Testing the Ricardian equivalence theorem in the framework of the permanent income hypothesis

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TESTING THE RICARDIAN EQUIVALENCE THEOREM IN THE FRAMEWORK OF THE PERMANENT INCOME HYPOTHESIS[•]

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Abstract

According to Ricardian Equivalence Theorem (RET), today's consumption decisions would be independent of some fiscal variables such as lump sum taxes, government debt outstanding or the budget deficit given that government expenditures are fixed. The Permanent Income Hypothesis (PIH) consumption function also implies that change in consumption cannot be forecast by the change in lag(s) of any variable including the change in those fiscal variables. Thus, the test of RET is a nested test of the PIH. After unit root tests and cointegration tests were conducted, the test of the RET were run by using a system in which coefficients of consumption, income, taxes and debt variables were determined in two steps. Among twenty countries that were chosen based on data availability, the result of this paper is that the RET holds in all countries and that the PIH holds in majority of the countries. The failure of the PIH occurs in developing countries.

Keywords: Ricardian Equivalence, Permanent Income Hypothesis, Rational Expectations, Intertemporal Utility Function, Sensitivity, Unit Root, Cointegration,

I. INTRODUCTION

The Ricardian Equivalence Theorem (RET) states that the shifts between bond financing and taxation have no effect on the allocation of resources between private consumption and investment, given that government expenditures and population growth are fixed.

The purpose of this study is to test the RET using the Permanent Income Hypothesis (PIH) consumption function that allows us to measure the effect, if any, of income, taxes,

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debt (or deficit) on the level of private consumption. According to the PIH, lagged and currently predicted values of income, tax and debt with zero innovations do not jointly have any effect on consumption behavior with given government expenditures.

The plan of this study is as follows. Section II derives a consumption function consistent with the Permanent Income Hypothesis (PIH) and explains the implications of the PIH for RET. The PIH states that consumption should not respond to predicted values of income, taxes and debt but should respond only to the innovations of current values of these variables. If, however, consumption responds to the predictable movements in variables in which innovations are zero, this would represent excess sensitivity of consumption. The excess sensitivity of consumption to taxes, government debt outstanding or deficit would be a measure of the failure of the RET as well as of the PIH. Section III presents an econometric method of testing the excess sensitivity of consumption to income, tax and debt. In section IV, before the testing of excess sensitivity of consumption to income, tax and debt, in order to avoid biased estimation results, unit root and cointegration tests are presented for the variables of twenty countries. The variables were found nonstationary but cointegrated; therefore, it sufficed to regress the variables in their levels rather than in differences in the VAR system.

Empirical evidence on the excess sensitivity of consumption to income, tax and debt for twenty countries gives the conclusion that income, tax and debt jointly have some effect on consumption mostly in developing countries, whereas tax and debt jointly do not have an effect in all countries.

II. THE PERMANENT INCOME HYPOTHESIS CONSUMPTION FUNCTION WITH RATIONAL EXPECTATIONS.

Intertemporal utility function of an infinitely-lived consumer with rational expectations is

$$U(t) = E\sum_{i=0}^{\infty} u\left(C_{t+i}\right)\left(1+\rho\right)^{-i} \tag{1}$$

where $U(t)$ is total utility and C_t is per capita consumption, i = 0, 1,2,….∞. E_t denotes the expectations operator conditional on information available at time t.

The utility function, u, satisfies the usual concavity conditions, with $u'\rangle 0$, $u''\langle 0$ and ρ is the discount rate; $0\langle \rho \langle \infty$. The right hand side of the eq. (1) is the expectation of the discounted value of total consumption, conditional on information available at time t. The budget constraint is,

$$W_{t+1} = (1+r)\ (W_t + Y_t - T_t - C_t) \tag{2}$$

$$W_t = K_t + B_t \tag{3}$$

where r is real interest rate, W is wealth, Y is labor income, T is taxes, K is capital and B is bonds. The transversality conditions for the optimization problem are

$$\lim_{i\to\infty} E_t\left[K_{t+i}(1+r)^{-i}\right] = 0 \tag{4}$$

$$\lim_{i\to\infty} E_t\left[B_{t+i}(1+r)^{-i}\right] = 0 \tag{5}$$

Taking into account these conditions, wealth evaluation becomes,

$$W_t = \sum_{i=0}^{\infty}(1+r)^{-i}\ E[\,C_{t+i} + T_{t+i} - Y_{t+i}\,]. \tag{6}$$

The consumer budget constraint then becomes

$$\sum_{i=0}^{\infty} R^{-i} E(C_{t+i}) = K_t + B_t + \sum_{i=0}^{\infty} R^{-i} E(Y_{t+i}) - \sum_{i=0}^{\infty} R^{-i} E(T_{t+i}) \tag{7}$$

where R = 1+r is the gross interest rate. Maximization of eq.(1) subject to eq.(7) by lagrangian gives the Euler equation;

$$L = U(t) + \lambda\left[K_t + B_t + E_t\sum_{i=0}^{\infty} R^{-i}\left(Y_{t+i} - T_{t+i}\right) - E_t\sum_{i=0}^{\infty} R^{-i} C_{t+i}\right], \tag{8}$$

$$E\left[u'\left(C_{t+i}\right)\right] = \lambda\left({}^{R}\!/_{\delta}\right)^{-i}, \tag{9}$$

where $\delta = (1+\rho)$ is the discount rate. Therefore, the time path or change in consumption depends on r and ρ. Eq. (9) implies that expected marginal utility of consumption at any time is constant. And if $r = \rho$, then

$$u'(C_t) = E_t[u'(C_{t+1})]. \tag{10}$$

Inserting certainty equivalence behavior,[1] $C_t = E_t[C_{t+1}]$, from eq.(10) into budget constraint in eq.(7), one can obtain the consumption function given in eq.(11)

$$C_t = \frac{r}{R}\left[K_t + \sum_{i=0}^{\infty} R^{-i} E_t\left(Y_{t+i}\right)\right] + \frac{r}{R}\left[B_t - \sum_{i=0}^{\infty} R^{-i} E\left({}_t T_{t+i}\right)\right] + u_t, \qquad (11)$$

where rR^{-1} is the annuity value. Therefore C_t is proportional to permanent income that is equal to annuity values of the capital stock at time *t* and expected discounted present value of future labor income, plus annuity value of the bond stock at time *t*, less the annuity value of expected discounted present value of taxes. If there is no transitory consumption, the disturbance term u_t will be zero. The first term on the right hand side of eq. (11) is Flavin's definition of permanent income that is equal to the annuity value of net worth. Net worth is equal to the sum of real wealth and the present discounted value of current and future labor income.[2] In eq.(11) the permanent income is equal to the sum of the first term explained above, plus the annuity value of bonds at time *t* and the expected present discounted values of current and future taxes. Eq. (11) can be used to evaluate the RET within the PIH.

