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PERMANENT INCOME, IMPORT PRICES, AND THE DEMAND FOR IMPORTED CONSUMER DURABLES: A STRUCTURAL ECONOMETRIC INVESTIGATION

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ABSTRACT

This paper derives a rational expectations, permanent income model of the demand for imported consumer durable goods. Assuming that the preferences of the representative household are addilog, our model implies that the log of the exact but unobservable utility index of permanent income must in equilibrium be cointegrated with log consumption of nondurables. Using nondurables consumption as our noisy proxy for permanent income, we estimate that log nondurables consumption, the log relative price of durables imports, and log spending on durables imports are cointegrated, and that this cointegrating vector exactly identifies the model's structural parameters. We are unable to reject the essential empirical implications of the model, and obtain sensible estimates of the price and income elasticities of the demand for imported consumer durables. In particular, we find that consumer durables imports are quite price elastic in the long run, and that the permanent income elasticity of imported durable goods demand averages 2.3.

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by

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1. Introduction

This paper employs a version of the rational expectations, permanent income hypothesis to derive and estimate a structural econometric import demand equation for consumer durable goods. We show that, with addilog (Houthakker (1960)) preferences, the log of the demand for imported consumer durables is linear in the log of the relative price of imported durables and the log of the forward looking utility index of permanent income, the marginal utility of wealth. This index is unobservable, but our model implies that the observed consumption of nondurable goods provides a noisy signal of the marginal utility of wealth. Theory implies that the marginal utility of nondurables consumption possesses a unit root. If, as is the case in US data (Campbell and Deaton (1990), the log of equilibrium nondurables consumption also contains a unit root, our model implies that the log of the utility index of permanent income must in equilibrium be cointegrated with log nondurables consumption. Our version of the forward looking permanent income model can be used to estimate the price elasticity of the demand for imported durables, and it predicts that the log of the nondurables consumption is the correct "activity" variable on the right-hand-side of the durables import demand equation.

The permanent income hypothesis implies that the demand for nondurables and the demand for imported durable goods share a stochastic trend and that this trend may be identified with the log marginal utility of wealth. Moreover if, as we confirm empirically, the equilibrium relative price of imported durables contains a stochastic supply trend that is not cointegrated with permanent income, our model is shown to imply that there exists exactly one cointegrating vector among the log demand for imported durables, log consumption of non-durables, and the log relative price of imported durables. This cointegrating vector exactly identifies the import demand equation's two structural parameters, the elasticities of marginal utility with respect to imported durables consumption, η and nondurables consumption, α.

Using quarterly NIPA data for the period 1973:1 - 1992:1, we find that the demand for imported consumer durables, the relative price of imported durables, and nondurables consumption are cointegrated, and that, as is predicted by the theoretical model, this cointegrating vector is unique. We estimate this cointegrating vector with the non-linear least squares technique recently proposed by Phillips and Loretan (1991).

The results of the empirical work may be summarized as follows. The price elasticity of demand for imported consumer durables is estimated to average -1.76 during our sample. The elasticity of import demand with respect to an increase in real spending is estimated to average 2.33 during our sample. These estimates are in the range reported by previous authors (and surveyed in Goldstein and Kahn (1988)) who have estimated static, *ad hoc* import demand equations under the restriction of constant price and expenditure elasticities. In the context of our theoretical specification, the Marshallian price elasticity of import demand is not constant but in fact converges to -1 as the share of total spending that falls on imports rises, while the elasticity of import demand with respect to an increase in real spending is not constant but in fact declines over time as the share of spending that falls on imports rises.

2. The Model

We begin by deriving the demand for the stock of imported consumer durables, Z_t, from a rational expectations permanent income model. Letting P_t denote the price of imported durables in terms of nondurables, H_t the consumption of nondurable goods, D_t the stock of durable produced domestically, s the flow of durable services, δ the rate at which durables depreciate, A_t assets, y_t labor income, and r_t the real rate of interest, the representative household selects $\{H_t, Z_t, D_t, A_t\}$, $t = 0,\ldots,T$ so as to:

$$(1) \qquad \max E \sum_{t=0}^{t=\infty} \beta^t u(H_t; sZ_t; sD_t)$$

s.t.

