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Basel II and the Money Supply Process: Some Empirical Evidence from the Greek Banking System (1995-2006)

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CENTRE OF PLANNING AND ECONOMIC RESEARCH

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Η Βασιλεία ΙΙ και η διαδικασία προσφοράς χρήματος:

Εμπειρικά αποτελέσματα από το Ελληνικό τραπεζικό σύστημα.

Γιάννης Παναγόπουλος

ΠΕΡΙΛΗΨΗ

Το συγκεκριμένο άρθρο έχει ως σκοπό να διερευνήσει τις συνέπειες από την εφαρμογή της Βασιλείας ΙΙ σε ότι αφορά την ενδογένεση ή μη της προσφοράς χρήματος στο Ελληνικό τραπεζικό σύστημα. Αναλυτικότερα, η εφαρμογή των κανονισμών και αρχών της Βασιλείας ΙΙ δημιουργεί έναν νέο τρόπο παρουσίασης του υπάρχοντος νομισματικού και πιστωτικού περιβάλλοντος. Ο τρόπος αυτός -όπως αναλυτικά εκτίθεται και στην μελέτη των Παναγόπουλου και Πελετίδη (2007)- μπορεί να συνοψισθεί εδώ στην εκτίμηση των δύο παρακάτω παραγόντων :

Α) Ενός πολλαπλασιαστή ιδίων κεφαλαίων των τραπεζών αλλά και

Β) Ενός νέου πολυμεταβλητού πιστωτικού μοντέλου (ή μοντέλου δανειακού χαρτοφυλακίου) του τραπεζικού συστήματος.

Τα οικονομετρικά αποτελέσματα από την εκτίμηση των δύο αυτών παραγόντων (ή φάσεων Α και Β) θα κάνουν πιο ξεκάθαρο το υπάρχον νομισματικό πλαίσιο λειτουργίας, του Ελληνικού τραπεζικού συστήματος, το εξεταζόμενο χρονικό διάστημα (1995-2006). Για παράδειγμα, ένα νομισματικό ή πιστωτικό περιβάλλον που «ακολουθεί» τις γενικές μακροοικονομικές αρχές του Νεο-Κεϋνσιανισμού (New Keynesianism) και ακόμα πιο συγκεκριμένα της Νεο-Συναινετικής (New Consensus) προσέγγισής του, αποτελεί πρόσφορο έδαφος για μια αποτελεσματική εφαρμογή των αρχών της Βασιλείας ΙΙ, κυρίως πάνω στο δανειακό χαρτοφυλάκιο [banking book] αλλά και το χαρτοφυλάκιο αγοραπωλησιών [trading book] των τραπεζών.

Από την άλλη πλευρά ένα νομισματικό πλαίσιο λειτουργίας που θα «ακολουθεί» την Μετα-Κεϋνσιανη (Post Keynesian) νομισματική σκέψη, το εξεταζόμενο χρονικό διάστημα, θα περιόριζε σημαντικά τις πιθανότητες αποτελεσματικής εφαρμογής της Βασιλείας ΙΙ.

Με βάση τα οικονομετρικά αποτελέσματα στο Ελληνικό τραπεζικό σύστημα παρατηρούνται δύο πράγματα : 1) Ο πολλαπλασιαστής ιδίων κεφαλαίων των τραπεζών κατ' ουσία δεν δείχνει να λειτούργησε το εξεταζόμενο χρονικό διάστημα και 2) Στο νέο πολυμεταβλητό μοντέλο δανείων του τραπεζικού συστήματος που εξετάζουμε η σημαντικότερη μεταβλητή είναι αυτή της ενεργού ζήτησης (Α.Ε.Π.) και δευτερευόντως η μεταβλητή των ιδίων κεφαλαίων των τραπεζών. Κατ' επέκταση το νομισματικό πλαίσιο λειτουργίας της χώρας μας προσεγγίζει περισσότερο σε αυτό που αναφέραμε ως Μετα-Κεϋνσιανη (Post Keynesian) νομισματική σκέψη και ειδικότερα στην Δομική έκφρασή της (Structuralism).

