Capital mobility in developing countries: An empirical study.

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Abstract:

This paper examines the degree of capital mobility in ten developing countries of Asia using the intertemporal approach to the current account. To assess Feldstein and Horioka's claim of limited international capital mobility for a set of developing countries, we model the consumption-smoothing motive of consumers and simulate the path of optimal consumption-smoothing current account for comparison with the consumption-smoothing component of the actual current account. Major findings of this paper are the theoretical model works well for developing countries with relatively smaller sample size, and capital flows have been excessive in six out of ten countries studied.

Key words: Capital mobility, intertemporal approach, current account movements, consumption-smoothing.

JEL classification code: *D91, E21, F32.*

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While capital mobility stands as a crucial simplifying assumption of many standard open economy models, in most empirical works, tests of capital mobility using the idea of savings-investment correlation have failed to validate the assumption. Most tests based on savings-investment correlations reject the null hypothesis of high capital mobility if the correlation is “too high”. In a well-known paper, Feldstein and Horioka (1980) claimed that even among industrial countries, capital mobility is sufficiently limited since changes in national saving rates ultimately change domestic investment rates by the same amount. As argued by Obstfeld and Rogoff (1995), if one accepts the Feldstein and Horioka’s claim based on savings-investment correlation, their results pose a stern macroeconomic puzzle, since in reality, capital was quite mobile within the developed world during the period under consideration of Feldstein and Horioka’s study.

The mostly cited problem of tests of capital mobility using savings-investment correlation is that perfect capital mobility does not necessarily imply a zero correlation between savings and investment. As argued by Obstfeld (1986), Cardia (1991) and Ghosh (1995), a number of common factors and variety of shocks simultaneously can stimulate a positive correlation between savings and investment. A persistent but temporary productivity shock, for instance, would raise savings because wages are temporarily high, but would also elevate investment since capital is more productive. Economies with productivity shocks, therefore, would exhibit a positive correlation between savings and investment, regardless of how mobile its capital is to partner countries. Thus a positive (zero) correlation between savings and investment does not, itself, provide evidence against (for) capital mobility. Apart from such conceptual problems, there are some technical problems associated with such tests. Typically, time-series data on savings and investment suffer from non-stationarity, and in case their degree of non-stationarity is different and they are thus not co-integrated, any inference drawn on the basis of simple Ordinary Least Squares estimation will be spurious and deceptive. Besides, in case they are not co-integrated, their asymptotic correlation is zero indicating perfect capital mobility, even if in reality that does not hold (see Engel and Granger (1987))[2].

The purpose of this paper is to examine the degree of capital mobility in neighbor developing countries of South Asia and Asia Pacific using an intertemporal current account model, often argued as the most credible alternative of the savings-investment correlation test. The underlying current account model, primarily constructed for small open economies, has been rigorously studied for relatively large industrialized countries as may be found in relevant literature. Hence, this study is motivated to validate the model's applicability for relatively small developing countries of Asia. In conducting the test for capital mobility, we follow the methodology adopted by, among others, Ghosh (1995) and Obstfeld & Rogoff (1996), and generate a time series for the optimal current account which should have been observed given the actual shocks to the economy to compare its variance with the variance of the consumption-smoothing component of the actual current account series. We use data for ten developing countries that are of similar sizes, norms and from (almost) same region, and due to information constraints and perhaps our implied curiosity, we conduct our study with annual rather than quarterly data of these countries. We use established results for cross comparison with our results, and attempt to find out the extent to which the estimated parameters differ for developed and developing countries under the same model.

The intertemporal current account model, which we use to assemble the "benchmark" current account series, combines the assumptions of perfect capital mobility and of "consumption-smoothing" behavior to predict that the current account acts as a *shock absorber* to smooth consumption in the face of shocks to output, investments and government expenditure (see Sachs (1981); (1982)). Output above its long run discounted average (permanent level), for instance, contributes to a higher current account surplus because of consumption-smoothing. This is because rather than raising consumption point to point, individuals prefer to accumulate interest-yielding foreign assets as a way of smoothing consumption over future periods. We use the model to derive a reduced-

[2] Other major criticisms of savings-investment tests can be found in Summers (1988) and Fieleke (1982).

form present value model of current account that can be estimated by an unrestricted Vector Auto Regression (VAR). Focusing on the consumption-smoothing component of the current account allows us to avoid potential econometric problems, because the consumption-tilting parameter incorporated current account series will (typically) be stationary. In this way, one can test whether capital has been inadequately mobile by comparing the variances of the optimal consumption-smoothing current account and the consumption-smoothing component of the actual current account.

The theoretical approach we adopt is primarily suggested by Campbell's (1987) work on savings, and its extension to the current account is due to Sheffrin and Woo (1990), Otto (1992), Obstfeld & Rogoff (1995), Ghosh (1995) and Hoffmann (2001)[3]. Our point of departure, therefore, is the stream of literature that adopts a plausibly parallel methodology and addresses similar issues for industrialized countries. Examining the extent of capital mobility in a set of developing countries may reinforce the robustness of the approach, and hence the criterion to measure capital mobility using the intertemporal current account model can be made more versatile if our collection of developing country annual data fits the model. The paper is organized as follows. Section II discusses the basic model and derives the econometric model from the theoretical representation. Section III illustrates the data source and data processing technique. Section IV presents the different steps of estimation and analyzes the derived results. Section V discusses the tests of interesting hypotheses. Section VI compares the results with those established in literature, and section VII concludes the paper. Annex reports the tables used in different sections and some diagrams of interest.

