The Ricardian Equivalence Hypothesis: Evidence from Bangladesh

By

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Abstract

This paper examines the Ricardian equivalence hypothesis (REH) and its sources of failure in the case of Bangladesh using various theoretical specifications, annual data from 1974-2001 and linear and non-linear time series techniques. The general findings tend to invalidate the REH: a finite time horizon and the presence of liquidity-constrained individuals are the sources of deviation from the REH. Empirical results reveal that real per capita private consumption (C) under various specifications is cointegrated generally at the 5% level with real per capita income (Y), government expenditure before and after interest rate repayments (G & G2), taxes (T) and the interest rate (r). Results reveal that an increase in G, G2, T and r reduces C and that that an increase in budget deficits raises trade deficits. These results highlight the importance of fiscal policies in boosting private consumption and controlling trade deficits, which are the prime goals of stabilisation policies being followed by Bangladesh.

***Key words*: Ricardian Equivalence; Bangladesh; Cointegration analysis; Rational Expectations.**

***JEL Classification*: H61; H62; O10; O11.**

1. Introduction

The main aim of this paper is to examine the Ricardian equivalence hypothesis (REH) (explained below) and its sources of failure in Bangladesh, using various theoretical specifications, annual data from 1974-2001 and time series techniques. Bangladesh is a less developed country (LDC), which is associated with a low level of saving, investment, per capita income and with a high rate of both fiscal and trade deficits[1] (Siddiki (2000, 2002), where both types of deficits generally move together (figure 1 in the appendix). The sustainability and the consequences of such high deficits are a major concern for policy makers of developed and developing countries. Very few studies (reviewed below) investigate the consequences of fiscal deficits on private consumption and trade deficits in LDCs. As far as the present author is concerned, no such study on Bangladesh has been carried out. This type of analyses is particularly important for Bangladesh since it has been following stabilisation and structural adjustment policies[2], the success of which mainly depends on the nature of the relationships between fiscal policies and private consumption and trade deficits. One of the novelty of this paper is to investigate the sources of failure of the REH in a developing country such as Bangladesh, which is still an under researched area. Thus, the findings of this paper would be important for policy makers in Bangladesh and other LDCs.

Economic theory and empirical evidence are also not decisive for drawing a general conclusion on the consequences of fiscal deficits on private consumption and the balance of payments despite the central focus of macroeconomic analyses

[1] The average of fiscal deficits during our sample periods is about 6% of GDP, ranging from 3-9% of GDP and the average of trade deficits is more than 7% of GDP, ranging from 3.54 - 12.51% of GDP.

[2] These policies are prescribed by international institutions such as the World Bank and the International Monetary Fund, and are based on demand management policies which suggest reducing the budget deficits in order to reduce trade deficits and to increase private investment, thereby increasing in income and consumption.

concerning the effect of fiscal deficits on macroeconomic variables. In addition, most of empirical studies (reviewed below) examining the effects of fiscal deficits on private consumption and on trade deficits are mainly concentrated on developed countries with some few exceptions[3].

There are mainly two types of views on the consequences of fiscal deficits on other macroeconomic variables. The Keynesian model predicts that a rise in fiscal deficits increases aggregate demand which in turn stimulates short-run output and employment, raises interest rates and also causes a crowding out in private investment. The Keynesian proposition asserts that the increase in aggregate demand caused by fiscal deficits also widens (reduces) current account or trade deficits (surpluses), implying that taxes should be raised in order to reduce budget deficits and therefore trade deficits[4].

The REH, in contrast with the Keynesian proposition, states that it is government purchases and marginal taxes rather than the ratio of debt to taxes that have an impact on private consumption and on trade deficits. That is, the mode of financing fiscal deficits, i.e. whether fiscal deficits are financed by debt or by tax increases, is inconsequential in its effects upon private consumption and therefore trade balances, since economic agents consider present period's deficit financing as a future period's tax liability (Barro (1974, 1989)). The stability of saving and

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[3] For example, Ghatak and Ghatak (1996); Gupta (1992); Haque (1988); Khalid (1996).

[4] The relationship, according to the twin deficits hypothesis, between government budget deficits and trade deficits can be summarised as follows (see Khalid and Guan (1999) for a good review). Firstly, in a Mundell-Flemming framework, an increase in government deficits are thought to exert an upward pressure on real interest rates, which boosts capital inflows and hence causes an appreciation in real exchange rates and a reduction in competitiveness, causing trade (or current account) deficits (Rosenweig and Tallman (1993), p. 580; Khalid and Guan (1999), 390). This mechanism is effective under both fixed and flexible exchange rate regimes. Under a fixed exchange rate regime, trade deficits deteriorate due to a positive income effect caused by the government's excess expenditures and due to an appreciation in real exchange rates. Secondly, the Keynesian absorption theory predicts that a rise in budget deficits increases domestic absorption and hence an expansion in imports causing current account deficits (see from Khalid and Guan (1999), 390)). A strong correlation between saving and

investment is crucial in supporting the REH as instability in both factors may cause both deficits not to be correlated. Thus, according to the REH, fiscal policies do not affect the equilibrium level of trade balances, current account, interest rates, money demand, private consumption, investment and saving (Vamvoukas (1999))[5]. The REH is, however, based on some strong assumptions: (a) capital markets are perfect and the consumer does not face any borrowing constraints; (b) both the private and public sectors have the same planning horizons; (c) taxes are non-distortionary (Barro (1974, 1989)).

Two types of empirical investigation to examine the REH have been carried out. One is the estimation of structural private consumption models to examine the impact of government expenditures on private consumption (Becker (1997); Ghatak and Ghatak (1996); Khalid (1996)). Empirical evidence on this issue is inconclusive (see Leiderman and Blejer (1988) and Seater (1993) for a survey). Authors opposed to the REH argue that the failures of the proposition are mainly caused by the violation of its underlying assumptions. That is, the REH fails mainly due to finite time horizons, non-altruistic or inoperative bequest motives, childless couples, liquidity constraints and uncertainty (see Seater (1993)).

The other type of empirical investigation explores the consequences of budget deficits on trade deficits; some support the assertion that a budget deficit causes a trade deficit while many oppose it (Vamvoukas (1999); Normandin (1999) and references are therein). It is also argued that a simple violation of the REH does not necessarily imply that the Granger causality runs from budget deficits to trade deficits or to private consumption (Normandin (1999)). The legitimacy of strict stabilisation

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investment (Feldstein and Horioka (1980)) also causes budget deficits and the current accounts of the balance of payments to move together, supporting the twin deficits hypothesis.

[5] Note, however, that LDCs in general, and Bangladesh in particular, are characterised by imperfect capital markets (Siddiki (2001, 2002); Auerbach and Siddiki (2002); Ghatak (1995)).

policies is criticised when the magnitude of the Granger causality is negligible even when the REH is not violated[6].

This paper is organised as follows: section two explains the variables used in our analysis and sources of data. Section three surveys various specifications of the consumption functions which are used to test the REH and to find the sources of departures, if any, from the REH. This section also explains the link between budget and trade deficits. In section four, models are estimated and empirical results are explained. Section five draws conclusions.

2. Variables and Sources of Data

In this section, we explain the variables, and their data sources, which are used in specifying the REH (section three) and empirical modelling (section four). C is private consumption, Y is gross domestic product (GDP), T is taxes, d is budget deficits, TD is trade deficits, G (G2) is government expenditures excluding (including) interest payments on government debt, GI is government investment expenditures, RB interest payments on government debt; W is wealth and A is assets: both W and A are defined as the sum of total broad money supply and deposits in various government sponsored saving schemes; r is real interest rates, bank rates minus the rate of inflation measured from the consumer price index. All variables but r are expressed in real per capita natural logarithm terms (the GDP deflator with base 1990 is used).

