Inverse Demand Systems for Composite Liquid Assets: Evidence from China

Gary Wong[a], **Qiao Yu**[b]

[a]Queensland University of Technology, Brisbane, Australia[**]
[b]National University of Singapore, Singapore

Abstract

This paper applies the concept of inverse demands and its related scale and substitution effects to model the demand for liquid assets in China. We also propose a new model, termed the Modified Almost Ideal Inverse Demand System (MAIIDS), which nests the Almost Ideal Inverse Demand System (AIIDS) as a special case. We estimate this new model and its special case by using Chinese panel data and find it statistically superior to the AIIDS. Results also reveal the improved regularity features of the MAIIDS, and show that demand patterns of liquid assets across different income groups in China are distinctive.

KEY WORDS: AIIDS; MAIIDS; Regularity; Liquid assets.

JEL Classification: D11; D12; E41.

1. INTRODUCTION

Chinese households' demands for liquid assets have witnessed significant changes during the economic transition from the centrally planned regime to a market system. This phenomenon results from three basic reasons. First, the economy has experienced a robust expansion with an average annual real GDP growth over 9% in the past two decades. Second, due largely to significant economic marketization and decentralization, her national income is redistributed in favor of households and enterprises rather than the state. For instance, the ratio of government revenue to GDP declined dramatically from 31.2% in 1978 to 11.6% in 1997. Third, the economy is quickly "monetized" as the ratio of broad money to GDP increased from 45% in 1981 to 106% in 1997, whereas financial reforms gradually introduced a variety of financial instruments for individuals to diversify assets portfolios. Therefore, in-depth analyses of China's household assets demand, such as identification of liquid assets demand determinants and understanding of substitutability among different liquid assets, consist of a micro foundation for optimal capital mobilization and effective monetary policy.

Against the backdrop of China's rapid economic expansion and macroeconomic volatility since the late 1970s, many authors have examined this focal issue from various angles. The early work done by Chow (1987) and Feltenstein and Farhadian (1987) established the basic framework for subsequent studies. Although different specification and estimation methods have been proposed and evaluated by Feltenstein and Ha (1991), Li (1992), Ma (1993), Hafer and Kutan (1994), Huang (1994), Yu (1997) and Xu (1998), the dominant approach has been

[**] Address for Correspondence: Dr Gary Wong, School of Economics and Finance, Queensland University of Technology, Gardens Point Campus, Brisbane, QLD 4001, Australia, Tel: +61-7-3864 2521, Fax: +61-7-3864 1500, E-mail address: g.wong@qut.edu.au.

to express different liquid assets as linear or log-linear functions of interest rates and other variables, and they are estimated on an equation by equation basis. Despite the simplicity and hence its widespread popularity, shortcomings of this approach are well known. The most obvious of these is that those models are inconsistent with an underlying preference with the choice of explanatory variables and functional forms resting largely on ad hoc considerations. As a result, the estimates obtained are of limited use for analyzing the substitutability and complementarity relationships among all assets. Additionally, movements of liquid asset prices in China as revealed by movements of interest rates are very sticky. It has long been recognized that quantities of liquid assets supply in China are determined in advance of their current rental prices. Consequently, prices rather than quantities appear to be endogenous in the demand and supply relationships. To avoid theoretical and statistical inconsistency, the specification of inverse demands with rental prices of assets depending on quantities, may be required to empirically analyze the pattern of liquid assets demand in China.

In this paper, we propose a theoretically and statistically consistent framework for modeling and estimating complete demand systems for liquid assets, where the concepts of duality theory, inverse demands, substitution effect and scale effect are all incorporated. More specifically, we generalize a parametric representation of the direct utility function in order to generate inverse demand systems for composite liquid assets in the spirit of the Almost Ideal Inverse Demand System (AIIDS) of Barten and Bettendorf (1989) and Eales and Unnevehr (1994). Like the AIIDS, this new model, termed the Modified Almost Ideal Inverse Demand System (MAIIDS), is a flexible system, but it is more general than the AIIDS in providing more flexibility to the form of quantity effects and in preserving regularity properties in a wider region of quantity space. Since the MAIIDS includes the AIIDS as a special case, it permits nested testing using conventional statistical techniques. Thus, it enables us to shed light on the abilities of the AIIDS, now the most widely used inverse demand system, to provide satisfactory approximations to observed behavior.

We estimate this new model and its special case by using Chinese household panel data in the period of 1990-1997. Once the models are estimated, the coefficients can be used to compute the scale, own/cross quantity and complementarity elasticities among different liquid assets, which are useful for macroeconomic policy analysis. We further adopt Fry, Fry and McLaren's (1996) procedure to transform the deterministic equations to log-ratio form for estimation. This procedure not only restricts the shares implied by the model to the unit simplex, but also provides a transparent representation of the restrictions implied by the AIIDS.

The remainder of this paper proceeds as follows. Section 2 develops a formal theoretical model of liquid assets demand. The empirical specification of our new inverse demand equations is discussed in Section 3. Descriptions of the data and estimation method are provided in Section 4, followed by the interpretation of empirical estimates in Section 5. Finally, Section 6 recapitulates and concludes.

2. THE THEORETICAL MODEL

Let R_{λ}^{N} represent the N-tuples of real numbers, let Ω^{N} represent the nonnegative orthant, and let Ω_{+}^{N} represent the strictly positive orthant. Suppose that individuals' preferences are represented by a direct utility function:

$$u = U(\mathbf{x}) \tag{1}$$

where $\mathbf{x} \in \Omega^{N}$ is an Nx1 vector of liquid assets demand. The direct utility function U($\mathbf{x}$) is said to be regular if it satisfies the following regularity properties (**RU**):[1]

RU1: U: $\Omega^{N} \to R_{\lambda}$
RU2: U is continuous
RU3: U is nondecreasing in $\mathbf{x}$
RU4: U is quasiconcave in $\mathbf{x}$.

The uncompensated inverse demand equations are related to the direct utility function via Hotelling-Wold's identity:

$$r_{i} = \frac{p_i}{m} = R_{i}^{UC}(\mathbf{x}) = \frac{\partial U(\mathbf{x})/\partial x_i}{\sum_j [\partial U(\mathbf{x})/\partial x_j] x_j} \tag{2}$$

where p_i is the rental price of asset i, $m \in \Omega_{+}^{1}$ is the total expenditure on liquid assets, $r_i \in \Omega_{+}^{1}$ is the normalized rental price of asset i, and the superscript UC reminds us that we are considering uncompensated functions.

Dual to (1) is the distance function, defined by:

$$D^{C}(\mathbf{x}, u) = \text{Max}_{d} \{d : U(\mathbf{x}/d) \geq u\} \tag{3}$$

where the superscript C is to indicate that (3) represents the compensated functions; i.e., the functions are conditioned on $\mathbf{x}$ and u. This function formally measures the amount by which all quantities of assets must be changed proportionally to attain a particular utility level (Anderson 1980; Cornes 1992, pp.72-84). The definition of D^{C} in (3) implies that it will inherit the following regularity conditions $\mathbf{RD^{C}}$:

$RD^{C}1$: $D^{C}: \Omega^{N} \times R_{\lambda} \to \Omega_{+}^{1}$
$RD^{C}2$: D^{C} is continuous
$RD^{C}3$: D^{C} is nondecreasing in $\mathbf{x}$
$RD^{C}4$: D^{C} is nonincreasing in u
$RD^{C}5$: D^{C} is concave in $\mathbf{x}$

[1] The notation u=U($\mathbf{x}$) is indicative of that used in the rest of this paper. Upper case letters denote functions, and the corresponding lower case letters denote the scalar values of those functions.

