«ΣΠΟΥΔΑΙ», Τόμος 51, Τεύχος 1ο-2ο, Πανεπιστήμιο Πειραιώς / «SPOUDAI», Vol. 51, No 1-2, University of Piraeus

THE USEFULNESS OF COMMERCIAL BANK PORTFOLIO BEHAVIOUR MODELLING. RETROSPECTION AND PROSPECTS

By

Demetres N. Subeniotis , Nikolaos B. Georgopoulos , Victoria Pekka - Economou

Abstract

The paper aims to develop a methodology for the exploitation of commercial banks' portfolio behaviour models in the implementation of macroeconomic policy. As it has been shown, for the attainment of a chosen set of macroeconomic targets, it can be determined a *sufficient,* reconstruction of the consolidated commercial banks' portfolio, which, in its turn, can be succeeded in via a large number of alternative government intervention packages. The four successive stages of the methodology comprise: estimation of alternative bank portfolio behaviour models and selection of the prevailing specification; distinction of strategic central government targets that are better explained by the endogenous variables of the prevailing specification; determination of the desired reconstruction in the consolidated banking sectors' portfolio, given the desired changes in the macroeconomic targets, and finally; calculation of the alternative central government intervention packages. The empirical demonstration, regarding the Greek case, reveals that such a methodology would be of primary importance for both the policy makers and the monetary authorities of any country (G21/D78).

1. Introduction

The bank portfolio behaviour models (B.P.B.M.) available so far in the literature [Parkin (1970), Parkin-Gray-Barret (1970), Courakis (1974, 1975, 1980, 1981, 1984, 1988, 1989), White (1975), Bailey - Driscoll - Ford (1980), Borrio (1984), Sharpe (1973, 1974), Spencer (1984, 1989), Berndt-McCurdy-Rose (1980), Subeniotis (1992, 1996, 1998)], although offer sufficient solutions to the problem of *«how banking institutions should distribute or redistribute their available funds so as to maximise their expected profit given a change*

* University of Macedonia, Department of Business Administration.
** University of Piraeus, Department of Business Administration.
*** University of Piraeus, Department of Business Administration.

in an exogenous variable», they neither answer the question of *«which distribution or redistribution of their available funds can better facilitate the attainment of macroeconomic targets»,* nor *«determine alternative government intervention packages that would lead to the desired bank portfolio redistribution previously mentioned».*

This paper aims to develop a methodology which distinguishes the macroeconomic targets that are better explained by the endogenously determined items of the banks' consolidated balance sheet and suggests a large number of alternative government intervention packages for the attainment of each and every set of macroeconomic targets previously chosen.

The four successive stages of the methodology comprise: a) an estimation of alternative bank portfolio behaviour models and selection of the prevailing specification; b) a distinction of macroeconomic targets that are better explained by the endogenous variables of the prevailing specification; c) a determination of the desired reallocation in banks' portfolio given the desired changes in the macroeconomic targets, and d) a calculation of the alternative intervention packages. Since, from the point of view of the individual researcher, the overall *empirical* evaluation of the methodology seems to face considerable complications and impossibilities, we thought safer to simulate its performance based on a) the best Jacobian matrix available in the literature with reference to the portfolio behaviour of the Greek commercial banks and b) the assumptions of the set of macroeconomic targets that are better explained by the endogenous balance sheet items of these institutions.

This paper is divided into four sections. Section 1 describes the procedures of building, estimating and testing a bank portfolio behaviour model and defines the frontiers of its usefulness. Section 2 presents the four successive stages of the methodology and explains its potential ability to exploit bank portfolio models in macroeconomic policy implementation. Section 3 demonstrates the methodology on Greek data, while section 4 reports the conclusions.

2. The usefulness of B.P.B.M.: Retrospection and Prospects

Previous empirical studies of bank portfolio behaviour *adopted* one of the classical theoretical frameworks (Mean Variance Expected Utility, Safety First e.t.c), *determined* the choice and non choice items of the institutions' consolidated balance sheet, *used* the most appropriate mechanism in order to calculate the expected returns of the choice or/and the non choice set items, *derived* the asset/liability demand/supply functions and finally *estimated* these functions using the econometric method of maximum likelihood. In case of statistically significant estimates, the banking institutions could utilise the implied Jacobian matrix, in order to optimise the structure of their portfolio each time they had to face changes in exogenous variables.

This approach is considered to be statisfactory for the financial institutions, as long as it ensures an optimum portfolio structure (and thus maximisation of their profits), but on no account can it be considered a sufficient mean for the attainment of macroeconomoic targets. In particular, *if* we suppose[1] that the optimum portfolio selections of the banking institutions are described by the estimated demand functions (1.1.)