Data sources: Bangladesh Bureau of Statistics (various years) *Statistical Yearbook of Bangladesh*, Government of Bangladesh (various issues) *Bangladesh Economic Review*, Bangladesh Bank (various issues) *Economic Trends*.

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[6] The violation or failure of the REH imply that a government can affect trade deficits or private consumption by changing the timing of taxes.

3.1 Various Specifications of the REH and Crowding-out Hypothesis

There are mainly two types of consumption functions used in the literature to test the REH. One is based on ad hoc, i.e. the Buiter and Tobin (1979), consumption functions. The second type of consumption functions incorporates the rational expectations hypothesis which assumes the availability of perfect information about future government fiscal policies. That is, economic agents can predict future government fiscal policies. This type of consumption functions is also used to find the causes or sources of the failures, if any, of the REH. In addition, analyses on the consequences of budget deficits on trade deficits are also used to test the REH. In this section, we will review various theoretical specifications, which will be used in the next section to test the REH in Bangladesh.

Various formulations of the Buiter-Tobin type approach for examining the REH and crowding-out hypothesis used in the literature are summarised below (see, Ghatak and Ghatak (1996) for a survey):

$$C_t = a_0 + a_1 Y_t + a_2 G_t + a_3 T_t + a_4 W_t \qquad (1)$$

$$C_t = a(Y_t - T_t - d_t), \quad 0 < a < 1 \qquad (2)$$

$$d = G_t + RB_t - T_t \qquad (3a)$$

implies that

$$d = G2_t - T_t \qquad (3b)$$

where the total government fiscal deficit (*d*) is the sum of primary deficits (*G* - *T*) and interest payments (*RB*) on bonds; the expressions (3a) and (3b) state that an increase in (*G* - *T*) and a resulting augmentation in *RB* raise *d*. Various forms of equation (2) which incorporate expressions (3a) and (3b) and some other restrictions are used in order to test the REH. For example, Buiter and Tobin (1979) estimated the following equation:

$$C_t = a_0 + a_1 Y_t + a_2 T_t + a_3 d_t \qquad (4)$$

subject to the following restrictions:

$$0 < a_1 < 1, \quad a_2 < 0, \quad a_3 < 0, \quad a_1 = |a_2| \text{ and } a_2 = a_3. \qquad (5)$$

The REH is confirmed if a_1, a_2 and a_3 are statistically significant and the restrictions in equation 5 are satisfied. The statistically significant coefficients and equation 5 recapitulate the main assertion of the REH: the mode of financing fiscal deficits - i.e. whether fiscal deficits are financed by debt or by tax increases - is inconsequential on private consumption since economic agents consider present period's deficit financing as future period's tax liabilities (Barro (1974, 1989)).

The restriction $a_2 = a_3$ implies that the sign and magnitudes of the coefficients for both taxes and government expenditures are the same: both taxes and government expenditures exert the same effect on consumption. Rational agents with perfect foresight, i.e. in the absence of uncertainty, would be inclined to believe that deficits incurred by the government today will be completely offset by rising taxes in the next period.

The coefficient a_1 represents marginal propensity to consume and this, in accordance with standard theory, is positive and less than one. The restriction implying that the coefficients of income and taxes are equal but opposite in sign, i.e., $a_1 = |a_2|$, indicates that consumption losses due to an imposition of taxes are equal to consumption gains resulting from a same amount of increase in income or vice versa. The coefficient of (Y-T) simply measures the impact of disposable income on C if the restriction $a_1 = |a_2|$ is validated.

Incorporating equation (3b), Kormendu (1983) proposes the following 'augmented consolidated approach':

$$C_t = a_1 Y_t + a_2 T_t + a_3 G2_t \quad (6)$$

A statistically insignificant a_2 implies that government deficits have no impact on current consumption, lending support to the REH. This follows from the fact that the consumption decisions of rational consumers depend on the present value of government expenditures rather than on the timing of taxes (Barro (1989)). Using expression (3b) and imposing the restriction that the coefficients of taxes and government spending are equal, though opposite, in sign Boskin (1988) also provides the following:

$$C_t = a_1 (Y_t - G2_t) + a_2 d_t \quad (7)$$

a positive and statistically significant value of a_2 invalidates REH. To test REH and crowding-out hypothesis, equation (2) can also be rewritten as

$$C_t = a_0 + a_1 Y_t + a_2 G2_t + a_3 RB_t \quad 0 < a_1 < 1. \quad (8)$$

subject to the restrictions explained in equation (5) and as

$$C_t = a_1 Y_t + a_2 G2_t \quad 0 < a_1 < 1. \quad (9a)$$

A negative and statistically significant a_2 implies that government consumption crowds out private consumption. The crowding out hypothesis asserts that an increase in government expenditure or investment results in a reduction in private consumption or expenditure. Deficit financing raises real interest rates, which in turn reduces private or any other interest-sensitive form of private spending. Thus, we can write:

$$C_t = a_1 Y_t + a_2 r_t + a_3 G2_t \quad 0 < a_1 < 1, a_2, a_3 < 0 \quad (9b)$$

and

$$C_t = a_1 Y_t + a_2 r_t + a_3 GI_t \quad 0 < a_1 < 1, a_2, a_3 < 0 \quad (9c)$$

where GI is government investment.

Incorporating the rational expectations proposition, Aschaur (1985) derived the second type of consumption function, to test the REH, which maximises intertemporal utility subject to a budget constraint (see also Gupta (1992) for a review, pp. 20-21). Aschaur assumes that a representative household with a quadratic utility function maximises the net present value of consumption in the current and future periods. The author uses the following Eüler equation:

$$E_{t-1}C_t^* = a + bC_{t-1}^* \qquad (10a)$$

where E is expectations operator and C^* is the effective private consumption described by

$$C_t^* = C_t + \theta G2_t \qquad (10b)$$

where C is actual private consumption and $G2$ is government consumption. According to equation (10b), government utilities influence private utilities and each unit of $G2$ is assumed to yield the same utility as θ units of private spending. A positive value of θ implies that government spending is a substitute for private spending. On the other hand, a negative value of θ indicates government spending is a complement to private spending[7]. Substitution of the lagged of equation (10b) into (10a) gives the following:

$$E_{t-1}C_t^* = a + bC_{t-1} + b\theta G2_{t-1} \qquad (10c)$$

Assume that expectations are formed at time t-1 and taking the expectations of equation (10b), then we can write:

$$E_{t-1}C_t^* = C_t + \theta E_{t-1}G2_t \quad \Rightarrow C_t = E_{t-1}C_t^* - \theta E_{t-1}G2_t \qquad (10d)$$

Substituting equation (10c) into (10d) and incorporating the rational expectations hypothesis, i.e. actual consumption is expected consumption plus a random error u_t which is purely a random walk, we obtain the following:

[7] $C_t^* = C_t + \theta G2_t \Rightarrow C_t = C_t^* - \theta G2_t \Rightarrow$ A positive value of θ gives a negative coefficient for G2 and thus implies that an increase in G2 reduces C, i.e. government spending is a substitute for private spending. On the other hand, a negative value of θ gives a positive coefficient of G2, implying that an increase in G2 raises C, i.e. government spending is a complement to private spending.

$$C_t = a + b\,C_{t-1} + b\theta G2_{t-1} - \theta E_{t-1} G2_t + u_t \qquad (10e)$$

Assume that $E_{t-1}G2_t$ is given by

$$E_{t-1}G2_t = \gamma + \varepsilon(L)G2_t + \omega(L)d_t \qquad (10f)$$

where L is lag operator and ε and ω are two suitable polynomials, the lag operator implies:

$$E_{t-1}G2_t = \gamma + \varepsilon_1 G2_{t-1} + \varepsilon_2 G2_{t-2} + \cdots + \omega_1 d_{t-1} + \omega_2 d_{t-2} + \cdots \qquad (10g)$$