The consumption function in eq.(11) at t+1 is

$$C_{t+1} = rR^{-1}\left[R(K_t + B_t + Y_t - T_t - C_t) + \sum_{i=0}^{\infty} R^{-i} E_{t+1}\left(Y_{t+i+1}\right) - \sum_{i=0}^{\infty} R^{-i} E_{t+1}\left(T_{t+i+1}\right)\right] + u_{t+1} \qquad (12)$$

Multiplying consumption at time t by R, and rearranging this, yields

$$RC_t = r\left(K_t + B_t\right) + r\left(Y_t - T_t\right) + r\left[\sum_{i=0}^{\infty} R^{-(i+1)} E_t\left(Y_{t+i+1}\right) - \sum_{i=0}^{\infty} R^{-(i+1)} E_t\left(T_{t+i+1}\right)\right] + Ru_t, \qquad (13)$$

Subtraction of (13) from (12) yields

$$\Delta C_{t+1} = rR^{-1}\sum_{i=0}^{\infty} R^{-i}\left(E_{t+1} - E_t\right)\left(Y_{t+i+1} - T_{t+i+1}\right) + \eta_{t+1}, \qquad (14)$$

where the error term $\eta_{t+1} = u_{t+1} - Ru_t$. If expectations are rational (meaning that $(E_{t+1} - E_t)(Y_{t+i+1} - T_{t+i+1})$ =0), then as the PIH implies, changes in income, taxes, capital stock and holdings of government bonds will not affect the changes in consumption given that government expenditures are fixed. In eq. (14) consumption responds to the revisions in future income and taxes. If consumption changes by more than revisions in permanent income caused by innovations in current income and taxes, this amount will stand for the "excess sensitivity" of consumption to changes in income and taxes. Excess sensitivity can be tested by seeing whether consumption responds to even predictable changes in income and taxes.

III. THE ECONOMETRIC METHOD

Considering the VAR system below, we can define the effects of innovations on future values of these variables as impulse response functions or dynamic multipliers. For simplicity, assuming it is a first order VAR system,

$$\mathbf{x}_t = \mathbf{k} + \mathbf{\Phi}_1\mathbf{x}_{t-1} + \mathbf{e}_t \qquad (15)$$

where $\mathbf{x}_t$ is an n × 1 vector containing each of n variables included in the system.

$\mathbf{k}$ is an n × 1 vector of intercept terms.

$\mathbf{\Phi}_1$ are n × n matrices of coefficients, i = 1,2..,p; and

$\mathbf{e}_t$ is an n × 1 vector of error terms (unanticipated component of the series).

By iterating eq.(19) backward to obtain

$\mathbf{x}_0 = \mathbf{k} + \mathbf{\Phi}_1\mathbf{x}_{-1} + \mathbf{e}_0$

$\mathbf{x}_1 = \mathbf{k} + \mathbf{\Phi}_1\mathbf{x}_0 + \mathbf{e}_1$

$\mathbf{x}_2 = \mathbf{k} + \mathbf{\Phi}_1\mathbf{x}_1 + \mathbf{e}_2$

....

....

$\mathbf{x}_t = \mathbf{k} + \mathbf{\Phi}_1\mathbf{x}_{t-1} + \mathbf{e}_{t.}$.

We can calculate the $\mathbf{x}_t$ recursively as follows,

$\mathbf{x}_t = \mathbf{k} + \mathbf{\Phi}_1(\mathbf{k} + \mathbf{\Phi}_1\mathbf{x}_{t-2} + \mathbf{e}_{t-1}) + \mathbf{e}_{t.}$

$\mathbf{x}_t = (\mathbf{I} + \mathbf{\Phi}_1)\,\mathbf{k} + \mathbf{\Phi}_1^{2}\,\mathbf{x}_{t-2} + \mathbf{\Phi}_1\mathbf{e}_{t-1} + \mathbf{e}_{t.}$

And after n iterations,

$$\mathbf{x}_t = (\mathbf{I} + \mathbf{\Phi}_1 + \ldots + \mathbf{\Phi}_1^{n})\,\mathbf{k} + \sum_{i=0}^{n}\Phi_1^{i}\,\mathbf{e}_{t-i} + \mathbf{\Phi}_1^{n+1}\,\mathbf{x}_{t-n-1} \qquad (16)$$

Convergence requires that as n goes to infinity $\mathbf{\Phi}_1{}^n$ will vanish. Stationarity requires that the characteristic roots, or eigenvalues of $\mathbf{\Phi}_1$ lie within the unit circle. Assuming the stationarity condition is met, the solution for $\mathbf{x}_t$ is,

$$\mathbf{x}_t = \mu + \sum_{i=0}^{n} \Phi_1^i \, \mathbf{e}_{t-i} \tag{17}$$

Eq.(17) is moving average representation of eq.(15). Writing eq.(15) and eq.(17) in matrix form, we obtain (15)' and (17)'.

$$\begin{bmatrix} Y_t \\ T_t \\ B_t \end{bmatrix} = \begin{bmatrix} k_1 \\ k_2 \\ k_3 \end{bmatrix} + \begin{bmatrix} p_{11} & p_{12} & p_{13} \\ p_{21} & p_{22} & p_{23} \\ p_{31} & p_{32} & p_{33} \end{bmatrix} \begin{bmatrix} Y_{t-1} \\ T_{t-1} \\ B_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \end{bmatrix} \tag{15)'$$

$$\begin{bmatrix} Y_t \\ T_t \\ B_t \end{bmatrix} = \begin{bmatrix} \bar{Y} \\ \bar{T} \\ \bar{B} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} p_{11} & p_{12} & p_{13} \\ p_{21} & p_{22} & p_{23} \\ p_{31} & p_{32} & p_{33} \end{bmatrix}^i \begin{bmatrix} \varepsilon_{1,t-i} \\ \varepsilon_{2,t-i} \\ \varepsilon_{3,t-i} \end{bmatrix} \tag{17)'$$

where Y_t is income, T_t is tax revenue and B_t is the bonds held by the individual at time t. $\bar{Y}$, $\bar{T}$, $\bar{B}$ stand for the means of Y_t, T_t and B_t, respectively. p_{kj}^i is the coefficient of k th equation, j th variable at time i in the VAR system. The coefficients p_{kj}^i can be used to generate the effects of $\varepsilon_{1,t-i}, \varepsilon_{2,t-i}, \varepsilon_{3,t-i}$ on $\{Y_t\}$, $\{T_t\}$ and $\{B_t\}$ sequences.