$$A_1 = J\ X \tag{1.1}$$

with,

$$A_1' = [a_{11},\ a_{12},\ ...,\ a_{1k}]'$$

$$X' = [E \mid A_2]' = [X_1,\ X_2,\ ...,\ X_v]'$$

$$E' = [e_1,\ e_2\ ....,\ e_k]'$$

$$A_2' = [a_{21},\ a_{22},\ ..,\ a_{2\mu}]'$$

and where (') denotes the transpose of a vector or matrix, A_1 is a (kxl) vector of the selectable (choice) assets/liabilities of their consolidated balance sheet, X is a (vxl) apportioned matrix, E is a (kxl) vector of the expected returns/cost on the choice balance sheet items, A_2 is a (μx1) vector of the non-choice balance sheet items and J is a (kxv) Jacobian matrix, while ($v=k+\mu$), *then,* those interested can *estimate* the total effect *of each* direct or indirect means of policy (X_J, j = l, ..., v), on each one of the choice variables (a1i, i=1, ..., k), *or/and choose* the best out of the available means (x_1 or x_2 ...or x_v), for achieving a desired level in *one* of the choice variables ($\alpha_{11}=\alpha_{11}^*$ or $\alpha_{12}=\alpha_1^*$..., or $a_{1k}=a_{1k}^*$), where (*) it denotes the desired level. On the contrary, those in charge of exercising the economic policy, by having an estimated model of bank portfolio behaviour at their disposal: *neither* can determine simultaneously *all* the qualitative and quantitative characteristics of the institutions' available funds reallocation ($\Delta\alpha_{11}$ and $\Delta\alpha_{12}$ ..., and $\Delta\alpha_{1k}$), given a change in a nonchoice set item (Δx_1, or Δx_2, ..., or ΔX_v), where Δ denotes a change; *nor* know the best, for achieving the macroeconomic targets, portfolio reallocation ($\Delta\alpha_{11}=\varphi$ and $\Delta\alpha_{12}=\psi$..., and $\Delta\alpha_{1k}=\zeta$), where φ, ψ, ..., and ζ denote the optimum changes under consideration; *nor even* determine whether and which macroeconomic targets are explained significantly by the choise set items of the consolidated balance sheet of these institutions.

Given the above, one may argue that in the context of macroeconomic policy implementation, the utility of bank portfolio behaviour models themselves is rather trifling. As it will be shown in what follows, when the B.P.B.Ms are placed in a wider framework of analysis, their *potential* utility is not at all negligible.

3. The methodology

The proposed methodology comprises four stages

STAGE 1: Selecting the optimum Jacobian and determining the maximum number of strategic central government targets

The policy makers, after choosing the financial institutions through which they would like to achieve the macroeconomic targets, use data of their consolidated balance sheets, in order to estimate alternative portfolio behaviour models and finally select the model which best satisfies their objective expectations. The objective expectations and, consequently, the selection of the best model, have to be based on a multitude of *complementary* criteria. That is, on the statistical significance of the estimated parameters, on the R^2 and the DW_{-t} or DW_{-h} of each estimated demand/supply function, on the "compatibility" of the signs of the estimated parameters, on the empirical acceptance of the Engel, Gournot and Symmetry restrictions, on nested tests like the Likelihood Ratio (LR) test or/and on non-nested test like the Akaiky Information Criterion (A.I.C.) or/and the Schwarz Banessian Criterion (S.B.C.), on the ex-post (Historical Simulation Performance) behaviour of each model and finally, on the forecasting behaviour of each model as this can be recorded through the criteria: Root Mean Squared Forecast Error (RMSFE), Theil & Theil Partial Inequality Coefficients (T.I.C.), Turning Points Prediction (T.P.P), Janus Quotient (J.Q), the Davinson McKinnon "P" test and the Structural Stability Test (S.S.T) by Pesaran - Smith &Yeo.

If we suppose that the model 1.1 has been chosen on the basis of the above criteria, then, the policy makers will not only have at their disposal the best possible Jacobian matrix of the total effects of each and every direct or indirect means of intervention, but they will also know the *maximum number* of the macroeconomic targets they will potentially be able to achieve *simultaneously* by intevening in the portfolio selection process of these institutions. The necessity for solving equation systems originating from the proposed methodology, demonstrates that the *maximum number of simultaneously attainable macroeconomic targets cannot be larger than k*[4].

STAGE 2: Determining the macroeconomic central governement targets

Having decided upon the model specification that better explains the portfolio behaviour of the bankin institutions and, by implication, having at the same time determined the number and the identity of the balance sheet items and their return/cost contained in vectors A_1, A_2, and E respectively, we can now examine the significance of the model in the context of implementing economic policy and therefore, we can determine *whether* and *which* macroeconomic targets can be explained by the *choice balance sheet* items of the A_1 vector. In particular, the policy makers have to choose a set of $k+\lambda$ macroeconomic targets, where $(\lambda>0)$, which they believe are possible to be explained by the *choice balance sheet items* of the banking institutions, and then, they have to successively estimate the indicative model

$$M^{\xi}_{t} = \Pi^{\xi} A_{1,t} + u_t \qquad (1.2)$$

where

$$M^{\xi\prime} = [\mu^{\xi}_{1}, \mu^{\xi}_{2}, \cdots, \mu^{\xi}_{k}]'$$

is a (1xk) matrix containing the ξ compination of macroeconomic targets, t denotes time, ξ takes the values $(1, \ldots, \tau-1, \tau)$, where τ is the number of alternative combinations implied when $k+\lambda$ variables are combined per k, Π^{ξ} is a (kxk) matrix of unknown coefficients which corresponds to the ξ combination of macroeconomic targets and u is the disturbance vector. In view of the above, model (1.2) should be estimated τ times and as predominant estimation will be deemed the one which ensures the maximum interpretative strength for the variables of the vector A_1. Alternatively, as best estimation will be selected the one which ensures the most important role for the banking institutions in the context of macroeconomic targets implementation. Obviously, the prevailing estimation, e.g. $\Pi^{\xi=\tau-1}$, entails a specific set of macroeconomic targets and particularly it determines the macroeconomic targets contained in the $(\xi=\tau-1)$ combination.