Substitution of equation (10g) into (10e) gives:

$$\begin{aligned} C_t = (a-\theta\gamma) + bC_{t-1} + \theta(b-\varepsilon_1)G2_{t-1} - \theta\varepsilon_2 G2_{t-2} - \theta\varepsilon_3 G2_{t-3} - \cdots - \\ - \cdots - \theta\omega_1 d_{t-1} - \theta\omega_2 d_{t-2} - \cdots - + u_t \end{aligned} \qquad (10h)$$

Considering the limited number of observations and the possibility of multicollinearity among lagged variables with a limited number of observations, we chose one lag of *G2* and *d* in our empirical analysis in the next section; the rational expectations hypothesis also implies that actual government spending is expected spending plus a random error υ_t. Thus equation (10f) can be written as follows:

$$G2_t = \gamma + \varepsilon_1 G2_{t-1} + \omega_1 d_{t-1} + \nu_t \quad (10i)$$

In the case of one lags for *G* and *d*, equation (10h) can be written as:

$$C_t = \delta + bC_{t-1} + \eta_1 G2_{t-1} + \mu_1 d_{t-1} + u_t \quad (10j)$$

$$\text{with} \quad \begin{aligned} &\delta = (a - \theta\gamma), \\ &\eta_1 = \theta(b - \varepsilon_1), \\ &\mu_1 = -\theta\omega_1 \end{aligned} \qquad (10k)$$

The cross equation restrictions in equation (10k), which are apparent from the corresponding coefficients of equations (10h) and (10j), are based on a rational expectations hypothesis. The acceptance of these restrictions in empirical analyses validates the REH. Following Aschaur (1985), we first estimate (10i) and (10j) under restrictions given by (10k) and then the unrestricted version of (10j) to test whether the restrictions are violated or not. The REH is rejected when the restrictions are violated.

There are two main types of difficulties associated with this form of intertemporal consumption function. The first is a general one associated rational expectations since only past values of $G2$ and d may not enough to estimate $E_{t-1}G2_{t-1}$. The second problem is related to the number of lags to be used for annual data and this problem become very acute with the short time series and with the presence of multicolinearity among lag variables as is the case for Bangladesh.

In addition, many authors use a discrete-time version of the Blanchard (1985) model to test the REH and to find the sources of departures from the REH (see Himarios (1995) for a survey). According to the Blanchard (1985) model, the REH breaks down if a fraction (μ) of the population dies in each period and transitory consumption or preference shocks are absent:

$$C_t = \alpha \left[(1+r) A_{t-1} + \sum_{j=0}^{j=\infty} \left(\frac{1-\mu}{1+r} \right)^j E_t Y_{l,t-j} \right] \qquad \text{(11a)}$$

where A_{t-1} is the stock of real assets outstanding at the end of period (t-1), r is constant real returns on these assets, μ is the constant probability of dying, $Y_{l,t}$ is the real disposable labour income and E_t is the expectations operator, α is the propensity to consume out of total wealth. The first term in the brackets is the non-human wealth and the second term is human wealth. This model predicts that the REH fails if $\mu > 0$, implying that a fraction of people die in each period, because a positive value of μ ($\mu > 0$) causes economic agents to use different discount factors for taxes and interest payments (see Himarios (1995), p. 166).

The aggregate budget constraint can be written as follows:

$$A_t = (1+r) A_{t-1} + Y_{l,t} - C_t \tag{11b}$$

Equations (11a, 11b) are used by many authors in deriving the aggregate consumption function in the form of observable variables. For example, Evans (1988) solves the model and derives the following consumption function in the form of non-human wealth by eliminating human wealth from the equation:

$$C_t = \frac{1+r}{1-\mu}(1-\alpha) C_{t-1} - \alpha\mu \frac{1+r}{1-\mu} A_{t-1} + \alpha\varepsilon_t \tag{11c}$$

On the other hand, Haque (1988) provides the following consumption function by eliminating (after substituting for) non-human wealth:

$$\begin{aligned} C_t = (1+r)\left(1-\alpha+\frac{1}{1-\mu}\right) C_{t-1} - \frac{(1+r)^2}{1-\mu}(1-\alpha)\, C_{t-2} \\ -\alpha\mu\frac{1+r}{1-\mu} Y_{l,t-1} + \alpha\varepsilon_t - \alpha\frac{1+r}{1-\mu}\varepsilon_{t-1} \end{aligned} \tag{11d}$$

Hayashi (1982) incorporates both human and non-human wealth in the consumption function:

$$\begin{aligned} C_t = \frac{1+r}{1-\mu}\left[1-\alpha(1-\mu)\right] C_{t-1} - \alpha\mu\frac{(1+r)^2}{1-\mu}\, A_{t-2} \\ -\alpha\mu\frac{1+r}{1-\mu} Y_{l,t-1} + \alpha\varepsilon_t \end{aligned} \tag{11e}$$

where $\varepsilon_t = \sum_{j=0}^{\infty}(1-\mu) \Big/ (1+r)^j (E_t - E_{t-1}) Y_{l,t+j}$. The presence of an infinite time horizon, i.e. $\mu = 0$, indicates that consumption in all three approaches follows a random walk, i.e. $\alpha = 1$, implying that only lagged values of consumption rather than any other variables explains current consumption (Hall (1978)).

Examining the validity or departures, if any, of the REH using equations 11c, 11d and 11e is based on whether $\mu > 0$ or $\mu = 0$; and consequently, whether all coefficients other than lagged consumption are zero[8]. The REH breaks down if $\mu > 0$. The difference in the time horizons of the government and of private economic agents has been considered as a potential source of failure of the REH (Haque (1988)). A positive value of μ generates a positive coefficient of lagged income: a positive and statistically significant coefficient of lagged income invalidates the REH. On the other hand, a zero vale of μ gives a positive coefficient of lagged consumption but a zero value for the coefficient of lagged income: current consumption only depends on past consumption rather than on any other variable. Thus, differences in the horizons of the government and of private economic agents cannot be regarded as a source of departure from the REH.

Results of the linear version of 11c, 11d and 11e encounter the following difficulties (Himarios's (1995)): Firstly, the equations are misspecified because of the violation of the perfect capital market assumption. Secondly, (non-linear) restrictions implicit in each equation are not taken into account with linear estimation. Himarios's (1994) (reviewed in Himarios's (1995)) shows that the Blanchard (19885) model gives the following three equivalent solutions, corresponding to equations 11c-11e, when the assumption of perfect capital markets is relaxed:

$$C_t = \left(\frac{1+r}{1-\mu}\right)(1-\alpha)C_{t-1} - \alpha\,\mu\left(\frac{1+r}{1-\mu}\right)A_{t-1} + \lambda Y_t - \lambda\left(\frac{1+r}{1-\mu}\right)(1-\alpha)Y_{t-1} + u_t \qquad (11c')$$

$$C_t = \left(\frac{1+r}{1-\mu}\right)\left[1+(1-\alpha)(1-\mu)\right]C_{t-1} - (1-\alpha)\frac{(1+r)^2}{1-\mu}C_{t-2} + \lambda Y_t - \left(\frac{1+r}{1-\mu}\right)\left[\alpha\mu + \lambda\left[(1-\mu)+(1-\alpha)\right]\right]Y_{t-1} + \lambda(1-\alpha)\frac{(1+r)^2}{1-\mu}Y_{t-2} + \eta_t \qquad (11d')$$

[8] A zero value of μ supports the assumption of infinite horizon that the individual's subjective probability of survival is unity while a positive value of μ, i.e. a fraction of population (μ) dies each period, indicates a finite horizon or survival rate.

$$C_t = \left(\frac{1+r}{1-\mu}\right)[1-\alpha(1-\mu)]C_{t-1} - \alpha\mu\frac{(1+r)^2}{1-\mu}A_{t-2} + \lambda Y_t - \left(\frac{1+r}{1-\mu}\right)[\lambda - \alpha(\lambda-\mu)]Y_{t-1} + u_t \qquad (11e')$$

The parameter λ represents the fraction of income that goes to liquidity constrained households. If μ = λ = 0, then equations 11c'-11e' reduce to a random walk specification. Thus when equations 11c'-11e' are estimated as unconstrained linear models that ignore liquidity constraints and finite time horizons. If the null hypothesis that there is no liquidity constraint (i.e. λ = 0) is rejected, it could be argued that the presence of liquidity constraints causes the REH to fail. Similarly, if the null hypothesis implying the presence of infinite horizon (μ = 0) is rejected, it could be argued that the presence of a finite horizon causes the violation of the REH.