$\dfrac{\partial Y_t}{\partial \varepsilon_{1,t}} = p_{11}$ is the instantaneous effect of one unit change in $\varepsilon_{1,t}$ on Y_t.

$\dfrac{\partial Y_{t+i}}{\partial \varepsilon_{1,t}} = p_{11}^i$ is the effect of one unit change in $\varepsilon_{1,t}$ on Y_{t+i}. It is also referred to as the impulse-response function or dynamic multiplier. The cumulative effect of one unit change in $\varepsilon_{1,t}$ on Y_t through time is given by,

$$\sum_{i=0}^{\infty} \frac{\partial Y_{t+i}}{\partial \varepsilon_{1,t}} = \sum_{i=0}^{\infty} p_{11}^i \,. \tag{18}$$

And the present value of this cumulative effect is

$$\sum_{i=0}^{\infty} R^{-i}\left[p_{11}^i\right] = \frac{1}{1 - R^{-1}p_{11}} \text{ , provided that } \left|R^{-1}p_{11}\right| \langle 0 ,$$

where, $R^{-1} = \dfrac{1}{1+r}$ = discount factor.Finally the sum of cumulative effects of $\varepsilon_{1,t}, \varepsilon_{2,t}, \varepsilon_{3,t}$ on $\{Y_t\}$is given by,

$$\sum_{i=0}^{\infty}\left[\frac{\partial Y_{t+i}}{\partial \varepsilon_{1,t}} + \frac{\partial Y_{t+i}}{\partial \varepsilon_{2,t}} + \frac{\partial Y_{t+i}}{\partial \varepsilon_{3,t}}\right] = \sum_{i=0}^{\infty} p_{11}^{i} + \sum_{i=0}^{\infty} p_{12}^{i} + \sum_{i=0}^{\infty} p_{13}^{i} \,. \tag{19}$$

The present value of these cumulative effects on $\{Y_t\}$ is

$$\sum_{i=0}^{\infty} R^{-i}\left[p_{11}^{i} + p_{12}^{i} + p_{13}^{i}\right], \tag{20}$$

The present value of the sum of cumulative effects of $\varepsilon_{1,t}, \varepsilon_{2,t}, \varepsilon_{3,t}$ on $\{T_t\}$is given by

$$\sum_{i=0}^{\infty} R^{-i}\left[p_{21}^{i} + p_{22}^{i} + p_{23}^{i}\right], \tag{21}$$

And present value of sum of cumulative effects of $\varepsilon_{1,t}, \varepsilon_{2,t}, \varepsilon_{3,t}$ on $\{B_t\}$is

$$\sum_{i=0}^{\infty} R^{-i}\left[p_{31}^{i} + p_{32}^{i} + p_{33}^{i}\right]. \tag{22}$$

Let eq.(20), eq.(21) and eq.(22) be $\mathbf{\Omega}_1$, $\mathbf{\Omega}_2$ and $\mathbf{\Omega}_3$ respectively. Note that $\mathbf{\Omega}_i$ is the present value of the of sum of the cumulative effects of $\varepsilon_{1,t}, \varepsilon_{2,t}, \varepsilon_{3,t}$. When the current forecast errors are realized, the sum of the present value of revisions in future income, taxes and bonds is

$$\mathbf{\Omega}_1\mathbf{e}_t + \mathbf{\Omega}_2\mathbf{e}_t + \mathbf{\Omega}_3\mathbf{e}_t \tag{23}$$

where $\mathbf{e_t} = \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \end{bmatrix}$.

And the revision in permanent income is

$$rR^{-1}\left[\mathbf{\Omega}_1 + \mathbf{\Omega}_2 + \mathbf{\Omega}_3\right] \tag{24}$$

If there is excess sensitivity of consumption to variables in the VAR, it implies that consumption responds even to predictable changes in income, taxes and bonds whose innovations are zero. If there is no excess sensitivity of consumption to the variables, it means that consumption changes only by the revision in permanent income given by eq.(24). By the introduction of the actual changes in income, taxes and bonds that represent predictable changes in the VAR system, the "excess sensitivity" can be tested with the following equation,

$$\Delta C_{t+1} = \mathrm{k} + rR^{-1}\left[\boldsymbol{\Omega}_1 + \boldsymbol{\Omega}_2 + \boldsymbol{\Omega}_3\right]\mathbf{e}_t + \alpha_1 \Delta Y_{t+1} + \alpha_2 \Delta T_{t+1} + \alpha_3 \Delta B_{t+1} + n_{t+1} \qquad (25)$$

Eq. (25) is the unrestricted version of the model. The coefficients α_1, α_2 and α_3 are the excess sensitivity parameters. The PIH states that α_1,α_2 and α_3 are jointly equal to zero. The RET implies that α_2 and α_3 are jointly equal to zero.

IV. TESTING THE EXCESS SENSITIVITY ACROSS COUNTRIES

In this section, excess sensitivity test will be performed for twenty countries; Belgium, Canada, Chile, France, Egypt, El Salvador, Finland, Germany, India, Italy, Japan, Malaysia, Pakistan, South Africa, Singapore, Sweden, UK, USA, Turkey and Venezuela. The countries were chosen based on availability of data.

Annual Private Consumption and GDP data were drawn from World Bank Data CD-ROM 1995 for the period 1960 to 1993. The Tax Revenues, Government Debt Outstanding data were drawn from World Bank Data CD-ROM 1995 and IFS CD-ROM 1995 for the period 1970 to 1993. Nominal annual values were divided by the GDP deflator and population to derive real per capita values. C_t, Y_t, T_t and B_t stand for real per capita private consumption, real per capita GDP, real per capita tax and real per capita debt, respectively.