Με άλλα λόγια τα αποτελέσματα αναδεικνύουν πρώτον, ότι η προσφορά χρήματος στο Ελληνικό τραπεζικό σύστημα είναι μάλλον ενδογενής (money endogeneity) και δεύτερον, ότι υπάρχει περιορισμένο μόνο έδαφος για μια πλήρως αποτελεσματική εφαρμογή των κανόνων και αρχών της Βασιλείας ΙΙ. Λαμβανομένου δε υπ' όψιν και των ισχυρών τάσεων για εξαγορές και συγχωνεύσεις που συζητούνται μεταξύ των Ελληνικών τραπεζών, τα πράγματα αναμένεται να εξελιχθούν ακόμα πιο δύσκολα για τους εν λόγω κανόνες και αρχές.

CONTENTS

ABSTRACT *

The main purpose of this paper is to examine the Basel II influence on the debate concerning the money endogeneity process in the Greek banking system. The emergence of the importance of equity, through Basel II directives, is initially discussed by creating and applying a "new credit (equity) multiplier". Then a new multivariate loan model, which contains banks' equity and interbank debt as explanatory variables, is briefly presented and next tested. From the econometric part of this paper, it is obvious that although the equity multiplier is not operative, the loan model favours a new type of Structuralism regarding the Greek monetary system and its money supply process.

J.E.L. Classification : E51, E12, C22, C12.
Keywords : Basel II, money supply, co-integration.

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1. Introduction

The aim of this paper is to examine the Greek banking system and the money supply process under the Basel II framework. To do so, we need to bring forward something that is persistently neglected in the monetary and banking literature: the link between credit expansion and the equity of banks. In brief, this paper's contribution is twofold: in the theoretical part, the determination of the new credit (or equity) multiplier and a redefined multivariate loan model and in the empirical part their implementation in the Greek banking system.

In section 2, we discuss the importance of bank equity (raised by the Basel II directives) for credit expansion and consequently for the money supply process. We express the importance of bank equity through the "new credit multiplier" model. The aforementioned "multiplier" is next extended to a new multivariate loan model which is presented in section 3. This model contains explanatory variables which theoretically cover both Orthodox[1] (New Keynesian/New Consensus) -emerging from the Basel II proposals- and Post Keynesian [*PK*][2] (Horizontalists and Structuralists) monetary views. The significance of the explanatory variables will reveal the expected effectiveness of the Basel II rules and consequently the nature of the money supply process in the examined banking system.

In section 4, co-integrating econometric techniques are briefly presented and then implemented for the new credit multiplier and the multivariate loan models in the Greek banking system. Finally, in section 5, we conclude.

2. The equity multiplier under the Basel II influence

In the recent years, the Bank for International Settlements (*B.I.S.*) Committee issued some new directives for the G-10 banks, which had two supplementary aims: First, to clarify the different categories of collateral, attached to the different bank loans; and second to explain the way we should calculate the actual banks' credit exposure in the

[1] For an interesting review of the Orthodox theories see Taylor, J. and Woodford, M. eds. (1999), Handbook of Macroeconomics, Amsterdam : North Holland Edition.
[2] For an interesting review of the Post Keynesian theories see Arestis, P. and Sawyer, M. eds. (2006), A Handbook of Alternative Monetary Economics, Edward Elgar Publishing Limited.

banking book (*L*). These directives aimed at stabilising the banks' relatively low capital adequacy ratio (C.A.R.= Equity/Assets).[3] More specifically, the *B.I.S.* Committee directives focused on three main issues (see Basel II, 2006, Pillar I):

1. New formulas (the *Standardized* and the *Internal Rate Based* [*I.R.B.*] methods), for a more accurate estimation of the credit risk exposure, taking into account not only the collateral but also the haircuts attached to them.[4]
2. The increased number of banking book categories with an analogous increase in the financial collateral, for a more accurate calculation of the *Credit Risk* exposure.
3. The re-estimation of the bank's C.A.R., also taking into account the bank's exposure to the Operational Risk[5].