Undoubtedly, the equation system (1.2) may not ensure the information inflow desired by the policy makers or may simply not ensure so much information inflow as it could, fr instance, ensure a dynamic or a vector autocorrelation model. In this case, it is obvious that the behaviour of alternatively determined models must be also examined. Additionally, it is possible to observe that the choice balance sheet items of the banking institutions are not capable of explaining k strategic variables/targets. In view of this, and if the policy makers insist in finding a way to affect no less than k strategic variables, then, they could properly adjust the model in order to use the explanatory power of fiscal policy means, like the V.A.T., other taxes, e.t.c. Although dealing with such real world problems is generally inevitable, the adjustments in model specification implied each time on no occasion reduce the value of the proposed methodology, which, exactly for this reason, approaches the whole issue in its most general form.

On the assumption that the equation system (1.2) exhibits a sufficient explanatory power, we can proceed to the next stage, where, given the macroeconomic targets, we can determine the desired (or sufficient) banks' portfolio adjustment.

STAGE 3: Determination of the sufficient adjustment in banks' portfolio

Since it has been decided *which* macroeconomic targets are explained by the choice balance sheet items of the banking institutions, or similarly, since it is known *how much* are the chosen macroeconomic targets affected by any reallocation of banks' available funds, we may now proceed to determine both: the required changes to the macroeconomic variables given their desired levels and the banks' portfolio adjustment that is sufficient to generate the required changes under consideration.

In this framework, those responsible for economic policy implementation, with the help of knowledge they command by way of estimating and solving general equilibrium models or even by exploiting internal information as with the priorities of the governmental policy, can set the strategic targets and therefore can specify the matrix.

$$\Delta M^{d\,\prime} = [(\mu^d{}_1-\mu_1),\ (\mu^d 2-\mu 2)...,\ (\mu^d{}_k-\mu k)]' = [\Delta\mu^d\, 1\ ,\ \Delta\mu^d\ 2\ ...,\ \Delta\mu^d\ k]'$$

where $\mu^d i$ represents the desired level of the i macroeconomic variable (i=1..k), ($\mu^d i$ - μ_i) represents the deviation between the desired and the real level of the i macroeconomic variable, and ΔM^d is a (kxl) matrix of the desired changes in the macroeconomic variables/targets . It should be mentioned that the macroeconomic variables contained in the ΔM matrix are those contained in the (ξ = t-1) combination and therefore are those which ensure the maximum interpretative power for the A_1 vector.

In view of the above and based on the estimation of the equation (1.2), we are now in the position to solve the equation system (1.3)

$$\Delta M^d = \Pi^{\xi} \Delta A_1 \quad (1.3)$$

where

$\Delta A_1' = [\Delta\alpha_{11}, \Delta\alpha_{12}, ..., \Delta\alpha_{1k}]'$

is a (lxk) matrix of *sufficient unknown changes* of the choice balance sheet items of the banking institutions and where Π^{ξ} is the estimated Π^{ξ} matrix, in order to calculate the *sufficient* portfolio restructuring ΔA_1^s,

$$\Delta A_1^s = (\Pi^{\xi}) - \Delta M^d \quad (1.4)$$

Given the (1.4), the policy makers already know the sufficient portfolio adjustment and the only thing they have to do further is to find out by which intervention policy they will be able to impose such an adjustment on the banking institutions.

STAGE 4: Qualitative and quantitative determination of the intervention policy

Given the vector ΔA_1^s and the Jacobian matrix J, the monetary authorities can solve the equation system (1.5)

$$\Delta A_1^s = J^{\lambda} \Delta X^{\lambda} \quad (1.5)$$

where ΔX^{λ} is a (kx1) matrix of *unknown changes* in the exogenous variables of the banks' demand/supply functions contained in the λ package of intervention means, and (λ=1, ..., ρ), with ρ=ν!/ [k! (ν-k)!], while J is a (kxk) matrix which contains the columns of the Jacobian that *correspond* to the intervention means contained in the λ package, and therefore they can determine the λ *sufficient* intervention policy $\Delta\chi^{\lambda s}$,

$$\Delta X^{\lambda s} = (J^{\lambda})^{-1} \Delta A_1^s \quad (1.6)$$

In concluding, we may argue that for every set of k macroeconomic central government targets ΔM^d and for every *sufficient* readjustment in banks' portfolio ΔA_1^{s}[8], there are ρ altenrative but equivalent intervention policies.