Similar to equation 11d above, Haque (1988) explores whether a finite time horizon in life span, i.e. μ > 0, and resulting differences in discount factors of the private and government sectors are causes of departure from the REH. He uses following linear model in his estimation:

$$C_t = \eta_0 C_{t-1} + \eta_1 C_{t-2} + \eta_2 (Y_{t-1} - T_{t-1}) + v_t \qquad (12a)$$

A statistically insignificant η_2 implies that the individual's subjective probability of survival is unity, supporting the assumption of an infinite time horizon, and so that the differences in the horizons between the government and private economic agents cannot be regarded as a source of the departure from the REH (Haque (1988), p. 328).

Khalid (1996) also uses the following reduced form equation to explore the sources of departures the REH in 20 LDCs (p. 420):

$$C_t = \lambda_0 + \lambda_1 C_{t-1} + \lambda_2 Y_{t-1} + \lambda_3 Y_{t-2} + \lambda_4 G_{t-1} + \lambda_5 G_{t-2} + u_t \qquad (12b)$$

the coefficient of C_{t-1} (λ_1) is statistically significant and close to unity when (current) consumption follows a random walk. On the other hand, if the lagged income coefficients are statistically significant, then economic agents faced liquidity constraints since the consumption of economic agents without liquidity constraints should depend upon current income rather than past income.

3.2 The twin deficits and REH

The Keynesian proposition asserts that the government deficits resulting from excess or increased government expenditures reduce current account or trade surpluses, and vice versa. One of the policy implications of the Keynesian proposition is the desirability of raising taxes in order to reduce budget deficits, which in turn will reduce trade deficits. The REH, in contrast with the Keynesian proposition, states that a tax increase would contract budget deficits but would not alter trade or current account deficits.

Rearranging the accounting identity relating gross national income on an expenditure basis and an income basis, the link between fiscal accounts and the external balance can be expressed as (Agenor (1999)):

$$(I^P - S^P) + (G - T) = M - X - N_T \qquad (13a)$$

Where I^P is private investment, S^P is private saving, G is government spending, T is government revenue, M is imports, X is exports and N_T is net current transfers from abroad. This equation states that as long as (I^P - S^P) remains stable, changes in fiscal deficits (G-T) will be closely associated with movements in current account deficits (X–M - N_T). However, the relationship between fiscal and external deficits may be weakened if increases in government expenditures are associated with reductions in private investment (the crowding out effect). This happens when economic agents can anticipate that a current increase in public debt is associated with a future tax increase. Thus, the following specification can be used to test whether fiscal deficits cause trade deficits:

$$TD = \alpha + \alpha_1 d \qquad (13b)$$

TD is trade deficits and d s budget deficits. A statistically insignificant α_1 confirms the REH while a negative and statistically significant α_1 violates the REH.

4. Interpretation of the results of the REH and the crowding-out hypotheses for Bangladesh, 1974-2001

Integration and cointegration analyses are used in our empirical investigation (Engle and Granger (1987)). The integration analysis shows that data are first difference stationary, i.e. the levels are non stationary, while the first differences are stationary (table 1 in the appendix). Results from cointegration regression are reported in table 2 in the appendix.

The general findings of the extensive empirical exploration in this paper confirm that the REH is violated in Bangladesh where the presence of liquidity constrained households, i.e. the presence of imperfections in the financial markets and finite survival rates are the sources of deviation from the REH. Empirical results show that real per capita private consumption (C) under various specifications is cointegrated generally at the 5% level with real per capita income (Y), government expenditures before and after interest rate repayments (G & G2), taxes (T), interest rate (r) and government's interest repayments (RB) (table 2 in the appendix). The results from the corresponding error correction models for various specifications support the long-run relationships of private consumption with income, interest rate and fiscal variables (table 3 in the appendix).

The cointegrated or long-run relationship of C with G or G2 and T invalidates the REH since this proposition postulates no impact or relationship on private consumption of G and T (equations 1, 6 and 9 in table 2 in the appendix). The results reveal that the coefficient of G2 is negative and statistically significant, implying that an increase in government expenditures (exclusive of interest rate repayments) reduces private consumption. The coefficient of taxes becomes statistically significant with a negative sign when government expenditures (G or G2) are excluded from the model. This is plausible since the impact of fiscal policies could be captured by government expenditures when both G (or G2) and T are included, causing T to be insignificant in the model.

Results also reveal that the coefficient of budget deficits is negative and statistically significant, implying that an increase in budget deficits reduces private consumption (equations 4 and 7 in table 2 in the appendix). In addition, the coefficient for interest rate is negative and statistically significant (equation 9b in table 2 in the appendix). Deficit financing raises real interest rates, which in turn reduce private or any other interest sensitive form of private spending. Empirical results on the relationship between budget (d) and trade deficits reveal that budget deficits exert a positive and statistically significant impact on trade deficits, refuting the REH (equation 13b in table 2 in the appendix).

Thus, our results on the private consumption function estimation, and the relationship between trade and budget deficits do not confirm the REH. The REH is also rejected due to the violation of restrictions explained in equation 5 on equations 4 and 8: (i) $a_1 < 1$ and (ii) $a_1 = |a_2|$ and $a_2 = a_3$ (table 2 in the appendix)[9].

The violation of $a_1 < 1$ ($a_1 = 1.23$, in equation 4 without an intercept and $a_1 = 1.22$ in equation 8 with an intercept) is simply due to the fact that private consumption in a developing country such as Bangladesh is influenced by many unreported factors. There are many sources of incomes that are not included in the national account and thus per capita income is generally underestimated. This result is

[9] The restriction $a_1 < 1$ implies that marginal propensity to consume is less than one; $a_1 = |a_2|$ implies that consumption losses due to an imposition of taxes are equal to consumption gains resulting from a same amount of increase in income or vice versa; $a_2 = a_3$ asserts that deficits incurred by the government today will be completely offset by rising taxes in the next period.

also consistent with the poor accounting system in Bangladesh in which many economic activities are left unreported.

Our results violate the restriction $a_1 = |a_2|$: $a_1 = 1.23$ and $a_2 = -0.23$ in equation 4 without an intercept, $a_1 = 1.22$ and $a_2 = -0.376$ in equation 8 with an intercept. The violation of this restriction indicates the differential impact on private consumption of income and taxes and thereby invalidates the REH.