These Basel II "directives" to banks assume that credit demand is supply driven and therefore they have a rather New Keynesian "insight" (see Rochon, 1999). The existence of a "floor" (8%) for the C.A.R. can be interpreted as a Central Bank attempt to control, through the inspection of the bank's equity elements (e.g. Tier I & II [6]), the banks' aggregate demand proxies (e.g. the banking book portfolio[7]). Moreover, these "directives" could also be interpreted as the missing *quantitative* link (between the Asset

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[3] The Basel II (2006) C.A.R. has the following algebraic form :

$$C.A.R. = \frac{Equity\ (Tier\ I + Tier\ II)}{(Credit\ Risk\} + \{Market\ Risk\} + \{Operational\ Risk\}} \geq 8\%$$

[4] The new mathematical formula in Basel II (2006 - Pillar I), for a *banking book* actual exposure (*E*) has the following form :

$$L^{Actual} = E_i^{\ f} = \max\{0, [E_i * (1 + H_i^{\ e}) - Co * (1 - H_i^{\ co})]\}$$

with H_i^e, the haircut attached to the bank's specific credit exposure E_i, and H_i^{co}, is the haircut attached to the collateral. If, on the other hand, the Haircuts and Collateral method of estimation is based on external data we then deal with the *Standardised* methodology for the E_i^f calculation. If, on the other hand, their estimation is based on internal *Value at Risk* models then the E_i^f calculation is based on the I.R.B. approach. Finally, when $E_i * (1 + H_i^e) \leq Co * (1 - H_i^{co})$ we accept that $E_i^f = 0$.

[5] *Operational risk* refers to the risk that deficiencies in information systems or internal controls will result in unexpected loss. The risk is associated with human error, systems failure and inadequate procedures or controls (see Akkizidis & Bouchereau, 2006).

[6] *Tier I* is the bank's Core capital, according to Basel II (2006) and basically consists of equity capital (at common stocks) plus disclosed reserves (mainly the post tax retained earnings e.g. profits). *Tier II* basically consists of preferred stock and subordinated debt (see Chami and Cosimano, 2001).

[7] Note that according to the Basel II (2006) terminology, *banking book* is every bank's portfolio of loans (e.g. Mortgages, consumers' loans, working capital loans, etc).

and the Liability side of the banks) which appears in the *Balance Sheet* version of New Keynesianism (see Panagopoulos and Spiliotis, 2008). Using Lavoie's (2003, p. 514) terminology, we can say that the Orthodox school -through the C.A.R.- has now invented a new multiplier (a "new credit or equity multiplier") to replace the existing reserve one. If C.A.R. can be assessed as a new multiplier, then the following alternatives should be examined:

Case 1 : *The bank's equity determines (causes) the banking book portfolio* (e.g. Equity ⇒ Loans).

If this is the causal relationship between banking book (loans) and its equity, then the new multiplier is operative. This implies that the Central Bank, in a world where the role of reserve requirements is diminishing (Lavoie 2006), is capable of controlling the banks' banking book through an effectively imposed relationship with equity (the 8% "floor").

Case 2 : *The banking book portfolio determines the bank equity* (e.g. Loans ⇒ Equity).

If this is the causal relationship between the banking book and its equity, then the new multiplier is operative but reversed. Alternatively, the aggregate demand factors –proxied by the loans- are determining the bank's equity. As a theoretical concept, this is similar to a Horizontalist monetary view that "*banks sell loans and look for reserves* (now equity) *later*". As a process, it is the increased interest revenues, from the new sold loan, which increase the bank's profitability and consequently restore the imposed quantitative relationship with equity (the Basel's II *ex ante* "floor").

Case 3 : *The bank's equity is in feedback with the banking book portfolio* (e.g. Equity ⇔ Loans).

If this is the causal relationship between the banking book and its equity then, it is assumed that the bank's equity is constraining loans expansion and at the same time Loans create the bank's equity. As a theoretical concept, this can be considered as a Structuralist monetary view where "*banks' loans feedback with reserves* (*now equity*)".

Case 4 : *The bank's equity does not determine the banking book portfolio* (e.g. Equity ≠ Loans).

In this case the "new multiplier" is obviously non-operative. Such a result may be expected to hold in immature banking systems (expressed through a low total credit to GDP ratio). In these systems the C.A.R. level is possibly well above the predetermined "floor" and therefore it is perhaps more difficult to be caught in causality tests.