The lag number = 4 was determined for Belgium, Chile, France, El Salvador, Italy, Japan, Malaysia, South Africa, Singapore, Sweden, UK, USA, Turkey and Venezuela. The lag number = 3 was determined for Canada, Egypt, Finland, Germany, India and the Pakistan by the results obtained from Akaike Information Criterion (AIC), and Schwartz Bayesian Criterion (SBC). In the VAR of order 4, the variables are estimated as follows:

$$\begin{aligned} Y_t = {} & \mathrm{m}_1 + (\mathrm{a}_{11}\mathrm{L} + \mathrm{a}_{12}\mathrm{L}^2 + \mathrm{a}_{13}\mathrm{L}^3 + \mathrm{a}_{14}\mathrm{L}^4)\, Y_t \\ & + (\mathrm{b}_{11}\mathrm{L} + \mathrm{b}_{12}\mathrm{L}^2 + \mathrm{b}_{13}\mathrm{L}^3 + \mathrm{b}_{14}\mathrm{L}^4)\, T_t \\ & + (\mathrm{c}_{11}\mathrm{L} + \mathrm{c}_{12}\mathrm{L}^2 + \mathrm{c}_{13}\mathrm{L}^3 + \mathrm{c}_{14}\mathrm{L}^4)\, B_t + \mathrm{u}_{1t} \end{aligned}$$

$$T_t = \mathrm{m}_2 + (\mathrm{a}_{21}\mathrm{L} + \mathrm{a}_{22}\mathrm{L}^2 + \mathrm{a}_{23}\mathrm{L}^3 + \mathrm{a}_{24}\mathrm{L}^4)\, Y_t$$

$$+ (b_{21}L + b_{22}L^2 + b_{23}L^3 + b_{24}L^4)\ T_t$$

$$+ (c_{21}L + c_{22}L^2 + c_{23}L^3 + c_{24}L^4)\ B_t + u_{2t}$$

$$B_t = m_3 + (a_{31}L + a_{32}L^2 + a_{33}L^3 + a_{34}L^4)\ Y_t$$

$$+ (b_{31}L + b_{32}L^2 + b_{33}L^3 + b_{34}L^4)\ T_t$$

$$+ (c_{31}L + c_{32}L^2 + c_{33}L^3 + c_{34}L^4)\ B_t + u_{3t} \qquad (26)$$

where L is lag operator. From eqs.(25) and (26), excess sensitivity tests were conducted by the equation below

$$\Delta C_t = k + rR^{-1}\left[\mathbf{\Omega}_1 + \mathbf{\Omega}_2 + \mathbf{\Omega}_3\right]\mathbf{e}_t$$

$$+ \alpha_{11}\Delta Y_t + \alpha_{12}L\Delta Y_t + \alpha_{13}L^2\Delta Y_t + \alpha_{14}L^3\Delta Y_t$$

$$+ \alpha_{21}\Delta T_t + \alpha_{22}L\Delta T_t + \alpha_{23}L^2\Delta T_t + \alpha_{24}L^3\Delta T_t$$

$$+ \alpha_{31}\Delta B_t + \alpha_{32}L\Delta B_t + \alpha_{33}L^2\Delta B_t + \alpha_{34}L^3\Delta B_t + n_t \qquad (27)$$

The problem with this test in eq.(27) is that ΔC_t might respond to innovations rather than the predicted parts in ΔY_t, ΔT_t, ΔB_t. Then such a response could be interpreted as excess sensitivity. This, however, would be wrong interpretation. Therefore, we will first decompose ΔY_t, ΔT_t and ΔB_t into innovations and predicted parts by using the system given in eq.(26) and then use only predicted parts in which innovations are zero in eq.(28) below. Lagged values are the predicted values. In eq.(28) below there is no any current variable (the variable at time t), hence all values in the system are the predicted values. If change in consumption responds to these values, it would be excess sensitivity of consumption to variables given in the system.

$$\Delta C_t = b + \alpha_{11}\left[[(a_{11} -1)L + a_{12}L^2 + a_{13}L^3 + a_{14}L^4)]\ Y_t + (b_{11}L + b_{12}L^2 + b_{13}L^3 + b_{14}L^4)T_t\right.$$

$$\left.+ (c_{11}L + c_{12}L^2 + c_{13}L^3 + c_{14}L^4)\ B_t\right] + \alpha_{12}L\Delta Y_t + \alpha_{13}L^2\Delta Y_t + \alpha_{14}L^3\Delta Y_t$$

$$+ \alpha_{21}\left[(a_{21}L + a_{22}L^2 + a_{23}L^3 + a_{24}L^4)Y_t + [(b_{21}-1)L + b_{22}L^2 + b_{23}L^3 + b_{24}L^4)]\ T_t\right.$$

$$\left.+ (c_{21}L + c_{22}L^2 + c_{23}L^3 + c_{24}L^4)\ B_t\right] + \alpha_{22}L\Delta T_t + \alpha_{23}L^2\Delta T_t + \alpha_{24}L^3\Delta T_t$$

$$+ \alpha_{31}\left[(a_{31}L + a_{32}L^2 + a_{33}L^3 + a_{34}L^4)\ Y_t + (b_{31}L + b_{32}L^2 + b_{33}L^3 + b_{34}L^4)\ T_t\right.$$

$$\left.+ [(c_{31} -1)L + c_{32}L^2 + c_{33}L^3 + c_{34}L^4)]\ B_t\right] + \alpha_{32}L\Delta B_t + \alpha_{33}L^2\Delta B_t + \alpha_{34}L^3\Delta B_t$$

$$+ v_t \qquad (28)$$

where $b = k + \alpha_{11}\, m_1 + \alpha_{21}\, m_2 + \alpha_{31}\, m_3$

and $v_t = \; rR^{-1}\left[\Omega_1 + \Omega_2 + \Omega_3\right]\mathbf{e}_t + n_t + \alpha_{11} u_{1t} + \alpha_{21} u_{2t} + \alpha_{31} u_{3t}$