II. The intertemporal current account model:

To construct a "benchmark" series of the current account, following Sachs (1982) and Obstfeld & Rogoff (1995), we prefer to adopt an intertemporal model of current account

[3] In a more comprehensive paper on present value models, Campbell & Shiller (1987) apply the same methodology to stock prices.

determination (with international borrowing and lending) that emphasizes the intertemporal trade implied by the divergence of savings and investment rather than the conventionally-emphasized intratemporal trade balance. Since the intertemporal approach recognizes the fact that private saving and investment decisions result from forward looking calculations based on expectations of future productivity growth, government spending demands, real interest rates etc., it views the current-account balance as the outcome of forward-looking dynamic saving and investment decisions. The standard stochastic small open economy model that we use is the infinite horizon framework of international borrowing and lending. With a risk-less bond being the only internationally traded asset in the model, we assume world interest rate is constant[4]. In our analysis, the assumption of a small open economy (and a constant world interest rate) is more realistic, since all chosen samples are relatively small developing economies[5]. We model our economy in a way such that future levels of output, investment and government expenditure are all random variables, and individual agents can only choose contingency plans for future consumption. The economy is assumed to be populated by a single, infinitely-lived representative agent household which, faced with this uncertainty, maximizes the expected value of lifetime utility described by:

$$\sum_{t=0}^{\infty} \beta^t \mathbf{E}_t [\mathrm{u}(c_t)] \qquad (1)$$

Where β is the subjective discount rate, and $\beta \in (0,1)$, u(.) is the instantaneous utility function with u′(.) > 0, u″(.) < 0, and c_t is the consumption of a single good. The operator $\mathbf{E}_t$ [.] is a probability weighted average of possible outcomes (or simply, a mathematical conditional expectation) in which probabilities are conditioned on all information available to the decision maker up to and including time *t*. The social planner's problem, therefore, is to maximize (1) subject to the economy's dynamic budget constraint:

4 When conducting the estimation, this assumption was visually verified from data. Each series of international interest rate considered had a roughly horizontal trend, implying that the assumption of constant world interest rate is justifiable. Besides, the assumption that our small open economy takes the world interest rate as given is also reasonable.

5 Development economists have the ground to argue why we generalize the set of ten countries to be small developing economies when the set involves emerging market economies like Singapore, Philippines, and perhaps Malaysia. There is, however, no doubt that these economies are small relative to the world economy and their choice of policies cannot influence, among others, the world interest rate. Except these three, the rest of the countries considered are developing countries, measured in terms of standard world development indicators.

$$b_{t+1} = (1+r)b_t + q_t - c_t - i_t - g_t \qquad (2)$$

Where b is the level of foreign assets held by the economy, r is the fixed world interest rate, q is the level of domestic output (GDP), i is the level of investment, and g is the level of government expenditure. Following Obstfeld & Rogoff (1995), we define the identity that links the current account to the saving-investment balance as:

$$CA_t = b_{t+1} - b_t = rb_t + q_t - c_t - i_t - g_t \qquad (3.1)$$

Expression *(3.1)* simply states that our economy's current account balance at any time t is the change in the value of its net claims on the rest of the world, i.e. the change in its net foreign assets. In order to incorporate the consumption-smoothing motive in the current account series, it is useful to define national cash flow as output minus government expenditure minus investment. Then the consumption-smoothing motive, induced by the concavity of the utility function implies that fluctuations in national cash flow only affect consumption by the expected present value of such fluctuations. Using *(2)* to eliminate consumption levels in *(1)*, we can turn the household's problem into the unconstrained maximization of

$$\sum_{t=0}^{\infty} \beta^t \mathbf{E}_t \left[\mathrm{u}\{(1+r)b_t - b_{t+1} + q_t - i_t - g_t\} \right] \qquad (3.2)$$

with respect to the sequence of contingency plans for net foreign asset holdings. The first order condition with respect to an unconditional change in b_{t+1} is the stochastic Euler equation:

$$\mathbf{E}_t\{\mathrm{u}'(c_t)\} = (1+r)\beta \mathbf{E}_t\{\mathrm{u}'(c_{t+1})\} \qquad (3.3)$$

With a view to empirical implementation, we impose a quadratic form of u(.) that satisfies the standard concavity conditions, and has the form

$$\mathrm{u}(c_t) = c_t - \frac{\boldsymbol{\omega}}{2} c_t^2 \qquad (3.4)$$

where $\boldsymbol{\omega} > 0$ is a constant. In addition, in order to constrain consumption to follow a "no-trend" long-run path, we specify that $\beta(1+r)=1$. The quadratic form of utility function does not, in any way, limit the model to certain outcomes. Within the standard class of utility functions used in literature, Ghosh and Ostry (1997) consider the case of constant absolute risk aversion, and obtain similar theoretical results[6]. Note that the marginal utility of consumption from *(3.4)* is linear in c_t , and substituting the marginal utility in *(3.3)* yields

$$\mathbf{E}_t c_{t+1} = c_t \qquad (3.5)$$

We assume that No *Ponzi-Games* exist in the bond market, i.e. lenders will not permit the households to die with unpaid debts, and it is not optimal for the households to leave the scene with unused resources. Hence for any time *T*, the No *Ponzi-Games* constraint implies that $\lim_{T\to\infty}(1+r)^{-T} b_{T+1} = 0$. Following Obstfeld and Rogoff (1996) and using the No *Ponzi-Games* constraint and *(3.5)*, we can derive the stochastic version of the intertemporal budget constraint, where the optimality conditions of the household's problem are already incorporated:

$$\sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t c_t = \mathbf{E}_t\left\{(1+r)b_t + \sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t (q_t - i_t - g_t)\right\} \qquad (3.6)$$

that in turns, with simplifications, yields the optimal path for consumption:

$$c_t^* = (r/\theta)\left\{b_t + (1+r)^{-1}\mathbf{E_t}\left[\sum_{i=0}^{\infty}\left(\frac{1}{1+r}\right)^i (q_{t+i} - i_{t+i} - g_{t+i})\right]\right\} \qquad (4)$$

with θ defined as:

$$\theta \equiv \frac{\beta(1+r)r}{[\beta(1+r)^2 - 1]}$$

[6] The parameter restriction $\beta(1+r)=1$ is also fairly innocuous and could easily be relaxed. We impose this restriction to simplify the model for theoretically tractable results. Note that with this restriction, we implicitly assume that permanent changes in output do not affect the current account whereas temporary changes do. Temporary increase in output causes surpluses in the current account, and temporary declines produce deficits.

and θ is the constant proportionality reflecting the consumption-tilting dynamics of consumption (Ghosh, 1995). Consumption, is therefore proportional to permanent national cash flow, and the current account can be interpreted as the transitory (cyclical) part of national cash flow. We can interpret the decision rules based on an estimate of θ with a limiting restriction of θ on 1, such that for $\theta < 1$ ($\theta > 1$), the country is consuming more than (less than) its current permanent cash flow, i.e. it is tilting consumption towards the present (the future). For $\theta = 1$, there is no consumption-tilting component to the current account[7]. We define the optimal consumption-smoothing current account by:

$$CA_t^* \equiv y_t - i_t - g_t - \theta c_t^* \qquad (5)$$

Where y_t is the national income (GNP), which is equal to domestic output q_t (GDP) plus net interest payments from foreign assets (rb_t). Using *(4)* and *(5)*, it is straightforward to find:

$$CA_t^* = y_t - i_t - g_t - r\left\{ b_t + (1+r)^{-1} \mathbf{E_t}\left[\sum_{i=0}^{\infty} \left(\frac{1}{1+r} \right)^i (q_{t+i} - i_{t+i} - g_{t+i}) \right] \right\} \qquad (6)$$

and *(6)* can be further simplified as:

$$CA_t^* = \left\{ -\mathbf{E_t}\left[\sum_{i=1}^{\infty} \left(\frac{1}{1+r} \right)^i \mathbf{\Delta}(q_{t+i} - i_{t+i} - g_{t+i}) \right] \right\} \qquad (7)$$

Expression *(7)* states that the optimal current account is the expected present discounted value of changes in national cash flow. Hence, the current account deficit is a predictor of future increases in national cash flow. To generate this optimal current account series, we need to calculate the expected present discounted value of changes in national cash flow, where according to our assumption, the expectation is conditional on the information set used by individual agents. One way to capture this information of consumers is to have

[7] With parameter restriction of $\beta(1+r) = 1$, the hypothesized benchmark value of θ is 1.

them base forecasts on current and lagged current account in addition to current and lagged changes in national cash flow. Following the techniques developed by Campbell and Shiller (1987), we first estimate an unrestricted VAR in CA_t and $\Delta\,(q_t - i_t - g_t)$, where CA_t is the actual consumption-smoothing component of the current account, defined as:

$$CA_t \equiv y_t - i_t - g_t - \theta c_t \qquad (8)$$

To obtain an estimate of θ, we can apply a simple econometric method which is valid and consistent with our analysis. We discuss it later. The VAR may be written as:

$$\begin{bmatrix} \Delta(q_t - i_t - g_t) \\ CA_t \end{bmatrix} = \begin{bmatrix} \gamma_1 & \gamma_2 \\ \gamma_3 & \gamma_4 \end{bmatrix} \begin{bmatrix} \Delta(q_{t-1} - i_{t-1} - g_{t-1}) \\ CA_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \qquad (9)$$

Or simply, $\mathbf{Z_t} = \boldsymbol{\gamma}\mathbf{Z_{t-1}} + \mathbf{\Gamma_t}$

where $\mathbf{Z_t} \equiv [\Delta(q_t - i_t - g_t) \quad CA_t]$, $\boldsymbol{\gamma}$ is the coefficient (transition) matrix of the VAR and $\mathbf{\Gamma_t}$ is a vector of stochastic disturbances with zero conditional means.