$RD^C 6$: D^C is homogeneous of degree one (HD1) in $\mathbf{x}$.

The empirical importance of the distance function lies in two features. The first is the "derivative property"; that is, differentiation of D^C with respect to quantities $\mathbf{x}$ yields a system of compensated inverse demand share form:

$$r_i = R_i^C(\mathbf{x}, u) = \partial D(\mathbf{x}, u) / \partial x_i. \tag{4}$$

Second, duality theory demonstrates that at the optimum:

$$D^C(\mathbf{x}, u) = 1. \tag{5}$$

The compensated inverse demands can then be converted into the uncompensated inverse demands by substituting for u from the inverted form of (5); i.e.,

$$r_i = R_i^C(\mathbf{x}, u) = R_i^C[\mathbf{x}, U(\mathbf{x})] = R_i^{UC}(\mathbf{x}).$$

Likewise, the uncompensated inverse demand functions can be converted back to compensated functions via the following identical relationship:

$$r_i = R_i^{UC}(\mathbf{x}) = R_i^{UC}(\mathbf{x} * d) = R_i^{UC}[\mathbf{x} * D^C(\mathbf{x}, u)] = R_i^C(\mathbf{x}^*, u)$$

where $\mathbf{x}^* = \mathbf{x}/d$ is a reference vector in quantity space lying on the indifference surface.

To describe substitution possibilities between the liquid assets, it is useful to derive the quantity, scale and complementarity elasticities of inverse demands. Let F_{ij}^{UC} denote the uncompensated quantity elasticities for asset i with respect to x_j, S_i^{UC} the scale elasticity of asset i, F_{ij}^C the compensated quantity elasticities for asset i with respect to x_j, and σ_{ij} the Hicks elasticities of complementarity between assets i and j. [See Sato and Koizumi (1973); Kim (2000)] In notation, they are defined as:

$$F_{ij}^{UC} = \frac{\partial \log(R_i^{UC})}{\partial \log(x_j)}$$

$$S_i^{UC} = \frac{\partial \log[R_i^{UC}(\mathbf{x})]}{\partial \log(d)} = \frac{\partial \log[R_i^{UC}(\mathbf{x} * d)]}{\partial \log(d)} = \sum_j F_{ij}^{UC}$$

$$F_{ij}^C = \frac{\partial \log[R_i^C(\mathbf{x}, u)]}{\partial \log(x_j)} = F_{ij}^{UC} - S_i^{UC} w_j$$

$$\sigma_{ij} = \frac{U(\mathbf{x})\left[\partial^2 U(\mathbf{x}) / \partial x_i \partial x_j\right]}{[\partial U(\mathbf{x}) / \partial x_i][\partial U(\mathbf{x}) / \partial x_j]}$$

where $w_j = r_j x_j$ is the budget share of asset j, and note that $\sigma_{ij} = \sigma_{ji}$.[2]

Quasiconcavity of the direct utility function implies that F_{ii}^{UC}, F_{ii}^{C} and σ_{ii} are nonpositive. Furthermore, interpretation of quantity and scale elasticities can be made in a manner similar to price and expenditure elasticities. For example, demand for asset i is said to be flexible (or inflexible) if F_{ii}^{C} and F_{ii}^{UC} are less than (or greater than) minus one. Likewise, σ_{ij} is negative (or positive) if assets i and j are Hicksian q-substitutes in the Hicksian sense; assets i and j are classified as gross (or net) substitutes and complements according to whether F_{ij}^{UC} (or F_{ij}^{C}) is negative and positive respectively. Lastly, assets are termed luxuries (or necessities) if their scale elasticities are greater than (or less than) minus one.

3. MODEL SPECIFICATIONS

3.1 The AIIDS Specification

The theoretical antecedent of the model to be considered is the AIIDS developed by Barten and Bettendorf (1989) and Eales and Unnevehr (1994). This model is now the most commonly used inverse demand system because it retains all desirable properties of Deaton and Muelbauer's (1980) Almost Ideal Demand System (AIDS). As shown in Eales and Unnevehr (1994), the functional form of the derived share equations of AIIDS is very similar to the AIDS, except the exogenous variables are quantities rather than prices and expenditure.

For purposes of exposition, it is useful to exhibit the logarithmic distance function corresponding to the AIIDS:

$$\log(D^{C}) = \log[X1(\mathbf{x})] - uX2(\mathbf{x}) \tag{6}$$

where Xk($\mathbf{x}$), k=1 and 2, are two positive and continuous functions of quantities.[3] The AIIDS results if X1 is specified as an HD1 Translog functional form, and X2 is specified as an HD0 Cobb-Douglas functional form.

The direct utility function dual to the AIIDS is given by:

$$u = \log(X1)/X2. \tag{7}$$

Applying Hotelling-Wold's identity to (7) after some manipulation, we obtain the AIIDS share equations:

$$x_i R_i^{UC} = W_i^{UC} = E1_i - E2_i \log(X1) \tag{8}$$

[2] See Anderson (1980), Kim (2000) and Sato and Koizumi (1973) for the derivation of the quantity, scale and complementarity elasticity equations.

[3] Since X1($\mathbf{x}$) is a real, continuous, HD1, nondecreasing and concave function, it can be interpreted as the index of aggregate quantity demand for liquid assets.

where W_i^{UC} is the uncompensated budget share equation, and $Ek_i = \partial\log(Xk)/\partial\log(x_i)$, k=1, 2.[4] As X1 is HD1 in **x** but X2 is HD0 in **x**, $\Sigma_i E1_i = 1$ and $\Sigma_i E2_i = 0$. Moreover, the scale, quantity and complementarity elasticities corresponding to the AIIDS take the forms:

$$S_i^{UC} = -1 - E2_i / W_i^{UC}$$

$$F_{ij}^{UC} = -\delta_{ij} + \frac{E1_{ij} - E2_i E1_j - E2_{ij}\log(X1)}{W_i^{UC}}$$

$$F_{ij}^{C} = F_{ij}^{UC} - W_j - E2_i \frac{W_j^{UC}}{W_i^{UC}}$$

$$\sigma_{ij} = \frac{(-E2_i - \delta_{ij})\log(X1)}{W_j^{UC}} + \frac{(E1_{ij} - E1_j E2_i)\log(X1) - E2_{ij}[\log(X1)]^2}{W_i^{UC} W_j^{UC}}$$

where $Ek_{ij} = \partial^2 \log(Xk)/[\partial\log(x_i)\partial\log(x_j)]$, (k=1, 2).