Considering eq.(28) as an unrestricted system, we then run excess sensitivity test as follows:

$$\Delta C_t = b + v_t \tag{29}$$

$$\begin{aligned}\Delta C_t = \; & b + \alpha_{11}\left[[(a_{11} - 1)L + a_{12}L^2 + a_{13}L^3 + a_{14}L^4)]\, Y_t\right.\\ & + (b_{11}L + b_{12}L^2 + b_{13}L^3 + b_{14}L^4)T_t\\ & \left.+ (c_{11}L + c_{12}L^2 + c_{13}L^3 + c_{14}L^4)\, B_t \right]\\ & + \alpha_{12}L\Delta Y_t + \alpha_{13}L^2\Delta Y_t + \alpha_{14}L^3\Delta Y_t + v_t\end{aligned} \tag{30}$$

Before estimating eq.(26) and conducting the sensitivity tests by eqs.(29) and (30), to avoid biased results, we will run unit root tests and, if necessary, cointegration tests. Unit root tests will be conducted to see if variables are stationary. If they are not stationary, cointegration tests will be performed to see if one or more linear combinations of these variables are stationary. If there exists such a stable linear combination, estimation of VAR based on level of the variables would suffice. The statistical implication of this is that one can first run a VAR given by eq.(26) to obtain the parameters and then use these parameters in eq.(28). If the variables in the VAR system are not cointegrated, the excess sensitivity parameters would be biased.

In Table 1, all Dickey-Fuller test results indicate that all variables for each country are nonstationary except, C_t and Y_t (by DF test without trend) and T_t and B_t (by DF test with and without trend) of Chile, C_t (by DF test without trend) of Finland, Y_t and B_t (by DF test without trend) of Japan, B_t (by DF test without trend) of Turkey and C_t and Y_t (by DF test with and without trend) of UK. Table 2 shows that all nonstationary variables are I(1).[3] Table 3 gives the results of cointegration tests by Johansen methodology that determines the number of non-zero eigenvalues by the maximum likelihood method.[4]

The estimated eigenvalues are given in the first column of Table 3-B.[5] λTrace and λMax test the number of eigenvalues, r, that are statistically different from zero. In the three variable case, n = 3, λTrace tests the hypothesis that there is no cointegration, against alternative that there are 1, 2, or 3 cointegration vectors. If H_0: r = 0 is rejected against H_1: r > 0 , then H_0 is r ≤ 1 is tested against hypothesis r = 2 or 3. The λ Max is more specific than the λTrace test, whose null hypothesis is that there are no cointegrating vectors against the hypothesis that there is one cointegrating vector.

Since calculated values of λTrace exceed the tabled critical value of 35.06 at the 0.05 level, the test statistics for each country result in rejection of no cointegration among variables and accept one of the alternative hypothesis that there are one or more cointegrating vectors. Furthermore, the same test statistics indicate that the alternative hypothesis that there are two or three cointegrating vectors should be accepted at the 0.05 level for Chile, Finland, Italy, Malaysia, Singapore, South Africa, Sweden, Turkey and the USA. Finally the λTrace test statistic indicates that H_1: r =3 is accepted at the 0.05 level for Malaysia and the USA.

The λMax test shows that the H_0: r = 0 (against H_1: r =1) is rejected at the 0.05 and 0.01 levels for each country except Germany and India. The Ho: r =1 (vs. H_1: r = 2) is rejected at 0.05 for Chile, Finland, Italy, Malaysia, Singapore, South Africa, Sweden, Turkey and the USA. The H_0: r = 2 (vs. H_1: r = 3) is rejected at 0.05 for Malaysia and the USA.

In conclusion, Table 3-A and Table 3-B show that there is at least one cointegrating vector among the variables for each country. Since variables are cointegrated, they should be estimated in levels.[6] Hence, when variables are cointegrated, the parameters that were obtained from the VAR estimation based on levels can be used to measure the excess sensitivity parameters.

The results of the F statistics tests for eqs. (29) and (30) are shown in columns 1 and 2 of Table 4, respectively. The results given by Table 4 were obtained from the restrictions on the coefficients that were estimated in two steps. First, parameters in system given by eq.(26) were estimated by a VAR system and at the second step, the coefficients α_{11}, α_{21} and α_{31} in eq.(28) were estimated using the coefficients obtained at the first step. In the first column, the null hypothesis is that all coefficients are jointly zero, whereas alternative hypothesis is that at least one of these coefficients is not equal to zero. The null hypothesis is rejected in six countries: Chile, El Salvador, India, Pakistan, Singapore and Turkey. The second column shows that the null hypothesis indicated by the eqs.(30) is accepted in all countries at the 0.05 level. In summary, the PIH holds in fourteen countries, whereas the RET holds in twenty cases. The failure of the PIH occurs in developing countries.

V. CONCLUSION

We tested the RET for twenty countries by using an "excess sensitivity test notion" and a VAR forecast method. Before testing RET, we conducted DF unit root tests, and the cointegration tests by Johansen procedure and concluded that the variables are nonstationary but cointegrated.

Although the basic purpose was to test the RET, we tested both the PIH and the RET separately. We conducted these tests by using income, tax and debt as explanatory variables. We estimated the coefficients of the regression equations in two steps. The result is that the PIH holds in a majority of the countries whereas the RET holds in all twenty cases. The failure of the PIH occurs in developing countries in all regressions.

The excess sensitivity test for RET used in this study is relatively more efficient than other test procedures that use only the contemporaneous values of variables as explanatory variables. In this study, in order for the consumption function equation to be exactly identified, consumption is regressed on both current (obtained from reduced form parameters) and lagged changes in variables.

The RET and the PIH held in the majority of the countries. The different test results for the PIH and the RET in some developing countries may arise simply from the fact that the PIH test and the RET test employ different variables. The failure of PIH might also be attributed to some factors such as the type of data or sample period used in the model. The data or sample period by itself may cause statistical rejection at a certain level of significance although the theory is correct. Or the failure may originate in structure of the economies under study, i.e., imperfect credit markets. If some individuals are unable to borrow, their consumption might be excessively sensitive to income, tax, and government borrowing (or deficit), with government expenditures are given. Even if individuals revise upward their permanent income due to new information and hence plan to increase their current consumption, they may not be able to fund this increase in consumption at time *t*.

When they reach to an increased income or a credit at time $t+1$, they will increase their consumption due to upward revision in their permanent income at time t. Then this result would be an excess sensitivity of consumption to previously predicted income (lagged income). The failure of the PIH, on the other hand, seems not to be explained by liquidity constraints given the supportive evidence for the RET. These constraints, if present, should have produced rejection of RET as well.