Recall that expression *(7)* defines the optimal current account as an infinite sum of discounted values of changes in national cash flow. The term $\mathbf{E_t\Delta}(q_{t+k} - i_{t+k} - g_{t+k})$ in the infinite sum in *(7)* can be rewritten as:

$$\mathbf{E_t\Delta}(q_{t+k} - i_{t+k} - g_{t+k}) = [\mathbf{1} \quad \mathbf{0}]\mathbf{E_t Z}_{t+k} = [\mathbf{1} \quad \mathbf{0}]\boldsymbol{\gamma}^{\mathbf{k}}\mathbf{Z_t} \qquad (10)$$

hence, the optimal current account is simply:

$$CA_t^* = -[\mathbf{1} \quad \mathbf{0}]\left[\frac{1}{(1+r)}\boldsymbol{\gamma}\right]\left[\mathbf{I} - \frac{1}{(1+r)}\boldsymbol{\gamma}\right]^{-1}\begin{bmatrix} \mathbf{\Delta}(q_t - i_t - g_t) \\ CA_t \end{bmatrix} \qquad (11)$$

The optimal current account measure in *(11)* is valid as long as the infinite sum in *(7)* converges, which in turn is conditional on the stationarity of variables used in the VAR. Generally, time series of national aggregates such as q_t, i_t and g_t are non-stationary (often of the first order). Hence, assuming $(q_t - i_t - g_t)$ is I(1), its first difference will be stationary. The other variable used in the VAR, CA_t, which is the consumption-smoothing component of the current account, will also be stationary since it has been adjusted for the consumption-smoothing motive of agents.

Recall we stated that we employ a simple econometric method to estimate θ for all samples, and generate the series of current account adjusted for consumption-smoothing motive. From the model, the optimal current account series, CA_t^*, will be an I(0) process. Under the null hypothesis that the actual consumption-smoothing module of the current account and optimal current account are equal, the consumption-smoothing component of the actual current account will also be I(0). In principle, we calculated the consumption-smoothing component of the current account using *(8)*. If CA_t in *(8)* is I(0), an estimate of θ may be obtained as the cointegrating parameter between c_t and $(y_t - i_t - g_t)$, and that we can get regressing $(y_t - i_t - g_t)$ on c_t using Ordinary Least Squares.

Once we calculate the optimal current account series, we can perform a number of interesting tests for capital mobility and verify the validity and robustness of the model for a class of datasets similar to the ones we have used. According to our modeling approach, if agents have more information about the evolution of national cash flow than is limited in its own past values, then this supplementary information should be reflected in the current account. Hence an implication of the estimated VAR is that current account should Granger cause subsequent changes in national cash flow, and we can simply use Block-Granger non-causality tests in the estimated VARs for this purpose. Secondly, our conjecture is that the ratio of variance of the optimal current account to variance of the actual (consumption-smoothing) current account is equal to one, which is tantamount to saying that the two variances are equal. If the variance of the optimal current account exceeds the variance of the actual current account (and the ratio exceeds one), then actual current account has not varied amply to allow capital flows to smooth consumption in light of fluctuations in national cash flow. Finally, to justify the twin assumptions of perfect capital mobility and the intertemporal consumption-smoothing current account model, the sample correlation between the actual and optimal current account may be examined.

III. Data and variables:

For estimation and testing the validity of the model, most empirical works have focused on the current account dynamics of major industrialized developed countries. In comparable studies, Ghosh (1995) uses quarterly time series dataset of national aggregates of five major industrialized countries, and Taylor (1996), Jones & Obstfeld (1999) and Hoffmann (2001) use similar datasets of seven industrialized developed countries. The main motivation of this paper is to test equivalent theoretical results for developing countries of Asia that are of similar size, norms and possess similar structure of the economy. Quarterly time series of national aggregates for these countries are considerably difficult to accumulate from secondary sources. In our analysis, we use time series of annual national aggregates of ten developing countries of Asia, namely, Bangladesh (1973-2002), Indonesia (1960-2001), Malaysia (1955-2001), Myanmar (1950-1995), Nepal (1970-2002), Pakistan (1960-2001), The Philippines (1948-1999), Singapore (1960-2001), Sri Lanka (1950-1999) and Thailand (1950-1999). The reasons of this choice of samples are obvious enough: these countries are almost of similar sizes, possess similar pattern of institutions and structure of economy, and are located in a neighborhood inside Asia. Understandably, relatively large Asian economies like India and China and strong Asian economies like Korea and Japan are not included in the group. All data, for the purpose of estimations and inference in the remainder of the paper are collected from the International Monetary Fund's *International Financial Statistics (IFS)*, March 2003 edition.

In processing data for estimation of θ, (9) and other inferences, we used *IFS* reported national aggregates in local currency, where private consumption, c_t is household consumption expenditure (line 96f), government expenditure, g_t is government consumption expenditure (line 91f), investment, i_t is the sum of gross fixed capital formation and changes in inventory (lines 93e+93i), GNP, y_t is the nominal Gross National Income (line 99a) and GDP, q_t is the nominal GDP (line 99b). We define current account using simple national income identity, i.e. $CA \equiv y\text{-}c\text{-}i\text{-}g$. All data are converted into real terms using the implicit GDP deflator with 1995 as the base year. Data for Bangladesh, Indonesia, Pakistan, Philippines and Thailand are in billions of 1995 local currency, and for Malaysia, Myanmar, Nepal, Singapore and Sri Lanka are in Millions of 1995 local currency.

