THE LONG RUN RELATIONSHIP BETWEEN SAVING AND INVESTMENT IN INDIA

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Abstract

In the long run, the present value of current account balance would not get indefinitely large without precipitating in a macroeconomic crisis. This simple insight produces an econometrically testable relationship between saving and investment. We develop and test a variant of such a testable hypothesis for India using the recent cointegration methodology. The results indicate that there exists a positive long run relationship between saving and investment in India. This convergence implies that India is unlikely to suffer macroeconomic instability like countries such as Mexico in the long run.

JEL Codes: C32, E20, O11

Introduction

In the past sixteen years, economists have been studying the relationship between saving and investment with renewed vigor. The biggest impetus comes from Feldstein and Horioka (1980). The main focus of the literature following Feldstein and Horioka is international capital mobility in the industrialized countries. With more sophisticated econometric methodology and more data availability for other countries, we are beginning to understand the relationship between saving and investment better. We are also recognizing the implications of the presence or absence of close relationships between saving and investment.

In this paper, we develop a model which produces a clearly econometrically testable hypothesis: saving and investment should be cointegrated. We test this theory for India. During the last few years, the saving rate in India has fallen marginally raising concern that it might adversely affect economic growth. We take a long run view. We explore whether there is a long run relationship between saving and investment which is crucial for macroeconomic stability.

A Dynamic Stochastic Model of Saving and Investment

Suppose that there are n countries in the world each of them small enough not to affect the world interest rate (R) individually. We will use subscript t to denote time and subscript i to denote a country. We formulate a variant of the linearized version of the model proposed by Feldstein (1983) which is used by Coakley *et al* (1995):

$$S_{it} = a_k + S_{it-1} + b_k R_t + e_{kit} \qquad (1)$$

Equation (1) summarizes the stylized facts that saving (S) is a process with unit root and that saving at time t for country i (S_{it}) depends positively on (real) world interest rate (R) at time t.

$$I_{it} = a_l + I_{it-1} - b_l R_t + e_{lit} \qquad (2)$$

Equation (2) encapsulates the stylized facts that investment (I) is also a unit root process but has a negative relation with interest rate.

More generally,

$$I_{it} = a_l + I_{it-1} - b_l R_t + d(S_{it-1} - I_{it-1}) + e_{lit} \qquad (2^{/})$$

The additional term $d(S_{it-1} - I_{it-1})$ is an error correction term to reflect a risk premium. The terms e_{kit} and e_{lit} are iid white noise processes and a_k, b_k, a_l, b_l and d are constants. Two equations (1) and ($2^{/}$) (or, (1) and (2) as ($2^{/}$) becomes identical to (2) if d = 0) can be used to solve for R_t:

Subtracting ($2^{/}$) from (1), we get

$$S_{it} - I_{it} = a_k - a_l + S_{it-1} - I_{it-1} + (b_k - b_l)R_t - d(S_{it-1} - I_{it-1}) + e_{kit} - e_{lit} \qquad (3)$$

If it is a closed system with n countries, then total saving in each period must be equal to the total investment in that period. This means $\Sigma S_{it} = \Sigma I_{it}$ summing over i.

Summing over i in equation (3), we get,

$$0 = n(a_k - a_l) + n(b_k - b_l)R_t + \Sigma(e_{kit} - e_{lit}) \qquad (4)$$

Thus, assuming $b_k \neq b_l$, we solve for R_t from (4) by noting that differences of independence white noise processes still produce white noise (say, z_t):

$$R_t = [a_l - a_k + \Sigma(e_{kit} - e_{lit})/n]/(b_k - b_l)= R^* + z_t \qquad (5)$$

Let $C_{it} = S_{it} - I_{it}$. Then, from equation (3) we get by substituting the expression (5),

$$C_{it} = C_{it-1} - d(C_{it-1}) + (b_k + b_l)z_t + (e_{kit} - e_{lit}) \qquad (6)$$

