (GAP_{t-1} \leq \gamma_2) + \\ + \; \varphi_2 \, GAP_{(t-1)} \, I \, (GAP_{t-1} > \gamma_2) + v_t \, . \qquad (3)$$

Quarterly data over the same period on prime lending rates along with deposit rates were employed from Bloomberg database. Figure 2 displays the behavior of the lending-deposit rate spread over the period of 1988-2006. The picture displays that from the beginning of 1990s the spread follows constantly a downturn path, though not on a smooth pattern. The reported results in Table 5 (with the output gap being measured through the HP filter) exhibit that spreads behave in a procyclical manner, though an asymmetric pattern seems to be present. In particular, a standard F-test displays that the symmetry null hypothesis ($\varphi_1=\varphi_2$) is rejected. In regard to adjustments, it appears that φ_2 is greater than φ_1, indicating that banks adjust their spreads differently to rising versus declining business cycle conditions.

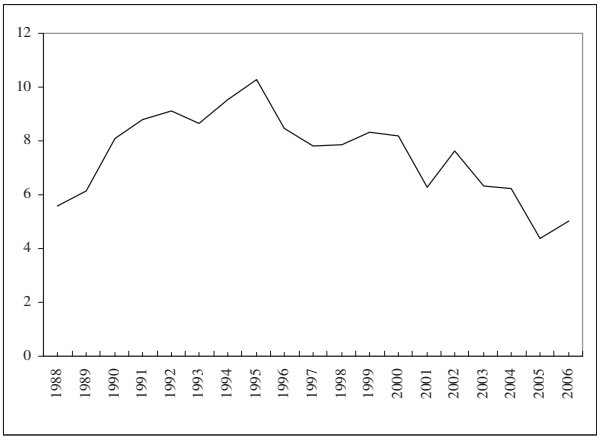

Fig. 2. Interest rate spreads

Table 5. Estimates for the threshold regression interest rate spread model

$Spread_t = \varphi_1 \, GAP_{(t-1)} \, I \, (GAP_{t-1} £ \gamma_2) + \varphi_2 \, GAP_{(t-1)} \, I \, (GAP_{t-1} > \gamma_2) + v_t$	
φ_1 =	0.237
	(4.16)*
φ_2 =	0.489
	(4.59)*
γ_2 =	-0.108
F test: p-value = 0.00	

Notes: F is a standard F distribution test for the symmetry null hypothesis H_0: $\varphi_1=\varphi_2$. * denotes significance at 1%.

These results support the argument that Greek banks' spreads do contribute to a financial non-accelerator by dampening the propagation of business cycle fluctuations. In addition, the procyclicality of interest rate spreads indicates the weakness of the adverse selection problem. Although recessions are characterized by a higher number of borrowers with bigger default probabilities, the Greek banks need not to increase spreads.

Conclusions, policy implications and suggestions for further research

This study attempted to identify whether bank profitability in the Greek banking system is affected by business cycle conditions through the methodology of panel multiple threshold models. After controlling for certain variables, such as bank capital, credit risk, labor productivity, operating expenses management, and expected inflation, the empirical findings display that there has been a positive relationship between bank profitability and the business cycle. This positive association remains robust in either phase of the business cycle (except in the case for non-interest income). Our estimates are consistent with the procyclical feature of bank profits for both high and low profitable banks as well as in both cyclical phases, i.e. booms and recessions. In addition, booms seem to have affected more intensively bank profitability than recessions.

The above empirical findings are very crucial for banks in order to select those buffer instruments that will isolate them from the impact of certain phases of the business cycle. These results are also crucial for central banks (the supervisors or the regulators) in monitoring banks' profitability over certain phases of the business cycle, once a sound banking system seems imperial for the stability of the monetary and capital markets as well as for economic growth. In addition, the monetary authorities should also be very critical about the extent to which monetary policy could have differing effects on output given certain asymmetries in the banking sector.

Finally, the results about the asymmetric procyclical behavior of Greek banking profitability also raise interest into the question in what ways and to what extent asymmetric banking profitability implies the possibility to change the capital buffer as well as lending under Basel II.

The approach used in this study can be extended to provide robustness for the validity of the conclusions in a sample of countries or blocks of countries, such as European versus American banks. Finally, the sample can also be extended to investigate the impact of business fluctuations on bank profitability for emerging or transitional countries whose banking systems are not equipped with the appropriate mechanisms to insulate them, to a certain extent, from economic fluctuations.

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