Using annual data for these countries (over a relatively short time period for Bangladesh and Nepal, in particular) may be questionable, which this researcher humbly acknowledges. Surely, this researcher would have preferred to work with quarterly data of the same countries (possibly) for the same sample period. Most studies in literature that were mainly concerned with testing the reduced-form implications of the present-value current account model, like those of Sheffrin & Woo (1990), Hoffmann (2001) and others, used higher frequency datasets of industrialized countries. As mentioned earlier, collecting quarterly time series of national aggregates of the chosen countries over the chosen sample period is a daunting task. Most developing countries do not have reported quarterly time series before the 1990s, and using the reported quarterly data from 1990s again restricts our sample size to be small, possibly of the same size as we have used from the annual data. In addition to testing the model's robustness for developing country data, it will, however be interesting to check if the model works with relatively smaller datasets. We speculate that for the purpose of analyzing capital mobility in a neighborhood of small open economies, small frequency data sets are acceptable, since increasing the frequency of the data set will not necessarily increase the precision of the estimates. For our chosen sample, time series for Bangladesh and Nepal have only 30 and 32 year's data, respectively, which may not be a convincing sample size one would like to use for estimating a reduced form present value model of current account. The rest of the chosen countries have larger frequency of time series, e.g. 51 year's data for the Philippines, 49 year's data for Thailand and Sri Lanka and others having over 41 year's data. Some missing observations for the sample of Myanmar are collected from its Government's official economic data source. Tests of unit root, cointegration tests and estimation of VAR systematically excludes observations for lagged variables and differences, and we recognize the obvious caveats of losing precision and reliability of estimated parameters. However, we also acknowledge that a robust and consistent model tested on different frequencies of datasets is more reliable than the ones which are sensitive to volume of frequency. In conducting the estimations, therefore, we do not readily exclude a dataset just because it has a relatively low frequency.

IV. Estimation and results:

Before getting started with the estimation of the consumption-tilting parameter (θ) and the VAR, our first stride is to verify that both c_t and $(y_t - i_t - g_t)$ are I(1), and that they are cointegrated. We conduct unit root tests for c_t and $(y_t - i_t - g_t)$ for each of the ten countries over available sample period, and a summary of results of the tests are presented in Annex table 1. We report the Augmented Dickey-Fuller (ADF) t-statistic, and the cointegrating regression Durbin-Watson statistic. To test if c_t and $(y_t - i_t - g_t)$ are cointegrated, we regress $(y_t - i_t - g_t)$ on c_t and test the saved residuals (u_t as reported in Annex table 1) for a unit root. Note that if c_t and $(y_t - i_t - g_t)$ are both I(1) and cointegrated, the consumption-smoothing component of the current account is stationary, which we test and report the results summary in Annex table 1.

Although the ADF tests reported in Annex table 1 are for a specification with no constant and a time trend, we attempted various specifications that give us quite similar results. The choice of lag length for the ADF tests is based on standard likelihood ratio test. For all samples except Singapore, c_t and $(y_t - i_t - g_t)$ are found to be I(1) and significantly cointegrated[8]. For the sample of Bangladesh, we fail to reject the null of presence of a unit root in the generated consumption-smoothing component of the current account series (CA_t). Nevertheless, we keep the sample for further estimation, considering a blend of facts, such as a very small DW statistic from the cointegrating regression, a large

[8] Our conclusion that the processes are I(1) is based on a unit root test on their first differences. Note that if the null hypothesis of presence of a unit root in their first differences can be statistically rejected, we can conclude that they are I(1).

ADF-t statistic for the CA_t series (although not large enough for 5% level of significance), and stationarity of the residuals from the cointegrating regression. For the sample of Singapore, the CA_t series is not stationary, and c_t and $(y_t - i_t - g_t)$ are not cointegrated. We attempted to find if the first difference of the variables (for Singapore) are stationary, and failed to reject the null of presence of unit root for the first differences. This may be due to the fact that current account deficits of Singapore have been sustained over most of the chosen sample period (until 1993) so that, consumption and income may not even be cointegrated processes. We, however, keep the sample for curiosity.

The estimated values of the consumption-tilting parameter (θ) and their estimated standard errors are presented in Annex table 2. By definition, θ is the estimated degree of consumption-tilting, and therefore the magnitude of θ can be used to interpret the movements in the consumption-smoothing component of the current account. Despite the elusiveness of the decision to include the sample of Singapore in this estimation, all estimated θ are statistically significant at 1% level. Except for the samples of Malaysia and Singapore, all other estimates of θ indicate that most developing countries are tilting consumption towards the present, and hence are consuming more than their current permanent cash flow. The estimated θ for Singapore is too large (1.318) indicating that the country, on average have been increasing their stock of foreign assets. Similar conclusions can be drawn for Malaysia. The other eight samples with an estimate of θ less than unity exhibit deficits in the current account. The lowest cases are of Nepal (0.76), Myanmar (0.81) and Sri Lanka (0.84), exhibiting substantial deficits in the current account and too much tilting of consumption towards the present.

Annex tables V.1 and V.2 present the summary of results of the VAR estimation for all ten samples. Due to a relatively smaller frequency of samples, we started with three lags and successively eliminated lags which were statistically insignificant using both F-test and likelihood ratio test on the exclusion restrictions. The final VARs have been between one and two lags. We report the estimated coefficients with t-stats (and indicate statistical significance levels using asterisks), coefficient of determination (R^2) and DW statistic for each single equation.

V. Tests of interesting hypotheses:

To test for Granger causality of CA_t on $\Delta(q_t - i_t - g_t)$ and the hypothesis that capital flows have responded to consumption-smoothing behavior, we employ a simple Block-Granger non-causality test to the estimated VARs for all samples and report the result summary in Annex table 3.