Our results also give $a_2 = -0.227$ and $a_3 = -0.137$ for equation 4 without an intercept and $a_2 = -0.376$ and $a_3 = -0.002$ equation 8 with an intercept (table 2 in the appendix). The violation of the restriction $a_2 = a_3$, i.e. the differential impact of taxes and government spending on private consumption, implies that the consumption decision of a rational agent will be affected by government fiscal policy. The finding of $|a_2| > |a_3|$ indicates that a reduction in consumption caused by a rise in taxes is higher than a reduction in consumption due to a rise in government expenditures. This differential impact implies that a rising deficit financing financed by issuing bonds instead of taxation will tend to raise consumption owing to the wealth effects.

Similarly, the estimates of coefficients of equation 9 also reject the REH because the restriction that the coefficient of Y be equal in absolute value to the coefficient of G2 is not satisfied (table 2 in the appendix). The rejection of the REH in our analysis in the case of Bangladesh should imply the acceptance of the crowding out hypothesis, which is confirmed by the negative and statistically significant coefficients of G, G2, T and r in our analysis.

The results on the rational expectations rule also tends to some extent to violate the REH[10] (table 4 in the appendix). We first consider the estimated values of

[10] As explained in the footnote of table 4 below, Eviews gives somewhat unstable and implausible results, which are mainly caused by the mis-specification of the model, since only past values of *G2* and *d* may not enough to estimate $E_{t-1}G2_{t-1}$. In

b and θ. The results on *b* are contradictory: the value of *b* is statistically insignificant in the unrestricted model while statistically significant in the restricted model. The parameter θ measures the extent of the *ex ante* crowding out of private consumption expenditures by government expenditures. $\theta = -0.38$ and is statistically significant, indicating a certain degree of complementarity between government and private expenditure. This result contradicts our earlier findings[11]. Having found the violation of the REH in the Buiter-Tobin type models and contradictory results in rational expectation models, further investigation using linear and non-linear models is carried out in order to explore the robustness of the results from Buiter-Tobin type models.

Empirical results from all three models (equations 11c, 11d & 11d) reveal that consumption follows a random walk, i.e. $\alpha = 1$ is rejected (table 5 in the appendix). On the other hand, the empirical results support the presence of infinite horizon, i.e. $\mu = 0$, which implies that consumption should follow a random walk, i.e. $\alpha = 1$. These conflicting findings, which are thought to be caused by model mis-specification and non-linear restrictions, lead us to estimate equations 11c', 11d' and 11e', which incorporate financially constrained households (λ). Empirical findings from the non-linear estimation of these models reveal that μ and λ are statistically significant (table 6 in the appendix). These results imply that the presence of finite horizons (i.e. $\mu > 0$) and the presence of financial constrained households or imperfections in financial markets (i.e. $\lambda > 0$) are the sources of the failures of the REH. Both sources of failure

addition, selecting the number of lags to be used for annual data is arbitrary and difficult and such problems become very acute with the short time series as is the case for Bangladesh.

[11] As explained above, the finite horizon ($\mu > 0$)and the presence of liquidity-constrained individuals are considered as the main sources of deviation from the REH. Estimated results from the linear and non-linear version of equations 11c, 11d & 11e are used to explore the sources of the departures of the REH (tables 5 and 6 in the appendix). The presence of infinite horizon, i.e. $\mu = 0$, suggests that consumption in all three approaches follows a random walk: only lagged values of consumption rather than any other variables explains current consumption (Hall (1978)). A linear models test the hypothesis that all coefficients other than the coefficient of lagged consumption are insignificant, i.e. consumption follows a random walk model, implying that the coefficient of lagged consumption is one (Hall (1978)). On the other hand, the non-linear models examine whether $\mu = 0$ and $\alpha = 1$.

of the REH are consistent with the existing literature on developing countries (Ghatak and Ghatak (1996), Khaled (1996), Haque (1988)).

The results of linear estimation of equations 11c' and 11d' reveal that the coefficients of lagged income or lagged disposable income in all three models are positive and statistically significant (table 6 in the appendix). The positive coefficient of past income implies that a group of individuals is faced with liquidity constraints, so that their consumption decision is also influenced by past income. Thus, these results in 11e' are consistent with the non-linear estimation results. Similar results are derived when the Khaled (1996) model, which includes income and government expenditures, is estimated. The results in the Khaled (1996) model reveal that lagged government expenditures exert a positive impact on current consumption. This result is consistent with the fact that (lagged) government expenditures increase (lagged) private income, which in turn raises (current) consumption.

5. **Conclusions**

This paper examines the Ricardian equivalence hypothesis (REH) and its sources of failure in the case of Bangladesh using various types of theoretical specifications, annual data from 1974-2001 and linear and non-linear time series techniques. The empirical findings tend to invalidate the REH and reveal that a finite time horizon and the presence of liquidity-constrained individuals are the sources of deviation from the REH. Empirical results show that real per capita private consumption (C), under various specifications, is cointegrated generally at the 5% level with real per capita income (Y), government expenditures before and after interest rate repayments (G & G2), taxes (T), budget deficits (d) and the interest rate (r).

The results reveal that the coefficients of G2, d and r are is negative and statistically significant, implying that an increase in these variables reduces private consumption: deficit financing raises the real interest rate which in turn reduces private or any other interest sensitive form of private spending. The coefficient for the variable taxes becomes statistically significant with a negative sign when government expenditures (G or G2) are excluded from the model. This result is plausible, since the impact of fiscal policies is captured by government expenditures when both G (or G2) and T are included, causing T to be insignificant in the model.

Empirical findings on the relationship between the budget (d) and trade deficits imply that budget deficits exert a positive and statistically significant impact on trade deficits, refuting the REH. Thus, our results on private consumption function estimation, and on the relationship between trade and budget deficits do not confirm the REH.

The finding of the differential impact of taxes and government expenditures violates the REH and indicates that a reduction in consumption caused by a rise in taxes is higher than a reduction in consumption due to a rise in government expenditures. This differential impact implies that a rising deficit financed by issuing bonds instead of taxation will raise consumption owing to wealth effects. The violation on this restriction indicates the differential impact on private consumption of income and taxes and hereby invalidates the REH.

Results from non-linear estimation methods imply that the presence of finite horizons and the presence of financial constrained households or imperfections in the financial markets are the sources of the failures of the REH. The results from the linear model reveal that the coefficients of lagged income or lagged disposable income positively affect current consumption, implying that some individuals are faced with liquidity constraints, therefore their current consumption decision is also influenced by past income. Thus both linear and non-linear methods provide consistent results which confirm the existing literature.

In short, our extensive empirical exploration confirms that the REH is violated in Bangladesh where the presence of liquidity constrained households, i.e. the presence of imperfections in the financial markets and finite survival rates are the sources of the deviation of the REH. Thus, fiscal policies should be used as important policy instruments in order to boost private consumption and control trade deficits, which are the prime goals of stabilisation policies being followed in Bangladesh.

