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PORTFOLIO ALLOCATION BY GREEK BANKS

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Abstract

The purpose of this paper is to study the portfolio allocation decisions of Greek banks over the Period 1955 to 1981. The theoretical approach used to derive the demand equations for bank assets is based on a modified version of the Dynamic Generalized Linear Expenditure System. This procedure allows us to calculate both the wealth and interest rate elasticities. We conclude that the Greek banks are relatively sensitive to changes in the various interest rates, with mortgages showing the highest own-interest elasticity.

1. Introduction

Following the pitfalls paper of Brainard and Tobin (1968), studies of financial behaviour have recognized the need to use a complete systems approach incorporating the balance-sheet identities. Models of this type have been constructed for many countries, including the united States [Hendershott (1971)], Great Britain [Green (1982)], and Canada [Brox and Maclean (1986)].

A major problem frequently encountered in such efforts is the multicollinearity associated with the term structure of interest rates. Backus et al. (1980) have suggested the use of Bayesian priors to help overcome this problem. Saito (1977) suggested applying the Linear Expenditure System (LES) in order to reduce the number of parameters that must be estimated while at the same time satisfying all of the theoretical restrictions of the system.

The purpose of this paper is to show how some of the more recent advances in expenditure theory, specifically the DGLES (Dynamic Generalized Linear Expenditure System) variant of the expenditure systems family developed by Gamaletsos (1981), may be applied to yield more valuable insights into the portfolio allocation problem. As an empirical example, a model of the portfolio

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allocation of Greek banks is estimated, allowing the calculation of the wealth and interest-rate elasticities and a relative measure of risk associated with each asset category.

In section 2 of this paper the theoretical model is discussed. In section 3 the data sources, estimation techniques, and main empirical findings are reported. A summary of the major implications and some suggestion for further research are contained in the final section.

2. The Theoretical Model

The theoretical model used in this paper to derive the complete system of demand functions for financial securities is based on the traditional Linear Expenditure System (LES), widely used in consumer theory studies. Saito (1977) has shown that the LES-type model can be adapted to a form which is suitable for estimating the demand for financial securities of a national (or sectoral) economy. To accomplish this puprose, two modifications are required. Following Saito (1977), the first modification involves maximizing an expected constant absolute-risk-aversion utility function [Equation (1)], subject to the wealth constraint [Equation (2)]; that is,

$$U(H) = -\exp\left(-\sum_{i=1}^{n} H_i \rho_i\right) \qquad (1)$$

$$\text{s. t. } W = \sum_{i=1}^{n} H_i \qquad (2)$$

where H_i (i= 1, 2, ..., n) is the end-of-period holdings of the ith security, ρ_i is the return per dollar invested in the ith asset, and W is the end-of-period net wealth. The second modification concerns ρ_i, the expected rate of return. In the present context, this rate of return is assumed to be stochastic, and an increasing function of r_i, the current rate of interest. The gamma family of probability density functions represents a flexible extensive collection of continuous distributions characterized by two parameters.

Following Saito (1977), we shall assume that r_i and ρ_i are connected as:

$$Z_i = \rho_i \,/\, (1 + r_i), \qquad (3)$$

where Z_i is an independent gamma random variable with probability density function:

$$f_i(Z) = \{\, \theta_i^{-\alpha_i} Z^{\alpha_i - 1} \exp(-Z/\theta_i) \,/\, \Gamma(\alpha_i),\ 0 < Z < \infty \quad (4)$$
$$0 \ \textit{elsewhere}$$

$\alpha_i > 0$, $\Theta_i > 0_i$; the parameters α_i and Θ_i are the two characteristic constants which determine the unique member of the gamma family corresponding to Z_i, i= 1, 2, ..., n. By integrating equation (1) with respect to the joint density function of $Z_1, Z_2, ..., Z_n$, we obrain the expected utility function:

$$E(U) = -\int_0^\infty \ldots -\int_0^\infty \exp\left(-\sum_{i=1}^{n} H_i\rho_i\right)\left[\prod_{i=1}^{n} f_i(Z_i)\right] \partial Z_1 \cdots \partial Z_n$$
$$= -\prod_{i=1}^{n} [1 + \theta_i H_i (1 + r_i)]^{-\alpha i} \quad (5)$$