For the samples of Bangladesh, Myanmar and Philippines, the likelihood ratio test for Granger Causality fails to reject the null that CA_t is non-causal for $\Delta(q_t - i_t - g_t)$. A reasonably acceptable explanation for this non-causality of current account for Myanmar can be a relatively more closed structure of the economy with policy conservativeness towards capital mobility that was prolonged during the 1962-1988 autocratic regime. Among the other seven samples, for Sri Lanka, Thailand, Singapore, Pakistan and Malaysia we can comfortably reject the null hypothesis (at 1% and 5% levels) of no Granger causality. Note that from Annex table V.1 and V.2, the formal validity of the model is also strong for these samples as most of the estimated VAR coefficients for these five samples and individually statistically significant. The tests for Nepal and Indonesia allow us to reject the null of no Granger causality at 7% level.

In calculating CA_t^*, we require a proxy for the world interest rate r. The world interest rate in this model is the constant interest earned from per unit foreign assets held by a particular country. We considered various series of international interest rates of USA and UK (presumably the largest trading partners of the developing countries studied) for the time periods under consideration, and reached a conclusion that these generally vary within a range of 4% to 8%. We tested our results for a variety of annual interest rates between a range of 4% to 8%, and reached a conclusion that various interest rates between this range give very similar results.

To perform the next test, that is whether capital mobility has been too limited to allow consumption-smoothing behavior, we calculate the ratio of variance of optimal current account to variance of actual consumption-smoothing component of the current account, and test whether this ratio is significantly different from unity. The summary is reported in Annex table 4. Results indicate that except for the samples of Pakistan, Singapore and Sri Lanka, the two variances are not equal for all others considered. For Thailand only, the variance of the optimal current account significantly exceeds variance of the actual current account, implying that the actual current account of Thailand over the sample period has not varied significantly enough to allow capital flows to smooth consumption. For the rest six, variance of actual current account significantly exceeds variance of the optimal current account. Hence in these six countries in this analysis, capital flows have been much more volatile than would be justified by expected changes in national cash flow. For Bangladesh and Malaysia, actual current account movements have been more than ten times as large as would have been necessary for consumption-smoothing, while for Nepal and Philippines, the movements have been approximately two times too large.

The last column in Annex table 4 report the sample correlations between CA_t and CA_t^*. For all samples, this value ranges from a maximum of 0.999 for Singapore and a minimum of 0.108 for Malaysia. In the worst two cases, i.e. for Malaysia (0.108) and Pakistan (0.429), the model does not provide credible results of current account movements. For most other samples, the sample correlations indicate that the model does reassuringly well in explaining the major current account movements, though not necessarily the magnitude of these movements. This is exhibited in the figures 1.1 to 1.10 presented in the Annex. Note that from the sample correlations, the model very well explains the movements in current account in the cases of Singapore, Sri Lanka, Thailand, Nepal and Bangladesh. Of these, we retained the sample of Singapore for the sake of curiosity after it failed to pass the series of stationarity tests that we conducted. This result, therefore, indicates an econometric puzzle, and is interesting for further testing. The samples of Nepal and Bangladesh possess the smallest frequency in this analysis, but the data show consistent and reliable results in all estimations and tests. We cannot help but prescribe (even if evaluation is based on distinct cases) that one should not readily exclude a relatively small sample before conducting any estimation of the types we have applied here. In other words, although this approach incorporates sophisticated time series analysis like unit root tests and VAR estimation, the model is in no way sensitive to smaller frequency of data. This point is made clearer when we compare our set of results with those established in literature.

That the model does well in explaining major movements in current account is further verified visually in figures 1.1 to 1.10, where we plot the series of optimal current account (*CA**) and actual consumption-smoothing component of the current account (*CA*) for all ten countries under consideration. Except for the cases of Malaysia and Pakistan, disregarding the magnitude of actual flows, it is quite momentous how highly correlated the two series are. Most surprisingly, the sample of Singapore, which we have been most skeptical about, shows almost a perfectly coinciding *CA** and *CA* series. Among the relatively small two samples, the plot of Nepal shows a high degree of correlation between the two series. Plots of Sri Lanka, Indonesia, Bangladesh and Thailand reassure that the model worked well for these samples.

VI. Comparison with relevant studies:

Since a comprehensive analysis of our estimation, tests and results has already been presented, it is now convenient to compare our results with those (based on industrialized countries) established in literature and check the analytical robustness of the model. As far as the issue of applicability of the model in the cases of developing countries is concerned, there is no doubt that the model does reassuringly well to explain major movements in the current account of developing countries. In this sense, the model is theoretically consistent and empirically tested for samples of different groups of countries. Our analysis of annual data of national aggregates does equally well as did quarterly national aggregates in Ghosh (1995), Jones & Obstfeld (1999) and Hoffmann

(2001)[9]. However, we had very low sample correlation between *CA** and *CA* in the cases of Malaysia (0.108) and Pakistan (0.429) and concluded that the model did not work well in these cases. The lowest sample correlation in Ghosh's (1995) study was that for the United Kingdom (0.691), and even in the worst case the model worked reasonably well in explaining the characteristics of the movements of the current account.