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Appendix

Figure 1
Budget (TBD) and Trade Deficits (TD) in Bangladesh

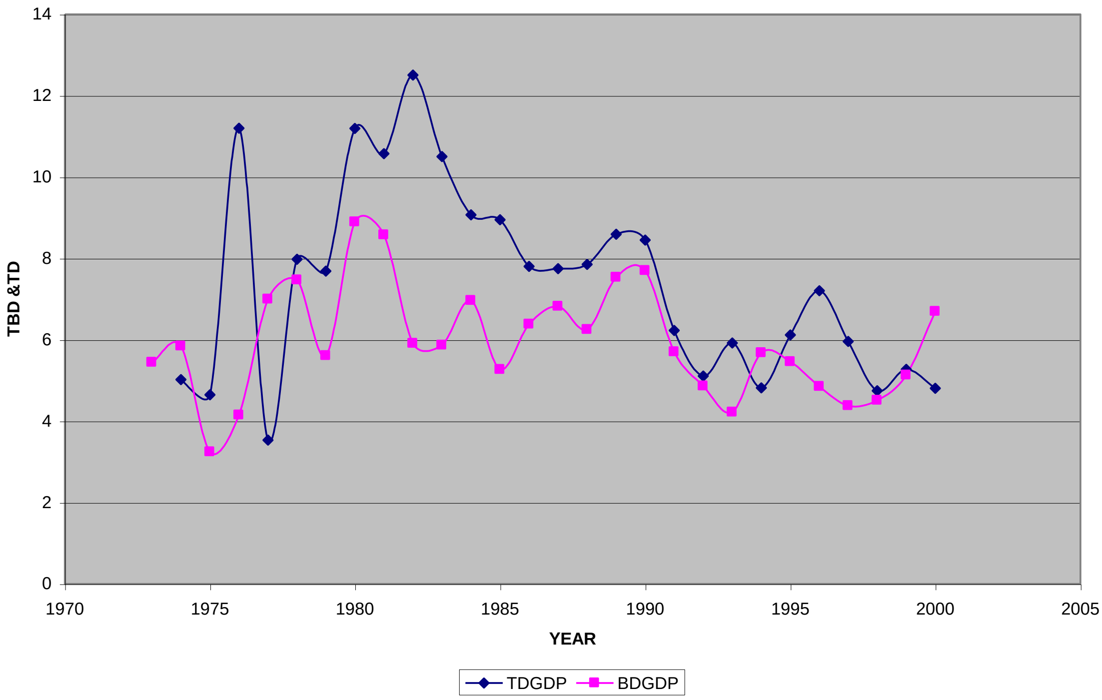

Table 1: Augmented Dicky-Fuller Test for Unit Roots (check the results again: do tests again using updated data

Variables	Levels	First Difference	Variables	Levels	First Difference
B	-2.7025	-5.97	T	-1.8274	-7.7743
TD	-1.6986	-10.4779	Y	2.7543	-5.6563
C	-0.19880	-5.4599	Y-G2	2.2529	-5.1653
G	-1.2947	-7.1405	Y-T	2.0148	-4.8938
G2	-1.1432	-6.8550	W	-1.6169	-66.2374
'r'	-2.5044	-7.6366	RB	-2.9009	-4.8115

The Schwartz Bayesian Criterion (SBC) is selecting number of lags. In all cases, the number of lags based on SBC appears to be sufficient to secure the lack of autocorrelation of error terms. Critical value with 22 observations is –2.9750.

Table 2: Results on the REH: Equations 1 and 4: sample period: 1974-2001

Equation no. and variables (1)	Estimated coefficients (2)	t-values (3)	R^2, DW, ADF and its critical value(CV) and other diagnostic tests[12] (4)
1. C = f(INPT, Y, G, T, W); Sample periods: 1974-2001 (28 observations)			
INPT	-0.118	-0.12	R^2 = 0.94; DW = 1.69; **ADF =-4.5963 (CV=-4.9527)**; AR2-$\lambda^2(2)$ = 0.883[0.643]; RESET-F(1, 22) = 0.6578[0.426]; NOR- $\chi^2(2)$ = 12.1909[0.002]; H-F(1, 26) = 3.18[0.086]
Y	1.300**	9.12	
G	-0.340**	-5.21	
T	-0.037	-0.68	
W	-0.019	-0.45	
1a. C = f(INPT, W, G, T)			
INPT	8.515	19.02	R^2 = 0.76; DW = 0.99; **ADF =-2.7157 (CV=-4.5276)**; AR2-$\lambda^2(2)$ = 7.27[0.026]; RESET-F(1, 23) = 6.2451[0.020]; NOR- $\chi^2(2)$ = 2.2609[0.323]; H-F(1, 26) = 0.13439[0.717]
W	0.276**	4.64	
G	-0.402**	-2.95	
T	0.132	1.21	
1b. C = f(INPT, W, G, T) with AR(1)			
INPT	9.00	17.57	R^2 = 0.82; DW = 1.996 (the coefficient of AR(2) is not significant)
W	0.290**	3.92	
G	-0.482**	-3.42	
T	0.127	1.45	
AR(1)	0.576**	3.73	
1. C = f(Y, G, T) without intercept and W			
Y	1.288**	43.22	R^2 = 0.95; DW = 1.78; **ADF =-4.9352 (CV[13]=-4.17)**; AR2-$\lambda^2(2)$ = 0.62589[0.731]; RESET-F(1, 24) = 0.16354[0.689]; NOR-$\chi^2(2)$ = 7.14[0.028]; H-F(1, 26) = 0.08[0.071]
G	-0.346**	-5.75	
T	-0.054	-1.44	
4. C = f(INPT, Y, T, d)			
INPT	-0.32	-0.52	R^2 = 0.94; DW = 1.78; ADF =-4.9570 (CV= -4.5276); AR2-$\lambda^2(2)$ = 0.523[0.770]; RESET-F(1, 23) = 0.24121 [0.628]; NOR- $\chi^2(2)$ = 3.522[0.172]; H-F(1, 26) = 2.6964[0.113]
Y	1.284**	12.63	
T	-0.246**	-5.51	
d	-0.137**	-4.87	
4. C = f(Y, T, d) without intercept[14]			
Y	1.233**	49.28	R^2 = 0.94; DW = 1.74; ADF =-4.7405 (CV= -4.17); AR2-$\lambda^2(2)$ = 0.76572[0.682]; RESET-F(1, 24) = 0.25744[0.617]; NOR- $\chi^2(2)$ = 5.2754[0.072]; H-F(1, 26) = 2.1681[0.151]
T	-0.227**	-9.54	
D	-0.137**	-4.92	

[12] Throughout our analysis, t-statistics are reported in the parentheses, ** and * represent 1% and 5% significance levels, respectively. AR2- $\lambda^2(2)$ is chi square tests for second order residual joint autocorrelation; RESET-F is the F test for mis-specified functional form; NOR- $\lambda^2(2)$ is the chi square statistic for testing normality; H-F is the F statistics for testing heteroscedasticity; probability values are reported in the square brackets.

[13] Estimation is carried out using *Microfit 4.0*, which provides critical values (CVs) of Dickey-Fuller and Augmented Dickey-Fuller (ADF) tests when a constant is included with a model; we use CVs from Charemza and Deadman (1997) (p. 288) if a model is estimated without a constant. There is no significant difference between the CVs obtained from both sources. The CVs of ADF tests reported in this paper are based on 30 observations.

[14] Wald Statistic $\lambda^2(1)$ = 2480.6 [.000] for $a_1=|a_2|$; Wald Statistic $\lambda^2(1)$ = 5.9936[.014] for $a_2=a_3$; where for a_1, a_2 and a_3 are the coefficients of Y, T and d, respectively.