$$(2) \qquad H_t + P_t Z_t + D_t + A_t = (1+r_{t-1})A_{t-1} + y_t + (1-\delta)P_t Z_{t-1} + (1-\delta)D_{t-1};$$

$$(3) \qquad A_T \geq 0.$$

Assuming an interior solution, the first-order conditions are given by:

$$(4a) \qquad u_H = \lambda_t;$$

$$(4b) \qquad u_Z = \lambda_t P_t/s - \beta(1 - \delta)E_t P_{t+1}\lambda_{t+1}/s$$

$$(4c) \qquad u_D = \lambda_t/s - \beta(1 - \delta)E_t\lambda_{t+1}/s$$

$$(5) \qquad \lambda_t = \beta(1+r_t)E_t\lambda_{t+1};$$

where λ_t is the Lagrange multiplier on the accumulation constraint (2).

We shall assume that u is an addilog (Houthakker (1960)) utility function:

$$(6) \qquad u(H_t, sZ_t, sD_t) = A_t H_t^{1-\alpha}(1-\alpha)^{-1} + B_t(sZ_t)^{1-\eta}(1-\eta)^{-1} + C_t(sD_t)^{1-\psi}(1-\psi)^{-1}$$

where A_t, B_t, and C_t are random, stationary shocks to preferences. Using (6), (4b) is easily solved for the optimal stock of imported durables:

(7) $$Z_t = s^{1/\eta-1}B_t^{1/\eta}\lambda_t^{-1/\eta}P_t^{-1/\eta}(1-\beta(1-\delta)E_t[(\lambda_{t+1}/\lambda_t)(P_{t+1}/P_t)])^{-1/\eta}.$$

where $(1-\beta(1-\delta)E_t[(\lambda_{t+1}/\lambda_t)(P_{t+1}/P_t)]) \equiv V_t$ is the expected rate of capital loss incurred on holding an imported durable good between t and t+1 discounted at the intertemporal marginal rate of substitution in consumption $\mu_{t+1} = \beta(\lambda_{t+1}/\lambda_t)$. Under the modest restriction, verified below, that $(P_{t+1} - P_t)/P_t = \pi + \epsilon_{t+1}$ is a stationary stochastic process V_t may be written:

(8) $$V_t = (r_t+\delta-\pi)/(1+r_t) - (1-\delta)cov_t(\mu_{t+1}\epsilon_{t+1}) - (1-\delta)E_t\epsilon_{t+1}/(1+r_t).$$

Letting lower case letters denote logs, we see that:

(9) $$z_t = (b - v)/\eta - (1/\eta)p_t - (1/\eta)\log\lambda_t + (b_t - b)/\eta - (v_t - v)/\eta.$$

Along the optimal path, the log of the optimal stock of imported consumer durables is linear in the log of the relative price of imported durables and the log of the marginal utility of wealth, the utility index of permanent income implied by the permanent income hypothesis. The log of the desired stock of imported durables is increasing in b_t, the log of the stationary stochastic shock to preferences, and is decreasing in v_t, the log of the stochastic shock to the expected rate of capital loss on holding imported durables. We note that v_t will be a stationary stochastic process if r_t is stationary. We also remark that the assumption that r_t, while stochastic, is in the date t information set is not restrictive but merely eases the notation required to exposit the model.

If, given the assumption of addilog preferences, we had data on $\log\lambda_t$, this utility index of permanent income would be the proper "activity" variable to include on the right-hand-side of our demand equation for imported consumer durables. Such data is not available. However, using the fact that

(10) $$A_tH_t^{-\alpha} = \lambda_t;$$

the log of the desired stock of imported consumer durables may be expressed as:

$$(11) \qquad z_t = \gamma - (1/\eta)p_t + (\alpha/\eta)h_t + e_t;$$

where $\gamma \equiv E(b_t - a_t - v_t)$ and $e_t \equiv \gamma_t - \gamma$. Thus, if the model is true, log consumption of domestically produced goods may be used as a noisy proxy for the unobserved log marginal utility of wealth.