To maximize E(U), subject to the wealth constaint [Equation (2)], we define the function:

$$\Phi = -\prod_{i=1}^{n} [\, 1 + \theta_i H_i (1 + r_i)\,]^{-\alpha_i} - \lambda\left(\sum_{i=1}^{n} H_i - W\right) \quad (6)$$

where λ is a Lagrange multiplier. Differentiating equation (6) with respect to H_i and then equating these partial derivatives to zero result in the equations:

$$\alpha_i\theta_i (1 + r_i) [-E(U)] \,/\, [\, 1 + \theta_i H_i (1 + r_i)\,] - \lambda = 0,\ i = 1, 2, ..., n. \quad (7)$$

These equations can be manipulated algebraically to yield the following equivalent forms:

$$\frac{\lambda}{-E(U)} = \frac{\alpha_i\theta_i (1 + r_i)}{1 + \theta_i H_i (1 + r_i)} = \frac{\alpha_i}{H_i + [\theta_i (1 + r_i)]^{-1}} = \frac{\sum_{i=1}^{n} \alpha_j}{\sum_{j=1}^{n} H_i + \sum_{j=1}^{n} [\theta_j (1 + r_i)]^{-1}} \quad (8)$$

or

$$\alpha_j \left[\sum_{j=1}^{n} H_j + \sum_{j=1}^{n} \{\theta_j (1 + r_j)\}^{-1}\right] = H_i\left(\sum_{j=1}^{n} \alpha_j\right) + [\theta_i (1 + r_i)]^{-1} \sum_{j=1}^{n} \alpha_j \quad (9)$$

This latter equation can be rearranged to obtain:

$$H_i = -[\theta_i(1+r_i)]^{-1} + \frac{\alpha_i}{\sum_{j=1}^{n}\alpha_j}\left[\sum_{j=1}^{n} H_j + \sum_{j=1}^{n}\{\theta_j(1+r_i)\}^{-1}\right] = \gamma_i P_i + b_i\left(W - \sum_{j=1}^{n}\gamma_j P_j\right) \quad (10)$$

where $\gamma_i = -\Theta_i^{-1}$, $P_i = (1+r_i)^{-1}$, $b_i = \alpha_i / (\Sigma\alpha_j)$, $0<b_i<1$ and $\Sigma b_i = 1$.

Saito interprets the a_i's as a measure of risk and the u_i's as scale parameters. This follows as the mean of the gamma distribution is $\alpha\Theta$ and the variance of the gamma distribution is $\alpha\Theta^2$. Thus, for a constant value of Θ, risk as measured by the variance of the gamma function is proportional to α^1.

The model developed so far has been based on two fundamental assumptions: first, it has been assumed that the risk associated with each individual asset, the α_i's in equation (10), has been constant over time and independent of the security price $P_i = 1/(1+r_i)$; and second, the model has benn restricted to the derivation of the demand for financial securities, ignoring the demand for non-portfolio assets (such as transaction demand for money and non-financial assets) and levels of personal income. To accounnt for these defects of the model [Equation (10)], two additional modifications have been applied.

Our main departure from the version of the model suggested by Saito involves substituting $\alpha_i = \delta_i P^r_i$ in the gamma family. This allows both the mean and variance of the distribution to be functions of security prices, P_i's, which in turn depend upon the interest rates, r_i's. Therefore, this modified form of the model allows risk to vary through time with the nominal interest rates.

With this substitution, b_i becomes equal to $\delta_i P_i^{\tau}(\Sigma_j \delta_j P_j^{\tau})^{-1}$ and thus equation (10) becomes consistent with the GLES demand system[2]. These demand equations are assumed to be homogeneous; they satisfy the adding-up conditions and, therefore, the accounting restrictions[3].