We can take expectations in (6) on both sides conditional on time t-1 to get

$$E_{t-1}(C_{it}) = C_{it-1} - d(C_{it-1}) \qquad (7)$$

For a country i, the present value of the conditional expectations of C_{it} must be bounded above:

$$E_{t-1}(\Sigma\, C_{it} /(1 + R^*)^t) < \infty \qquad (8)$$

Given (7), (8) follows provided $(1\text{-}d)/(1+R^*) < 1$. In fact, we can show by simple algebra that

$$E_{t-1}(\Sigma\, C_{it} /(1 + R^*)^t) = C_{it-1}(1\text{-}d)(1+R^*)/(R^*+d) \qquad (9)$$

provided $(1\text{-}d)/(1+R^*) < 1$.

This solvency condition for the country shows that in the long run, the only credible path of saving and investment should be such that they are cointegrated. Otherwise (9) does not hold. Moreover, the cointegrating vector should be (1, -1) because $C_{it} = S_{it} - I_{it}$ by definition. Any other relation would not be viable in the long run. Thus, the model actually produces a testable hypothesis. However, since our model rests on a number of restrictive assumptions (such as a closed system assumption and a small country assumption), the empirical results may not exactly produce a cointegrating vector (1, -1).

The other implication of the model is the relation between import and export. If, the central bank activities are ignored (and in the long run, the central bank cannot continue to buy or sell securities without a credibility constraint), the capital account is the flip side of net export. Hence, in the long run, export and import should be cointegrated with a cointegrating vector of (1, -1) as well.

What Can We Say About Cross Section Correlation Between Saving and Investment?

Feldstein and Horioka (1980) upset conventional wisdom by proclaiming that a high saving investment correlation in pooled cross section data of a number of (industrialized) countries imply capital immobility among them. This assertion holds under very restrictive theoretical conditions (see Frankel (1992)). Moreover, simulations with artificial economies have shown that high saving and investment correlation can persist even with perfect capital mobility (Baxter and Crucini (1993) and Finn (1991)). We deliberately refrain from drawing any conclusion based on pooled cross section analysis of our dataset for the following reason: All the basic series exhibit unit roots. Gonzalo (1994) has shown that in the presence of unit roots in the time series data, none of the usual test statistics for the ordinary least square regressions have standard distributions. Hence, any inference drawn from them are very likely to be erroneous even with very large samples. Therefore, applying their argument in these data series seem entirely inappropriate.

Data and Methodology

The data are from the Penn World Table and it is for the period 1950-92. Penn World Table data which were developed by the International Comparison Project in cooperation with the World Bank are reportedly more reliable than data from other sources. The data are being constantly updated. We use the most recent version of the Penn World Table (version 5.6). The data series are described in detail in Summers and Heston (1991). The two variables considered are gross domestic saving and gross domestic investment as percentages of gross domestic product. We call these variables SR and IR respectively.

We use the Phillips-Perron (1988) unit root test. The test is well suited for analyzing time series whose differences may follow mixed ARMA (p,q) processes of unknown order in that the test statistic incorporates a nonparametric allowance for serial correlation. Consider the following equation:

$$y_t = \tilde{c}_0 + \tilde{c}_1 y_{t-1} + \tilde{c}_2 (t - T/2) + \nu_t \tag{10}$$

where $\{y_t\}$ is the relevant time series in equation (10), T is the number of observations and ν_t is the error term. The null hypothesis of a unit root is H_0: $\tilde{c}_1 = 1$. We can drop the trend term to test the stationarity of a variable without the trend.

