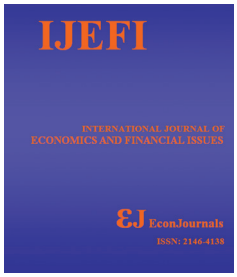


International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2015, 5(2), 312-323.

Portfolio Behaviour of Commercial Banks: The Expected Utility Approach: Evidence from Jordan

Alaaeddin Al-Tarawneh[1]*, Mohmmad Khataybeh[2]

[1]Department of Business Economics, The University of Jordan, Jordan, [2]Department of Banking and Financial Sciences, Hashemite University, Jordan. *Email: a.altarawneh@ju.edu.jo

ABSTRACT

This paper attempts to explain the banking performance in Jordan to draw out the implications of related theories and evidence for policy makers. Accordingly, they can influence the banking industry, which, in turn, impacts the economy overall. We investigate the portfolio behaviour of Jordanian banks. The model used is based on the portfolio choice theory, originated by Hicks (1935) and developed by Markowitz (1952) and Tobin (1958). Several nested models are developed to test the theoretical restrictions, including symmetry and homogeneity of the interest rate matrix. The empirical results, in general, clearly do not provide any support for interest rates which are important in determining the general composition of the portfolio holdings of Jordanian banks. The results show, however, that availability of funds is more important in determining the structure of these portfolios.

Keywords: Portfolio, Banking, Risk Aversion, Finance, Expected Utility Approach
JEL Classifications: G11, G21, G17, C51

1. INTRODUCTION

Banks play a crucial role in a country's economy, generating credit throughout the economy. Banks take savings from small and large depositors, make loans, operate payments systems, and provide a mechanism for the transmission of the monetary policy (Garcia, 1997). At the micro-level, the main objective for individual bank is to maximise the value of profit. To do so, banks hold a portfolio of assets and attempt to structure their portfolios to maximising their return.

With factors such as market interest rate levels, loans and cash demands, discount rate level and monetary policy actions, banks aim to have the desired distribution of assets in its portfolio. If the asset distribution is not as desired, then the bank will attempt to adjust its portfolio composition by increasing some or decreasing other holding assets, depending upon the cost of doing so (Andersen and Burger, 1969).

This paper aims to investigate the portfolio behaviour of commercial banks operating in Jordan. It also aims to determine if the yields or assets rate of return influence portfolio composition of banks operating in Jordan and analyses the manner in which they adjust to changes in such variables. Understanding the causal factors of portfolio change is of utmost importance for the efficient operation of monetary policy, as portfolio changes ultimately affect the flow of funds into alternative investment forms.

Based on the above exploratory research the rates of return are proposed as being important factors in determining the portfolio allocation of banks in Jordan. This research tests the hypothesis that the demand for the choice of assets is independent of the composition of non-choice assets for the commercial banks in Jordan in monthly data from 2002 to 2009.

This paper adopts a narrow view of the portfolio approach, using mean-variance methods, and uses interest rates and exogenous assets as determinants of the balance sheet composition. The expected utility (EU) model is commonly reduced to the mean-variance model of portfolio behaviour. When using this approach, portfolio choice decisions are based on the trade-off between their expected return and risk, where the former is the mean of the probability distribution of returns and the latter is usually approximated by the variance of that distribution. A number

of static models, as well as dynamic models are tested in this paper on the portfolio behaviour of Jordanian banks. In order to determine the underlying static relationship we opted to use the mean-variance EU approach. Moreover, the researcher applied the (Andersen and Burger, 1969) process of the general stock adjustment to introduce dynamics to the model. Therefore, the models presented in this work are based on the mean-variance approach of portfolio theory as originated by Hicks, 1935 and developed in works of Markowitz, 1952, 1959 and Tobin, 1958, 1965, and continued in several studies by, amongst others, (Parkin, 1970, Parkin et al., 1970).

2. ALTERNATIVE THEORIES OF BANK PORTFOLIO BEHAVIOUR

Studies dealing with portfolio behaviour of banks over the last four decades will be reviewed. The significance of this paper stems from the fact that changes in portfolio composition ultimately affect the flow of funds into alternative investment forms. Many studies have dealt with portfolio behaviour in the banking literature; such as the traditional approach, the precautionary approach and the portfolio theoretical approach.

(Robinson, 1962) started the analysis of the traditional bank behaviour approach. She conducted a study on the conflicting problem between banks' profitability and safety. In addition, she argued that this conflicting problem should be resolved before going through investment of banks funds, and she listed the legal reserve requirements (imposed by Central Banks), safe investment, and advances to customers and investment in the open market for income generation as steps to be taken sequentially.

The Central Bank imposes reserve requirement as a legal requirement for banks to permit customers to withdraw deposits upon demand, so this policy should be followed by banks. A bank is holding of cash for all possible contingencies and, for investment protection such dual-use is considered as the second priority (Hester and Pierce, 1975). By fulfilling its obligation, legal requirement of reserve, protective investment, making loans to customers, then the available funds can be invested on the open market to generate income. Therefore, the first priority in the above framework is safety and interest rates do not influence the choice of the bank's portfolio. In addition, this framework does not specify how a bank optimizes, and hence when portfolio composition is adjusted, due to the absence of marginal analysis which, in turn, comes from the exclusion of interest rates from influencing the choice variables.

The models about traditional banking behaviour are descriptive and not analytical. The applications of a linear programming framework were suggested by Chamber and Charnes, 1961. They view the bank's problem as one of constrained profit maximization, where the constraints are the "requirements laid down by the bank examiners which are interpreted as defining limits within which the level of risk associated with the return on portfolio is an acceptable" and the balance sheet constraint. This model has advantages, for example marginal analysis is considered as one of them. The reliability of the model is low as uncertainty is absent from the model due to the assumption that the bank knows "the levels that will prevail, at various dates in the future, of demand and time deposits, of interest rates and of the bank's net worth."

Orr and Mellon (1961) and Porter (1961) applied a new approach of bank portfolio behaviour. This theory is based on two basic assumptions: the bank minimizes expected loss or maximizes expected return, and the bank is subject to random flows of deposits and estimates the probability distribution of deposits flows. Choosing the optimal beginning-of-period allocation of the funds to maximize expected profits among reserves and other assets is one of the bank's problems.

The precautionary model is based on many factors, one of which is uncertainty which plays an important factor but banks are nevertheless viewed as risk neutral. (Hicks, 1935) propose the theory of bank behaviour under risk aversion upon which most of the empirical work is based, considered as a popular portfolio theory. He was the first to introduce the idea of mean-variance (μ, σ^2) in his paper, which was further developed by Markowitz (1952, 1959). This pioneering study of efficient portfolio selection, along with Tobin's (1958) paper on liquidity preference, all makes explicit the assumptions of risk aversion. The portfolio theoretical approach provides some assumptions; it assumes that the bank maximizes EU, whose arguments are commonly the expected value and variance of return subject to the balance sheet constraint of the portfolio. In general, the maximization of EU will result in the selection of a diversified portfolio for a risk averse bank. Most of the empirical work on bank portfolio behaviour is based on this approach. More studies that dealt with prominent empirical work on commercial bank portfolio behaviour were undertaken by the following scholars: Kane and Malkiel, 1965, Parkin (1970), Parkin et al., (1970), Sharpe, 1974a, Kagigi et al., 2001.