Moreover, the operative or non-operative role of the new multiplier is only the first stage of our discussion. This stage is mere defining the causality part of the money supply process. In a second stage we proceed with the construction of a multivariate loan model which can also be considered as an extension of the multiplier. The significance of its explanatory variables –as will be presented later- will give us a clearer view of the theoretical framework applicable to the money supply process.

3. A loan model under the Basel II influence

The build up of our loan model is based on the Panagopoulos and Spiliotis (2008) methodology, where loan demand and supply functions are equated (e.g. $L^S = L^D = L^e$)[8]. In brief, the algebraic form of the long run loan model will be:

$$L^e_t = c + \phi_1 * L^e{}_{t-i} + \phi_2 * aE_t + \phi_3 * E.R._t + \phi_4 * T.B._t + \\ + \phi_5 * A.D._t + e_t \qquad (1a)$$

and

$$\Delta L^e_t = c + \sum_{i=1}^{n1} \theta_1 * \Delta L^e{}_{t-i} + \sum_{i=1}^{n2} \theta_2 * a\Delta E_{t-i} + \sum_{i=1}^{n3} \theta_3 * \Delta E.R._{t-i} + \sum_{i=1}^{n4} \theta_4 * \Delta T.B._{t-i} + \\ + \sum_{i=1}^{n5} \theta_5 * \Delta A.D._{t-i} + \rho * e_{t-1} + u_t$$

[8]More analytically, the loan supply function will have the following functional form: $L^S_t = f(aE, E.R., L^S_{t-i}, T.B.)$. The demand for loans (from Households and Firms) is expected to have the following functional form: $L^d_t = g(L^d_{t-i}, A.D.)$.

(1b)

will represent its lagged dynamic error-correction form,

with :

aE, the Equity variable multiplied with the Basel I & II predetermined coefficient

regarding its relationship with loans (e.g. α=8%)),

$E.R.$, the excess reserve variable,[9]

$T.B.$, the trading book of the banks, a quantitative "substitution effect" variable which could be proxied by variables like: the value of Treasury Bills and Government Bonds and/or the value of Stocks and/or the value of Derivatives (e.g. Options, Futures etc),

$A.D.$, the aggregate demand of the economy proxied by variables like :

$G.D.P._{t-i}$, the gross domestic product (in nominal terms) and/or W_{t-i}, the aggregate wage and salary share of the economy.

The statistical significance, of the model 1b coefficients, corresponds to different monetary school of thought. More specifically, if the θ_5 (aggregate demand) coefficient is the only significant variable in the model, this will imply that an Horizontalist view is prevailing. If the θ_2 (Equity) coefficient is the only significant variable, this will imply that the loan market follows a New Keynesian/Basel II framework. In addition, if this is accompanied by a significant negative θ_3 (excess reserves) coefficient, this will be a strong indication for a New Consensus interpretation of the financial system. This last case will imply that the Central Bank controls indirectly (through the discount rates) the interbank market and directly the credit channel (through the Basel II directives). Moreover, if θ_3 is higher than θ_2 then the priority belongs to the "money channel" of the system.

Moreover, if coefficients θ_3 and θ_5 are significant, this will be interpreted as a PK/Structuralist determination of the system. In other words, the aggregate demand proxy will play its prime role but the Central Bank has some tightening power.

[9]This variable can be defined either as the bank's Balance Sheet difference between "Claims against other Financial Institutions" and "Liabilities against other Financial Institutions" or by

In addition, we have the "substitution effects" in the model. If the coefficient θ_4 (trading book) is significant and negative, this will imply that the trading book proxies play a role in the money supply process. Their importance has a rather PK/Structuralist interpretation.

Finally, particular attention should be given to the coefficients on the lagged values of the depended variable (θ_1). The significance of such variables can reinforce the Horizontalism explanation of the loan market. The more statistically significant and positively signed the lagged dependent variables are, the more oligopolistic the loan market becomes.[10] In other words, the stronger the seller-borrower link is the more the banking book portfolio is expected to grow. But the more it grows, the more it operates counter to the Basel II equity directives objectives, on the issue of the equity-loan link.