Now we should take a moment to investigate the regularity properties of the AIIDS. As being noted, the AIIDS is regular if it satisfies the regularity conditions RU1 to RU4 over the entire nonnegative orthant $\Omega^N = \{\mathbf{x}: \mathbf{x} \geq 0\}$. It is clear from (8) and the continuity of X1 and X2 that the requirements of RU1 and RU2 are met. However, it is shown in Appendix B that for X1 sufficiently large, the AIIDS share equations will violate the monotonicity (RU3) and curvature (RU4) conditions. Unfortunately, there is no simple parametric restriction available to ensure that the AIIDS is regular even over a region containing the sample data. In response to these irregular features, we next suggest a modification to the AIIDS, which is more flexible in capturing alternative shapes for the effects of quantities on the budget share equations, and in preserving regularity conditions in a wider region of quantity space.

3.2 The Modified AIIDS (MAIIDS) Specification

Using some intuition stemming from Cooper and McLaren's (1992 and 1996) Modified AIDS model, and from their ideas about global regularity conditions, we choose the general form of the direct utility function as:

$$U(\mathbf{x}) = \left[\frac{(X1)^{\lambda} - 1}{\lambda}\right]\frac{1}{X2} \tag{9}$$

where X1 is defined as before, X2 now is HDη instead of HD0 in **x**, and λ and η are the parameters to be estimated. Hotelling-Wold's identity applied to (9) gives the MAIIDS budget share equations:

$$W_i^{UC} = \frac{(1 + \lambda IX)E1_i - E2_i IX}{1 + (\lambda - \eta)IX} \tag{10}$$

[4] The general form of the AIIDS budget share equations (8) is derived by Eales and Unnevehr (1994), while the linearized version of (8) in first-difference form is derived by Barten and Bettendorf (1989). Although both forms are very similar to each other, it is noteworthy that interpretation is different between the two.

where $IX = (X1^{\lambda} - 1)/\lambda$, and $E1_i$ and $E2_i$ are defined as before in which $\Sigma_i E1_i = 1$ and $\Sigma_i E2_i = \eta$. In the form (10), one sees the direct connection between the AIIDS and MAIIDS; setting λ and η to be zero reduces (10) to (8). Selection between the MAIIDS and AIIDS is hence based on the statistical significance of λ and η.

To facilitate comparison with AIIDS it is shown that for MAIIDS:

$$\frac{\partial W_i^{UC}}{\partial \log(X1)} = \frac{(1+\lambda IX)[\lambda E1_i - E2_i - (\lambda-\eta)W_i^{UC}]}{1+(\lambda-\eta)IX}, \tag{11}$$

whereas for AIIDS $\partial W_i^{UC}/\partial \log(X1) = -E2_i$. (11) shows how the response of MAIIDS budget share equations to growth in aggregate quantity X1 can be modified by X1, the levels of quantity demands x_i, and the estimated budget shares W_i^{UC}. More importantly, it is shown in Appendix C that the MAIIDS allows the imposition of regularity conditions over a more extensive region of quantity space.

If we define Z as $-\eta IX/[1 + (\lambda - \eta)IX]$, which is a monotonic mapping of X1 into the $[0, -\eta/(\lambda-\eta)]$ interval, then the MAIIDS budget share equations take the form:

$$W_i^{UC} = (1 - Z)\, E1_i + Z\, E2_i / \eta, \tag{12}$$

and it follows that:

$$S_i^{UC} = -1 + (1-Z)\left[\frac{\lambda E1_i - E2_i}{W_i^{UC}} - (\lambda-\eta)\right] \tag{13}$$

$$F_{ij}^{UC} = -\delta_{ij} + \frac{1}{W_i^{UC}}\left\{\frac{E2_{ij} Z}{\eta} + (1-Z)\left[E1_{ij} + E1_j\left[-\eta - Z(\lambda-\eta)\left(\frac{E2_i}{\eta} - E1_i\right)\right]\right]\right\}$$

$$F_{ij}^{C} = F_{ij}^{UC} - W_j^{UC} + (1-Z)\left[\frac{\lambda E1_i - E2_i}{W_i^{UC}} - (\lambda-\eta)\right]W_j^{UC}$$

$$\sigma_{ij} = \frac{(-E2_i - \delta_{ij})}{V_j} + \frac{\frac{\eta(Z-1)}{Z}[E1_{ij} + E1_j(\lambda E1_i - E2_i)] - E2_{ij}}{V_i V_j}$$

where $V_i = \eta E1_i (Z-1)/Z - E2_i$.

The MAIIDS budget share equations, rewritten as (12), have some interesting and intuitively attractive interpretations. If $\lambda < 0$, then the budget shares W_i^{UC} will monotonically move from $E1_i$ for the poor (when $X1 \to 0$ then $Z \to 0$) to $E2_i/\eta$ for the rich (when $X1 \to \infty$ then $Z \to 1$). On the other hand, if $\lambda > 0$, then W_i^{UC} will converge to $E1_i$ for $X1 \to 0$ and to $(\lambda E1_i - E2_i)/(\lambda - \eta)$ for $X1 \to \infty$ [when $X1 \to \infty$ then $Z \to -\eta/(\lambda - \eta)$].

3.3 Empirical Inverse Demand Functions

As mentioned by Cooper and McLaren (1992) in the context of Marshallian demands, the budget share systems such as (8) and (10) only relate to individuals or households and may not fulfill the exact aggregation conditions. Borrowing their ideas about aggregation issues, the appropriate estimating forms of AIIDS and MAIIDS are:

$$\textbf{AIIDS}:\ W_i^{UC} = E1_i - E2_i \log(X1) + \sum_k \delta_{ik} d_k$$
$$\textbf{MAIIDS}:\ W_i^{UC} = (1 - Z)\, E1_i + Z\, E2_i \,/\, \eta + \sum_k \delta_{ik} d_k$$

where d_{ik} are the social economic variables acting as a proxy for the change in distribution of spending power, and δ_{ik} are the parameters satisfying $\sum_i \delta_{ik}=0$.

We next turn our attention to the issue of choosing the functional forms for the aggregate quantity functions X1 and X2. Note that the AIIDS corresponds to the specification of X1 Translog and X2 Cobb-Douglas; that is,

$$X1 = \exp\left[\sum_j \alpha_j \log(x_j) + 1/2 \sum_i \sum_j \gamma_{ij} \log(x_i)\log(x_j)\right]$$
$$X2 = \prod_j x_j^{\beta_j}$$

where $\sum_j \alpha_j = 1$, $\sum_j \gamma_{ij} = 0$, $\gamma_{ij} = \gamma_{ji}$, and α_j, β_j, and γ_{ij} are the parameters, leading to the AIIDS and MAIIDS estimating forms:

$$\textbf{AIIDS}:\ W_i^{UC} = \alpha_i + \sum_j \gamma_{ij} \log(x_j) - \beta_i \log(X1) + \sum_k \delta_{ik} d_k$$

$$\textbf{MAIIDS}:\ W_i^{UC} = \frac{(1+\lambda IX)\left[\alpha_i + \sum_j \gamma_{ij} \log(x_{ij})\right] - \beta_i IX}{1 + (\lambda - \eta) IX} + \sum_k \delta_{ik} d_k\ .$$

Recall that when λ=0 and η=0, the MAIIDS becomes the AIIDS.