As can be seen from equation (5), in the special case in which $\beta(1+r) = 1$ the permanent income hypothesis implies that the marginal utility of wealth is a martingale, so that shocks to marginal utility of wealth are permanent (Hall (1978)). Taking logs of both sides of (10) and comparing with (9), we see that:

$$(12) \qquad z_t = (b_t - v_t)/\eta - (1/\eta)p_t - (1/\eta)log\lambda_t;$$

$$(13) \qquad h_t = a_t/\alpha - (1/\alpha)log\lambda_t.$$

As reported in Campbell and Deaton (1990) and as demonstrated in Table 1 below, it is not possible to reject the hypothesis that the log of nondurables consumption h_t is nonstationary in levels but stationary in first differences. It follows from (13) that, if the preference shock a_t is stationary, $\log\lambda_t$ is also nonstationary in levels but stationary in first differences, and is in fact cointegrated with h_t. According to our model, in an open economy equilibrium in which h_t is I(1), the log stock of imported durables z_t and h_t share a stochastic trend. This trend can be identified with the log of the marginal utility of wealth, $\log\lambda_t$.

While the theory implies that the log consumption of nondurables, h_t and the desired stock of imported durables, z_t, share a stochastic trend, these two variables are not necessarily cointegrated. In fact, as revealed by equation (11), if the equilibrium relative price of imports contains a stochastic supply trend that is not cointegrated with log λ_t, the model implies that z_t and h_t are not cointegrated. Rather, the model implies that z_t, h_t, and p_t together are cointegrated. Furthermore, from the results of Stock and Watson (1988), the existence of two common trends among three nonstationary variables implies that there exists a unique cointegrating vector. In the context of our model, if two stochastic common are found to be present in the data, these trends can be identified with the log marginal utility of wealth $\log\lambda_t$ and a shock to the supply of imported duralbes. This cointegrating vector is $[1,1/\eta,-\alpha/\eta]'$, as is defined by equation (11). We note that this cointegrating vector exactly identifies the model's two structural parameters α and η.

In the empirical work, we investigate the cointegrating relationship between h_t, p_t, and ζ_t, the log of real spending on imported durables where

$$(12) \qquad \zeta_t = \log(\delta Z_{t-1} + (Z_t - Z_{t-1})).$$

Data are readily available for real spending on durables imports, but not for the stock of imported durables. While it would be possible to construct a estimate of the acumulated stock of imported durables from data on the available flows, this is not necessary. Subtracting z_t from both sides of (12) we obtain an expression for the log ratio of real spending to the stock of imported durables:

$$(13) \qquad \zeta_t - z_t = \log(\delta + \Delta z_t) - \Delta z_t.$$

From (11) we see that $\zeta_t - z_t$ is predicted by the theory to be stationary as long as preference shocks a_t and b_t, the real interest rate r_t, and shocks to the rate of change in the relative price of imported durables ϵ_t are stationary. Using (13) to substitute for z_t in (11), we obtain the equation to be estimated:

$$(14) \qquad \zeta_t = \gamma - (1/\eta)p_t + (\alpha/\eta)h_t + \upsilon_t;$$

where $\upsilon_t = e_t + \log(\delta + \Delta z_t) - \Delta z_t$ is a composite, stationary stochastic disturbance that combines the influence of preference shocks, shocks to the expected rate of capital loss on durables, and measurement error.

3. The Data and Empirical Preliminaries

The data used in this paper are obtained from the National Income and Product Accounts and are constructed as follows:

ζ_t: Log of 1987 dollar per capita spending on imported durable consumer goods excluding automobiles.

h_t: Log of 1987 dollar per capita spending on nondurable consumer goods.

p_t: Log of the deflator for imported consumer durables minus log of deflator for nondurable consumer goods.

The NIPA accounts provide quarterly data on consumer durables imports and the consumer durables import deflator beginning with 1967:1. A preliminary analysis of the data indicates that the relationship among ζ_t, h_t, and p_t may have shifted sometime during the sample of available data 1967:1 - 1992:1. This could be due to the increased volatility and persistence of shocks to the relative price of durables imports that appears to have taken place since the advent of floating exchange rates in 1973:2. Thus, we shall confine our attention to the sample 1973:2 through 1992:1, a period that corresponds to the modern era of floating exchange rates. Imported automobiles are excluded from the analysis because of the voluntary export restraints that have been imposed on Japanese auto exports since 1982. The presence of quotas on such a large fraction of auto exports suggests that a separate analysis of the demand for imported automobiles is appropriate.

TABLE 1

Testing for Unit Roots

The Augmented Dickey-Fuller Regression:

$$\Delta x_t = \mu_0 + \mu_1 t + \phi x_{t-1} + \rho_1 \Delta x_{t-1} + \ldots + \rho_p \Delta x_{t-p} + \epsilon_t.$$

Variable	Estimated ϕ	t-ratio
ζ_t	-0.1372	-2.534
p_t	-0.0599	-1.459
h_t	-0.1109	-2.734

The Fuller (1976) critical values from Table 8.5.2 are:

-3.15 at the 10 percent level;
-3.45 at the 5 percent level;
-4.04 at the 1 percent level.