4. Demonstrating the methodology on Greek data

The proposed methodology represents a strategic approach and therefore it does not enter into testing its empirical validity. Such test presumes an extensive empirical research on bank portfolio behaviour modelling (stage 1); *requires* the construction, estimation and evaluation of a general equilibrium model of the real and financial sectors of the economy in order to discover the extent and the magnitude of any transmission mechanism between the bank portfolio behaviour and the real macroeconomy (stage 2); and depends crucially upon the use of internal information as to the macroeconomic priorities (targets) of the governmental policy (stage 3). From the point of view of the monetary authorities (which may determine the optimal macroeconomic targets, decide as to whether the elements of the A_1 matrix does provide them with the best information with reference to the target variable M and choose the desired intervention means) the ultimate evaluation of the methodology is a straight forward task. From the point of view of the individual researcher (who has no access to the policy reaction function of the government) the above issues seem to imply considerable complications and impossibilities. As a consequence, the individual researcher can *only* make use of equation (1.6), while, even this is only feasigle by assuming both:a hypothetical set of targets for the ΔA_1^s vector and an appropriate Jacobian matrix J.

The Jacobian matrix of the *total multiplier effects* J^T employed in the following demonstration describes the portfolio behaviour of the Greek Commercial Banks and its calculation has been based on the best *impact multiplier effects* Jacobian matrix J^{IM} available in the literature[9] with reference to these institutions. In particular, the J^{IM} *is* a maximum likelihood estimation of the dynamic mean-variance-expected utility model (1.7)

$$A^G_{1,t} = L\ A^G_{1,t-1} + J^{IM}\ X^G + u_t \qquad (1.7)$$

where

A^G1,t is a (4x1) vector containing the choice balance sheet items of the Greek Commercial Banks at the end of the t time period, L is a (4x4) response matrix, $A^G1,t-1$ is a (4x1) vector of lagged choice variables, J is a (4x14) *impact* multiplier effects Jacobian matrix, $X^G = [E^G{}_t: A^G2.t]$ is a (14x1) partitioned vector, where A^G2 is a (10x1) vector of non choice set balance sheet items, E^G is a (1x4) vector of choice variables' interest rates, u_t is a (4x1) disturbance vector, whereas the G intex denotes the origin of the data used. In proceeding and by following the specification of the (1.7) model, we define the $A^G{}_1.t$, $E^G{}_t$ and $A^G{}_{2,t}$ vectors as

$A^G{}_{1\cdot t}$ = [C, ELA, TBS, BGA]

$E^G{}_t$ = [INF, EIRLA, EIRTS, EIRBA]

$A^G{}_{2.t}$ = [DBG, EXL, AFE, OA, STD, SAD, TMD, BLD, LFE, OL]

where

C	=	Cash & non-interest bearing current accounts with the Bank of Greece
ELA	=	Endogenous Loans and Advances
TBS	=	Treasury Bills & Securities
BGA	=	Bank of Greece Advances
INF	=	Rate of Infuriation
EIRLA	=	Expected Interest Rate on Loans &Advances
EIRTS	=	Expected Interest Rate on Treasury Bills and Securities
EIRBA	=	Expected Interest Rate on Bank of Greece Advances
DBG	=	Commercial Banks' Deposits with the Bank of Greece except non interest bearing current accounts
EXL	=	Exogenous Loans and Advances
AFE	=	Assets in Foreign Exchange
OA	=	Other Assets
STD	=	Sight Deposits
SAD	=	Saving Deposits
TMD	=	Time Deposits
BLD	=	Blocked Deposits
LFE	=	Liabilities in Foreign Exchange
OL	=	Other Liabilities

By using the following formula proposed by Theil (1971),

$$J^T = J^{IM} + LJ^{IM} \sum_{g=0}^{\infty} L^g \quad (1.8)$$

we are in the position to calculate the total effect response matrix J^T (see Table 1), where g denotes the number of the repeated elimination of the lagged endogenous variables.

TABLE 1

Total Multiplier Effects Jacobian Matrix (in billion drachmas)

BGA	TBS	ELA	C	
123,012	1067,380	-1000,200	-190,790	INF
-105,768	387,041	325,940	-607,040	EIRLA
-186,480	-1012,160	638,049	560,930	EIRTS
169,262	-445,200	36,110	236,460	EIRBA
-0,191	-0,717	0,251	-0,311	DBG
-0,695	-6,905	7,060	-0,528	EXL
-0,007	-0,313	-0,480	-0,198	AFE
-0,060	-0,167	-0,356	-0,385	OA
0,331	-0,064	0,094	0,631	STD
-0,107	1,033	0,199	-0,160	SAD
0,484	0,548	-0,125	0,101	TMD
-2,260	-0,949	4,067	0,064	BLD
-0,184	0,523	0,486	0,159	LFE
0,059	0,463	0,230	0,274	OL

Turning to the specification of hypothetical sets of *sufficient* changes in choice balance sheet items ΔA_1^s and so as to reveal how flexible and therefore useful the methodology is, we assume fifteen scenarios (s=1,...,15) classified in four groups. Specifically,

I. the first group ΔA_1^s (s = 1,...,4) presumes that the desired changes in macroeconomic varialbes can be accomplished through an *increase in one or more endogenous assets*

II. the second group ΔA_1^s (s = 5,...,7) assumes that the policy objectives can be attained through a *reallocation of endogenous assets*

III. the third group ΔA_1^s (s = 8,...,11) examines the case where the macroeconomic targets can be achieved through *matching increases/decreases in endogenous assets and liabilities,* while.