The final modification embodied in the DGLES version of the model is to allow the minimum subsistence coefficients, the γ_i coefficients in our basic formulation [Equation (10)] to be functions of the lagged holdings of the ith asset of the form:

$$\gamma_i / (1+r_i) = \gamma_i^* / (1+r_i) + \gamma_i^{**} H_{i-1} \quad (11)$$

where H_{i-1} is the lagged holdings of asset i and γ_i^* and γ_i^{**} are parametric constants. After equation (11) is substituted into equation (10), the final set of expenditure equations for financial securities, in its explicit formulation, becomes:

$$H_i = \frac{\gamma_i^* + \gamma_i^{**} H_{i-1}}{1 + r_i} + \frac{\delta_i [\,1/\,(1 + r_i)\,]^{\tau}}{\Sigma\delta_j [\,1/\,(1+r_j)\,]^{\tau}} [\,W - \Sigma \frac{\gamma_j^* + \gamma_j^{**} H_{i-1}}{(1\,/\,r_j)}] \qquad (12)$$

The significance of the theoretical model discussed above rests on the fact that it allows the calculation of two types of elasticities: wealth elasticities and interest elasticities. The definition of these elasticities and their final expressions are summarized below:

$$E : W = (\partial H_i/\partial W)\,/\,(H_i/W) = b_i/\,S_i \qquad (13)$$
$$E{:}W > 0,\ \text{for}\ b_i > 0$$

$$E : r_{ii} = \frac{(\partial Q_i\,/\,\partial r_i)}{(Q_i\,/\,r_i)}$$

$$= \{\,b_i\,\frac{\gamma_i^* + \gamma_i^{**}H_{i-1}}{1 + r_i} + [\,(1\text{-}\tau)\,b_i + \tau b_i b_i\,]\,[W - \sum_{j=1}^{n} \frac{\gamma_j^* + \gamma_j^{**} H_{i-1}}{1 + r_j}]\,\}\,\frac{r_i}{Q_i} \qquad (14)$$

$$E : r_{ii} > 0,\ \text{for}\ 0 < b_i < 1\ \text{and}\ -\infty < \tau < 0$$

$$E : r_{ij} = \frac{\partial Q_i\,/\,\partial r_j}{Q_i\,/\,r_j}$$

$$= \frac{r_j}{Q_i}\,[b_i(\gamma_j^{*}+\gamma_j^{**}\,H_{i-1})\frac{1 + r_i}{(1+r_j)^2} + \tau\, b_j\, b_i\, \frac{1 + r_i}{1+r_j}\,(\,W - \sum_{j=1}^{n} \frac{\gamma_j^{*}+\gamma_j^{**}\,H_{i-1}}{1+r_j})\,] \qquad (15)$$

$$E : r_{ij} < 0,\ \text{for}\ 0 < b_i < 1\ \text{and}\ -\infty < \tau < 0$$

where E:W is the expenditure elasticity with respect to wealth, $E{:}r_{ii}$ is the own-interest-rate elasticity, $E{:}r_{ij}$ is the cross-interest-rate elasticity, and S_i is the actual share of the portfolio held in the form of asset i. Since $Q_i = H_i/P_i = H_i\,(1+r_i)$ measures the end-of-period holdings of the ith asset, both the own-interest elasticity [Equation (14)] and the cross-interest elasticity [Equation (15)] are quantity elasticities. The fact that these elasticities are derived directly from the theoretical model [Equation (12)] on a simultaneous basis provides certain advantages over other alternatives where demand functions for financial securities are specified on a single-equation basis.

3. The Empirical Estimation of the Model.

3.1. Data and Method of Estimation

This study uses annual Greek data for the period 1955 to 1981[4]. Holdings and interest rates on six categories of bank assets, reserves, foreign currency assets, treasury bills, securities, loans, and mortgages are used. The total portfolio holdings of the bank sector is defined as the sum of the six assets considered.