(Ply, 1971) investigated this model by suggesting three assets: a riskless asset, advances and deposits. The purpose of this model was to determine sufficient conditions for financial intermediation. Ply concludes that the expected return differential is positive between assets and liabilities, and the intermediation will hold for the stochastic independence between assets and liability return. Consequently, intermediation will exist when there is a positive risk premium on advances and a negative risk premium on deposits only.

Banks are considered as microeconomic firms that maximize an objective function operating within the framework of balance sheet constraints, authoritative control and market constraints. Banks are supposed to achieve certain goals such as satisfying the depositors, attracting borrowers, maximizing their wealth and fulfilling their commitments to the Central Bank. Studies on the portfolio behaviour of commercial banks were started by Edgeworth (1888), who pointed out the importance of random and unsystematic deposit flows that create uncertainty for shaping a bank's optimal portfolio.

Both Ply (1971) and Parkin et al., (1970) did not pay attention to the liquidity problem in their models that could arise due to randomness of cash requirements and default risks. To incorporate

the issue of deposit variation, Kane and Malikiel (1965) have tackled it by modification of the Tobin and Markowitz portfolio model. They suggest that the variation of deposits is based on the customers' relationship, as when the relationship is good it will decrease and increase when it is bad. In turn, (Sealey, 1980) accommodates random deposits supply as one of the uncertainties for a bank via an implicit supply function included random deposit supply in his model.

Risk aversion can arise either because the bank's objective function is concave in returns, or because influential depositors, whose deposits are the major source of the bank's funds, or banking authorities, induce it to act as a risk averter are examples of explicit allowance the Portfolio-theoretical approach provides. It can support diversification and handle constraints (Freund, 1956).

Moreover, the portfolio theoretical approach places great emphasis on the importance of uncertainty over future rates of return, future deposits withdrawals uncertainty and, therefore over future liquidation costs. Furthermore, expected profit and its variability is a bank consideration in portfolio theoretical models and, therefore, they considered to be risk averse and they maximize EU.

3. METHODOLOGY AND DATA

To estimate the coefficient of the system of equations, full information maximum likelihood (FIML) is employed. This paper employed (FIML) because whether the static or the dynamic system is estimated, one of the equations must be deleted from the system, without the loss of any information. (Barten, 1969) proved that under FIML, it is possible to estimate the coefficients of the deleted equation indirectly by imposing restrictions of Cournot and Engel aggregation respectively, regardless of which equation is omitted. Barton also explained that even when restrictions are imposed on the matrices of coefficients, FIML estimates the likelihood function under the assumption that the contemporaneous errors have a jointly normal distribution. Provided that the likelihood function is correctly specified, on the whole, FIML estimators are consistent, asymptotically efficient and asymptotically normally distributed (Zellner 1962). Another gain of FIML is that tests of parameter restrictions can be seen as likelihood ratio test.

3.1. Choice Non-choice Items and Estimation Procedures

Choice and non-choice items in the balance sheet have to be separated in order to settle the optimal portfolio of banks and, therefore, its asset demand and liabilities supply equations. In the Jordanian case, the banks have to take whatever deposits they can at the rates which the Central Bank of Jordan (CBJ) predetermined since the system of controls imposed by the CBJ. The assets, in general, are outside the control for reasons related to the behaviour of depositors[1] or to the behaviour of the Central Bank in imposing controls on quantities or on deposits rate of return or on both.

In the context of Jordan, Tables 1 and 2 show the composition of each set of assets, bearing in mind the above considerations.

1 Perhaps and as consequence operating bank setting rates of return on deposits rather than the Central Bank.

Table 1: Balance sheet items and rate of return

Assets	Rate of return
Corporate bonds (CORP)	Average interest rates corporate bonds (CBR)
Loans to private (PRIVATE)	Average private loans rate (PRI)
Loans to public (PUBLIC)	Average public loans rate (PUB)
G. Bonds (GBONDS)	Average interest rate on G. bonds (GRATE)
T. Bills (TBILLS)	Average interest rate on T. Bills (TRATE)
Deposits with Central Banks (DWCB)	Overnight deposit window rate (WR)
Cash (CASH)	Inflation (INF)
Other assets (OTHER)	None
Liabilities	Rate of return
Demand deposits	Average demand deposits rate
Time and saving deposits	Average time saving rate
Credit from CBJ	Weighted average interest rates on interbank
Capital and allowances	None
Un classified liabilities	None

CBJ: Central Bank of Jordan

Table 2: Classification of assets between choice and non-choice items

	Status
Assets	
Corporate bonds (CORP)	Endogenous
Loans to private (PRIVATE)	Endogenous
Loans to public (PUBLIC)	Endogenous
G. Bonds (GBONDS)	Endogenous
T. Bills (TBILLS)	Endogenous
Deposits with Central Banks (DWCB)	Endogenous
Cash (CASH)	Endogenous
Other assets (OTHER)	Exogenous
Liabilities	
Demand deposits (DD)	Exogenous
Saving and Time deposits (STD)	Exogenous
Credit (borrowing) from Central Bank (CFCB)	Exogenous
Capital and allowances (CAPITAL)	Exogenous
Un classified liabilities (UN)	Exogenous
Interest rate (rate of return)	
Inflation (INF)	Exogenous
Average rate interest on T. Bills (TRATE)	Exogenous
Average interest rates on G. Bonds (GRATE)	Exogenous
Average interest rates corporate bonds (CBR)	Exogenous
Average public loans rate (PUB)	Exogenous
Average private loans rate (PRI)	Exogenous
Overnight deposit window rate (WR)	Exogenous
Average demand deposits rate (DDR)	Exogenous
Average time saving rate (STDR)	Exogenous
Weighted average interest rates on interbank (INTER)	Exogenous

These tables also indicate the status of the liabilities and provide details of the notation that we have adopted for the scalar variables and returns. It is possible to delete one equation from the system without any loss of information, as we mentioned earlier, due to the balance sheet identity.

3.2. The Nature of Data

For the estimation of the EU model, we use monthly time series data from 2002 to 2009. The data were collected from the CBJ and the Association Banks in Jordan. Below we provide the nature of

the key endogenous and exogenous variables that will be used in our econometric work.

3.2.1. Aggregation of data

Commercial banks behave identically and have the same expectations, the same returns, the variance-covariance matrix perceptions and identical utility functions. Aggregation over choice compositions can easily be accommodated on theoretical grounds by assuming that all commercial banks operating in Jordan form one representation agent. The following rules should be considered before taking aggregation over different assets and over elements of the assets. Firstly, the aggregation items have to be homogeneous (Courakis, 1974). Consequently, they must have the same return and risk characteristics so as not to be distinguished by a decision unit as different assets (Bailey et al., 1982). However, previous research in portfolio behaviour theory shows how different endogenous and exogenous variables employed in the estimation would themselves be composed of elements on which the aggregation principles may or may not apply. Recognizing inconsistencies caused by such aggregation, but simultaneously being deprived of alternative options as regarding information and computational facilities, we have to employ the assumption that all such aggregated elements of banks are homogeneous. In addition, due to the existence of non-stationarity among endogenous/exogenous variables, one alternative is to estimate the system (static or dynamic) in ratio forms. We adopt this approach and divide the assets and liabilities of the balance sheet by the total liabilities (total deposit, credit from Central Bank, capital and allowances, and unclassified liabilities).