IV. the forth group ΔA_1^s (s = 11,..., 15) examines combinations of the adjustments assumed within the first and the second group.

Yes, although the monetary authorities may theoretically combine the fourteen policy means (v=14) per four (k=4) in order to derive a large number (ρ) of alternative intervention packages $\Delta X^{\lambda s}$ (λ= 1,...,ρ) for the attainment of each and every ΔA_1^s (s=1,...,15), let us simplify the demonstration by employing only the following (λ=1,...,5) intervention cases.

I. Case $\Delta X^{\lambda=1.s}$ = *[ΔINF, ΔEIRLA, ΔEIRTS, ΔEIRBA]:* all the instruments chosen are interest rates and therefore it represents an interest rate management.

II. Case $\Delta X^{\lambda=2.s}$ = *[ΔEIRLA, ΔEIRTS, ΔEIRBA, ΔDBG]:* it comprises interest rate management with Central Bank interventions

III. Case $\Delta X^{\lambda=3,s}$ = *[ΔEIRLA, ΔEIRBA, ΔDBG, ΔLFE]:* it considers the administrative manipulation of both, interest rates and non-choice liabilities.

IV. Case $\Delta X^{\lambda=4,s}$ = *[ΔSTD, ΔSAD, ΔTMD, ΔLFE]:* it deals with the indirect administrative manipulation of the various deposit categories.

V. Case $\Delta X^{\lambda=5,s}$ = *[ΔEIRLA, ΔEIRBA, ΔDBG, ΔAFE]:* it comprises both, interest rate instruments and non-choice set assets.

Given the above, we may now use equation (1.6) in order to calculate alternative sufficient intervention packages $\Delta X^{\lambda,s}$, (see Table 2).

TABLE 2

Selected Policy Objectives & Suggested Intervention Packages

Sufficient Changes in Choice Set Items ΔA_1^s (s = 1,...15)					**Selected Intervention Package (1) Case $\Delta X^{\lambda=1,s}$ = [ΔINF, $\Delta EIRLA$, $\Delta EIRTS$, $\Delta EIRBA$]**			
Scenario	*C*	*ELA*	*TBS*	*BGA*	ΔINF	$\Delta EIRLA$	$\Delta EIRTS$	$\Delta EIRBA$
$\Delta A_1^{s=1}$	10	0	0	0	–	–	–	–
$\Delta A_1^{s=2}$	0	10	0	0	–	–	–	–
$\Delta A_1^{s=3}$	0	10	10	0	–	–	–	–
$\Delta A_1^{s=4}$	0	10	10	0	–	–	–	–
$\Delta A_1^{s=5}$	0	0	-15	0	4,34	4,34	4,35	4,34
$\Delta A_1^{s=6}$	15	0	-15	0	-10,06	-1,06	0,65	0,00
$\Delta A_1^{s=7}$	-30	15	15	0	0,83	0,98	-1,03	0,08
$\Delta A_1^{s=8}$	-20	0	0	-20	11,69	11,68	11,70	11,58
$\Delta A_1^{s=9}$	0	15	15	30	-17,56	-17,49	-17,58	-17,36
$\Delta A_1^{s=10}$	0	-25	0	-25	14,65	14,58	14,66	14,47
$\Delta A_1^{s=11}$	0	0	15-	15-	8,77	8,74	8,79	8,68
$\Delta A_1^{s=12}$	-20	20	20	20	-11,72	-11,64	-11,74	-11,57
$\Delta A_1^{s=13}$	-10	-10	30	10	-7,14	5,61	6,78	-0,12
$\Delta A_1^{s=14}$	-10	30	-10	10	-0,99	4,95	3,69	0,53
$\Delta A_1^{s=15}$	15	-15	-15	-15	8,79	8,73	8,81	8,68

(continued)

ΔA_1^s (s=1,....,15)	**Selected Intervention Package (2) Case $\Delta X^{\lambda-2}$= [$\Delta EIRLA$, $\Delta EIRTS$, $\Delta EIRBA$, ΔDBG]**				**Selected Intervention Package (3) Case $\Delta X^{\lambda=3,s}$ = [$\Delta EIRLA$, $\Delta EIRBA$, ΔDBG, ΔLFE]**			
Scenario	$\Delta EIRLA$	$\Delta EIRTS$	$\Delta EIRBA$	ΔDBG	$\Delta EIPLA$	$\Delta EIRBA$	ΔDBG	ΔLFE
$\Delta A_1^{s=1}$	0,66	0,78	-0,71	-10,00	-1,32	0,08	-0,88	9,20
$\Delta A_1^{s=2}$	1,84	0,97	1,05	-10,00	1,02	2,03	1,28	11,28
$\Delta A_1^{s=3}$	0,46	0,20	-0,64	-10,00	0,29	-0,44	-7,80	2,20
$\Delta A_1^{s=4}$	2,30	1,17	0,40	-20,00	1,32	1,59	-6,5	13,5
$\Delta A_1^{s=5}$	-0,06	-0,03	0,01	15,46	-0,04	0,06	11,79	-3,62
$\Delta A_1^{s=6}$	-0,01	-0,08	-0,09	-0,03	-0,02	0,07	10,46	10,32
$\Delta A_1^{s=7}$	-0,05	-0,05	0,02	-0,08	0,05	0,02	-7,20	-7,02
$\Delta A_1^{s=8}$	-0,02	-0,03	-0,08	41,61	-0,02	-0,08	41,19	-0,41