The sample is 1974:2 through 1992:1. Variables are as defined in the text. All three equations were estimated with four, three, and two lags of Δx_t, and the lag length for calculating the t-test was chosen as recomended by Campbell and Perron (1991).

We begin by reporting the results obtained from a Dickey-Fuller(1979) test of the hypothesis that each of the series ζ_t, p_t, and h_t possesses a unit root. The alternative is that each series is stationary about a deterministic trend. The Dickey-Fuller test is just a t-test that the coefficient ϕ on the lagged level is equal to zero in the following regression:

$$\Delta x_t = \mu_0 + \mu_1 t + \phi x_{t-1} + \rho_1 \Delta x_{t-1} + \ldots + \rho_p \Delta x_{t-p} + \epsilon_t. \tag{15}$$

The results of these tests are reported in Table 1 and are easily summarized. We cannot reject at even the 10% level the null hypothesis of a unit root in any of the three variables ζ_t, p_t, and h_t. With no strong evidence against the null hypothesis of a unit root in ζ_t, p_t, or h_t, we turn next to an investigation of the number of stochastic trends that are present among the three variables in our system.

Stock and Watson (1988) demonstrate that any system of m I(1) variables has a common trends representation, and that in a system containing of m I(1) variables being driven by $n \leq m$ common trends, the number of linearly independent cointegrating vectors must equal m - n. It follows immediately from Stock and Watson's result that if there exists one common trend among m variables, then all m(m-1)/2 possible pairs of these variables must be cointegrated. Of course, if there exists n = m - 1 common trends among m variables, the cointegrating vector is unique up to scale.

We recall from Table 1 that the hypothesis of a unit root in the relative price of imports cannot be rejected. Consider the hypothesis that the log relative price of imports p_t and $\log\lambda_t$, the utility index of permanent income, do not share a common stochastic trend, as would be the case if the relative price of imports is driven in part by a stochastic supply shock trend that is not cointegrated with $\log\lambda_t$. Following Granger and Engle (1987) we test the null hypothesis that p_t and h_t are not cointegrated by running the regression:

$$(16) \qquad p_t = \mu + \beta h_t + \epsilon_t.$$

We then regress changes in the estimated residuals, $\Delta\epsilon_t$ on one lagged level of the residual and lagged changes:

$$(17) \qquad \Delta\epsilon_t = \phi\epsilon_{t-1} + \rho_1\Delta e_{t-1} + \ldots + \rho_p\Delta e_{t-p} + e_t.$$

The test is just a t-test on the coefficient ϕ; the appropriate critical values are those reported in Phillips and Ouliaris (1989) since the cointegrating regression has a constant term. As can be seen from the results in Table 2, p_t and h_t do not appear to be cointegrated according to the Granger-Engle test: the t-ratios fall well below the level that would be required to reject the null of nocointegration at even the 10 percent level.

If p_t is driven in part by a stochastic supply trend that is not cointegrated with $\log\lambda_t$, we should not expect ζ_t and h_t to be cointegrated. Table 2 also reports the results of tests that ζ_t and h_t are cointegrated. As can be seen from Table 2, ζ_t and h_t do not appear to be cointegrated according to the Granger-Engle test. For completeness, Table 2 also reports the results of a test that ζ_t and p_t are cointegrated. These variables do not appear to be cointegrated.

Taken together, these results indicate that a single common stochastic trend cannot explain the long-run behavior of ζ_t, p_t, and h_t. If in fact there are two common stochastic trends present among $[\zeta_t, p_t, h_t]$, these three variables will be cointegrated, and the cointegrating vector will be unique up to a multiplicative scale factor. It follows that the parameters of interest,

TABLE 2

Testing for A Common Trend

The Cointegrating Regression: $x_t = \mu + \beta y_t + \epsilon_t$.

The Dickey-Fuller Regression: $\Delta\epsilon_t = \phi\epsilon_{t-1} + \rho_1\Delta\epsilon_{t-1} + .. + \rho_p\Delta\epsilon_{t-p} + e_t$.
(Augmented)

Variables	Estimated ϕ	t-ratio
$[\varsigma_t, h_t]$	-0.1399	-2.2629
$[\varsigma_t, p_t]$	-0.0662	-1.7843
$[p_t, h_t]$	-0.0606	-2.1340

The Phillips-Ouliaris(1989) critical values from Table IIb are:

-3.06 at the 10 percent level;
-3.36 at the 5 percent level;
-3.96 at the 1 percent level.