3.2.2. Endogeniety and exogeneity of bank's assets

The endogeniety or exogeniety of assets is not covered in the majority of the literature regarding the treatment of liability items. The real nature of assets may depend on regulations of the monetary authority, however, in this paper; we treat both private and public sector loans as endogenous variables, and since the loans ratios do not seem to have constraints on loans. The "Cash" is treated as an endogenous asset because of the fact that observed volumes are held irrespective of, and in addition to the reserve ratio regulations. Not far away from "Cash," we will classify the deposits with Central Banks as endogenous, since the monetary authority does not seem to have any constraints.

Our next step is to examine the status of Treasury and Corporate bonds, and Treasury bills. These items are viewed as a separate account within the balance sheet, and in fact, banks in Jordan showing a high risk averse behaviour to private sector loans may diversify their portfolio by some form of collateral security. Thus, there is a possibility that banks prefer investing in governmental bonds and bills, as well as corporate bonds. We treat them as endogenous variables. Finally, "other assets" will be treated as an exogenous variable.

3.2.3. Endogeniety and exogeneity of bank's liabilities

We can notice that the literature distinguished whether deposits should be regarded as endogenous or exogenous variables. As Brainard and Tobin, 1968 have argued, "banks must be willing to accept demand and time deposits at prevailing interest rate in at least as large volume as the public wishes to hold." Based on the above, the status of the deposits depends on the process of observed interest rate information assimilation. Commercial banks have to accept the volume of deposits demanded by the depositors. Therefore, we will take demand deposits, and saving and time deposits as exogenous variables. The potential borrowing of banks from the CBJ has to be treated as an endogenous variable since no valid regulation restricts this item. Parkin (1970) noticed that it is a well-established practice in the literature for treating capital and allowances as exogenous. Finally, unclassified liabilities will also be treated as exogenous variables.

Before presenting the main results of estimating the model of portfolio behaviour in Jordan, it is useful to examine some descriptive statistics that would help in shedding more light on the results.

In order to avoid spurious regressions, we conducted unit root tests, to ensure that the ratios are I(0). If a variable contains a unit root I(1), then it is non-stationary and regression involving the series can falsely imply the existence of a meaningful economic relationship (Philips, 1986). We opted to use the (Kwiatkowski et al., 1991) Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test to test the null hypothesis that a series contains a unit root. This test confirms presented in Table 3 that all interest rate variables, endogenous and exogenous variables, are I(0) processes.

On the other hand, the portfolio return is normally distributed, since that is one of the essential assumptions made in the mean-variance model.

This approach is fulfilled if the returns of all items are normally distributed. The normality of each return is investigated by using the Jarque–Bera statistics test, and it was found that all variables are normally distributed. Tables 4-6 indicate the mean; standard deviation and the relative measures of dispersion (would help in indicating the extent of volatility of our variables). In fact, the KPSS test, assumes that under the null hypothesis the variable is stationary or trend stationary, confirming that they are I(0) processes.

Table 4 shows that no active variable were study from the dependant variable, the highest relative measure of dispersion, the coefficient of variation, stood at (0.49879) which is the GBONDS.

The (INF) appears changing over at an incredible rate of relative measure of dispersion (1.102526); therefore, the main interest rate is stable in general (Table 5). Also, it is important to mention

Table 3: Unit root test (KPSS)

Assets		Liabilities		Interest rate	
CORP	0.140924	DD	0.145821	INF	0.138233
PRIVATE	0.145713	STD	0.14458	TRATE	0.141828
PUBLIC	0.140417	CFCB	0.135138	GRATE	0.145895
GBONDS	0.142463	CAPITAL	0.134826	CBR	0.145802
TBILLS	0.145452	UN	0.144056	PUB	0.142716
DWCB	0.144739			PRI	0.144028
CASH	0.142316			WR	0.137274
OTHER	0.145554				

All variables in this table are stationary at 5% as the critical value at this level is 0.146000. KPSS: Kwiatkowski–Phillips–Schmidt–Shin

that the value of dispersion PRI does not appear to be changing relatively to the movements on TRATE or WR.

Table 6 shows the correlations among main interest rates. It shows that there are high correlations among the interest rate variables which may cause multicollinearity. Keep in mind to take this in consideration while run the regression.

Table 7 shows that the exogenous variables were non-active, (CFCB) being 0.223 measure of dispersion.

4. RESULTS OF THE GENERAL FRAMEWORK

The dynamic model was estimated. However, this model deals with exogenous variables as independent separate variables, as shown in Table 8.

4.1. Review of the Empirical Results on the Dynamic Model

This section presents and discusses the results from the dynamic model. Seven equations were constructed, with six equations being estimated and one being a residual equation derived from the balance sheet identity. The general model is, in effect, following equation without any restrictions being imposed upon the matrices of coefficients.

$$A_{1,t} = L\Gamma R_t + LBA_{2,t} + (I - L)A_{1,t-1} + \varepsilon_t \equiv \Lambda R_t + \Pi A_{2,t} + ZA_{1,t-1} + \varepsilon_t$$

To achieve this, symmetry, homogeneity and joint test for both (homogeneity and symmetry) are tested against the general unrestricted form. Table 9 reports the results of testing these special cases of the general model. The overall statistics for each equation in the model are presented in Table 10 and graphs of actual, fitted and residuals series from each of the six estimated equations in Figure 1.

Table 9 shows that these restrictions are rejected at the 1% level of significant. We can conclude that the restricted models are significantly different from the general model, which means imposing restrictions is not supported by the data upon which our study is based.

Table 10 shows that all of estimated equations have a high Adj-R^2, and a very small SSR. In addition, it seems that most equations do

Table 4: Descriptive statistics for the endogenous variables

Variables	CORP	PRIVATE	PUBLIC	GBONDS	TBILLS	DWCB	CASH
Mean	0.010355	0.389939	0.205124	0.004138	0.094142	0.189121	0.009728
Maximum	0.017014	0.449327	0.292675	0.008459	0.154328	0.253431	0.015711
Minimum	0.005288	0.323725	0.166398	0.000993	0.064227	0.122909	0.007099
SD	0.002498	0.030943	0.030881	0.002064	0.026447	0.038690	0.001832
SD/mean	0.241236	0.079355	0.150547	0.49879	0.28092	0.204578	0.188322

SD: Standard deviation

Table 5: Descriptive statistics for the main interest rate (%)

Variables	CBR	PRI	PUB	GRATE	TRATE	WR	INF
Mean	9.358333	8.808333	7.323958	5.825244	4.692049	3.612500	4.501101
Maximum	11.50000	10.50000	8.400000	7.370076	7.134444	5.200000	19.46228
Minimum	7.600000	7.400000	6.000000	4.565000	2.120000	2.000000	−3.589209
SD	0.948091	0.785080	0.839266	0.923810	1.776126	1.135110	4.962584
SD/mean	0.101309	0.08912	0.11459	0.158587	0.378539	0.314217	1.102526