$\Delta A_1^{s=9}$	0,08	-0,05	0,01	-62,51	0,09	0,15	-69,00	-6,40
$\Delta A_1^{s=10}$	-0,09	-0,05	-0,01	52,16	-0,08	-0,15	46,06	-6,02
$\Delta A_1^{s=11}$	-0,03	0,08	-0,06	31,21	-0,04	-0,05	41,36	10,01
$\Delta A_1^{s=12}$	0,09	-0,07	0,12	-41,73	0,10	0,11	-50,80	-8,95
$\Delta A_1^{s=13}$	-1,54	-0,37	-7,26	0,00	-1,22	-7,64	-4,26	-4,26
$\Delta A_1^{s=14}$	3,96	2,70	-0,45	0,00	1.71	2,27	32,31	32,31
$\Delta A_1^{s=15}$	-0,07	0,05	-0,09	31,30	-0,07	-0,08	38,10	6,71

(continued)

ΔA_1^s (s=1,...,15)	**Selected Intervention Package (4) Case $\Delta X^{\lambda=4,s}$=[Δ*STD*, Δ*SAD*, Δ*TMD*, Δ*LFE*]**				**Selected Intervention Package (5) Case $\Delta X^{\lambda=5,s}$=[Δ*EIRLA*, Δ*EIRBA*, Δ*DBG*, Δ*AFE*]**			
Scenario	Δ*STD*	Δ*SAD*	Δ*TMD*	Δ*LFE*	Δ*EIRLA*	Δ*EIRBA*	Δ*DBG*	Δ*AFE*
$\Delta A_1^{s=1}$	31,90	26,00	-23,40	-22,8	-1,71	-0,94	1,60	-11,60
$\Delta A_1^{s=2}$	-27,50	-41,60	27,50	50,00	0,54	0,77	4,40	-14,4
$\Delta A_1^{s=3}$	7,91	17,90	-4,90	-10,10	0,19	-0,70	-7,20	-2,80
$\Delta A_1^{s=4}$	-19,60	-23,70	22,50	39,80	0.73	0,06	-2,80	-17,20
$\Delta A_1^{s=5}$	-12,43	-27,84	8,42	15,97	-0,02	0,01	10,82	4,49
$\Delta A_1^{s=6}$	37,82	14,87	-30,67	-21,29	-0,02	-0,03	13,22	-12,82
$\Delta A_1^{s=7}$	-131,42	-123,25	114,40	136,17	0,06	0,02	-9,08	8,72
$\Delta A_1^{s=8}$	-19,32	19,57	-28,16	-11,52	-0,02	-0,08	41,09	0,51
$\Delta A_1^{s=9}$	-102,44	-152,61	156,64	153,45	0,09	0,16	-70,71	7,95
$\Delta A_1^{s=10}$	131,85	205,10	-174,74	-205,87	-0,08	-0,15	44,45	7,47
$\Delta A_1^{s=11}$	23,33	29,55	-51,79	-29,93	-0,04	-0,06	44,04	-12,44
$\Delta A_1^{s=12}$	-155,90	-183,91	180,69	193,08	0,10	0,12	-53,20	11,12
$\Delta A_1^{s=13}$	42,00	106,00	-57,20	-86,80	-1,03	-7,15	-5,40	-5,40
$\Delta A_1^{s=14}$	-99,80	-132,40	72,70	154,00	0,36	-1,23	40,20	-40.20
$\Delta A_1^{s=15}$	116,93	137,93	-135,52	-144,81	-0,07	-0,09	39,90	-8,34

(1) Changes in balance sheet items are expressed in billion drachmas (b/dr)

(2) Canges in interest rates are expressed in percentage units (p/u)

The fact that most of the intervention packages may finally induce a *sufficient* portfolio adjustment does not mean that the monetary authorities should be indifferent as to which set of instruments is eventually chosen. On the contrary, and since the set of instruments selected each time must be in accordance with the primary and secondary objectives of the policy maker, the ultimate selection must be such as to facilitate the implementation of both. Specifically, if we assume that a set of macroeconomic targets can be attained via the $\Delta A_1^{s=14}$ scenario and if we also assume that the intervention options at the authorities disposal are only those described by the cases $\Delta X^{\lambda=1,s}$ to $\Delta X^{\lambda=5,s}$ then (see Table 2), the intervention package

$\Delta X^{\lambda=1,s}$= *[ΔINF = -0,99p/u, ΔEIRLA = 4,95p/u, ΔEIRTS = 3,69p/u, ΔEIRBA = 0,53p/u]*

would possibly have been chosen if, say, it was believed that the implied interest rate management was consistent with the market information inflow. On the other hand, if the monetary authorities were satisfied with the current money market status, thus wishing neither to manipulate the EIRBA nor to change the DBG, or simply, if they did not wish to increase that much the cost of money, then the intervention package