4. THE DATA AND ESTIMATION

4.1 Brief Remarks on the Database

Chinese household data used in this study cover the period of 1990-1997. The data are drawn from China's annual Family Income and Expenditure Survey of Urban Households conducted by the National Statistical Bureau of China (NSBC). The survey contains variables such as household income source, expenditures on goods and services, and holdings of various liquid assets. In each year, the statistical authority surveys more than 25,000 urban households from all thirty provinces and municipals. After obtaining individual household observations, the NSBC first aggregates the variables according to their residential provinces, and then computes the average values for all variables. Since the NSBC does not release the household data in 1994, we estimate the household demand model for the entire period of 1990-97 but lacking 1994 data. In addition, we use the data from 28 provinces to undertake regressions by excluding both Tibet and Hainan, because the people live in the former have quite different demand behavior and the latter is a newly autonomous province.

The asset variables examined here consists of four composite liquid assets: (1) currency holdings (x_1), defined as cash holdings by the end period minus cash holdings at the beginning of the period; (2) household bank savings (x_2), which is the aggregated deposits with all financial intermediaries including commercial banks and mutual saving banks; (3) government bonds (x_3), which is household holdings of all types of government equities, including short-term Treasury bill and long-term Treasury bonds, and Treasury-backed State Bank bonds, and (4) miscellaneous liquid assets (x_4), which contains informal assets such as household lending to small enterprises, and small time deposits at informal intermediaries and insurance companies.

The formula used for computing the rental price of each liquid asset is given by: $p_i = (r_T - r_i) / (1 + r_T) + \dot{p}$, where r_T is the benchmark interest rate, r_i is the own rate of return on asset i, and $\dot{p}$ is the annual inflation rate.[5] The first term of the formula is the opportunity cost of a specific holding asset i and the second term $\dot{p}$ is the inflation cost. In order to proxy the yields from different assets, we adopt the following measures. Three-year Treasury bill yield (r_T) is used as the benchmark interest rate. The yield of currency (r_1) is set to be zero. The yields of saving deposits (r_2) and government bonds (r_3) are represented by the interest rates of one-year term deposits and one-year banking notes (jirong zhaijuan) respectively, and the yield of the miscellaneous liquid assets (r_4) is proxied by the one-year lending rate of banks. Lastly, the change in the total cost of living index in each province is used as the measurement of inflation cost.

The dummies variables (d_k) are used to proxy the impacts of social economic factors on liquid assets demand from different development regions. As defined in

Table *1*, 28 provinces are categorized as three regions according to their degree of development and affluence. Region 1 consists of high income provinces; Region 2 includes the middle income provinces, and Region 3 contains the low income provinces. Based upon the above classification, we define two dummy variables d_1 equals one for the observations in Region 1 and zero otherwise, and d_2 equals one for the observations in Region 2 and zero otherwise.

[5] This formula is the revised version of Barnett's (1978) rental price formula.

4.2 The Stochastic Specification of the Share Equations

To implement the empirical analysis, the inverse demand functions need to be imbedded within a stochastic framework. The traditional approach to the stochastic specification is to append a normally distributed error term ε_i to the deterministic component, $W_i^{UC}(\mathbf{x};\theta)$; i.e.,

$w_i = W_i^{UC}(\mathbf{x};\theta) + \varepsilon_i \quad (i = 1,\ldots\ldots, 4)$

where θ is a vector of parameters. Fry, Fry and McLaren (1996), however, argued that this approach is statistically deficient. In particular, Conditions **RU** imply that the deterministic component $W_i^{UC}(\mathbf{x};\theta)$ are restricted to the closed unit interval (0, 1), leading to a nonzero probability that the modeled budget shares will fall outside the unit simplex. If the assumption of the normal distribution of the error term is maintained, an alternative transformation is necessary. One such transformation introduced by Fry, Fry and McLaren (1996) is defined as:

$$y_i = \log(w_i/w_4) \qquad (i = 1, 2, 3)$$

with Jacobian: $(w_1 \times\ldots\ldots\times w_4)^{-1}$. Thus, our general functional form for estimation becomes:

$$y_i = \log(w_i/w_4) = \log\left[W_i^{UC}(\mathbf{x};\theta)/W_4^{UC}(\mathbf{x};\theta)\right] + u_i \qquad (i = 1, 2, 3)$$

where u_i are the error terms characterized by a multivariate normal distribution with zero mean and constant contemporaneous variance covariance matrix.

Directly applying this procedure to the MAIIDS share equations, the budget share equations become:

$$y_i = \log(w_i/w_4) = \log\left\{\frac{\dfrac{(1+\lambda IX)\left[\alpha_i + \sum_j \gamma_{ij}\log(x_{ij})\right] - \beta_i IX}{1+(\lambda-\eta)IX} + \sum_k \delta_{ik} d_k}{\dfrac{(1+\lambda IX)\left[\alpha_4 + \sum_j \gamma_{4j}\log(x_{4j})\right] - \beta_4 IX}{1+(\lambda-\eta)IX} + \sum_k \delta_{4k} d_k}\right\} + u_i. \tag{14}$$

The corresponding specification for the AIIDS is exactly the same, except for the additional restriction that η=0 and λ=0. Henceforth, estimation of AIIDS and MAIIDS can be based upon (14).

5. EMPIRICAL RESULTS

5.1 Analysis of the Estimates

Estimation has been carried out by using the LSQ option (adjusted for a heteroscedastic variance covariance matrix) of TSP 4.5 computer package, which is well suited to the estimation of systems with complex cross-equation constrains. Table 2 presents the parameter estimates along with t ratios, R^2, and the maximized log likelihood values of the AIIDS and MAIIDS. There are a number of points worth to be highlighted. First, the estimated coefficients in both models take the same signs and similar magnitudes. Second, the overall fit of both models as reflected by the R^2 is quite good, noting that estimation is in log-ratio form. Third, on the basis of R^2, there is little to choose between the models, but on the basis of a comparison of log likelihood values, MAIIDS outperforms AIIDS. It is also noteworthy that the values of λ and η are significantly different from zero as reflected by their asymptotic t ratios. A chi-square test of the restrictions (λ=0 and η=0) implied by the AIIDS results in a calculated χ^2 statistic of 26.46, compared with the critical value for $\chi^2_{(2)}$ (at the 1% level) of 9.28. These figures indicate that the AIIDS is rejected in favor of the MAIIDS. Thus, the freeing up of λ and η is desirable on statistical grounds.

Casting some light on the aggregate demand coefficients or β_i, the positive signs are shown in savings and miscellaneous asset equations whilst the negative signs appear in cash and bond equations. Recall that for the AIIDS, $\partial w_i / \partial \log(X1) = -\beta_i$. Hence, under the AIIDS, an increase in aggregate assets demand will reduce the shares of savings and miscellaneous assets but raise the shares of cash and bonds. In other words, there exists a change in household preferences for liquid assets when the portfolio size changes. As for the magnitudes of β_i, we find that β_4 in the AIIDS is not significantly different from zero so that the effect of log(X1) toward miscellaneous assets is still unclear. On the other hand, the absolute values of β_1 and β_2 in AIIDS appear to be large and significantly different from zero.