SD: Standard deviation

Table 6: Correlation among main interest rate (%)

Variables	CBR	PRI	PUB	GRATE	TRATE	WR	INF
CBR	1.000						
PRI	0.862 (0.000)	1.000					
PUB	0.156 (0.129)	0.552 (0.000)	1.000				
GRATE	−0.378 (0.001)	0.056 (0.585)	0.801 (0.000)	1.000			
TRATE	−0.454 (0.000)	−0.131 (0.203)	0.504 (0.000)	0.737 (0.000)	1.000		
WR	−0.384 (0.000)	−0.090 (0.386)	0.483 (0.000)	0.651 (0.000)	0.967 (0.000)	1.000	
INF	−0.263 (0.010)	−0.150 (0.144)	0.211 (0.039)	0.403 (0.000)	0.525 (0.000)	0.520 (0.000)	1.000

Table 7: Descriptive statistics for the exogenous variables

Variables	DD	STD	CFCB	CAPITAL	UN	OTHER
Mean	0.155854	0.474517	0.022924	0.149299	0.197406	0.097452
Maximum	0.184747	0.509928	0.031072	0.174273	0.244025	0.123583
Minimum	0.105291	0.423442	0.014576	0.125372	0.135099	0.053027
SD	0.020821	0.022977	0.005123	0.015447	0.022391	0.019437
SD/Mean	0.133592	0.04821	0.223477	0.103463	0.113426	0.199452

SD: Standard deviation

not suffer from autocorrelation coefficients are very closed to 2. Furthermore, the estimated system does not suffer from residuals autocorrelation even with up to 12 lags (Table 11). Additionally, the estimated dynamic model is normally distributed; the Jarque–Bera coefficient is 138.57 with probability equal to 0.9929.

Table 8: Aggregation of balance sheet items

Endogenous	
CORP	Corporate bonds
PRIVATE	Loans to private sector
PUBLIC	Loans to public sector
GBONDS	Government bonds
TBILLS	Treasury bills
DWCB	Deposits with CBJ
CASH	Cash
Exogenous	
DD	Demand deposits
STD	Saving and time deposits
CFCB	Credit (borrowing) from Central Bank
CAPITAL	Capital and allowances
UN	Un classified liabilities
OTHER	Other assets

Table 9: Testing special cases of the general model

Theoretical restrictions	LR and W	Results
Symmetry	LR=29.566>$\chi^2_{(15,95\%)}$=25.00	Rejected
	W=30.6998>$\chi^2_{(15,99\%)}$=30.58	Rejected
Homogeneity	LR=26.618>$\chi^2_{(6,99\%)}$=16.81	Rejected
	W=30.4528>$\chi^2_{(6,99\%)}$=16.81	Rejected
Joint symmetry and homogeneity	LR=48.134>$\chi^2_{(21,99\%)}$=38.93	Rejected
	W=53.79118>$\chi^2_{(21,99\%)}$=38.93	Rejected

LR: Likelihood ratio, W: Wald test

4.2. Results on the Interest Rate Matrix

To start with, seven interest rates were employed in the dynamic analysis, CBR, which stands for the interest rate on corporate bonds rate; PRI is the interest rate on loans provided by the commercial banks to private sector; PUB represents the interest rate on loans provided by the commercial banks to public sector; GRATE is the interest rate on governments bonds; TRATE is the interest rate on the treasury bills; WR is the interest rate on commercial banks deposits with Central Bank; INF stands for the inflation rate used as rate of return on cash holding by the commercial banks (Table 12).

4.3. Results on the Own-Rate Effects

Table 11 shows that four out of the six interest rates appear insignificant, however, PUB, which stands for interest rate on public lending, and TBILLS, which presents Treasury bills rate, were significant with a negative sign. It is noticeable that all of interest rates on our model indicate insensitivity of the choice assets to the changes on their own-rates. Statistically, there will be no major changes in the holding of assets as a consequence of interest rate movements; as a result, monetary authority interest rate changes will not affect the assets holding by commercial banks in Jordan. In their study (McLaren and Upcher, 1986) have tested further restrictions on portfolio models. They say it is a common feature of such an unrestricted model to have results that clearly run counter to a prior expectation about the direction of interest rate effects and the insignificant coefficients, which we also faced in our results.

4.4. Results on the Cross-Rate Effects

Regarding the off-diagonal interest rate elasticity, 11 out of 30 from Table 11 has shown values that differ significantly from zero.

Table 10: The overall statistics for each equation in the model

Model	CORP	PRIVATE	PUBLIC	GBONDS	TBILLS	DWCB
R-bar squared	0.8613	0.9723	0.9674	0.9473	0.9814	0.9805
SSR	0.0001	0.0020	0.0023	0.0000	0.0010	0.0022
DW	2.201978	2.150973	1.850591	1.765558	2.131571	1.522687

Table 11: System residual portmanteau tests for autocorrelations

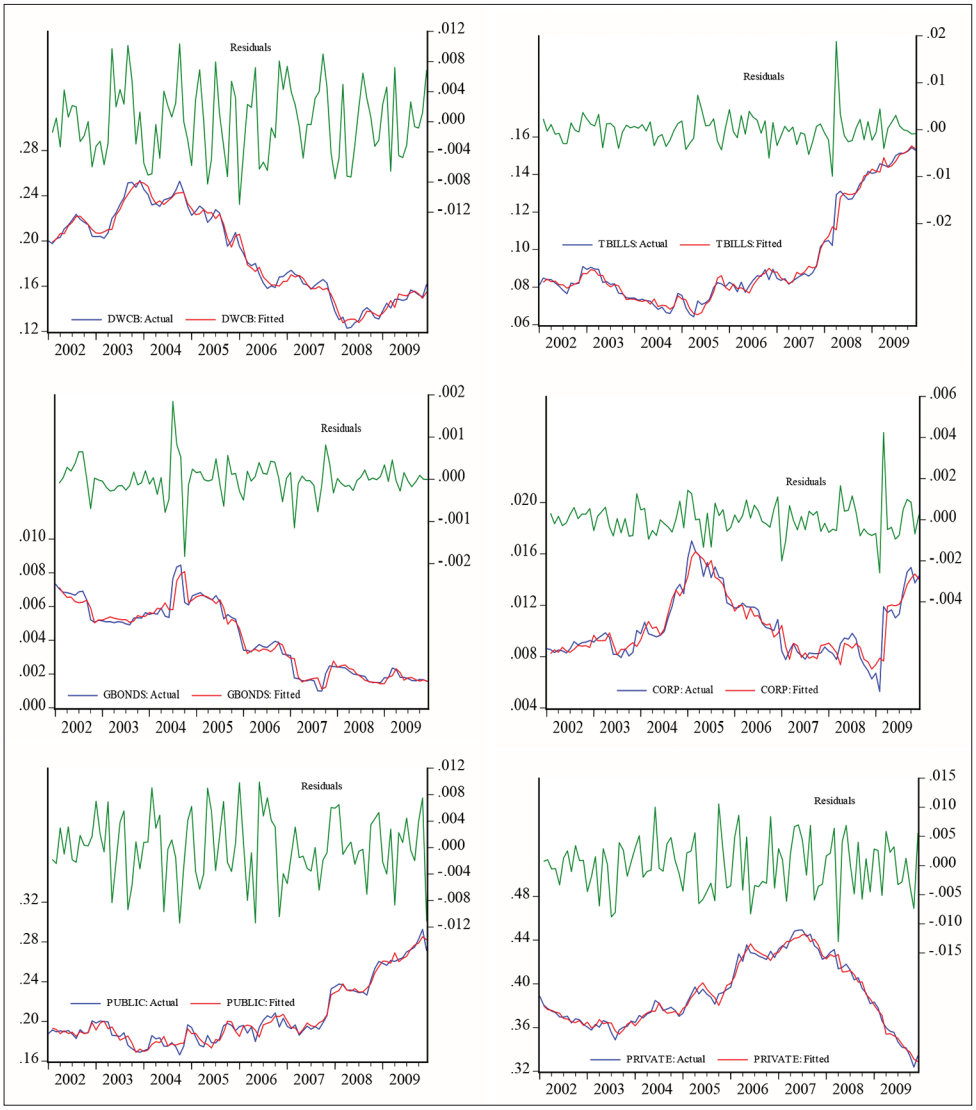
Lags	1	2	3	4	5	6	7	8	9	10	11	12
Q-Stat	41.5	70.1	108.4	148.9	180.3	210.1	255.0	295.7	334.0	371.8	421.7	457.8
P	0.245	0.540	0.472	0.372	0.480	0.600	0.435	0.364	0.340	0.322	0.180	0.188