Table 2: continued (equations 6, 7, 8 and 9a)

Eq. No. and variables (1)	Estimated coefficients (2)	t-values (3)	R^2, DW, ADF and its critical value(CV) and other diagnostic tests (4)
6. C = f(INPT, Y, T, G2)			
INPT	-0.250	-0.44	R^2 = 0.95; DW = 1.74; **ADF =-4.8158(CV= -4.5276)**; AR2-$\lambda^2(2)$ = 1.3736[0.503]; RESET-F(1, 23) = 0.002[0.962]; NOR- $\chi^2(2)$ = 5.1942[0.074]; H-F(1, 26) = 3.6864[.066]
Y	1.315**	14.06	
T	-0.037	-0.69	
G2	-0.356**	-5.79	
6. C = f(Y, T, G2) with out intercept			
Y	1.275**	46.46	R^2 = 0.95; DW = 1.72; ADF =-4.6720(CV= -4.17); AR2-$\lambda^2(2)$ = 1.6297[0.443]; RESET-F(1, 24) = 0.19454[0.663]; NOR- $\chi^2(2)$ = 7.1521[0.028]; H-F(1, 26) = 3.06[0.092]
T	-0.023	-0.54	
G2	-0.356**	-5.87	
7. C = f(INPT, (Y-G2), d)			
INPT	1.936**	3.72	R^2 = 0.87; DW = 1.26; **ADF =-3.6494(CV= -4.0706)**; AR2-$\lambda^2(2)$ =6.2157 [0.045]; RESET-F(1, 24) = 0.0845[0.774]; NOR- $\chi^2(2)$ = 5.40[0.067]; H-F(1, 26) = 1.1065[0.303]
(Y-G2)	0.851**	12.64	
d	-0.124**	-3.12	
7. C = f(INPT, (Y-G2), d) with AR(1)			
INPT	1.91**	2.66	R^2 = 0.89; DW = 1.75
(Y-G2)	0.86**	9.56	
d	-0.13**	-3.10	
AR(1)	0.35	1.96	
8. C = f(INPT, Y, G2, RB)[15]			
INPT	0.465	1.0422	R^2 = 0.95; DW = 1.67; ADF =-4.4421(CV= -4.5276); AR2-$\lambda^2(2)$ =1.31 [0.519]; RESET-F(1, 23) = 0.000[0.999]; NOR- $\chi^2(2)$ = 7.24[0.027]; H-F(1, 26) = 3.04[0.093]
Y	1.221**	15.60	
G2	-0.376**	-7.95	
RB	0.002	0.35	
8. C = f(Y, G2, RB) without intercept			
Y	1.297**	43.38	R^2 = 0.94; DW = 1.57; ADF =-4.2484(CV= -4.17); AR2-$\lambda^2(2)$ =1.4411[.486]; RESET-F(1, 24) = 1.09[0.308]; NOR- $\chi^2(2)$ = 0.98[0.613]; H-F(1, 26) = 3.97[0.035]
G2	-0.404**	-10.32	
RB	0.004	0.82	
9a. C = f(INPT, Y, G2)			
INPT	-0.007	-0.02	R^2 = 0.95; DW = 1.63; ADF =-4.4125(CV= -4.0706); AR2-$\lambda^2(2)$ =1.6780 [0.432]; RESET-F(1, 24) = 0.004[0.951]; NOR- $\chi^2(2)$ = 3.98[0.136]; H-F(1, 26) = 3.41[0.076]
Y	1.28**	15.94	
G2	-0.38**	-8.29	
9a. C = f(Y, G2) without intercept[16]			
Y	1.28**	52.02	R^2 = 0.95; DW = 1.63; ADF =-4.4142(CV= --3.82); AR2-$\lambda^2(2)$ =1.6832 [0.431]; RESET-F(1, 25) = 0.003[0.98]; NOR- $\chi^2(2)$ = 4.07[0.131]; H-F(1, 26) = 3.39[0.077]
G2	-0.38**	-12.27	

[15] Wald Statistic $\lambda^2(1)$ = 2.1201[.145] for $a_1=|a_2|$; Wald Statistic $\lambda^2(1)$ = 175.3211[.000] for $a_2=a_3$; where for a_1, a_2 and a_3 are the coefficients of Y, G2 and RB, respectively.

[16] Wald Statistic $\lambda^2(1)$ = 18077.4[.000] for $a_1=|a_2|$.

Table 2: continued (equations 9b and 13b)

Eq. No. and variables (1)	Estimated coefficients (2)	t-values (3)	R^2, DW, ADF and its critical value(CV) and other diagnostic tests (4)
9b. C = f(INPT, Y, G2, r)			
INPT	0.457	1.09	R^2 = 0.96; DW = 1.62; ADF =-4.7638 (CV= -4.5276); AR1-$\lambda^2(2)$ =2.02 [0.363]; RESET-F(1, 23) = 0.03[0.866]; NOR- $\chi^2(2)$ = 4.5466[0.103]; H-F(1, 26) = 4.27[0.049]
Y	1.1334**	12.86	
G2	-0.26**	-4.42	
'r'	-0.002**	-2.86	
9b. C = f(Y, G2, r) without intercept[17]			
Y	1.223**	38.87	R^2 = 0.96; DW = 1.51; ADF =-4.5417 (CV= -4.17); AR1-$\lambda^2(2)$ =1.94 [0.379]; RESET-F(1, 24) = 1.189[0.286]; NOR- $\chi^2(2)$ = 1.5589[0.459]; H-F(1, 26) = 4.5879[0.042];
G2	-0.310**	-7.76	
'r'	-0.002*	-2.63	
13b. TD = f(INPT, d)			
INPT	3.86**	2.93	R^2 = 0.11; DW = 1.82; ADF =-5.0352(CV= -3.5804); AR1-$\lambda^2(2)$ =0.73 [0.694]; RESET-F(1, 24) = 0.22[0.64]; NOR- $\chi^2(2)$ = 7.33[0.06]; H-F(1, 25) = 1.39[0.25]
d	0.38	1.74	

17 Wald Statistic CHSQ(1)= 11680.1[.000] for a1=|a2|; Wald Statistic CHSQ(1)= 57.9031[.000] for a2=a3

Table 3: Error correction models

Eq. No. and variables (1)	Estimated coefficients (2)	t-values (3)	R^2, DW, ADF and its critical value(CV) and other diagnostic tests (4)
ECM 1. Error correction (EC) model of equation 1: C = f(INPT, Y, G, T, W); statistically insignificant intercept and ΔT are excluded.			
ΔY	1.651**	5.88	R^2 = 0.85; DW = 1.52; AR1-F(1, 22)= 7.49[0.012]; RESET-F(1, 22) = 1.1982[0.286]; NOR- $\chi^2(2)$ = 1.0270[0.598]; H-F(1, 25) = 0.001[0.974]
ΔG	-0.343**	-6.08	
ΔW	-0.175*	-2.37	
U_{t-1}	-0.650**	-3.25	
ECM 4. EC model of equation 4: C = f(INPT, Y, T, d); statistically insignificant intercept is excluded.			
ΔY	1.150**	4.93	R^2 = 0.79; DW = 1.73; AR1-F(1, 22)= 1.78[0.196]; RESET-F(1, 22) = 0.114[0.739]; NOR- $\chi^2(2)$ = 1.33[0.513]; H-F(1, 25) = 0.181[0.674]
ΔT	-0.223**	-5.49	
Δd	-0.170**	-6.55	
U_{t-1}	-0.907**	-4.81	
ECM 6. EC model of equation 6: C = f(INPT, Y, T, G2); statistically insignificant intercept and ΔT are excluded.			
ΔY	1.24**	5.95	R^2 = 0.83; DW = 1.84; AR1-F(1, 22)= 0.38[0.542]; RESET-F(1, 23) = 0.15[0.702]; NOR- $\chi^2(2)$ = 2.74[0.254]; H-F(1, 25) = 0.17[0.683]
ΔG2	-0.434**	-9.03	
U_{t-1}	-0.881**	-4.8	
ECM 7. EC model of equation 7: C = f(INPT, (Y-G2), d); statistically insignificant intercept and Δb are excluded.			
ΔY	0.653*	2.18	R^2 = 0.57; DW = 1.78; AR1-F(1,)= 0.02[0.889]; RESET-F(1, 23) = 3.37[0.079]; NOR- $\chi^2(2)$ = 0.355[0.837]; H-F(1, 25) = 2.24[0.084]
Δ(Y-G2)	-0.165**	-4.89	
U_{t-1}	-0.760**	-3.985	
ECM 8. EC model of equation 8: C = f(INPT, Y, G2, RB); statistically insignificant intercept and RB are excluded.			
ΔY	1.225**	5.61	R^2 = 0.81; DW = 1.85; AR1-F(1, 23)= 0.167[0.686]; RESET-F(1, 23) = 0.202[0.657]; NOR-$\chi^2(2)$ = 4.1857 [0.123]; H-F(1, 25) = 0.17[0.689]
ΔG2	-0.448	-8.96	
U_{t-1}	-0.829**	-4.35	
ECM9b. EC model of equation 9b: C = f(INPT, Y, G2, r)			
INPT	0.01	1.01	R^2 = 0.89; DW = 1.78; AR1-F(1, 21)= 1.48[0.237]; RESET-F(1, 21) = 0.265[0.612]; NOR- $\chi^2(2)$ = 0.248[0.883]; H-F(1, 25) = 0.418[0.524]
ΔY	1.04**	4.83	
ΔG2	-0.366**	-6.81	
Δr	-0.001	-1.40	
U_{t-1}	-1.05**	-5.52	
ECM 13b. EC model of 13b: TD = f(INPT, b)			
INPT	0.02	0.39	R^2 = .48; DW = 2.28; AR1-F(1, 22) = 14.87 [.001]; RESET-F(1, 22) =.006[.939]; NOR- $\chi^2(2)$ = 6.886[.032]; H-F(1, 24) = 0.21410[.648]
Δd	0.157	0.73	
U_{t-1}	-0.93**	-4.6388	