The coefficients of the regional dummy variables (δ_{ik}) in both models turn out to have notable impact on the households' demands for liquid assets. Indeed, half of the estimated coefficients have t-ratios with absolute values larger than 1.65, and note that their signs and magnitudes in both models are very comparable. As indicated by the signs of δ_{k1} (k=1 to 4), households in Region 1 have higher shares in savings deposits but lower shares in cash and bonds when compared with Regions 2 and 3 households. These findings may reflect the higher popularity of traditional assets such as cash and bonds in less developed provinces. The positive sign of δ_{21} might be due to the fact that Region 1 households are more affluent, and hence they may have higher incentive and ability to save. One may perceive that the negative signs of δ_{11} and δ_{31} are the mirror images of the restricted investment opportunity of Region 3 households. Possibly, households in less developed provinces have lower discretionary income and are facing less convenient financial services, which restrict their opportunity for holding more sophisticated investment assets. The dummy coefficients of δ_{k2} demonstrate positive sign in cash, bonds and miscellaneous assets equations but negative in savings equation. Despite these, all of them are insignificantly different from zero at the 1% level, indicating that the impact of the dummy variable in Region 2 on the budget shares is trivial.

Of possibly greater importance than these statistical results are the regularity properties of the AIIDS and MAIIDS. Given the parameter estimates in Table 2, an analysis of the fitted values of both models indicates that the required monotonicity properties (RU3) are satisfied over the entire sample period. Nonetheless, for all quantities reduce by 900%, the monotonicity conditions of AIIDS (but not MAIIDS) are violated as the predicted shares of cash and bonds turn out to be negative for some observations. This finding is not surprising since the AIIDS will stray outside the (0, 1) interval under large changes in aggregate demand. It might be concluded that MAIIDS outperforms AIIDS as far as monotonicity requirements are concerned.

Regarding the curvature requirements, the parameter estimates reveal that both models cannot satisfy Condition RU4 at a substantial fraction of the quantity situation in our sample. This indicates that the unrestricted version of AIIDS and MAIIDS are not globally regular which is a disappointing aspect of this study. Though constrained estimation would be a simple option to deal with this problem, the irregular of the models might be caused by other factors such as oversimplified static theory, insufficiently robust functional forms, the application of an essentially micro theory specification to macro data, and the rather high level of aggregation of our series. Variations on the specifications in the inverse demand context need to be investigated along with these other potential sources of irregularity.

Since AIIDS is statistically dominated by MAIIDS, in the following subsection the coefficient estimates of MAIIDS will be used to compute the point estimates of the quantity, scale and complementarity elasticities.

5.2 Analysis of the Elasticity Estimates

Table 3 presents the estimates of uncompensated quantity elasticities, scale elasticities, compensated quantity elasticities and Hicks complementarity elasticities for the MAIIDS. The first part of this table reports the estimates of uncompensated elasticities. It is shown that our estimates offer no surprise; all the uncompensated own quantity elasticities (f_{ii}^{UC}) are negative and generally greater than minus one, which obeys the inverse law of demand, and indicates that all liquid assets are inflexible. We also find that, apart from f_{31}^{UC}, f_{34}^{UC} and f_{43}^{UC}, the uncompensated cross quantity elasticities are all negatively small. In the case of positive uncompensated cross quantity elasticities, the magnitudes are very small. While cash, savings deposits and bonds are shown to be gross weak substitutes among themselves, miscellaneous assets appear to be a gross complement for bonds.

Scale elasticities, reported in the second part of Table 3, measure the effects of a proportionate increase in quantity demands on the rental prices of liquid assets. The scale elasticities of cash and bonds are obviously different from minus one, suggesting nonhomothetic preferences. Furthermore, all assets, with the exception of cash and bonds, are necessities; of these, miscellaneous assets (or bonds) have the smallest (or highest) scale elasticity. This is perhaps intuitively plausible because the Chinese households have a persistent heritage of holding cash balance. Note also that bonds may be perceived as more sophisticated financial instruments compared with savings deposits and miscellaneous assets. Henceforth, the rental prices of cash and bonds would be less responsive to the growth of total portfolio size. Another noteworthy finding is that the scale elasticity for cash is greater than minus one, which does not agree with the findings in the studies of Baumol-Tobin type models. Not all studies obtain this result so ours can be viewed as a contribution to that debate, favoring the view that cash is a luxury good.

The third part of Table 3 gives the estimates of compensated own / cross quantity elasticities of assets demand. These estimates aim at measuring net substitution and complementarity relationships when utility is held constant. It is important to note that some of the liquid assets appearing to be gross substitutes change as complements when the definition of the compensated elasticities is used. This might appear to be a contradiction but it could be resolved easily when one considers scale effects in the final calculation. In this respect, it is useful to recall that $F_{ij}^{C} = F_{ij}^{UC} - S_{i}^{UC} w_{j}$. It is now apparent that only if the gross substitution effect (measured by the term F_{ij}^{UC}) is larger than the scale effect (measured by the term $S_{i}^{UC} w_{j}$) will F_{ij}^{C} have the same sign as F_{ij}^{UC}.

Primary interest of this study lies in the Hicks elasticities of complementarity between asset pairs; the fourth part of Table 3 contains the estimates of these elasticities. Overall, the Hicks elasticities of complementarity (σ_{ij}) contain the same information as the uncompensated quantity elasticities f_{ij}^{UC}; all of them take the same signs, but the Hicks complementarity elasticities are symmetric. The Hicks complementarity elasticities indicate that all liquid assets (except bonds and miscellaneous assets) are Hicksian q-substitutes to each other. Interestingly, bonds have an own quantity responsiveness that is two to five times that of any of the other three assets. In addition, σ_{24} indicates the strongest degree of gross substitution between savings deposits and miscellaneous assets in the portfolio. We also observe that cash-savings deposits, cash-miscellaneous assets, savings deposits-bonds and savings deposits-miscellaneous assets show a notably higher degree of substitution than the remaining asset pairs in the portfolio. Therefore, there exists notable substitution among those liquid assets. This implies the usual measurement of monetary aggregate in Chinese macroeconomic control is not optimal since in principle the effectiveness of any policy action designed to affect a particular monetary aggregate is reduced (see Barnett et al. 1992). In this case, broader definitions of money instead of M2 or M3 should be selected as target control in the context of the Chinese economy.

In order to examine regional variations in household assets demand, region-specific quantity, scale and complementarity elasticities are computed and reported in Table 4.[6] The first part of this table reports the uncompensated and compensated quantity elasticities in three regions. Comparing these quantity estimates among three regions, the differences turn out to be small. In particular, the gross and net substitution/complementarity patterns among three regions are very similar; of the 32 relevant points comparison only 2 (f_{13}^{UC} and f_{32}^{UC}) alter in sign, comparing the estimates in Regions 1, 2 and 3.