The significance of the model's coefficients gives us valuable information regarding the Basel II effectiveness. This can be summarised as:

1. If the Horizontalism's coefficients (θ_5 and secondary θ_1) are prevailing, the prospective effectiveness of Basel II directives upon banks' credit risk and expansion is almost nil.
2. If the Structuralist's coefficients (θ_5 and θ_3 jointly) explain the dependent variable in the model, then there is some room for Basel II effectiveness in restraining the banks' credit expansion.
3. Finally, if the New Keynesian and/or New Consensus coefficients (θ_2 and θ_3) have the explanatory power, then the Basel II directives, upon credit expansion, are expected to be effective.

4. Econometric methodology, data and empirical results

The bivariate VAR causality model

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the second account only.

[10] In an oligopolistic loan market, large portfolio banks have the capability to violate the predetermined (by Basel II) loan-equity link even if they do not have the adequate capital (from their equity) to finance the next new unit of loan. The interbank market can stand as a prop for them. Their enormous future profitability, from the growing size of their banking book, will give them the confidence to cover the lack of equity at the forthcoming Central Bank inspection (see Footnote 16, Panagopoulos and Spiliotis, 2008).

The econometric methodology of our study will begin from the bivariate relationship, related to the existence of the "equity multiplier" we mentioned in Section 3. For that reason we will implement a V.A.R. bivariate technique (see *Lutkepohl and Reimers* (1992)).[11]

An important point about the bivariate VAR causality [and the Johansen's] tests applied here, is the lag length selection procedure which has been implemented. It is known that these tests are very sensitive to the lag length specification (see Karfakis, 2004). For this reason we apply five different lag length selection criteria[12] in all our estimated causality relations (Tables 1, 2 and 3). It is important to mention that in many cases these tests select different optimal lag length (*k* in all Tables). In such cases we chose the sub-optimal lag length following the majority of the criteria's decision.

The EC.VAR (n) approach

After the determination of the causal relationship between *Equity* and *Loans* (the "equity multiplier"), we move to the loan modelling determination process. The econometric procedure applied is an error correction VAR with n variables (EC.VAR (n)).

The EC.VAR (n) approach, which is implemented next, is based on the Johansen (1988) and Johansen and Juselius (1990) multivariate co-integrated techniques. Alternatively we can say that here we have actually extend the previous VAR causality analysis to the case where the number of variables is $n > 2$ (a model case). This implies that initially we are looking for a co-integrating vector (r) which satisfies the assumption that $r < n$ (with $n > 2$). Then we move to the estimation of the E.C.VAR [loan] model.

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[11] An alternative interesting causal VAR approach, regarding the typical "multiplier effect", is provided by Caporale and Howells (2001). Its implementation is based on the assumption of a missing variable in the bivariate causality test procedure. In addition, an extensive survey of the various new methods for estimating co-integrating vectors and testing for causality in co-integrated VARs is given by Caporale & Pittis (1999). However in our case we choose to stay in line with the theoretical part of this paper, which is simply to reveal the existence and the direction of the equity multiplier. That is why the aforementioned causal VAR approach is implemented.

[12] These are: the LR statistic (*LR*), the Final Prediction Error (*FPE*), the Akaike Criterion (*AIC*), the Schwarz Criterion (*SC*), the Hannan-Quinn Criterion (*HQ*).

Data analysis

The data used for the VAR causality test [*Loans vs. Equity*] were derived from the quarterly *Financial Statements* and the annual *Balance Sheets* of the six largest banks of the Greek banking system[13] (accounting for the 85% of the system). The examined time period was from 1995Q1 to 2006Q1.

Data for the loan model implementation (1c) were also derived from the quarterly *Balance Sheets* mentioned above. More specifically, the interbank proxy (ER) was derived from this data source in two different ways: Either as the accounting difference between "Claims against other financial Institutions" minus the "Liabilities against other financial Institutions" (e.g. $x_t = C - L$) or simply as the "Liabilities against other financial Institutions" (or interbank debt) term. In addition, the GDP variable in nominal prices, was obtained from *Eurostat.* Finally, no "substitution effect" variable has been implemented because we have no such detailed information from the *Financial Statements* of the Greek banks or from the *Bulletin* of the Bank of Greece. Consequently, we cannot test model 1a as it is presented in section 3.1. Fortunately the crucial variables, for the determination of the money supply process, appeared and were tested in the empirical loan model [Table3].