Table 12: Dynamic EU model

Equation	Interest rate coefficients						
	CBR	PRI	PUB	GRATE	TRATE	WR	INF
CORP	−0.000068	−0.001676	0.001383	−0.000503	0.000066	−0.000226	−0.000060
	[−0.1750]	[−2.7324]	[2.4781]	[−0.5577]	[0.2000]	[−0.4920]	[−1.9183]
PRIVATE	−0.003742	−0.004617	0.008814	−0.015136	0.003440	0.001242	0.000408
	[−1.7380]	[−1.3558]	[2.8457]	[−3.0221]	[1.8880]	[0.4874]	[2.3324]
PUBLIC	0.002817	0.003216	−0.009603	0.016183	−0.001665	−0.000728	−0.000047
	[1.2108]	[0.8740]	[−2.8692]	[2.9903]	[−0.8460]	[−0.2645]	[−0.2498]
GBONDS	0.000063	−0.000318	−0.000301	−0.000520	−0.000074	−0.000004	−0.000009
	[0.3207]	[−1.0284]	[−1.0702]	[−1.1438]	[−0.4491]	[−0.0162]	[−0.5406]
TBILLS	0.003198	0.002929	−0.005075	0.013439	−0.002257	0.000089	0.000090
	[2.1261]	[1.2314]	[−2.3457]	[3.8417]	[−1.7739]	[0.0498]	[0.7367]
DWCB	−0.001783	0.001317	0.004377	−0.013135	0.000825	0.000210	−0.000414
	[−0.7899]	[0.3689]	[1.3484]	[−2.5021]	[0.4319]	[0.0788]	[−2.2599]

The values in [ ] are *t*-statistics. EU: Expected utility

Figure 1: Actual, fitted and residuals series from each of the six estimated equations



Therefore, the results show that the cross-rate somehow effects the decision of allocating the available funds between the choice set of assets. The most sensitive assets were the lending to private sector (PRIVATE) and followed by the Treasury bills (TBILLS).

4.5. Results on Non-choice Assets

However, corporate bonds and private lending both were appearing to have a significant sign with CAPITAL, UN, and the unclassified liabilities. In fact, results show that a bank's investment decisions in Jordan to invest in highly risk assets upon banks are being affected by capital and unclassified liabilities. On the other hand, lending to the public sector appears significant to time and saving deposits and credit from the Central Bank. Also, PUBLIC were significant to other assets but with negative sign. Furthermore, government bonds (GBONDS) are the only assets that none of the endogenous variables come out as significant. Treasury bills (TBILLS) were significant with the wrong sign to other assets (OTHER). Finally, deposits with the Central Bank appear to be significant with demand deposits (DD), which can be explained by banks' behaviour in investing their short-term deposits as deposits with the Central Bank for daily basis rate of return to avoid any unexpected customer withdrawals. These results are shown in Table 13.

Indeed, because of the non-linearity of the demand equations those coefficients cannot be very informative about the impact of the holding of assets as a result of interest rate movements.

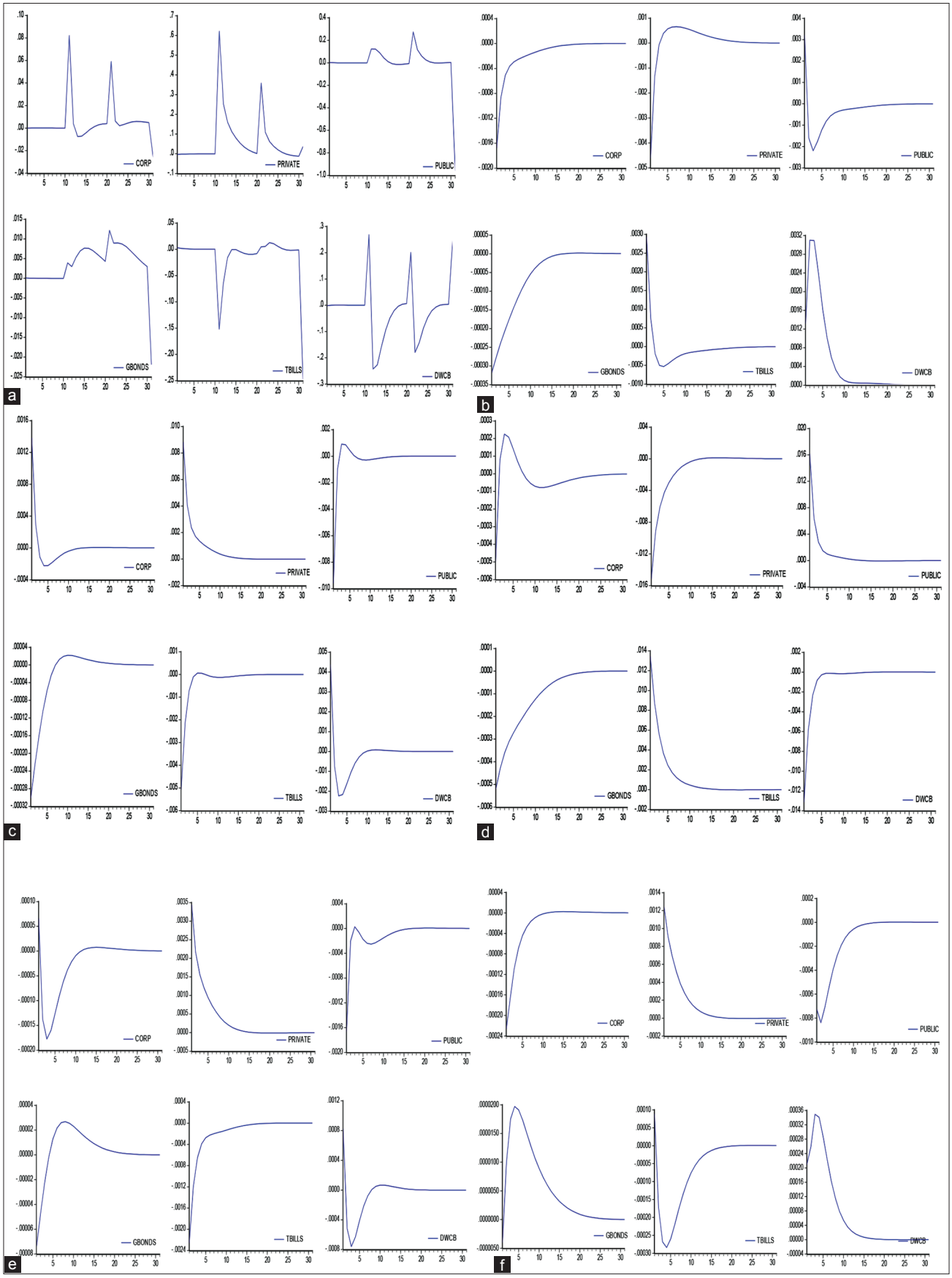
Table 14 shows the slopes of demand equations and more especially, the interest rate matrix elasticise that can be more informative about the impacts of portfolio composition.