The period chosen for this investigation: (1) reflects the unavailability of reliable time-series data for the post 1981 period, specifically for the interest-rate series; and (2) comprises a time span during which Greece underwent a number of economic, social and institutional changes. In particular, Greece moved from a period of rapid expansion (1953-1973) to a recession in 1974, caused mainly by the energy crisis, then a moderate growth path (1975-1979), and finally a stagnation stage in the post study period, particularly in the early eighties, In their effort to stabilize the performance of the economy, government authorities, given policy objectives, enacted a series of laws and decrees relating to: (1) industrial growth in general and regional development in particular; (2) the promotion of exports; (3) the creation of highly specialized human capital; (4) the legal structure of labour institutions and labour market inefficiencies; (5) the operation and institutional structure of the banking system, etc[5]. Undoubtedly, both the institutional and legal changes which have taken place during the study period and the unstable character of the Greek economy have had a profound effect on the composition of bank assets. This, in turn, has set the basic framework for exercising monetary policy options in accordance with the government's overall stabilization goals.

The theoretical model has been estimated using the full information maximum likelihood routine contained in the TROLL econometric package [TROLL Manual D0070R]. This system estimates regressions which are non-linear in the coefficients, but linear in terms of prices (interest rates), and income (wealth). Since the six assets considered sum to total wealth, $\Sigma H_i = W$, the variance-covariance matrix of the full system would be singular. To avoid this problem, one equation, namely the equation for home mortgages, has been deleted from the estimation system and its coefficients have been computed from then n-1 equations. The resulting estimates are invariant to the equations dropped and have the same asymptotic properties as maximum likelihood estimates. Furthermore, this estimation process allows corrective procedures for autocorrelation across the expenditure and demand equations. It is well known that non-linear estimation may converge to a local solution, if at all. Iterative searches, therefore, are required and the initial values of the coefficients are of paramount importance. For this paper, the initial values for the b_i's and the δ_i's have been set equal to the mean portfolio shares, the initial values of the γ_i^*'s have been set equal to minus one thousand and the initial values of the γ_i^{**}'s and of τ have been set equal to zero. Experimentation suggests that the estimates are not overly sensitive to starting values in the plausible range[6].

3.2. Statistical Results and Model Implications

The estimation results for the LES version of the model are presented in Table 1. All the b_i's are positive as postulated by the model and statistically significant at the one per cent probability lavel[7]. The γ_i's are negative as theoretically expected and significant at the five per cent level.

TABLE 1

Regression Results from the LES Version of the Model

Parametere Value

Holdings	b_i	γ_i	CR^2
1. Reserves	0.125 (8.22)	-95074 (2.45)	0.937
2. Foreign Currency Assets	0.094 (9.13)	-80172 (2.77)	0.762
3. Treasury Bill	0.223 (45.06)	-168591 (2.64)	0.993
4. Securities	0.034 (10.81)	-21663 (2.09)	0.873
5. Loans	0.419 (21.65)	-302511 (2.46)	0.992
6. Mortgages	0.105	-75585 (2.39)	

Note: Figures in parentheses are the t-statistics.

While the overall fit of the LES version of the model indicates that this approach for representing the portfolio allocation process is acceptable, the results from the DGLES version [Table 2] are clearly superior. In this case, all of the estimated δ_i's are in the theoretically appropriate range and statistically significant. The γ_i^*'s again are all negative as expected, but in this case their probability level is quite low (between five and ten per cent probability level). However, the critical parameters, τ and the γ_i^{**}'s, are all significant at the one per cent level and the corrected R-squared is higher for every equation. This indicates that the DGLES is better suited to the explanation of the portfolio allocation by Greek banks than is the simple LES.