U_{t-1} is the EC term, i.e. the lag value of residual of the corresponding equation.

Table 4: Estimates of Aschauer model[18]:

Constrained	Unconstrained	Hypothesised
α = -0.29 (-0.67)	δ = -0.29 (-0.00)	δ = -0.4385
b* = 1.03* (27.30)	*b* = 1.03 (0.04)	*b* = 1.03
θ = 0.47* (4.06)	η_1 = 0.47 (0.03)	η_1 = -0.0235
	μ_1 = 0.42 (0.03)	μ_1 = 0.1645
γ = 1.55** (3.24)	γ = 1.55 (1.38)	γ (C1) = 1.55
ε_1 = 1.08* (6.27)	ε_1 = 1.08 (1.90)	ε_1(C2) = 1.08
ω_1 = -0.35 (-1.66)	ω_1 = -0.35 (-1.35)	ω_1 (C4) = -0.35
Log likelihood (L_r) = 78.95819	Log likelihood(L_u) = -61.42386	
The Wald statistics = $-2\log(L_r/L_u)$ = - not significant		

[18] We use Eviews to estimate this non-linear model. The full information maximum likelihood and three-stage least squares methods are used to estimate both restricted and unrestricted models. Results obtained from the full information maximum likelihood methods are reported here. Both methods give somewhat unstable results. The full information maximum likelihood method in some cases gives unexpected positive values of log likelihood. Thus, further investigation will be made using other software packages in order derive stable results.

Table 5: Sources of the deviation of REH

Eq. No. and variables (1)	Estimated coefficients (2)	t-values (3)	R^2, DW and null hypotheses (4)
Evans (1988) Model) (eq. 11c): non-linear estimation (with r=4)			
α	0.81**	190.49	R^2 = 0.82; DW = 2.03; Wald Statistic $\lambda^2(1)$ = 2085.931 [0.000] for α =1.
μ	0.01	-1.69	
Haque (1988) Model (eq. 11d): non-linear estimation (with r=4)			
α	0.70**	5.67	R^2 = -4.75; DW = 2.01; Wald Statistic $\lambda^2(1)$ = 5.657[0.017] for α =1.
μ	-0.47	-0.77	
Hayashi (1982) Model) (eq. 11e): non-linear estimation (with r=4)			
α	0.80**	344.35	R^2 = 0.77; DW = 1.91; Wald Statistic $\lambda^2(1)$ = 7527.538[0.000] for α =1.
μ	0.000	0.42	
Himarios (1994) Model (eq. 11c') non-linear estimation			
α	0.98**	159.54	R^2 = 0.86; DW = 1.18; Wald Statistic $\lambda^2(1)$ = 14.88[0.000] for α =1. Wald Statistic $\lambda^2(1)$ = 10156.45[0.000] for μ =λ=0.
μ	-0.01	-1.40	
λ	0.89	25.52	
Himarios (1994) Model (eq. 11d') non-linear estimation			
α	1.18**	346.11	R^2 = 0.29; DW = 1.51; Wald Statistic $\lambda^2(1)$ = 2704.80 [0.000] for α =1. Wald Statistic $\lambda^2(1)$ = 432.7557 [0.000] for μ =λ=0.
μ	-2.67**	-6.82	
λ	3.31**	6.94	
Himarios (1994) Model) (eq. 11e') non-linear estimation			
α	0.79**	122.41	R^2 = 80; DW = 1.84; Wald Statistic $\lambda^2(1)$ = 1096.407 [0.000] for α =1. Wald Statistic $\lambda^2(1)$ = 3.70[0.157] for μ =λ=0.
μ	0.002	1.70	
λ	-0.07	-1.91	

Table 6: Sources of the deviation of REH

Eq. No. and variables (1)	Estimated coefficients (2)	t-values (3)	R^2, DW, ADF and its critical value(CV) and other diagnostic tests (4)
Evans (1988) Model) (eq. 11c) with AR(2)			
C_{t-1}	0.976**	118.34	R^2 = 0.91; DW = 2.02; $\chi^2(1)$ = 9.7601[.002] (to test the coefficient of A_{t-1} equal to zero. $\chi^2(1)$ = 8.63(00.003) (to test the coefficient of C_{t-1} equal to one).
A_{t-1}	0.030**	3.12	
AR(1)	-0.047	-0.53	
AR(2)	-0.891**	-10.23	
Haque (1988), Equation 11d			
C_{t-1}	0.50*	2.67	R^2 = 0.86; DW = 1.79; AR1-F(1, 23)= 13.95[0.001]; RESET-F(1, 23) = 3.58[0.071]; NOR- $\chi^2(2)$ = 31.2455[0.000]; H-F(1, 25) = 3.02[0.095]
C_{t-2}	-0.02	-0.14	
Y_{t-1}	0.51**	4.01	
Haque (1988) model when lagged disposable income is included			
C_{t-1}	0.374*	2.04	R^2 = 0.88; DW = 1.69; AR1-F(1, 23)= 4.08[0.055]; RESET-F(1, 23) = 2.85[0.105]; NOR- $\chi^2(2)$ = 45.48[0.000]; H-F(1, 25) = 2.36[0.137]
C_{t-2}	-0.053	-0.36	
$(Y_{t-1} - T_{t-1})$	0.672**	4.81	
Hayashi (1982) model eq. 11e			
C_{t-1}	0.216*	2.07	Linear estimation Sample 1975-1997; R^2 = 0.93; DW = 2.04 ; $\chi^2(2)$ = 58.93(0.000) (to test the coefficient of W_{t-2} and Y_{t-1} equal to zero.
A_{t-2}	-0.049**	5.03	
Y_{t-1}	0.810**	7.63	
Khalid (1996), equation 12c			
INPT	1.56	2.00	R^2 = 0.89; DW = 1.71; AR1-F(1, 20)= 1.53[0.230]; RESET-F(1, 20) = 0.02[0.898]; NOR- $\chi^2(2)$ = 25.9077[0.000]; H-F(1, 25) = 2.1432[0.156]; Wald Statistic $\lambda^2(1)$ = 8.5888[.003] for the csoefficient of C_{t-1}.
C_{t-1}	0.01	0.03	
Y_{t-1}	1.52*	2.41	
Y_{t-2}	-0.63	-1.06	
G_{t-1}	-0.26	-1.55	
G_{t-2}	0.13	1.39	