ENDNOTES

[1] Certainty equivalence behavior can be obtained from a quadratic utility function whose third derivative is zero.

[2] Flavin (1981). Flavin, however, formulates PIH as $C_t = r\left[W_t + \sum_{i=0}^{\infty} R^{-(i+1)} E_t Y_{t+i}\right]$. This difference comes from her wealth evaluation formula of $W_{t+1} = (1+r)W_t + Y_t - C_t$. In other words in her formula saving (Y_t - C_t) does not earn interest (pp. 977-978), since Y_t is paid at the and of period. Besides this, We define explicitly as the sum of K and B and add present value of future taxes into the equation.

[3] Significance levels for Tables 1 and 2 are given by Enders (1995, p.419).

[4] Johansen (1987).

[5] Significance levels for Table 3 are given by Enders (1995, p.420).

[6] See Engle and Yoo (1991), Enders (1995), Sims (1980), Doan (1992), Harvey (1992, pp.: 469-70) and Engle and Granger (1991).

Table 1: The Stationarity Tests

	C_t		Y_t		T_t		B_t	
Countries	1	2	1	2	1	2	1	2
Belgium	-1.51	-3.04	-1.48	-2.84	-1.04	-1.49	1.40	-0.53
Canada	-1.89	-2.52	-1.98	-1.06	-0.62	-1.01	1.61	-0.51
Chile	-4.48	-2.36	-4.52	-2.31	-645	-576	-6.48	-4.60
Egypt	0.75	-0.38	0.72	-0.49	-0.15	-1.82	-1.59	-2.96
El Salvador	0.22	-1.47	-0.77	-1.95	-0.06	-1.99	-1.42	-1.08
Finland	-3.00	-3.46	-2.76	-3.54	-1.37	-1.49	1.33	-1.47
France	-1.46	-1.83	-1.55	-1.77	-1.32	-1.37	1.41	-0.69
Germany	0.65	-1.45	0.41	-1.64	0.03	-1.31	-1.23	-2.13
India	-0.79	-2.27	-0.55	-2.01	0.88	-1.15	-0.79	-0.36
Italy	-1.21	-2.50	-1.23	-2.57	-1.62	-2.39	-0.70	-1.95
Japan	-2.84	-3.05	-3.54	-3.48	1.07	-0.80	-3.03	-3.09
Malaysia	-0.04	-3.57	0.20	-2.62	-1.28	-1.58	-1.02	-0.92
Pakistan	-0.67	-3.27	-0.64	-3.20	-1.03	-1.68	-2.16	-1.86
S. Africa	0.63	-1.72	0.44	-1.65	-0.03	-2.35	-0.52	-1.79
Singapore	5.84	1.88	2.27	0.50	1.65	-0.13	6.66	1.95
Sweden	-1.74	-1.34	-1.81	-1.23	-2.46	-2.08	-2.30	-1.77
Turkey	-2.21	-3.21	-2.02	-2.76	-1.28	0.69	-3.67	-2.28
UK	-3.68	-3.84	-3.85	-3.93	-1.58	-1.71	-1.44	-2.36
USA	0.67	-1.57	-0.78	-2.67	-1.03	-2.43	-2.05	0.97
Venezuela	-0.03	-1.40	0.62	-1.04	-0.55	-2.43	-1.36	-1.56

significance		0.01	0.05	0.10
1	$\Delta Y_t = \alpha_0 + \delta Y_{t-1} + \varepsilon_t$	-3.75	-3.00	-2.62
2	$\Delta Y_t = \alpha_0 + \delta Y_{t-1} + b_1 t + \varepsilon_t$	-4.38	-3.60	-3.24

Table 2: Test of Integration

Country	C_t 1	C_t 2	Y_t 1	Y_t 2	T_t 1	T_t 2	B_t 1	B_t 2
Belgium	-3.59	-6.41	-3.68	-6.90	-3.13	-5.65	-3.18	-6.26
Canada	-3.12	-7.51	-3.61	-3.76	-3.71	-3.86	-5.00	-4.87
Chile	4.48*	-4.52	-4.52*	-4.66	-645*	-576*	-6.48*	-4.60*
Egypt	-4.20	-5.29	-4.05	-5.27	-4.56	-5.12	-4.19	-4.43
El Salvador	-4.45	-5.41	-6.89	-6.88	-3.94	-4.26	-4.49	-4.50
Finland	-3.00*	-6.55	-6.60	-6.62	-5.73	-5.68	-3.45	-3.61
France	-4.24	-4.16	-4.14	-4.07	-3.04	-5.06	-5.99	-7.15
Germany	-3.46	-4.97	-3.66	-3.61	-4.90	-3.32	-4.12	-3.86
India	-5.54	-5.44	-4.94	-4.87	-3.22	-4.00	-3.11	-4.33
Italy	-6.39	-6.33	-7.01	-6.91	-5.65	-5.60	-3.92	-3.73
Japan	-6.76	-6.67	-3.54*	-6.89	-4.83	-4.64	-3.03*	-5.41
Malaysia	-5.66	-5.54	-3.62	-3.69	-3.12	-3.73	-3.99	-4.09
Pakistan	-3.84	-3.84	-3.67	-3.66	-3.67	-3.78	-3.84	-3.76
S. Africa	-3.88	-4.23	-3.72	-4.04	-3.41	-4.31	-3.95	-4.20
Singapore	-7.39	-7.28	-6.07	-6.04	-4.25	-4.23	-6.29	-6.30
Sweden	-4.59	-4.54	-5.78	-5.74	-5.12	-5.08	-3.80	-3.79
Turkey	-10.04	-9.64	-9.08	-8.76	-5.14	-5.02	-3.67*	-5.21
UK	-3.68*	-3.84*	-3.85*	-3.93*	-3.57	-6.28	-4.01	-6.52
USA	-3.77	-3.75	-4.50	-4.47	-4.02	-3.89	-3.82	-3.88
Venezuela	-6.25	-6.36	-5.31	-5.56	-4.47	-4.66	-3.60	-3.70

* indicates I(0) variables. All other variables are I(1).

significance		0.01	0.05	0.10
1	$\Delta^2 Y_t = \alpha_0 + \delta \Delta Y_{t-1} + \varepsilon_t$	-3.75	-3.00	-2.62
2	$\Delta^2 Y_t = \alpha_0 + \delta \Delta Y_{t-1} + b_1 t + \varepsilon_t$	-4.38	-3.60	-3.24