$\Delta X^{\lambda=2,s}$= *[ΔEIRLA = 3,96p/u, ΔEIRTS= 2,70p/u, ΔEIRBA = -0,45p/u, ΔBGA = 0,0b /dr]*

would probably have been designated as more appropriate. Similarly, if the monetary authorities had decided to allow the foreign exchange market to play a more substantial role in policy implementation then, they might have switched to the intervention package$\Delta X^{\lambda=3,s}$= *ΔEIRLA =* 1*,71p/u, ΔEIRBA = 2,27p/u, ΔDBG = 32,31b/dr, ΔLFE = 32,31b/dr].*Yet, if the current structure of interest rates is the desired and if the DBG is already at its optimal level, then such instruments should not be activated. Instead, the monetary authorities might have chosen to intervene through a deposit reallocation intervention package, provided this did not require an interest rate restructuring,$\Delta X^{\lambda=4,s}$= [ΔSTD = -99,80b/dr*, ΔSAD = -132,4b/dr, ΔMD = 72,7b/dr, ΔLFE = 154,0b/dr]*

or even through a mixed policy package as the

$\Delta X^{\lambda=5,s}$= [ΔEIRLA = 0,36p/u, ΔEIRBA=-1,23p/u*, ΔDBG = 40,2b/dr, ΔAFE= -40,2b/dr]*

The demonstration offered was based on hypothetical optimal adjustments of the choise set items, the total multiplier effect Jacobian employed was calculated by using the best impact multiplier effect Jacobian offered in the literature with reference to the portfolio behaviour of the Greek Commercial Banks whereas the intervention options chosen to participate in this "experiment" were only a small representative subset of those at the disposal of the policy maker. In the same vein, we provided some indicative justification as to why and when a specific intervention package should be preferred among equivalent alternatives and we emphasised the fact that the methodology's credibility will depend crucially on the empirical acceptance of the underlying bank portfolio behaviour model. Yet, despite the highly promising performance of the methodology on Greek data, it certainly merits further investigation.

5. Conclusion

This paper attempts to develop a methodology which would allow the commercial banks' portfolio behaviour models to play a substantial role in macroeconomic target implementation. The analysis indicated that such a methodology is feasible and that it should comprise four succesive stages. That is. estimation of alternative bank portfolio behaviour models and selection of the prevailing specification, distinction of strategic central government targets that are better explained by the endogenous variables of the prevailing specification, determination of the desired reconstruction in the consolidated banking sector's portfolio given the desired changes in the macroeconomic targets and calculation of the alternative central government intervention packages.

The empirical demonstration of the suggested framework was based on the portfolio behaviour of the Greek commercial banks and specifically on the best impact multiplier effects Jacobian matrix offered in the literature with reference to these institutions. As it has been shown, for the attainment of a chosen set of macroeconomic targets, it can always be determined a sufficient reconstruction of the consolidated commercial banks' portfolio, which, in its turn, can be succeeded in via a large number of alternative government intervention packages.

Given the multitude of restrictions and objectives that every government's economic policy attempts to achieve simultaneously, te large number of equivalent intervention packages that are provided by the suggested methodology for the attainment of each and every single set of chosen macroeconomic targets should be deemed as an extremely useful tool.

Notes

1. The relation (1.1) has been derived in a mean - variance expected utility context.

2. If the model (1.1) is a dynamic one, then the J matrix has to express the total multiplier effect. That is the sum of the *impact* and the *interim* multiplier effects.

3. As direct means of policy could be considered: The fixing of the interest rates, the volume of the compulsory deposits with the Central Bank or even the volume of the compulsory loans. Similarly, as indirect means of policy one may consider either the inflation level or the volume of the alternative sort of deposit with the banking institutions.

4. The symbol k represents the number of the choice balance sheet items of the banking institutions and depends on the specification of the predominant model. Besides, the reference to the non-nested tests aim at showing that even the number of the endogenous variables can not be determined in advance.

5. The fact that on the basis of the causality tests it is possible for us to determine the combination of the macroeconomic targets which ensure the maximum interpretative strength for the A_1 vector does not exclude the possibility of being also there other combinations of macroeconomic targets which ensure a significant interpretative strength for the A_1 vector as well. Such combinations can also constitute the object of analysis if the policy makers consider them as better serving the priorities of the desired economic policy.

6. In fact, the monetary authorities may want to achieve just one macroeconomic target, e.g. $\Delta\mu^d 1$, though potentially they may achieve k targets at the same time. Such a prospect is absolutely feasible provided they put in the vector ΔM^d where $\Delta\mu^d$ i=/=1=0.

7. Namely, if in the prevailing demand functions there are ν exogenous variables and k intervention means ($x1^1$, ...,X_{v-6}^{k-2}, X_{v-5}^{k-3}, X_v^k) have been chosen out of these to participate in the ΔX^λ vector, then the J matrix will be a kxk matrix, whose columns will be identical with the corresponding 1, v-6, v-5, and ν columns of the J matrix.

8. It must be noted that even if the sufficient readjustment of the portfolio consists in changing the level of only one choice balance sheet item, this change can be achieved once more through a large number of alternative equivalent intervention options.