The computed scale elasticities in Table 4 appear to be different from those in Table 3. As can be seen, the magnitudes of s_{i}^{UC} among three different regions are incomparable, revealing that the scale effects toward all asset prices are quite diverse across different income groups. This regional variation may be due largely to the difference in investment habit in urban China. Judging from the point estimates of s_{i}^{UC}, we find that miscellaneous assets are defined as luxury goods in Regions 1 and 3 but a necessity in Region 2. More interestingly, savings deposits are classified as luxury goods in Region 3 but as necessities in Regions 1 and 2. It might be concluded that the rental price of savings deposits is more responsive to the scale of assets demand in less developed provinces. Cash is expected to be a luxury but it is only in Regions 1 and 2 that we obtain the correct result for this asset. In Region 3, cash is grouped as a necessity, which reveals the fact that cash is more important in

[6] Quantity, scale and complementarity elasticities in three defined regions under the MAIIDS are calculated on the basis of the regional mean values (that is quantities) and the nationwide statistics (that is the estimated coefficients in Table 2).

less developed provinces. For the remaining item, bonds are recognized as luxury goods in all three regions. Note, however, that s_3^{UC} in Region 3 is notably larger than those in Regions 1 and 2, which is consonant with a "a prior expectation" in the Chinese economy context; that is traditional assets such as government bonds are more popular in less developed provinces.

The estimated Hicks complementarity elasticities, presented in the third part of Table 4, measure the substitutability of all assets pair in three different regions. It is shown that the signs of σ_{ij} (except σ_{34}) are consistently negative among the three regions. With respect to their magnitudes, however, one sees that the absolute values of σ_{ij} in Region 1 are notably larger than those in Regions 2 and 3. These findings yield two implications. First, there is evidence of stronger substitutability among the liquid assets in more developed provinces; second, substitutability of asset pairs across different income groups are fairly diverse. As being expected, cash should be a close Hicksian q-substitute for the other three assets. In Region 1, the estimated sign and size of σ_{1j} justifies this argument. Notwithstanding, cash turns out to be weak Hicksian q-substitutes for savings deposits, bonds and miscellaneous assets in Regions 2 and 3. We further read that savings deposits - bonds and savings deposits - miscellaneous assets in all regions show higher degree of substitution than other asset pairs in the portfolio, which is in line with the findings in Table 3.

6. CONCLUSIONS

This paper lays out an inverse demand system approach to the analysis of preference interaction among liquid assets and tests it on the Chinese panel data. In this approach, we implicitly assume that supplies of liquid assets in China are predetermined by the central bank with adjustments of rental prices of those assets providing the market clearing mechanism. This proposed method has several advantages over the traditional approach. In particular, the empirical model of assets demand presented here are more general than the traditional forms since they do not reply on the assumption that all liquid assets can be aggregated. Furthermore, it allows for the simultaneous estimation of all rental price functions of liquid assets. This feature not only ensures that the derived equation system is consistent with an underlying preference but also yields some insights about the substitution possibilities inherent in a consumer demand model.

In an empirical illustration, we have introduced a new inverse demand system, the MAIIDS, which nests Barten and Bettendorf (1989) and Eales and Unnevehr's (1994) AIIDS as a special case. We have also provided prima facie evidences in favor of improved regularity properties of MAIIDS relative to AIIDS. Using the standard modeling scenario, we have estimated this new form and tested the restrictions corresponding to its AIIDS special case. Judged by the likelihood ratio test, the AIIDS is dominated by the MAIIDS.

Among others, the empirical evidence that is of special interest to monetary authorities is the relatively small own quantity and cross quantity effects of the inverse demand for liquid assets. We also find that substitutability is moderately high among liquid assets, thereby indicating that broader definitions of money may be satisfactory macroeconomic policy targets in the context of the Chinese economy. Furthermore, bonds are relatively popular in less developed provinces. On the other hand, the substitutability among the liquid assets is much higher in wealthy provinces than in poor counterparts. Probably, these findings mirror three phenomena: diverse demand patterns of liquid assets across different income groups; increasing regional discrepancies in China's economic development during market oriented reforms; and limited investment channels in less developed regions. According to these, the government should maintain an adequate social network and speed up the reforming process in financial system particularly in the backward region.

Appendix A: Notation

The following is a listing of principal notation used throughout the paper.

$\mathbf{x} = (x_1, \ldots\ldots, x_N)'$	= a vector of quantities of liquid assets
$U(\mathbf{x})$	= the direct utility function
p_i	= the rental price of the ith liquid asset
m	= the total expenditure on liquid assets
$r_i = p_i / m$	= the normalized rental price of the ith liquid asset
$D^C(\mathbf{x}, u)$	= the distance function
$R_i^{UC}(\mathbf{x})$	= the uncompensated inverse demand equations
$R_i^{C}(\mathbf{x}, u)$	= the compensated inverse demand equations
F_{ij}^{UC}	= the uncompensated quantity elasticity equations
S_i^{UC}	= the scale elasticity equations
F_{ij}^{C}	= the compensated quantity elasticity equations
σ_{ij}	= the Hicks complementarity elasticity equations
W_i^{UC}	= the uncompensated budget share equations
EK_i (k=1, 2)	$= \partial \log(Xk) / \partial \log(x_i)$
EK_{ij} (k=1, 2)	$= \dfrac{\partial^2 \log(Xk)}{\partial \log(x_i) \partial \log(x_j)}$
IX	$= (X1^{\lambda} - 1)/\lambda$
Z	$= -\eta IX / [1 + (\lambda - \eta) IX]$
u_i	= the normally distributed error term
$\chi^2_{k'}$	= the Chi-Squared critical values with k' degree of freedom

Appendix B: Regularity Properties of AIIDS

In this paper it is claim that the AIIDS will violate Conditions RU3 and RU4 for X1 and hence IX large enough.

Consider these conditions in turn:

RU3: This condition requires that the budget shares W_i^{UC} lie globally in the unit interval. It follows from (8) that the AIIDS budget share equations are:

$$W_i^{UC} = E1_i - E2_i \log(X1). \tag{B1}$$

From (B1), it is apparent that for X1 sufficiently large or small, the budget shares W_i^{UC} will stray outside the (0, 1) interval, thereby violating Condition RU3.

RU4: This condition requires that the Hessian matrix of the direct utility function be negative semidefinite. The violation of this condition can be illustrated by investigating the AIIDS uncompensated own quantity elasticity equations. Given the specific Cobb-Douglas formulation of X2 in AIIDS, $E2_{ii} = 0$. The ith uncompensated own quantity elasticity F_{ii}^{UC} can then be simplified as:

$$F_{ii}^{UC} = -1 + (E1_{ii} / W_i^{UC}) - (E2_i\, E1_i / W_i^{UC}). \tag{B2}$$

The nature of the curvature violation problem for AIIDS is now obvious. For $E2_i > 0$, as X1 increases, W_i^{UC} decreases monotonically from $E1_i$ to $-\infty$. When W_i^{UC} tends to a negatively small number, the third term in (B2) – $(E2_i E1_i / W_i^{UC})$ turns out to be positively large and dominates in F_{ii}^{UC}. Thus, it is obvious that there is a tendency for the required nonpositivity of F_{ii}^{UC} to be violated when X1 is sufficiently large; this may occur even before W_i^{UC} strays outside the (0, 1) interval.

Appendix C: Regularity Properties of MAIIDS

This appendix investigates the regularity features of MAIIDS and provides a formal proof of the claim that MAIIDS will preserve the regularity conditions over a much wider range of quantity space than is AIIDS.