Empirical results

The *Johansen* long run [causality] results between loans and equity ($LLoans$ and $LEquity$ respectively) in the Greek banking system are presented in Table 1.[14]

(insert-*Table 1*)

From the rank of matrix $\Pi(r)$ of Table 1 it is obvious that there is no long run relationship between bank loans and equity in the examined period. Therefore we can accept *Case 3* of the "equity multiplier" effect, which says that it is non-operative[15].

[13] These banks are: Ethniki, Eurobank, Alpha, Piraeus, A.T.E. and Emporiki. Every variable implemented in our econometric models (e.g. *Loans, Equity and the Interbank proxy* (ER)) is constructed as a summation derived from the *Financial Statements* and the Annual *Balance Sheets* of these six banks. The corresponding data have been deposited in the KEPE archive and the are available upon request.

[14] Note here that the Residential part of the loans variable is weighted with 0.50, as it is recommended by the Basel II.

[15] In contrast to this result, in the *Eurozone* banking system the existence of a reversed *equity multiplier* (*Case 2*, in Section 2) was econometrically proven (see Panagopoulos and Spiliotis (2008), Table 2).

This result is not surprising, since the Greek banking system is not considered to be a mature one. This immaturity is also obvious by the evidence of Athanassiou (2006)[16]. Moreover, a simplified calculation of an aggregate C.A.R. (=Equity/Loans) for the Greek banking system -at 2006Q1- was estimated at about 12% (see Panagopoulos and Peletides, 2007). This implies that the Greek banking system has enough excess equity, which at the moment operates as a cushion, to spend before reaching the point for testing the direction of the "equity multiplier", if such multiplier is operative.

The selected [with the *Johansen* methodology: co-integrating vector (r)] loan model is presented in Table 3. In the same Table we present its EC.VAR analytical results.

[insert-*Table 3*]

According to the above EC results, the aggregate demand proxy ($LGDP$) is the most significant term (the second and the fourth lags). Moreover, the lagged dependent variable ($LLoans$) is also important (the fourth lag). This reveals the bank's attempt to establish a strong borrower-lender network which can lead to an oligopolistic structure. If such tendency prevails in Greece, then Basel II will become even more incapable of imposing equity control on banks. The third lag of the Basel II proxy ($LEquity$) is also significant. This can be interpreted as a central bank's attempt to restrain the aggregate banking book expansion. So, it would not be odd to say that the Greek banking system behaves in a Structuralist /PK manner[17]. Finally, the tested proxy of the interbank market (LER) is positive and statistically significant (the first and the third lags). This is evidence of an accommodatory Central Bank interbank behaviour [although both coefficients of the two lagged variables are too small for further discussion (0.02)].

Overall, the Greek banking system, during the time of Basel I applicability, seems to follow a Structuralist/PK framework without, however, the existence of a reversed or even a feedback "equity multiplier" effect.

5. Concluding comments

[16] Athanassiou (2006) presents (see Diagram 2) and analyses the Household Credit to GDP ratio of Greece which is low relative to the Eurozone's countries.

[17] On the other hand, the *Eurozone* banking system follows a rather Horizontalist/PK framework (see Panagopoulos and Spiliotis (2008), Table 4).

The main purpose of this paper was to examine the Greek banking system under the influence of Basel II directives. At the theoretical part, we briefly analysed how the Orthodox and Post Keynesian [PK] debate over the money supply process evolved mainly through the emergence of bank equity imposed by Basel II in the banking system (e.g. a new credit (equity) multiplier and a new multivariate loan model).

In the empirical part of this study we examined the loan supply process in the Greek banking system, taking into account these redefined –due to Basel II directives- theoretical elements. Our results first underline that the new equity multiplier is not operational in Greece. However, when banks' equity is included in the new multivariate loan model it has some explanatory value. Second, the interbank debt effect (*ER* variable) is marginally significant but with a positive (non-restraining) sign. Considering that all the aggregate demand proxies are significant (*GDP* and *Loans* lags), we can finally accept that the Greek banking system follows a redefined PK/Structuralism.

Based on the above results, we conclude that the prospects for an effective Basel II equity directives implementation are limited in the Greek banking system. Moreover, any acceleration of the mergers and acquisitions in the banking sector will further diminish the role of the Basel II directives.