Our VAR estimates are encouraging for the formal validity of the model, since in the cases of Indonesia, Malaysia, Nepal, Pakistan, Singapore, Sri Lanka and Thailand, there are significant coefficients of the current account in the equation explaining the changes in national cash flow. While our study could establish Granger causality of current account to changes in national cash flow for seven out of ten countries under consideration, the study by Ghosh (1995) could establish this only for the sample of USA out of five countries under consideration. The estimated consumption-tilting parameter θ for all developed countries in Ghosh's (1995) study varied within a short range of 1.08 (for Germany) and 0.96 (for Canada), indicating that the industrialized countries under inspection more or less had a consistent pattern of consumption tilting behavior. In our study, the degree of consumption-tilting for all developing countries varied within a range of 1.318 (for Singapore) and 0.766 (for Nepal), exhibiting a more precarious pattern of consumption-tilting behavior. This finding, among others, is also consistent with observed consumption behavior of the countries under consideration. Finding different consumption-tilting behavior for developed and developing countries once again reinforce the robustness of our model, and perhaps highlight another macroeconomic device for development economists to distinguish and explain the difference between these two groups of countries.

[9] Obstfeld & Rogoff (1996) present a similar study of five industrialized countries with annual data of national aggregates using the same data source. In their study, the data for Sweden, Belgium and Denmark fit the model almost perfectly.

VII. Concluding remarks:

To establish that capital mobility in developing countries smoothes consumption in the face of shocks to national cash flow, this study has followed the intertemporal approach to the current account, which was primarily applied for industrialized countries in comparable studies established in the literature. We have argued that the intertemporal current account model performs impressively well in characterizing the course and turning points of the current account and degree of capital mobility of eight (out of ten) developing countries studied.

Among the motivating caveats of this particular study, an important one may be the fact that we abstracted from testing the model with reform effects, i.e. we ignored the fact that the volatility of capital movements in these countries possibly could have varied in accordance with reforms in economic systems within the sample period considered. Myanmar is a unique example of extreme reform effects due to changes in political systems. During the period 1962-1988, Myanmar (formerly Burma) was ruled by an autocratic system abolishing all political parties, resulting in a more closed structure of the capital markets. It is often argued and statistically proven that the regime of autocracy drew former Burma into constantly worsening political as well as economic crisis. Major reforms might have affected volume and volatility of capital flows to and from Pakistan with the liberation of Bangladesh (which was East Pakistan until 1971). In this study, the data for Pakistan has not been adjusted for this major change, where due to the liberation of Bangladesh in 1971, the size of the Pakistan economy was virtually halved[10]. Behavioral attributes are also ignored, meaning that while making inferences regarding the consumption-smoothing behavior, we estimated an un-weighted average consumption-tilting parameter ignoring the changing pattern of behaviors (due to migration, demonstration effects, adoption of technology etc.) amongst the natives of these countries. From the theoretical point of view, testing several joint hypotheses, e.g. perfect capital mobility, quadratic utility function, consumption-smoothing behavior

[10] The *IFS* reported data for Pakistan during 1960-1971 is the data for West Pakistan only, which now is known as Pakistan. However, neither West Pakistan nor Pakistan data has been adjusted for any war shocks and various other reform effects.

restricts our ability to reject the model based on any one of these attributes. Note that we have assumed government expenditure to be exogenous in all our analysis, which is not always realistic in a small open economy. Government often lowers its expenditure in the face of imminent capital outflows and private sector often recognizes the government's reaction function. Our simple model also does not capture oil shocks, international currency shocks and international capital market shocks.

Apart from the caveats mentioned above, the model works well in case of annual national aggregates of developing countries. The model is useful for empirical estimation of the benchmark series of current account, and hence make comparison between the optimal and observed magnitudes of surpluses and deficits. Volatility of current accounts may be due to different economic facts which are beyond the capacity of the assumptions of our simple model. The extent of capital flows in developing countries (in general), for instance, may be caused by short-term capital flows that respond to speculation in the world foreign exchange market. The magnitude and precariousness of these private capital flows suggests that they are much larger than would be deemed necessary to smooth real idiosyncratic shocks to consumption arising from transitory shocks to output, government expenditure and investment. Within the reach of our model and estimation, we find that the current account, in general, acts more causally to changes in national cash flow in developing countries, and capital flows have been excessive in six out of ten countries studied.

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Annex tables:

Table 1: Test of unit root and cointegration.

Sample	Test statistic				
	t adf c_t	t adf $(y_t\text{-}i_t\text{-}g_t)$	t adf CA_t	t adf u_t	DW
Bangladesh (1973-2002)	-0.409	-0.468	-1.662	-2.233*	0.388
Indonesia (1960-2001)	-1.339	-0.003	-2.326*	-2.332*	0.712
Malaysia (1955-2001)	-0.79	0.372	-2.302*	-2.302*	0.54
Myanmar (1950-1995)	-1.265	-0.694	-3.194**	-3.197**	0.848
Nepal (1970-2002)	-1.61	-2.523	-2.755**	-2.752**	0.592
Pakistan (1960-2001)	-0.595	-0.776	-3.719**	-3.719**	0.952
Philippines (1948-1999)	-1.092	0.808	-3.832**	-3.368**	0.784
Singapore (1960-2001)	0.431	0.794	-0.617	-0.616	0.169
Sri Lanka (1950-1999)	-0.849	-2.179	-2.885**	-2.533*	0.591
Thailand (1950-1999)	-1.006	1.006	-3.275**	-4.126**	0.127

- * and ** indicate statistically significant at 5% level and 1% level, respectively, on the basis of ADF t critical values.
- $CA_t \equiv y_t - i_t - g_t - \theta c_t$
- DW is the Durbin-Watson statistic from cointegrating regression of $(y_t - i_t - g_t)$ on c_t.
- t-adf is the Augmented Dickey Fuller t statistic on z_{t-1} from the regression

$$\Delta z_t = \alpha_0 z_{t-1} + \sum_{j=1}^{2} \alpha_j \Delta z_{t-j} + \delta t$$

where z_t is c_t, $(y_t - i_t - g_t)$ and CA_t respectively, and ***t*** is the time trend.