9. See Subeniotis N. D., [1992], "The Portfolio Behaviour of the Greek Commercial Banks". Unpublished Ph.D. Thesis, University of Birmingham, U.K., pp 407.

References

Bailey R.W., Driscol M.J., Ford J.L. (1980), "On the Treatment of Binding Balance Sheet Ratios in Models of Financial Intermediary Portfolio Selection", Mimeograph Paper No 80.3 (Dec), Department of Economics, University of Birmingham.

Berndt E.R., Mc Curby T.H. and Rose D.E. (1980), "On Testing Theories of Financial Intermediary Portfolio Selection", Review of Economic Studies, XLVII, pp. 816-873.

Borrio M.J. (1984), "A Test of the Mean-Variance Model of Bank Portfolio Behaviour on Italian Data", *Greek Economic Review,* Vol. 16, No 1, pp. 77-98.

Courakis A.S. (1974), "Clearing Bank Asset Choice Behaviour", (A Mean Variance Behaviour), *Oxford Bulletin of Economics and Statistics,* Vol 3, No 3, pp. 173-201.Courakis A.S. (1975), "Testing Theories of Disco
Economic Studies, Vol XLII (4), pp. 643-648.

Courakis A.S. (1980), "In Search of an Explanation of Commercial Bank Short-Run Selection" *Oxford Bulletin of Economics and Statistics,* Vol. 42, pp. 305-335.

Courakis A.S. (1981), "Financial Structure and Policy in Greece:Retrospect and prospect", *Greek Economic Review,* Dec. pp. 205-243.

Courakis A.S. (1984), "Banking Policy and Commercial Bank Behaviour in Greece" in A. Verher-Straeten ed, *Competition and Regulation in Financial Markets,* edited by C. Goodhard, D. Currie and T. Llewllyn, Mc Millan (1987), pp. 150-186.

Courakis A.S. (1988), "Modelling Portfolio Selection", *Economic Journal,* Vol. 98, pp. 619-642.

Courakis A.S. (1989), "Does Constant Relative Risk Aversion Imply Asset Demands that are Linear in Expected Returns", *Oxford Economic Papers,* 41, pp. 553-566.

Davinson R. and Mc Kinnon, J.G. (1981), "Several Tests for Model Specification in the Presence of Alternative Hypotheses", *Econometrica,* 49, pp. 781-793.

Davinson R. and Mc Kinnon J.G. (1983), "Testing the Specification of Multivariate Models in the Presence of Alternative Hypotheses", *Journal of Econometrics,* 16, pp. 103-119.

Parkin J.M. (1970), "Discount House Portfolio and Dept Selection", *Review of Economic Studies,* Vol XXXVII, pp. 469-497.

Parkin J.M., Gray M.R., Barret R.J. (1970b), "The Portfolio Behaviour of the Commercial Banks" in K. Hilton ed. *The Econometric Study of the United Kingdom,* Mc Millan, London, pp. 229-251.

Pesaran, M.H., Smith R.P. and Yeo, S. (1985), "Testing for Structural Stability and Predictive Failure: A Review" Manchester School, 53, pp. 280-95.

Sharpe W.F. (1973), "A Quarterly Econometric Model of Portfolio Choice, Part I: Specification and Estimation Problems", *The Economic Record,* pp. 20-31.

Sharpe W.F. (1974), "A Quarterly Econometric Model of Portfolio Choice, Part I:Portfolio Behaviour of Australian Saving Banks", *The Economic Record,* pp. 20-31.

Spencer P.D. (1984), "Precautionary and Speculative Aspects of the Behaviour of Banks in the U.K. under Competition and Credit Control", *The Economic Journal,* (Sep.), Vol. 94, pp. 554-568.

Spencer P.D. (1989), "Speculative and Precautionary Balances as Complements in the Portfolio" (The Case of the U.K. Banking Sector 1972-1980), *Journal of Banking and Finance,* Vol. 13, pp. 811-850.

Subeniotis N.D. (1992a), "Does the Particular Source of Banks' Available Funds affect their Portfolio Behaviour", *Journal of Economics, Business, Statistics And Operational Research,* Vol. 42, pp 230-240.

Subeniotis N.D. (1992b), "The Portfolio Behaviour of the Greek Commercial Banks" Unpublished Ph.D. Tesis, University of Birmingham, U.K.

Σουμπενιώτης Ν. Δ..., (1996), Μια Μεθοδολογία για την Αξιοποίηση Μοντέλων Συμπεριφοράς Χαρτοφυλακίου των Χρηματοπιστωτικών Ιδρυμάτων στην Άσκηση Μακροοικονομικής Πολιτικής, Ειδική Έκδοση Πανεπιστημίου Μακεδονίας, σελ. 627-636.

Subeniotis N.D. and Efthymoglou G.P. (1998), "The Principle of Safety First in Modelling Bank Portfolio Behaviour, *Special Issue, University of Piraeus,* Greece".

Theil H. (1971), "Principles of Econometrics", North Holland Publishing Company, pp. 426-483.

White W.R. (1975a), "Some Econometric Models and Deposit Bank Portfolio Behaviour in the U.K. (1963-1970)" in G. Renton (ed) "Modelling the Economy", Heineman 1975.