Table 3-A: The Null and Alternative Hypothesis by Johansen Methodology

λMax Test		The level of significance			λTrace Test		The level of significance		
Ho:	H1	0.01	0.05	0.10	Ho:	H1	0.01	0.05	0.10
r = 0	r = 1	26.40	21.89	19.79	r = 0	r > 0	40.19	35.06	32.09
r = 1	r = 2	19.83	15.75	13.78	r ≤ 1	r > 1	24.98	20.16	17.95
r = 2	r = 3	12.74	9.09	7.56	r ≤ 2	r > 2	12.74	9.09	7.56

Table 3-B: Cointegration Test for Yt, Tt and Bt by Johansen Methodology

Countries	λ_i	λMax	λTrace	Countries	λ_i	λMax	λTrace
	λ_1= 0.7844	29.15	40.90		λ_1= 0.8340	30.52	42.68
Belgium	λ_2= 0.4465	11.24	11.75	Japan	λ_2= 0.4322	9.62	12.16
	λ_3= 0.0265	0.51	0.51		λ_3= 0.1385	2.54	2.54
	λ_1= 0.8242	27.82	38.64		λ_1= 0.9622	52.43	82.97
Canada	λ_2= 0.4903	10.78	10.82	Malaysia	λ_2= 0.7111	19.87	30.54
	λ_3= 0.0025	0.04	0.04		λ_3= 0.4868	10.67	10.67
	λ_1= 0.9751	62.81	96.31		λ_1= 0.9166	34.77	47.66
Chile	λ_2= 0.7951	29.95	33.50	Pakistan	λ_2= 0.5179	10.21	12.89
	λ_3= 0.3200	6.56	6.56		λ_3= 0.1737	2.67	2.67
	λ_1= 0.8067	24.65	37.98		λ_1= 0.9559	59.29	87.31
Egypt	λ_2= 0.5869	13.26	13.33	Singapore	λ_2= 0.7012	22.95	28.02
	λ_3= 0.0049	0.07	0.07		λ_3= 0.2342	5.03	5.07
	λ_1= 0.8825	40.69	56.24		λ_1= 0.9964	90.07	122.13
El Salvador	λ_2= 0.5260	14.18	15.55	South	λ_2= 0.7657	23.21	32.10
	λ_3= 0.0695	1.37	1.37	Africa	λ_3= 0.4260	8.88	8.88
	λ_1= 0.8911	31.04	56.03		λ_1= 0.7731	28.18	52.61
Finland	λ_2= 0.7024	16.97	24.98	Sweden	λ_2= 0.6411	19.47	24.43
	λ_3= 0.4360	8.02	8.02		λ_3= 0.2219	4.96	4.96
	λ_1= 0.8526	32.55	47.55		λ_1= 0.8785	40.05	61.99
France	λ_2= 0.5484	13.51	15.00	Turkey	λ_2= 0.5680	15.95	21.94
	λ_3= 0.0836	1.48	1.48		λ_3= 0.2707	6.00	6.00
	λ_1= 0.7281	19.54	35.72		λ_1= 0.8593	37.26	46.46
Germany	λ_2= 0.6459	15.57	16.19	UK	λ_2= 0.3820	9.14	9.20
	λ_3= 0.0401	0.61	0.61		λ_3= 0.0028	0.05	0.05
	λ_1= 0.7096	19.78	37.27		λ_1= 0.9943	87.97	129.38
India	λ_2= 0.5785	13.82	17.49	USA	λ_2= 0.7802	25.75	41.40
	λ_3= 0.2048	3.67	3.67		λ_3= 0.6017	15.65	15.65
	λ_1= 1.000	227.03	255.84		λ_1= 0.8798	40.25	49.88
Italy	λ_2= 0.8331	28.65	28.82	Venezuela	λ_2= 0.2808	6.26	9.63
	λ_3= 0.0104	0.17	0.17		λ_3= 0.1624	3.37	3.37

Table 4: Excess Sensitivity Test Results from eqs. (29) and (30)

Countries	1	2	Countries	1	2
Belgium	F(12,7) 1.09 (0.471)	F(8,7) 0.235 (0.970)	Japan	F(12,5) 0.329 (0.946)	F(8,5) 0.381 (0.891)
Canada	F(9,7) 2.527 (0.117)	F(6,7) 0.123 (0.989)	Malaysia	F(12,4) 3.12 (0.140)	F(8,4) 1.07 (0.506)
Chile	F(12,5) 5479 (0.000)	F(8,5) 1.42 (0.361)	Pakistan	F(9,5) 6.50 (0.026)	F(6,5) 1.27 (0.404)
Egypt	F(9,6) 0.779 (0.646)	F(6,6) 0.210 (0.960)	South Africa	F(12,4) 3.33 (0.127)	F(8,4) 0.430 (0.855)
El Salvador	F(12,7) 4.32 (0.030)	F(8,7) 1.52 (0.296)	Singapore	F(12,7) 4.82 (0.022)	F(8,7) 0.829 (0.604)
Finland	F(9,5) 3.23 (0.104)	F(6,5) 2.53 (0.163)	Sweden	F(12,7) 2.57 (0.107)	F(8,7) 0.050 (0.999)
France	F(12,5) 0.824 (0.639)	F(8,5) 0.005 (0.999)	Turkey	F(12,7) 13.62 (0.001)	F(8,7) 0.575 (0.772)
Germany	F(9,6) 1.43 (0.338)	F(6,6) 0.040 (0.999)	UK	F(12,7) 2.43 (0.121)	F(8,7) 0.428 (0.870)
India	F(9,7) 4.95 (0.023)	F(6,7) 0.066 (0.997)	USA	F(12,5) 2.38 (0.173)	F(8,5) 0.488 (0.824)
Italy	F(12,4) 1.53 (0.363)	F(8,4) 0.669 (0.708)	Venezuela	F(12,7) 0.677 (0.736)	F(4,7) 0.228 (0.972)

*the degrees of freedom and the levels of significance are in parenthesis.
Column 1: H_0: All variables are jointly equal to zero, eq. (29).
Column 2: H_0: $\alpha_{21} = \alpha_{22} = \alpha_{23} = \alpha_{24} = \alpha_{31} = \alpha_{32} = \alpha_{33} = \alpha_{34} = 0$, eq.(30)

BIBLIOGRAPHY

Aiyagari S, Rao. "Intergenerational Linkages and Government Budget Policies." In Preston J. Miller (ed.), The Rational Expectational Revolution, Massachusetts Institute of Technology Press, 1994, 151-168.