Table 1

The Johansen results between Equity and Loans (1995-2006)$^{\partial}$

Hypothesis: Johansen's Co-integration tests	**λ Max-eigenvalue**	**λ trace**	**$\Pi(r)$ value**	**No. of *lags* *(lag selection- k)****	***long-run result***
Equity *vs* Loans	5.17	5.19	0	4	Equity ≠ Loans

* The lag selection criterion (k) was based on the *F.R.E., L.R., H.Q.* tests.
∂. The variables are in logs.

Table 2

The Johansen results for the multivariate loan model (1995-2006)

Selected Co-integrating Vector (r) in Logs :

($LLoans, LGDP, LER, LEquity$)

Hypothesis: Ho	**H_1**	**No. of *lags* *(lag selection- k)*** ^{f}	**λ Max eigenvalue test**	**Critical Value 5%**
$r=0$	$r=1$	5	42.0	27.7
$r\leq 1$	$r=2$	5	19.4	20.9
$r\leq 2$	$r=3$	5	13.6	14.0
$r\leq 3$	$r=4$	5	3.0	3.8

* number of Co-integrating Vectors, $r=1$

Hypothesis: Ho	**H_1**	**No. of *lags* *(lag selection- k)*** ^{f}	**λ Trace eigenvalue test**	**Critical Value 5%**
$r=0$	$r=1$	5	78.2	47.2
$r\leq 1$	$r=2$	5	36.2	29.6
$r\leq 2$	$r=3$	5	16.7	15.4
$r\leq 3$	$r=4$	5	3.0	3.7

* number of Co-integrating Vectors, $r=3$

f. The lag selection criterion (k) was based on the *F.R.E., A.I.C., H.Q.* tests.

Table 3

The EC.VAR (n) for the multivariate loan model (1995-2006) ♣

Dependent Variable : $\Delta Log(Loans)$

$$\Delta L(Loans) = -0.21 - \underset{(-1.97)(-0.11)}{0.02 * \Delta L(Loans)_{t-1}} + \underset{(1.57)}{0.36 * \Delta L(Loans)_{t-2}} - \underset{(-0.36)}{0.07 * \Delta L(Loans)_{t-3}}$$

$$+ \underset{(2.21)}{0.36 * \Delta L(Loans)_{t-4}} - \underset{(-0.96)}{0.17 * \Delta L(Loans)_{t-5}} + \underset{(1.90)}{1.50 * \Delta LGDP_{t-1}}$$

$$+ \underset{(3.09)}{3.51 * \Delta LGDP_{t-2}} + \underset{(1.91)}{2.38 * \Delta LGDP_{t-3}} + \underset{(2.56)}{2.73 * \Delta LGDP_{t-4}} + \underset{(1.58)}{1.33 \Delta LGDP_{t-5}}$$

$$\underset{(-1.14)}{-0.10 * \Delta LEquity_{t-1}} - \underset{(-1.31)}{0.10 * \Delta LEquity_{t-2}} + \underset{(4.44)}{0.32 * \Delta LEquity_{t-3}}$$

$$+ \underset{(1.32)}{0.13 * \Delta LEquity_{t-4}} + \underset{(0.77)}{0.06 * \Delta LEquity_{t-5}} + \underset{(2.18)}{0.02 * \Delta ER_{t-1}} + \underset{(1.60)}{0.01 * \Delta ER_{t-2}}$$

$$+ \underset{(2.64)}{0.02 * \Delta ER_{t-3}} + \underset{(1.96)}{0.01 * \Delta ER_{t-4}} + \underset{(0.37)}{0.002 * \Delta ER_{t-5}} - \underset{(-2.75)}{0.19 * Z_{t-1}} + u_t$$

$$R^2 = 0.82, adjusted\ R^2 = 0.59, R.S.S. = 0.0201$$

$$Co - \text{int}\, egrarting\ \ Vector\,(r), in \log s:$$

$$LLoans = \underset{(10.37)}{2.04 * LGDP_t} + \underset{(5.75)}{0.48 * LEquity_t} - \underset{(-3.53)}{0.16 * ER_t} - 35.8$$

♣t-statistics in the parentheses.

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