Economic interpretation of the results further supports the superiority of the DGLES version of the model. The marginal allocation coefficients and the

TABLE 2

Regression Results for the DGLES Version of the Model

Parameter Value

Holdings	δ_i	γ_i^*	γ_i^{**}	τ	CR^2
1. Reserves	0.079	-31849	0.755	...	0.978
	(3.92)	(1.51)	(3.75)		
2. Foreign Currency Assets	0.065	-25896	1.435	...	0.803
	(3.83)	(2.03)	(11.39)		
3. Treasury Bills	0.252	-84336	0.723	...	0.957
	(14.40)	(1.63)	(10.31)		
4. Securities	0.015	-4556	1.054	...	0.888
	(2.17)	(1.64)	(19.25)		
5. Loans	0.462	-151066	0.753	...	0.995
	(12.91)	(1.73)	(8.73)		
6. Mortgages	0.127	-37591	0.668	...	...
		(1.65)	(13.17)		
				-3.687	
				(3.34)	

Note: Figures in parentheses are the t-statistics.

wealth elasticities from both version of the model are reported in Table 3. Here we note that while the marginal allocation coefficients are constant over time in the LES version, they vary with the interest-rate structure in the DGLES version. The results from the LES version suggest than 12.5 per cent of increases in the total portfolio would be allocated to primary reserves. The DGLES, on the other hand, indicates that the marginal allocation of reserves has fallen from 6.2 per cent in 1955 to 4.9 per cent in 1981. This lower marginal allocation of new portfolio to holdings to primary reserves is closer to the results obtained in similar studies for other countries, including Hendershott (1977) in his study of the American banking sector, Green (1982) for the United Kingdom, and Brox and Maclean (1986) for Canada.

Lower values of the marginal allocation coefficients from the DGLES version are also found for foreign currency assets and other securities. On the other hand, the marginal allocation coefficients from the DGLES are higher for loans, mortgages, and the holdings of treasury bills.

It should be noted that in this study we have not imposed any explicit estimation restrictions to capture the portfolio allocation effects rendered by the institutional nature of the Greek banking laws. However, the estimated parameters may be interpreted to show the effects of such requirements via either changes in the so-called subsistence coefficients or the marginal allocation coefficients.

Saito (1977) has shown that for the LES version of the model, the degree of risk associated with an asset is proportional to the size of the marginal allocation coefficients, that is, the bi's. On the other hand, in the case of the DGLES, risk is measured by the relative size of the δi's, which are functions of all rates of interest. Given this interpretation, we find that, first, in both models, loans represent the highest degree of risk for the banks, but the risk coefficient obtained from the LES (bs = 0.419) is somewhat lower than that obtained from the DGLES approach (δs = 0.468). Similar results are derived for mortgages, the second highest risk-bearing asset (b = 0.105, δ_6 = 0.136).

Second, and more important, the risk associated with reserves in the LES is surprisingly high (βι = 0.125) as compared to the risk coefficient obtained from the DGLES version (δι = 0.061). This fact alone provides strong support in favour of the DGLES over the LES framework.

The wealth elasticities derived from the DGLES version [Table 3] evaluated at the sample mean, indicate that foreign currency assets, treasury bills, and

TABLE 3

Marginal Allocation Coefficiens and Wealth Elasticities

	Allocation Coefficients			Wealth Elasticities
	1955	Mean	1981	Ew
1. Reserves				
DGLES	0.062	0.061	0.049	0.611
LES	0.125	0.125	0.125	1.242
2. Foreign Currency Assets				
DGLES	0.062	0.065	0.069	1.046
LES	0.094	0.094	0.094	1.521
3. Treasury Bills				
DGLES	0.246	0.254	0.251	1.120
LES	0.223	0.223	0.223	0.982
4. Securities				
DGLES	0.015	0.015	0.016	0.290
LES	0.034	0.034	0.034	0.658
5. Loans				
DGLES	0.477	0.468	0.477	0.962
LES	0.419	0.419	0.419	0.861
6. Mortgages				
DGLES	0.138	0.136	0.137	1.048
LES	0.105	0.105	0.105	0.808

mortgages are growing as proportions of the total portfolios. Wealth elasticities calculated from the simpler LES model show only reserves and foreign currency assets in the elastic range.