As shown in Section 3, the MAIIDS budget share equations are of the form:

$$W_i^{UC} = \frac{(1+\lambda IX)E1_i - E2_i IX}{1+(\lambda-\eta)IX}. \qquad \text{(C1)}$$

It is clear from (C1) that the requirements of RU1 and RU2 are met. Furthermore, it is equally clear from (C1) that in the region $\lambda \geq -1$ and $X1 \geq 1$, we have $IX \geq 0$, and thus the restrictions $1 \geq E1_i \geq 0$ and $0 \geq E2_i \geq -1$ are sufficient to ensure MAIIDS satisfies Condition RU3 or $1 \geq W_i^{UC} \geq 0$.

We next examine the maintenance of quasiconcavity restriction of MAIIDS. Given that X2 is replaced by the Cobb-Douglas form, the MAIIDS uncompensated own quantity elasticity equation F_{ii}^{UC} is given by:

$$F_{ii}^{UC} = -1 + (1 - Z)V_{ii}.$$

where

$$V_{ii} = \frac{1}{W_i^{UC}}\left[E1_{ii} + E1_i\left[-\eta - Z(\lambda-\eta)\right]\left(\frac{E2_i}{\eta} - E1_i\right)\right].$$

Clearly, the possible source of violation of nonpositivity of F_{ii} comes from the term V_{ii}. For $\lambda < 0$, however, Z asymptotes to unity when X1 increases. That implies the term V_{ii} asymptotes to zero and has less weight as X1 increases. Therefore, for X1 Translog and X2 Cobb-Douglas, MAIIDS appears to be more regular than AIIDS.

REFERENCES

Anderson, R. W. (1980), "Some Theory of Inverse Demand for Applied Demand Analysis," *European Economic Review*, 14, 281-290.

Barnett, W. A. (1978), "The User Cost of Money," *Economics Letters*, 1, 145-149.

Barnett, W. A., Fisher, D. and Serletis, A. (1992), "Consumer Theory and the Demand for Money," *Journal of Economic Literature*, 30, 2086-2119.

Barten, A. P. and Bettendorf, L. J. (1989), "Price Formation of Fish: An Application of an Inverse Demand System," *European Economic Review*, 33, 1509-1525.

Brown, M. G., Lee, J. Y. and Seale, J. L. (1995), "A Family of Inverse Demand Systems and Choice of Functional Form," *Empirical Economics,* 20, 519-530.

Chow, G. C. (1987), "Money and Price Determination in China," *Journal of Comparative Economics*, 11, 319-333.

Cooper, R. J. and McLaren, K. R. (1992), "An Empirically Oriented Demand System with Improved Regularity Properties," *Canadian Journal of Economics*, 25, 652-668.

Cooper, R. J. and McLaren, K. R. (1996), "A System of Demand Equations Satisfying Effectively Global Regularity Conditions," *Review of Economics and Statistics*, 78, 359-364.

Cornes, R. (1992), *Duality and Modern Economics*, Cambridge: Cambridge University Press.

Deaton, A. (1979), "The Distance Function in Consumer Behavior with Applications to Index Numbers and Optimal Taxation," *Review of Economic Studies*, 46, 391-475.

Deaton, A. and Muellbauer, J. (1980), "An Almost Ideal Demand System," *American Economic Review*, 70, 312-326.

Eales, S. J. and Unnevehr, L. J. (1994), "The Inverse Almost Ideal Demand System," *European Economic Review*, 38, 101-115.

Eales, S. J., Durham, C. and Wessells, C. R. (1997), "Generalized Models for Japanese Demand for Fish," *American Journal of Agricultural Economics*, 79, 1153-1663.

Feltenstein, A. and Farhadian, Z. (1987), "Fiscal Policy, Monetary Targets and the Price Level in a Centrally Planned Economy: An Application to the Case of China," *Journal of Money, Credit and Banking*, 19, 137-156.

Feltenstein, A. and Ha, J. (1991), "Measurement of Repressed Inflation in China: The Lack of Coordination between Monetary Policy and Price Controls," *Journal of Development Economics*, 36, 279-294.

Fry, J. M., Fry, T. R. and McLaren, K. R. (1996), "The Stochastic Specification of Demand Share Equations: Restricting Budget Shares to the Unit Simplex," *Journal of Econometrics*, 73, 377-385.

Hafer, R. W. and Kutan A. M. (1994), "Economic Reforms and Long-Run Money Demand in China: Implications for Monetary Policy," *Southern Economic Journal*, 60, 936-945.

Huang, G. (1994), "Money Demand in China in the Reform Period: An Error Correction Model," *Applied Economics*, 26, 713-719.

Huang, K. (1983), "The Family of Inverse Demand Systems," *European Economic Review*, 23, 329-337.

Kim, H. Y. (2000), "The Antonelli Versus Hicks Elasticity of Complementarity and Inverse Input Demand Systems," *Australian Economic Papers*, 39, 245-261.

Li, K. W. (1992), "Savings, Foreign Resources and Monetary Aggregates in China 1954-1989," *China Economic Review*, 13, 125-133.

Ma, G. (1993), "Macroeconomic Disequilibrium, Structural Changes, the Household Savings and Money Demand in China," *Journal of Development Economics*, 41, 115-136.

Park, H. and Thurman, W. (1999), "On Interpreting Inverse Demand Systems: A Primal Comparison of Scale Flexibilities and Income Flexibilities," *American Journal of Agricultural Economics*, 81, 950-958.
Sato, R. and Koizumi, T. (1973), "On the Elasticities of Substitution and Complementarity," *Oxford Economic Papers*, 25, 44-56.
Xu, Y. (1998), "Money Demand in China: A Disaggregate Approach," *Journal of Comparative Economics*, 26, 544-564.
Yu, Q. (1997), "Economic Fluctuation, Macro Control, and Monetary Policy in the Transitional Chinese Economy," *Journal of Comparative Economics*, 25, 180-195.

Table 1. Classification of 28 Provinces in China

Region 1:	Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong.
Region 2:	Shanxi, Liaoning, Anhui, Hubei, Hunan, Sichuan, Jilin, Heilongjiang, Jiangxi, Henan.
Region 3:	Guizhou, Yunnan, Shaanxi, Ningxia, Xinjiang, Inner Mongolia, Gansu, Guangxi, Qinghai.