4.6. Results on the System's Dynamic Matrix

Table 15 presents the lagged term estimation of the dynamic system by using Cournot aggregation. Briefly, this matrix describes the internal dynamic of the choice assets structure by examining the current assets depending on its lagged state in the absence of external pressure. In particular, it shows how the current stock of the j^{th} asset is subjective by changes in the structure of assets in the last period.

On the other hand, the off-diagonal elements of the dynamic matrix appears to be significant in the rows relating to the DWCB

Figure 2: The effects of main interest rate (exogenous) on endogenous variables, (a) CBR, (b) PRI, (c) PUB, (d) GRATE, (e) TRATE, (f) WR



deposits with central banks, which were significant with most lagged endogenous coefficients except for TBILLS(-1) and CASH(-1). Also, PUBLIC and TBILLS appear to be somewhat significant to some lagged endogenous coefficients. In fact, the

Table 13: Dynamic EU Model

Equation	Exogenous coefficients					
	DD	STD	CFCB	CAPITAL	UN	OTHER
CORP	0.048 [1.502]	0.026 [0.869]	0.048 [0.641]	0.082 [2.392]	0.059 [2.033]	−0.026 [−0.930]
PRIVATE	0.292 [1.643]	0.180 [1.080]	−0.215 [−0.523]	0.621 [3.260]	0.358 [2.221]	0.037 [0.243]
PUBLIC	−0.086 [−0.446]	0.340 [1.884]	0.933 [2.098]	0.124 [0.600]	0.275 [1.575]	−0.960 [−5.775]
GBONDS	−0.002 [−0.150]	0.0156 [1.028]	0.014 [0.376]	0.004 [0.225]	0.012 [0.832]	−0.022 [−1.569]
TBILLS	−0.009 [−0.076]	0.062 [0.529]	0.137 [0.478]	−0.152 [−1.143]	0.005 [0.041]	−0.247 [−2.302]
DWCB	0.671 [3.598]	0.284 [1.625]	−0.069 [−0.160]	0.269 [1.345]	0.201 [1.191]	0.254 [1.573]

The values in [ ] are *t*-statistics. EU: Expected utility

Table 14: Elasticises for EU model

Variables	CORP	PRIVATE	PUBLIC	GBONDS	TBILLS	DWCB
CBR	−0.061	−0.09	0.129	0.142	0.318	−0.088
PRI	−1.426	−0.104	0.138	−0.677	0.274	0.061
PUB	0.978	0.166	−0.343	−0.533	−0.395	0.17
GRATE	−0.283	−0.226	0.46	−0.732	0.832	−0.405
TRATE	0	0.041	−0.038	−0.084	−0.112	0.02
WR	−0.079	0.012	−0.013	−0.003	0.003	0.004
INF	−0.026	0.005	−0.001	−0.009	0.004	−0.01
DD	0.725	0.117	−0.065	−0.091	−0.016	0.553
STD	1.197	0.219	0.786	1.785	0.311	0.713
CFCB	0.105	−0.013	0.104	0.078	0.033	−0.008
CAPITAL	1.184	0.238	0.09	0.14	−0.241	0.212
UN	1.126	0.181	0.264	0.581	0.01	0.21
OTHER	−0.243	0.009	−0.456	−0.516	−0.256	0.131

EU: Expected utility

largest (in absolute value) off-diagonal elements are found in the rows relating to the PUBLIC and DWCB. The columns relating to lagged quantities for both instruments are much smaller in absolute value magnitudes. This suggests that changes in the lagged assets structure affect lending to private sector and deposits with the Central Bank, but that changes in both instruments have only a small impact on other assets portfolios.

4.7. The Impact, Interim and Total Multipliers

After estimating the dynamic model, in this part will calculate the multiplier effects of the choice assets to unit changes to the non-choice items. In view of the fact that the CBJ are controlling, at least officially, nearly all interest rates by setting them or in some cases by determining the maximum and minimum limits within the economy, some of these then can be regarded as (possible) direct policy instruments. Consequently, we deem interest rates on corporate bonds (CBR), lending to private sector (PRI), public lending (PUB), government bonds (GRATE), treasury bills (TRATE), and deposits with the Central Bank (WR) to be direct policy instruments. Therefore, the consequences of a one-step change in these exogenous variables are investigated by the calculation of impact (current), interim (ensuing periods) and total (cumulative) multipliers. Since the total multiplier effects are crucial for an overall evaluation of policy implementation, we proceed to derive these effects.

4.7.1. Impact effects of policy instruments on Jordanian banking portfolios

Table 16 shows the impact effects of the policy variables on the Jordanian banking portfolio. some of these effects caused by rates of return on, corporate bonds, private lending, public lending, government bonds, treasury bills, and deposits with central bank.

A 1% change *ceteris paribus* in the corporate bonds rate seems to cause an increase in the loans to the public sector and the Treasury bills by a very small fraction almost (0.003) percent. Surprisingly, the same percent change in corporate bonds rate would cause no changes in the holding of corporate bonds. On the other hand, such an increase produces reductions in the loans to the private sector and deposits with the Central Bank.

A 1% increase *ceteris paribus* in the private lending rate leads to an increase in the public loans and Treasury bills holding by (0.003) for both instruments, however, the corporate bonds holding appears to decrease after a 1% increase in the private lending rate by (−0.002). Surprisingly, this increase leads to a decrease in lending to the private sector. On the other hand, we can justify the increase on the deposits with the Central Bank in that the banks found it profitable and much safer to increase its holding of deposits with the Central Bank. In other words, banks diversified their holding assets to avoid the probability of private loans defaults.

A *ceteris paribus* 1% change in the public lending rate would produce an increase on corporate bonds, private lending and deposits with the Central Bank. This increase would lead to an unexpected decrease in the holding of public lending. However, we can summarise that the public sector have a variety of options to finance their operations instead of lending from commercial banks.