The concept of cointegration is proposed by Granger (1981). Engle and Granger (1987) provide an axiomatic foundation of the methodology. Two (or more) I(1) variables are said to be cointegrated if there exists a linear combination of them that is stationary. We use the Johansen-Juselius (see Johansen (1988) and Johansen and Juselius (1990) for details) tests for cointegration. The method can be shown to have the error correction representation of the VAR(p) model with Gaussian errors:

$$\Delta Z_t = a_0 + \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \ldots\ldots\ldots\ldots \Gamma_{p-1} \Delta Z_{t-p+1} + \Pi Z_{t-p} + BX_t + u_t \tag{11}$$

where Z_t is a an mx1 vector of I(1) variables, X_t is an sx1 vector of I(0) variables, Γ_1, Γ_2, Γ_{p-1}, Π are mxm matrices of unknown parameters, B is an mxs matrix and

$u_t \sim N(0, \Sigma)$. The maximum likelihood method is used to estimate (11) subject to the hypothesis that Π has a reduced rank, $r < m$. The hypothesis, therefore, is as follows:

$$H(r): \ \Pi = \alpha\beta' \qquad (12)$$

where α and β are m x r matrices. If certain conditions are fulfilled, equation (12) implies that the process ΔZ_t is stationary, Z_t is non-stationary, and that βZ_t is stationary. βZ_t are known as the cointegrating relations and β the cointegrating vector. In our model C_t plays the role of Z_t in (11). If we find that SR and IR are cointegrated, the relevant hypothesis for the vector β to be tested is

H_0: $\beta' = (1, -1)$.

Results

The results of the Phillips-Perron unit root tests on the levels and first differences of the variables are in table 1. The results indicate that both SR and IR are non-stationary in their level form but stationary in their first difference form. Thus, we proceed with the cointegration tests. The results of the maximal eigenvalue and trace tests are in tables 2 and 3 respectively. The results

[Tables 1-3 about here]

of both the maximal eigenvalue and trace tests indicate that there is one cointegrating vector. Thus, our results are quite robust. The normalized coefficients (we normalize the vector with respect to SR) for β are -1.000 and 1.1578 (for SR and IR respectively). Thus, we see that the coefficients of the vector are fairly close to (-1, 1). Next, we test the null hypothesis that β' is

(1, -1). The test statistic (the likelihood ratio) has a χ^2 distribution with one degree of freedom. The test statistic is 6.0216 and the p-value is .014 which indicates that we cannot reject the null hypothesis that β' is (1, -1) at the 5% level of significance. Thus, for India the strict condition of cointegrated saving and investment with the cointegrating vector (1, -1) cannot be rejected. Thus, the empirical results provide full support for our model.

Conclusions

In this paper, we develop and empirically test a variant of the Feldstein-Horioka hypothesis of saving-investment using data for India. First, we test for unit roots. We find that both saving and investment rates are non-stationary in their levels but stationary in their first differences. This gives us a high degree of confidence on the equations (1) and (2) that incorporate the stylized facts. Next, we proceed with the cointegration tests using the Johansen-Juselius framework. The results show that saving and investment ratios have a long run relationship for India. Our tests also show that we cannot reject the null hypothesis of a one-to-one correspondence between saving rate and investment rate. This convergence implies that if past data are any guide, India is unlikely to suffer from macroeconomic instability in the long run.

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Table 1. Phillips-Perron Unit Root Tests for Levels of Savings Ratios and Investment Ratios

	Level		First Difference	
	Test Statistic	Critical Value	Test Statistic	Critical Value
SR	-2.5168	-3.5189	-17.2314	-3.5217
IR	-2.6009	-3.5189	-8.9847	-3.5217

Note: The critical values at the 5% level are from Mackinnon (1991). The lag of 3 was determined using the Schwert (1989) Criterion.

Table 2. Maximal Eigenvalue Tests for Cointegration Between Saving and Investment

Null Hypothesis	Alternative Hypothesis	Test Statistic	Critical Value
r=0	r=1	15.8821	14.9000
r<=1	r=2	5.1311	8.1760

Note: The critical values from Osterwald-Lenum (1992) are for the 95% quantile.

Table 3. Trace Tests for Cointegration Between Saving and Investment

Null Hypothesis	Alternative Hypothesis	Test Statistic	Critical Value
r=0	r=1	21.0132	17.9530
r<=1	r=2	5.1311	8.1760

Note: The critical values from Osterwald-Lenum (1992) are for the 95% quantile.