Table 2. Comparison of Coefficients: AIIDS and MAIIDS

Parameter	AIIDS Estimate	AIIDS t-ratio	MAIIDS Estimate	MAIIDS t-ratio
α_1	0.375	20.077**	0.374	22.641**
α_2	0.403	21.501**	0.401	24.028**
α_3	0.086	15.887**	0.086	16.775**
α_4	0.136	27.880**	0.138	24.613**
γ_{11}	0.102	17.823**	0.102	19.232**
γ_{12}	-0.094	-17.446**	-0.094	-19.162**
γ_{13}	-0.003	-2.152**	-0.003	-2.586**
γ_{14}	-0.006	-6.161**	-0.006	-6.360**
γ_{21}	-0.094	-17.446**	-0.094	-19.162**
γ_{22}	0.140	25.797**	0.141	27.521**
γ_{23}	-0.016	-9.232**	-0.017	-10.364**
γ_{24}	-0.030	-16.252**	-0.031	-14.905**
γ_{31}	-0.003	-2.152**	-0.003	-2.586**
γ_{32}	-0.016	-9.232**	-0.017	-10.364**
γ_{33}	0.015	17.557**	0.016	18.326**
γ_{34}	0.004	5.396**	0.004	4.791**
γ_{41}	-0.006	-6.161**	-0.006	-6.360**
γ_{42}	-0.030	-16.252**	-0.031	-14.905**
γ_{43}	0.004	5.396**	0.004	4.791**
γ_{44}	0.032	19.381**	0.033	18.253**
β_1	-0.042	-3.949**	-0.021	-2.289**
β_2	0.047	4.534**	0.006	1.286
β_3	-0.006	-4.175**	-0.003	-2.321**
β_4	0.001	1.033	0.000	1.083
η	—	—	-0.017	-2.054**
λ	—	—	-1.936	-3.593**
δ_{11}	-0.033	-2.649**	-0.044	-3.686**
δ_{12}	0.016	1.525	0.012	1.168
δ_{21}	0.038	3.302**	0.048	4.333**
δ_{22}	-0.018	-1.868*	-0.015	-1.618
δ_{31}	-0.005	-2.719**	-0.005	-3.170**
δ_{32}	0.003	1.621	0.004	2.363**
δ_{41}	0.000	-0.083	0.001	0.653
δ_{42}	0.000	-0.215	0.000	-0.147

Table 2. Continued

	AIIDS	**MAIIDS**
Log-Likelihood	4440.89	4454.21
R^2		
Cash	0.645	0.641
Savings	0.660	0.643
Bonds	0.733	0.680
Miscellaneous Assets	0.761	0.801

AIIDS Restriction Test (η=0 and λ=0):

Likelihood Ratio Test Statistic: 26.46

1% Critical Value: $\chi^2_{(2)} = 9.21$

Note: * Significant at 10% level with a two-tailed test.
** Significant at 5% level with a two-tailed test.
Asset Set: {1=Cash, 2=Savings Deposits, 3=Bonds, 4=Miscellaneous Assets}.

Table 3. Elasticity Estimates: MAIDS

Uncompensated Quantity Elasticities			
f_{11}^{UC}	-0.488	f_{31}^{UC}	0.040
f_{12}^{UC}	-0.296	f_{32}^{UC}	-0.065
f_{13}^{UC}	-0.007	f_{33}^{UC}	-0.521
f_{14}^{UC}	-0.014	f_{34}^{UC}	0.138
f_{21}^{UC}	-0.136	f_{41}^{UC}	-0.042
f_{22}^{UC}	-0.810	f_{42}^{UC}	-0.351
f_{23}^{UC}	-0.024	f_{43}^{UC}	0.071
f_{24}^{UC}	-0.044	f_{44}^{UC}	-0.415
Scale Elasticities			
s_{1}^{UC}	-0.832	s_{3}^{UC}	-0.801
s_{2}^{UC}	-1.011	s_{4}^{UC}	-1.025
Compensated Quantity Elasticities			
f_{11}^{C}	-0.310	f_{31}^{C}	0.212
f_{12}^{C}	0.283	f_{32}^{C}	0.492
f_{13}^{C}	0.021	f_{33}^{C}	-0.494
f_{14}^{C}	0.033	f_{34}^{C}	0.184
f_{21}^{C}	0.080	f_{41}^{C}	0.178
f_{22}^{C}	-0.106	f_{42}^{C}	0.362
f_{23}^{C}	0.010	f_{43}^{C}	0.105
f_{24}^{C}	0.013	f_{44}^{C}	-0.357
Hicks Elasticities of Complementarity			
σ_{11}	-3.073	σ_{23}	-1.917
σ_{12}	-1.825	σ_{24}	-2.150
σ_{13}	-1.478	σ_{33}	-13.580
σ_{14}	-1.685	σ_{34}	0.062
σ_{22}	-2.452	σ_{44}	-7.446

Note: All elasticities are estimated at the sample mean values of exogenous variables. f_{ij}^{UC}, s_{i}^{C}, f_{ij}^{C} and σ_{ij} are the point estimates or the scalar values of the relevant elasticity equations in (13).

Table 4. Elasticity Estimates Among Different Regions: MAIIDS

Uncompensated and Compensated Quantity Elasticities			
	Region 1	**Region 2**	**Region 3**
f_{11}^{UC}	-0.522	-0.509	-0.459
f_{12}^{UC}	-0.117	-0.304	-0.378
f_{13}^{UC}	0.002	-0.007	-0.011
f_{14}^{UC}	-0.004	-0.014	-0.021
f_{21}^{UC}	-0.161	-0.138	-0.129
f_{22}^{UC}	-0.859	-0.799	-0.797
f_{23}^{UC}	-0.027	-0.024	-0.023
f_{24}^{UC}	-0.049	-0.045	-0.042
f_{31}^{UC}	0.108	0.017	0.036
f_{32}^{UC}	0.044	-0.062	-0.121
f_{33}^{UC}	-0.553	-0.584	-0.443
f_{34}^{UC}	0.130	0.122	0.157
f_{41}^{UC}	-0.048	-0.044	-0.036
f_{42}^{UC}	-0.422	-0.317	-0.331
f_{43}^{UC}	0.074	0.066	0.068
f_{44}^{UC}	-0.391	-0.457	-0.418
f_{11}^{C}	-0.293	-0.387	-0.257
f_{12}^{C}	0.479	0.073	0.351
f_{13}^{C}	0.035	0.015	0.018
f_{14}^{C}	0.043	0.020	0.038
f_{21}^{C}	0.094	0.106	0.066
f_{22}^{C}	-0.196	-0.045	-0.095
f_{23}^{C}	0.009	0.019	0.006
f_{24}^{C}	0.003	0.023	0.014
f_{31}^{C}	0.348	0.165	0.124
f_{32}^{C}	0.669	0.393	0.198
f_{33}^{C}	-0.519	-0.558	-0.430
f_{34}^{C}	0.179	0.163	0.182
f_{41}^{C}	0.156	0.188	0.137
f_{42}^{C}	0.110	0.403	0.292
f_{43}^{C}	0.102	0.108	0.094
f_{44}^{C}	-0.349	-0.392	-0.369

Table 4. Continued

Scale Elasticities			
	Region 1	**Region 2**	**Region 3**
s_1^{UC}	-0.904	-0.554	-1.018
s_2^{UC}	-1.006	-1.108	-0.981
s_3^{UC}	-0.949	-0.670	-0.445
s_4^{UC}	-0.807	-1.058	-0.871
Hicks Elasticities of Complementarity			
	Region 1	**Region 2**	**Region 3**
σ_{11}	-8.757	-2.336	-1.159
σ_{12}	-5.327	-1.427	-0.684
σ_{13}	-3.701	-1.165	-0.616
σ_{14}	-5.082	-1.290	-0.644
σ_{22}	-8.466	-1.839	-0.878
σ_{23}	-5.664	-1.444	-0.786
σ_{24}	-7.957	-1.571	-0.784
σ_{33}	-41.129	-10.253	-4.341
σ_{34}	0.459	-0.119	0.320
σ_{44}	-21.754	-5.719	-2.631