The sample is 1974:3 through 1992:1. All equations were estimated with four, three, two, one, and no lags of $\Delta\epsilon_t$, with the lag length for calculating the t-test was chosen as recomended by Campbell and Perron (1991).

α and η, can be recovered from the unique cointegrating vector defined by equation (14), $[1, 1/\eta, \alpha/\eta]'$. In light of the results reported in Table 2, a finding of cointegration among ζ_t, p_t, and h_t is evidence in favor of the hypothesis that two common trends, and thus a single cointegrating vector, explain the long-run behavior of these three variables.

Granger and Engle (1987) suggest estimating $[1, 1/\eta, -\alpha/\eta]'$ directly from the first-stage OLS regression:

$$\zeta_t = \gamma + \beta_1 p_t + \beta_2 h_t + \upsilon_t. \tag{18}$$

If it is found that, in the Dickey-Fuller regression:

$$\Delta\upsilon_t = \phi\upsilon_{t-1} + \rho_1\Delta\upsilon_{t-1} + \ldots + \rho_p\Delta\upsilon_{t-p} + \epsilon_t; \tag{19}$$

ϕ is significantly negative, the OLS estimates of $[1, 1/\eta, -\alpha/\eta]'$ given by $[1, -\beta_1, \beta_2]'$ are consistent, despite the fact that υ_t is correlated with p_t and h_t and is also likely to be serially correlated.

Recent research, as summarized by Campbell and Perron (1991), has documented that, with the samples sizes available for macroeconomic time series research, the OLS estimate of the cointegrating vector can be severely biased. Furthermore, it is not possible to test hypotheses about the parameters of the cointegrating vector when these are estimated by OLS (Campbell and Perron (1991), p. 56). Fortunately, both Stock and Watson (1989) and Phillips and Loretan (1991) have derived tractable methods for obtaining unbiased and asymptotically efficient estimates of the cointegrating vector. For this reason, we will rely on the cointegrating regression primarily for its estimates of e_t and Δe_t that are needed to test the hypothesis that ζ_t, p_t, h_t are cointegrated.

4. The Demand for Imported Consumer Durables: Empirical Results

The results of the Granger-Engle test of the hypothesis that ζ_t, p_t, h_t are cointegrated are presented in the top panel Table 3. The critical values are those reported in Phillips and Ouliaris (1989). It is seen that the estimated value of ϕ is -0.3133 with a standard error of 0.0777 and a t ratio of -4.032. Under the null hypothesis that υ_t is nonstationary, the estimated ϕ is significant at the 2.5% level using the Phillips-Ouliaris (1989) critical value of -4.022 reported in Table IIb.

In light of the results reported in Tables 2 and 3, we conclude that the data are consistent with the hypothesis that a single cointegrating vector restricts the long-run behavior of the data. The OLS estimate of the cointegrating vector is [1, 1.426, -5.493]. This implies an OLS estimate of η, minus the elasticity of marginal utility with respect to the serives yielded by impotred durables, of $\eta^{ols} = 0.701$ and an OLS estimate of α, minus the elasticity of marginal utility with respect to nondurables consumption, of $\alpha^{ols} = 3.850$.

Phillips and Loretan (1991) propose a parametric procedure for estimating the cointegrating vector in an equation in which the variables are in fact known to be cointegrated. The Phillips and Loretan approach tackles the simultaneity problem by including lagged and future values of the change in the regressors. The approach deals with the autocorrelation in the residuals by including lagged values of the stationary deviation from the cointegrating relationship. Phillips and Loretan prove that the estimates of the cointegrating vector obtained from this approach are unbiased and are asymptotically as efficient as maximum likelihood estimation of the full three variable system. Phillips and Loretan also demonstrate that simple t-tests can be used to test hypotheses about the parameters of the cointegrating vector estimated with their method.

TABLE 3

Testing for Cointegration

The Cointegrating Regression: $\zeta_t = \gamma + \beta_1 p_t + \beta_2 h_t + \upsilon_t$.