Table 4 reports the interest-rate elasticities calculated from both version of the model and evaluated at sample means. Since the primary reserves are not bearing, no elasticities are evaluated with respect to this asset.

The own-interest elasticities, given by the diagonal elements of the table, are all positive, as expected. While all elasticities are found to be inelastic with respect to changes in interest rates, the interest elasticities found in this study are higher than those predicted by traditional models. Also, it should be remembered that the interest-rate elasticities derived in this model are calculated on the assumption that total portfolio holdings are not affected by the change in interest rates (i.e., the wealth restraint holds the total portfolio to be allocated unchanged). Thus, if one assumes that changes in interest rates would encourage banks to raise interest rates on deposits and therefore to expand the size of the portfolio, the interest-rate elasticities would be even larger.

With the exception of loans, the own-interest-rate elasticities derived from the DGLES version of the model are larger than those from the LES. Mortgages are found to be the least interest-inelastic asset (0.728) and securities have the smallest own-interest elasticity (0.285). Lending has the highest own-interest elasticity calculated from the LES model (0.728), but the second lowest (0.443) based on the DGLES estimates. Given the size of the proportions of the portfolios directed into loans, the lower value derived from the DGLES is much more reasonable.

The cross-interest-rate elasticities are given by the off-diagonal items in Table 4. These elasticities indicate from where funds will be shifted in response to changes in other interest rates. As expected theoretically, all of the cross-

TABLE 4

Mean Interest Rate Elasticities

Holdings	Model	1	2	3	4	5	6
1. Reserves	DGLES	...	...	...	...	...	...
	LES	...	...	...	...	...	...
2. Foreign Currency Assets	DGLES	-0.022	0.609	-0.037	-0.010	-0.032	-0.034
	LES	-0.028	0.346	-0.021	-0.014	-0.019	-0.018
3. Treasury Bills	DGLES	-0.088	-0.139	0.577	-0.040	-0.130	-0.140
	LES	-0.063	-0.073	0.219	-0.032	-0.042	-0.040
4. Securities	DGLES	-0.006	-0.010	-0.011	0.285	-0.009	-0.010
	LES	-0.010	-0.011	-0.007	0.207	-0.006	-0.006
5. Loans	DGLES	-0.166	-0.260	-0.282	-0.075	0.443	-0.262
	LES	-0.134	-0.135	-0.088	-0.060	0.714	-0.074
6. Mortgages	DGLES	-0.058	-0.091	-0.098	-0.026	-0.085	0.728
	LES	-0.035	-0.041	-0.027	-0.018	-0.024	0.253

interest-rate elasticities are found to be negative, indicating that the Greek banks view all of the assets considered in this study to be gross substitutes. The largest responses to changes in other interest rates are found for changes in the lending rate. Here the largest effect is noted in the case of treasury bills where a one per cent increase in the lending rate will cause a 0.282 per cent decline in treasury bill holdings. Large shift effects are also noted in the case of foreign currency assets (-0.260), mortgages (-0.262), and reserves (-0.166)

Since conventional lending accounts for nearly fifty per cent of the total asset portfolios, it is not surprising that the largest cross-interest elasticities are found in this case. However, the effects for other assets are also quite significant, particularly in response to changes in mortgage rates and the yield on treasury bills.

Again, with few exceptions, we find that the cross-interest-rate elasticities derived from the DGLES are larger than those obtained from the LES. This results from the fact that the marginal allocation coefficients, the bi's, are themselves functions of the interest rates in the DGLES, while in the LES they remain constant, no matter how much the interest rates change.