A 1% increase in the government bonds rate would *ceteris paribus* produce an increase in the public lending and Treasury bills. Surprisingly, this increase will lead to a decrease in the holding of government bonds by −0.001. However, we can also conclude that the governmental entities have a variety of options to finance their operations. In fact, if government bonds rates increase they can move toward other financing options, such as loans from commercial banks or issuing new Treasury bills instead of governments bonds.

A *ceteris paribus* 1% increase in the treasury bills rate would lead to a small increase on the private lending and deposits with the Central Bank. Also, this increase will lead to a decrease on the treasury bills holding by banks.

A *ceteris paribus* 1% increase in the window rate (the rate of return on deposits with the Central Bank) has almost no effect except for a small increase in the private lending 0.001 and decrease on public lending by (−0.001) percent.

Table 15: Dynamic EU model

Equation	Lagged endogenous coefficients						
	CORP (-1)	PRIVATE (-1)	PUBLIC (-1)	GBONDS (-1)	TBILLS (-1)	DWCB (-1)	CASH (-1)
CORP	0.499 [5.730]	−0.051 [−1.530]	−0.024 [−0.871]	0.4413 [3.471]	−0.005 [−0.133]	−0.019 [−0.649]	−0.125 [−1.265]
PRIVATE	−1.064 [−2.202]	0.547 [2.981]	−0.021 [−0.140]	−0.180 [−0.255]	−0.157 [−0.729]	−0.076 [−0.460]	0.514 [0.936]
PUBLIC	1.685 [3.228]	−0.090 [−0.452]	0.400 [2.409]	−1.927 [−2.527]	−0.294 [−1.268]	−0.177 [−0.987]	−0.632 [−1.064]
GBONDS	−0.015 [−0.345]	0.007 [0.404]	−0.004 [−0.281]	0.824 [2.857]	0.004 [0.206]	−0.008 [−0.527]	−0.024 [−0.483]
TBILLS	0.653 [1.934]	−0.0305 [−0.238]	0.020 [0.184]	−0.995 [−2.019]	0.487 [3.243]	−0.089 [−0.770]	−0.116 [−0.301]
DWCB	−1.533 [−3.027]	−0.322 [−1.671]	−0.310 [−1.926]	1.876 [2.536]	0.0229 [0.102]	0.437 [2.522]	0.543 [0.944]

The values in [ ] are *t*-statistics. EU: Expected utility

Table 16: Impact effects of policy instruments on jordanian banking portfolios

Variables	CORP	PRIVATE	PUBLIC	GBONDS	TBILLS	DWCB
CBR	−0.000068	−0.003742	0.002817	0.000063	0.003198	−0.001783
PRI	−0.001676	−0.004617	0.003216	−0.000318	0.002929	0.001317
PUB	0.001383	0.008814	−0.009603	−0.000301	−0.005075	0.004377
GRATE	−0.000503	−0.015136	0.016183	−0.000520	0.013439	−0.013135
TRATE	0.000066	0.003440	−0.001665	−0.000074	−0.002257	0.000825
WR	−0.000226	0.001242	−0.000728	−0.000004	0.000089	0.000210
INF	−0.000060	0.000408	−0.000047	−0.000009	0.000090	−0.000414
DD	0.048149	0.292170	−0.085662	−0.002417	−0.009402	0.670705
STD	0.026133	0.180167	0.339707	0.015571	0.061630	0.284237
CFCB	0.047521	−0.215250	0.932707	0.014048	0.137405	−0.069130
CAPITAL	0.082143	0.621388	0.123664	0.003887	−0.152110	0.268789
UN	0.059066	0.358162	0.274582	0.012176	0.004653	0.201278
OTHER	−0.025796	0.037349	−0.960381	−0.021909	−0.247454	0.253670

Table 17: Total effects of policy instruments on Jordanian banking portfolios

Variables	CORP	PRIVATE	PUBLIC	GBONDS	TBILLS	DWCB
CBR	0.00078	−0.01315	0.00521	−0.00011	0.00854	−0.00068
PRI	−0.00519	0.00074	−0.00762	−0.00180	−0.00020	0.01424
PUB	0.00060	0.02252	−0.00998	−0.00069	−0.00884	−0.00388
GRATE	−0.00054	−0.04200	0.02961	−0.00323	0.03948	−0.02338
TRATE	−0.00069	0.01166	−0.00336	0.00009	−0.00603	−0.00142
WR	−0.00065	0.00464	−0.00402	0.00016	−0.00178	0.00218
INF	−0.00016	0.00143	−0.00068	0.00006	−0.00015	−0.00057
DD	−0.00849	0.59681	−0.35181	−0.02957	−0.18773	0.96217
STD	0.06865	0.13490	0.42924	0.06847	0.04250	0.23431
CFCB	0.16748	−1.06900	1.98744	0.03694	0.70787	−0.91290
CAPITAL	0.10272	1.26559	0.36392	0.07023	−0.27612	−0.50334
UN	0.12376	0.47140	0.53844	0.07851	0.05577	−0.28190
OTHER	−0.16753	0.69038	−1.75674	−0.11039	−0.77788	1.08236

Unit changes in the interest rate 1%

Turning to the changes in the exogenous variables, the demand deposits *ceteris paribus* change would lead to an increase on the holding of deposits with the Central Bank by (0.67) percent and (0.292) percent in the holdings of private lending. This change appears reasonable since the banks holding assets are regarding to their maturity and level of risk. However, there is no clear explanation why such an increase in demand deposits leads to a decrease in Treasury bills except that the banks prefer to hold the demand deposits as deposits with the Central Bank instead of Treasury bills to meet customers' withdrawals for their demand deposits. Saving and time deposits *ceteris paribus* change would lead to an increase on the holding of all holding assets, meaning that banks can diversify their holding assets regarding to the source of available funds. Such long-term deposits give banks more flexibility to hold different assets. Finally, the only instrument that seems to produce the most logical changes and, therefore, can be used as the monetary authorities to control the money supply and credit expansion in the banking system in Jordan was, the rate of return on deposits with the Central Bank (WR).

4.7.2. Total effects of policy instruments on the Jordanian banks' portfolios

The analysis of the impact effects of the (potential) policy instruments on Jordanian banks' portfolios presented in Table 16 cannot provide a complete picture, since the estimated reduced form of our model portrays the endogenous variables as being dependent upon lagged endogenous variables. For the complete picture we need to turn to the total multiplier effects which are given in Table 17.

Before we do so, we should make some remarks about the interim multiplier effects which when summed with the impact effects, of course, provide us with those total multiplier effects. They all exhibit cycles around zero of decreasing amplitude with time;

and they are zero or approach zero after around 19 periods: they all attain zero eventually, since as noted, the model is stable. The interim multiplier effects for exogenous variables (main interest rate) on the set of choice assets are shown in Figure 2.

There are alternations of signs between corresponding impact and total multipliers appears by comparing Tables 16 and 17, relating to several variables. These include only two effects, the effect of the corporate bond own-rate, which has the correct sign under the total effect; and lending to private sector own-rate.

A main reason for these results could be that the Central Bank were based primarily on direct controls (credit ceilings and preferential rates) as a means of influencing the behavior of the portfolio during most of the period. Therefore, it is not unlikely that the banks' response to these policies has been negative, particularly with regard to interest rates.