The Dickey-Fuller Regression: $\Delta\upsilon_t = \phi\upsilon_{t-1} + \rho_1\Delta\upsilon_{t-1} + .. + \rho_p\Delta\upsilon_{t-p} + \epsilon_t$
(Augmented)

Estimated ϕ	t-ratio
-0.3133	*-4.032**

The Phillips-Ouliaris(1989) critical values from Table IIb are:

-3.77 at the 5.0 percent level;
-4.02 at the 2.5 percent level*;
-4.31 at the 1.0 percent level.

The augmented Dickey-Fuller regression was estimated with four, three, two, one, and no lags; the lag length used to calculate the t-statistic for ϕ was chosen as recommended by Campbell and Perron (1991).

The OLS estimates of the parameters are:

Coefficient	Estimated Value
γ	*21.5544*
	(1.3059)
β_1	*-1.4257*
	(0.1389)
β_2	*5.4927*
	(0.2360)

The R^2 is 0.9773. The Durbin-Watson statistic is 0.4753.
The sample is 1973:2 through 1992:1. Variables defined in text.

Let y_t denote the vector $[p_t, h_t]'$ and let β denote the vector $[\beta_1, \beta_2]'$. The Phillips-Loretan equation is given by:

$$(20) \qquad \zeta_t = \mu + \beta' y_t + \rho(\zeta_{t-1} - \beta' y_{t-1}) + \sum_{j=-\tau}^{j=\tau} \phi_j \Delta p_{t-j} + \sum_{j=-\tau'}^{j=\tau'} \omega_j \Delta h_{t-j} + v_t.$$

The β's, ρ, and the ϕ's and the ω's are estimated by non-linear least squares. The implied estimates of β along with standard errors are reported in Table 4.

As shown in Table 4, the NLS estimate of the cointegrating vector differs somewhat from the OLS estimate . The NLS estimate of the cointegrating vector is [1, 1.769, -4.125]. This implies a NLS estimate of η, minus the elasticity of marginal utility with respect to the services yielded by foreign durables, of $\eta^{nls} = 0.567$ and a NLS estimate of α, minus the elasticity of marginal utility with respect to the consumption of nondurables, of $\alpha^{nls} = 2.367$.

We now use these NLS estimates of η and α to construct estimates of the familiar Marshallian price and the expenditure elasticities of the demand for imported consumer durables. To obtain estimates of these elasticities, it is necessary to place a restriction on ψ, the elasticity of marginal utility with respect to the services yielded by consumer durables of the domestic variety. Although it would in principle be possible to estimate η, α, and ψ jointly, we pursue a simpler approach and just impose the restriction that the subutility function for services yielded by durables is symmetric so that $\eta = \psi$.

If total real expenditure $C = H + P\delta Z + \delta D$ is to remain constant in the face of a rise in the price of imported durables, (7) can be used to show that:

$$(21) \qquad (\eta - 1)\theta_Z d\log P/\eta = [\theta_H/\alpha + (1 - \theta_H)/\eta] d\log\lambda;$$

where θ_H is the share of spending that falls on nondurables, θ_Z is the share of

TABLE 4

Estimation of the Parameters
Phillips and Loretan(1991) Non-Linear Least Squares

Phillips-Loretan equation with $\beta = [\beta_1, \beta_2]'$:

$$\zeta_t = \mu + \beta' y_t + \rho(\zeta_{t-1} - \beta' y_{t-1}) + \sum_{j=-\tau}^{j=\tau} \phi_j \Delta p_{t-j} + \sum_{j=-\tau'}^{j=\tau'} \omega_j \Delta h_{t-j} + v_t.$$

The nonlinear least squares estimates are:

Coefficient	Estimated Value
μ	*14.0369* *(6.7895)*
β_1	*-1.7689* *(0.6011)*
β_2	*4.1251* *(1.2300)*

The implied average elasticities are:

Elasticity	Estimated Value
$\epsilon_{Z,p;C}$	*-1.76*
$\epsilon_{Z,C;p}$	*2.33*

$\rho = 0.84$. The Phillips-Loretan equation was estimated with up to $\tau = 3$ leads and lags and with up to 2 lags of the equilibrium error with no significant difference in the results.

spending that falls on imported durables, and $\theta_D = 1 - \theta_H - \theta_Z$ is the share of spending that falls on durables of the domestic variety. Substituting for $\log\lambda$ in (13), we obtain the expression for the Marshallian price elasticity:

$$(22) \qquad \epsilon_{Z,p;C} = -(1/\eta)[1 - (1 - \eta)\theta_Z/((\eta\theta_H/\alpha) + (1 - \theta_H))].$$