Aschauer, David. "Fiscal Policy And Aggregate Demand," American Economic Review, 75 March -June, 1985, 117-127.

Barro, Robert J. "The Neoclassical Approach to Fiscal Policy," In Barro J. Robert. (ed.), Modern Business Cycle Theory, Harvard University Press, 1989,178-235.

------------------- "Government Spending, Interest Rates, Prices, and Budget Deficits in the United Kingdom," Journal of Political Economy, October 1987, Vol. 20, No 2 221-247.

------------------- "Are Government Bonds Net Wealth?" Journal of Political Economy, April 1974, Vol. 82, No.61, 1095-1117.

Bernheim, Douglas B. "Ricardian Equivalence: An Evaluation of Theory and Evidence," NBER, Macroeconomics Annual 1987, 263-304.

Buchanan, James, M. "Barro on The Ricardian Equivalence Theorem," Journal of Political Economy, 1976, Vol. 84, No.2, 337-342.

Campbell, John and Angus Deaton ."Why Is Consumption So Smooth?" Review of Economic Studies, July 1989, 357-374.

Campbell, John,Y. and Mankiw N. Gregory. "Consumption, Income, and Interest Rates: Reinterpreting the Time Series Evidence,"NBER, Macroeconomics Annual 1989, 185-216.

Campbell, John, Y. "Does Saving Anticipate Declining Labor Income? An Alternative Test of the Permanent Income Hypothesis," Econometrica , Vol. 55, No. 6 (November 1987), 1249-1273.

Christiano, Lawrence, J. "Why Is Consumption Less Volatile Than Income?" In Preston J. Miller (ed.), The Rational Expectational Revolution, Massachusetts Institute of Technology Press, 1994, 391-425.

Chrystal, Alec K. and Price Simon. Controversies in Macroeconomics. Harvester Wheatsheaf, New York, 1994.

Deaton, Angus. Understanding Consumption. Oxford University Press, New York, 1992.

Dickey, David, A., Jansen W. Dennis and Thornton L. Daniel. "A Primer on Cointegration with an Application to Money and Income," Federal Reserve Bank of St. Louis, March/April 1991.

Doan, T. Rats User's Manual, 4.0, Estima, 1992.

Enders, Walter. Applied Econometric Time Series. John Wiley & Sons, Inc. New York, 1995.

Engle, R. and Granger C. "Cointegration and Error Correction: Representation, Estimation, and Testing". In Engle and Granger (eds.), Long Run Economic Relationships. Readings in Cointegration., Oxford University Press, New York, 1991, 81-113.

Engle, R. and Yoo Sam. "Forecasting and Testing in Co-integrated Systems," In Engle and Granger (eds.), Long Run Economic Relationships. Readings in Cointegration, Oxford University Press, New York, 1991, 237-67.

Feldstein, Martin. "Perceived Wealth in Bonds and Social Security: A Comment," Journal of Political Economy, 1976, Vol. 84, No.2, 331-336.

Flavin, Marjorie. "The Adjustment of Consumption to Changing Expectations about Future Income," Journal of Political Economy, 89, 1981, 974-1009.

Frenkel, J. and Razin A. Fiscal Policies and the World Economy, 2nd ed. MIT Press,1994.

Hall, E. Robert. "Consumption," Modern Business Cycle Theory, Harvard University Press, 1989, 153-177.

------------------- "Intertemporal Substitution In Consumption," Journal of Political Economy, April 1988, Vol. 96, No.21, 339-357.

------------------- "Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence," Journal of Political Economy, 89, 1981, 971- 987.

Hamilton, James D. Time Series Analysis, Princeton University Press, Princeton New Jersey, 1994.

Harwey, C., Andrew. Forecasting, Structural Time Series Models and the Kalman Filter,.Cambridge University Press, 1992.

Johansen, Søren. "Statistical Analysis of Cointegration Vectors," In Engle and Granger (eds), Long Run Economic Relationships. Readings in Cointegration, Oxford University Press, New York, 1991, 131-152.

Leiderman, L. and Razin A. "Effects of Government Finance: Testing Ricardian Neutrality," In Helpman E., Razin A. and Sadka E.(eds.), Economic Effects of the Government Budget, , MIT Press, 1988, 107-121.

Mankiv, Gregory N. and Mathew Shapiro. "Trends, Random Walks and Tests of the Permanent Income Hypothesis," Journal of Monetary Economics, 1985, 16, 165-174.

Muellbauer, J. "Consumer Expenditure," In Tim Jeckinson (ed.), Readings in Macroeconomics, Oxford University Press 1996, 92-126.

Sargent, Thomas. "Rational Expectations, Econometric Exogenity, and Consumption," Journal of Political Economy, August 1978, 86, 633-700.

Seator, J. and Mariona R. "New Tests of the Life Cycle and Tax Discounting Hypothesis," Journal of Monetary Economics", March 1985, 195-215.

Shea, John. "Myopia, Liquidity Constraints, and Aggregate Consumption: A Simple Test," Journal of Money, Credit and Banking, February 1995, 798-805.

Sims, Christopher. "Macroeconomics and Reality," Econometrica , 48, January 1980, 1-49.

Sraffa, Piero. The Works and Correspondence of David Ricardo. Volume IV, Pamphlets and Papers, 1815-1823, Cambridge University Press, 1962.

Stock, James and Watson Mark. "Variable Trends in Economic Time Series," In Engle and Granger (eds.), Long Run Economic Relationships. Readings in Cointegration. Oxford University Press, New York, 1991, 17-49.

Thurston, Thom B. "Two Strong but Dubious Restrictions and Their Role in Rejecting the Permanent Income Hypothesis," 1993, Queens College, The City University of New York, unpublished paper.

Toshiki Yotsuzuka. "Ricardian Equivalence in the Presence of Capital Market Imperfections," Journal of Political Economy, December 1987, Vol. 20, No 3, 411-436.

Turnovsky Stephen. Methods of Macroeconomic Dynamic, Massachusetts Institute of Technology Press, Massachusetts, 1995.