It appears that the commercial banks are more sensitive in applying funds to more liquid assets than they are to non-liquid. The outcomes also confirm the significance of banks' capital (Pringle, 1974); regarding the response of banks towards choice assets.

The overall results may seem disappointing, they are typical of econometric models reported of banks behaviour (i.e. Muhammad, 2010; Humphrey, 1981; Spindt and Tarhan, 1980).

Clearly, the results that appear in this paper do not support the view that the entry of new banks, effecting the composition of the assets' holdings in Jordan, did not explain the behaviour of the portfolios. That means, during the sample period the new entrance of foreign bank did not provide any change to the composition of the Jordanian assets' holdings portfolio. In addition, Brown et al., 2008, and Beer et al., 2010, argue that foreign banks could supply more credits in foreign currency because they rely less on domestic deposits and have better and maybe cheaper resources access to the international capital markets. The observation of a lower lending rate of foreign banks could be easily explained by a different assets allocation via the "portfolio composition hypothesis."

5. CONCLUSION

This paper investigates the portfolio behaviour of Jordanian banks. The model used is based on the portfolio choice theory originated by Hicks (1935) and developed by Markowitz (1952) and Tobin (1958). Several nested models are developed to test theoretical restrictions including symmetry and homogeneity of the interest rate matrix. Additionally, the multiplier effects (current, interim and total) of the policy instruments on the behaviour of the Jordanian banks are calculated. The empirical results in general do not render any support for the argument that interest rates are an important determinant for the composition of Jordanian bank portfolios, and they do not fully explain the behaviour of such units. It seems that the availability of funds is more important in determining the structure of bank portfolios. Such results are reinforced by the fact that the myopic behaviour hypothesis is also rejected at any reasonable level of significance, which confirms that non-choice set assets and their composition are major determinants of the portfolio behaviour of banks in Jordan.

Another suggestion by Spindt and Tarhan (1980, p.203), which can be adjusted to the results is that banks tend to operate in a highly regulated environment and that these regulatory restrictions and other institutional considerations (i.e. customer relationships) dominate relative cost incentives in the short-run determination of the balance sheet structure. Similarly, if customer loyalty is strong, banks may be able to pass on increases in the cost of their funds, thus immunising to some degree against variations in liabilities costs in the portfolio, which seems to be the case in Jordan.

REFERENCES

Andersen, L.C., Burger, A.E. (1969), Asset management and commercial bank portfolio behavior: theory and practice. The Journal of Finance, 24(2), 206-221.

Bailey, R., Driscoll, M.J., Ford J., Mullineux A.W. (1982), The information content of monetary aggregates in the UK. Economics Letters, 9(1), 61-67.

Barten, A.P. (1969), Maximum likelihood estimation of a complete system of demand equations. Euorpean Economic Review, 1(1), 17-73.

Brainard, W.C., Tobin, J. (1968), Econometric models: their problems and usefulness, pitfalls in financial model building. American Economic Review, 58(2), 99-122.

Chamber, D., Charnes, A. (1961), Inter-temporal analysis and optimization of bank portfolio. Management Science, 7, 393-410.

Courakis, A.S. (1974), Clearing bank asset choice behaviour: a mean variance treatment. Oxford Bulletin of Economics and Statistics, 36(3), 173-201.

Edgeworth, F. (1888), Some new methods of measuring variation in general price. Journal of the Royal Statistical Society, 51, 346-368.

Freund, R.J. (1956), The introduction of risk into a programming model. Econometrica, 24(3), 253-263.

Garcia, G.G. (1997), Protecting Bank Deposits. Economic Issues No. 9. International Monetary Fund, Washington.

Hester, D.D., Pierce, J.L. (1975), Bank Management and Portfolio Behaviour. Yale University Press: New Haven.

Hicks, J.R. (1935), A Suggestion for simplifying the theory of money. Economica, 2(5): 1-19.

Humphrey, D.B. (1981), Intermediation and cost determinants of large bank liability composition. Journal of Banking and Finance, 5(2): 167-185.

Kagigi, K.A., Ford, J.L., Cadle, P.J. (2001), Portfolio Behaviour of Islamic Banks: A case study for Iran, 1984-1994. Discussion Paper. Department of Economics, University of Birmingham.

Kane, E.J., Malkiel, B.G. (1965) Bank portfolio allocation, deposit variability and the availability doctrine. Quarterly Journal of Economics, LXXXIX: 113-134.

Kwiatkowski, D., Phillips, P., Schmidt, P. (1991), Testing the null hypothesis of stationarity against the alternative of a unit root, how sure are we that economic time series have a unit root? Journal of Econometrics, 54, 159-178.

Markowitz, H.M. (1952), Portfolio selection. Journal of Finance, VII, 77-91.

Markowitz, H.M. (1959), Portfolio Selection, Efficient Diversification of Investment, (Cowles Foundation for Research in Economics; Monograph No. 16. New York: John Wiley and Sons.

McLaren, K., Upcher, M.R. (1986), Testing further restrictions on portfolio models. Australian Economic Papers, 25(47), 193-205.

Muhammad, Z. (2010), Portfolio Behaviour of Scheduled Banks of

Pakistan. University of Birmingham.
Orr, D., Mellon, W.G. (1961), Stochastic reserve losses and expansion of bank credit. American Economic Review, 51, 614-623.
Parkin, J.M. (1970), Discount house portfolio and debt selection. Review of Economic Studies, 37(4): 469-497.
Parkin, J.M., Gray, M.R., Barrett, R.J. (1970) The portfolio behaviour of commercial banks', In: Hilton, K., Heathfield, D.F. editors. The Econometric Study of the United Kingdom. London: MacMillan; p229-251.
Phillips, P.C.B. (1986), Understanding spurious regressions in econometrics. Journal of Econometrics, 33, 311-340.
Ply, D.H. (1971), On the theory of financial intermediation. Journal of Finance, 25, 737-747.
Porter, R.C. (1961), A model of bank portfolio selection. Yale Economics Essays, 1, 323-359.
Pringle, J. (1974), The capital decision in commercial banks. Journal of Finance, 29(3), 779-795.
Robinson, R.I. (1962), The Management of Bank Funds. 2nd ed. New York: McGraw-Hill Book Company.
Sealey, C.W. (1980), Deposit rate-setting risk aversion, and the theory of depository financial intermediaries. Journal of Finance, 35, 1139-1154.
Sharpe, I. (1974a), A quarterly econometric model of portfolio choice: part II: portfolio behaviour of australian savings banks. Economic Record, 50, 21-38.
Spindt, D.A., Tarhan, V. (1980), Liquidity structure adjustment behaviour of large money centre banks. Journal of Money, Credit and Banking, 17(2), 198-208.
Tobin, J. (1958), Liquidity preference as behaviour towards risk. Review of Economic Studies, 26, 65-86.
Tobin, J. (1965), The theory of portfolio selection. In: Hahn, F.H., Brechling, F.P.R., editors. The Theory of Interest Rates. NY: MacMillan.
Zellner, A. (1962), An efficient method of estimating seemingly unrelated regressions and test for aggregation bias. Journal of American Statistical Association, 57(289), 348-368.