In general terms, two basic lesson might be deduced from the analysis of the empirical findings. From a methodological point of view, the findings support the use of the DGLES as an approach for analyzing the portfolio allocation process of the Greek banks. This argument is supported by the fact that the DGLES: (1) corrects some of the ambiguities inherent in the LES version, including the static nature of the model, and the constancy of the allocation, subsistence and risk coefficients; and (2) as the estimates of the various elasticities suggest, allows greater substitution possibilities among asset holdings.

From the practical point of view, the findings have some rather significant policy implications related to more effective financial control of the Greek economy. Specifically, the relatively large values of the interest-rate elasticities found in this study imply that:

1. The Greek banks might be willing to shift large amounts of funds quickly in response to changes in the structure of interest rates. That is, the authorities, by following a flexible interest-rate structure, could achieve a more optimal allocation of their total wealth among asset holdings.

2. An effective financial control of the Greek economy via a more active interest-rate policy might, in turn, have further repercussions, positive or nega-

tive, on the performance of the Greek economy in general and certain sectors in particular. For instance, lowering the rate of interest for loans would reduce the loan holdings ($E : r_{ii} = 0.443$) and would increase most the holdings treasury bills (-0.282), followed by mortgage holdings (-0.262). The relative increase in treasury bill and mortgage holdings would affect the housing market, the business sector and, to a certain extent, the overall performance of the Greek economy. Similar implications could be derived by manipulating the interest rates for the remaining assets of our sample.

4. Summary and conclusions

The major objective of this paper has been to estimate the demand equations for portfolio assets of the Greek banks and then, based on these demand equations, to calculate wealth, and interest-rate elasticities. The methodology used to estimate the demand equations is a modified version of the DGLES demand system derived by maximizing an expected utility subject to the wealth constraint and assuming that the rates of return on the relevant financial securities follow a gamma density function. This methodology provides, among other things, information concerning: (1) the allocation of financial wealth among alternative portfolio holdings; (2) the degree of risk associated with the various forms of financial holdings; and (3) the degree of sensitivity and portfolio shifts with respect to changes in wealth and rates of interest over time.

The empirical findings tend to confirm the theory and are in line with the estimates obtained by other studies of this nature. This induces us to believe that our model provides an alternative to the traditional approaches for estimating complete systems of demand equations for financial securities.

Footnotes

1. It should be noted that the risk which Saito measures is relevant only to the risk on individual assets and not to the risk on a portfolio of assets since the gamma distribution used assumes implicity that th covariances between the various assets are zero.

2. It should be note that, in this form, equation (10) is equivalent to the GLES that is widely used in consumer demand theory, which is derived from a CES-type utility function subject to the income constraint. For a complete analysis of the GLES, see Gamaletsos [1970 and 1973]. It should also be noted that for a value of $\tau = 0$, $\alpha_i = \delta_i$, which is Saito's case.

3. As in the normal LES model the constraint $\Sigma b_i = 1$ insures that the wealth effects will sum to unity and the price (interest rate) effects will sum to zero, since in each equation the price effect is $\gamma_i P_i - b_i \gamma_i P_i$, and for the entire system, $\gamma_i P_i - \Sigma b_i \gamma_i P_i = 0$.

4. Data for the interest rates, with the exception of the rate on foreign currency assets, were taken from Bank of Greece, Department of Economic Studies, *The Greek Economy,* Research Report and Statistical Series, Vol 2, Athens, 1982. The interest rate on U.S. commercial paper, as reported in the *Bank of Canada Review,* was used for foreign currency assets. The data on security holdings were taken from the *Statistical Yearbook of Greece,* National Statistical Service of Greece, various issues. Details on the data construction or the actual series are available from the authors on request.

5. For a further analysis of this issue see, K. P. Prodromidis, *Products of Greece "84: The Export Performance of the Greek Manufacturing Sector,* (Athens: Link International Ltd., 1984).

6. For the properties of non-linear estimation, see Maddala [(1977) 171-181] and Pindyck and Rubinfeld [(1976) 225-234].

7. The evaluation of the estimates on the basis of the t-values should be considered with caution in light of the non-linear method of estimation.

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