Since our estimate of η, $\eta^{nls} = 0.567$ is less than 1, the estimated Marshallian price elasticity must, in absolute value, fall short of $1/\eta^{nls} = 1.769$. In our sample θ_Z, the share of spending that falls on imported durables, rises from 0.01 in 1967 to 0.04 in 1990. Using our estimate of $(\alpha/\eta)^{nls} = 4.125$, we determine that, in our sample, the Marshallian price elasticity of the demand for imports falls in the following range:

$$(22) \qquad 1.74 \leq \epsilon_{Z,p;C} \leq 1.76$$

We now derive an expression for the elasticity of demand for imported durables with respect to an increase in real expenditure, holding constant the relative price of imported durables. The source of such a permanent rise in real spending must be a permanent decline in the marginal utility of wealth. Using (7) it is straightforward to show that:

$$(23) \qquad d\log C = -(\theta_H/\alpha + (1 - \theta_H)/\eta)d\log\lambda.$$

Substituting for $\log\lambda$ and differentiating with respect to $\log C$, we obtain:

$$(24) \qquad \epsilon_{Z,C;p} = (\alpha/\eta)[1/(\theta_H + (\alpha/\eta)(1 - \theta_H))].$$

In our sample, the share of spending that falls on nondurable goods averages 0.75 and varies from 0.691 to 0.777. Since $(\alpha/\eta)^{nls} = 4.125$, we calculate that:

$$(25) \qquad 2.16 \leq \epsilon_{f,C;p} \leq 2.46.$$

These elasticity estimates are firmly in the range of those reported in the many studies surveyed by Goldstein and Kahn (1985), and those reported by Helkie and Hooper (1986) and Cline (1989). However, it should be pointed out that the Marshallian price elasticity and the expenditure elasticity are not constant if, as is the case in our sample, the share of spending that falls on durables, both imported and those produced domestically, is changing over time.

One message of this paper is that the permanent income hypothesis, along with the empirically testable restriction that the log relative price of imports and the log marginal utility of wealth are not cointegrated, predicts that the cointegrating vector for $[\zeta_t, p_t, h_t]$ is unique, and that estimates of this vector can be used to identify the parameters of an addilog household utility function. An expenditure elasticity in excess of unity is consistent with the theory when the concavity of the sub-utility function for nondurables exceeds the concavity of the sub-utility function for durable goods. Our estimate is that the elasticity of the marginal utility of nondurables consumption, α, is a bit more than four times the marginal utility elasticity of durables services.

6. Concluding Remarks

This paper has derived a rational expectations, permanent income model of the demand for imported consumer durable goods. Assuming that the preferences of the representative household are addilog, our model implies that the log of the exact but unobserable utility index of permanent income must in equilibrium be cointegrated with log nondurables consumption. Our version of the forward looking permanent income model predicts that the log of the nondurables consumption is the correct "activity" variable on the right-hand-side of the durables import demand equation, that log nondurables consumption, the log relative price of durables imports, and log spending on furables imports are cointegrated, and that this cointegrating vector exactly identifies the model's structural parameters. Using quarterly US data, we were unable to reject the essential empirical implications of the model, and were able to obtain sensible estimates of the price and spending elasticities of the demand for imported consumer durables.

Ogaki (1988;1992) was the first to explore the implications of addilog preferences for cointegration among the components of the consumption basket. Working independently, but later, Clarida (1991;1993) derived and estimated an open-economy permanent income model of the demand for imported consumer non-durables that provided the insights used to derive and estimate the open-economy permanent income model of the demand for imported consumer durables featured in this paper.

The model estimated in this paper captures the long-run determinants of the demand for imported consumer durables. According to the theoretical model, the short-run dynamics are assumed to arise from stationary stochastic shocks to real interest rates, import prices, and preferences. It is likely that the short-run dynamics of the adjustment of durable goods import demand to the long-run equilibrium defined by the cointegrating relationship (9) are also influenced by costs of adjustment and the aggregation of households pursuing Ss policies for the purchase of durables imports. However, as long as the deviations from the long-run cointegrating relationship defined by (9) are stationary, the econometric methods used in this paper provide unbiased and asymptotically efficient estimates of this cointegrating relationship.

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