- u_t is the saved residual from OLS regression of $(y_t - i_t - g_t)$ on c_t.

Table 2: Consumption-tilting parameter: the parameter describing the degree of consumption tilting.

Sample	*Estimate of θ*	*Estimated se (θ)*
Bangladesh (1973-2002)	0.949**	0.009
Indonesia (1960-2001)	0.953**	0.012
Malaysia (1955-2001)	1.046**	0.03
Myanmar (1950-1995)	0.815**	0.008
Nepal (1970-2002)	0.766**	0.012
Pakistan (1960-2001)	0.958**	0.005
Philippines (1948-1999)	0.945**	0.005
Singapore (1960-2001)	1.318**	0.035
Sri Lanka (1950-1999)	0.848**	0.006
Thailand (1950-1999)	0.905**	0.007

- ** indicate statistically significant at 1% level.

Table 3: Block-Granger non-causality Tests from unrestricted VAR estimation.

Sample	***LR statistic (CHSQ j)***	***p-value***
Bangladesh (1973-2002)	0.174 (j=1)	0.676
Indonesia (1960-2001)	5.396 (j=2)	0.067
Malaysia (1955-2001)	23.551 (j=2)	0.000
Myanmar (1950-1995)	2.09 (j=2)	0.352
Nepal (1970-2002)	3.463 (j=1)	0.063
Pakistan (1960-2001)	8.82 (j=2)	0.012
Philippines (1948-1999)	0.054 (j=1)	0.815
Singapore (1960-2001)	8.38 (j=2)	0.015
Sri Lanka (1950-1999)	7.28 (j=2)	0.026
Thailand (1950-1999)	11.92 (j=1)	0.001

- Test of null hypothesis that the coefficients of lagged values of CA_t in the block of equations explaining $\Delta(q_t - i_t - g_t)$ is zero, i.e. testing the null hypothesis that CA_t is non-causal for $\Delta(q_t - i_t - g_t)$.

Table 4: Variance of CA, CA*, their ratio and correlation between CA and CA*.

Sample	**Var (CA)**	**Var (CA*)**	**Ratio**	**P[F<=f] one tail**	**Corr (CA, CA*)**
Bangladesh (1973-2002)	259	20	0.07	0.000	0.962
Indonesia (1960-2001)	19134.11	7106.62	0.371	0.001	0.83
Malaysia (1955-2001)	15484.72	1309.90	0.08	0.000	0.108
Myanmar (1950-1995)	63713.57	20519.84	0.32	0.000	0.80
Nepal (1970-2002)	8362.16	3838.98	0.46	0.016	0.979
Pakistan (1960-2001)	93.2	102.9	1.09	0.41	0.429
Philippines (1948-1999)	376	255	0.67	0.07	0.607
Singapore (1960-2001)	4189.38	4750.78	1.13	0.34	0.999
Sri Lanka (1950-1999)	56058.47	72077.5	1.28	0.19	0.986
Thailand (1950-1999)	2626.02	4024.01	1.53	0.06	0.942

- Ratio = Var(CA*)/Var(CA).
- P[F<=f] one tail is the p-value, with one degree of freedom, for the null that the ratio of the variances is equal to one.

Table V.1: Results from unrestricted VAR estimation.

	Bangladesh (1973-02)		Indonesia (1960-01)		Malaysia (1955-01)		Myanmar (1950-95)		Nepal (1970-02)	
	ΔZ_t	CA_t	ΔZ_t	CA_t	ΔZ_t	CA_t	ΔZ_t	CA_t	ΔZ_t	CA_t
ΔZ_{t-1} (t-stat)	0.537 (3.272)***	-0.07 (-0.56)	0.351 (2.21)**	-0.106 (-0.64)	-0.05 (-0.237)	-1.09 (-2.69)**	0.015 (0.103)	-0.01 (-0.15)	0.09 (0.514)	-0.18 (-1.03)
ΔZ_{t-2} (t-stat)			0.25 (1.68)*	0.209 (1.32)	0.743 (4.323)***	0.986 (3.48)***	0.466 (3.27)***	0.087 (1.31)		
CA_{t-1} (t-stat)	0.061 (0.403)	0.827 (6.86)***	-0.119 (-0.733)	0.619 (3.64)***	0.007 (0.047)	1.409 (5.53)***	0.45 (1.35)	0.733 (4.67)***	-0.245 (-1.85)*	0.608 (4.57)***
CA_{t-2} (t-stat)			-0.27 (-1.49)	0.14 (0.72)	-0.428 (-2.27)**	-0.979 (-3.15)***	-0.465 (-1.23)	0.263 (1.46)		
R^2	-0.65	0.636	0.097	0.41	0.46	0.63	0.19	0.64	-0.26	0.41
DW	2.43	1.85	2.05	1.89	2.32	2.01	2.13	2.04	1.99	1.98

Column variables regressed on row variables, with $\Delta Z_t = \Delta(q_t - i_t - g_t)$.
*, **, *** indicate statistically significant at 10%, 5% and 1% levels respectively.

Table V.2: Results from unrestricted VAR estimation.

	Pakistan (1960-01)		Philippines (1948-99)		Singapore (1960-01)		Sri Lanka (1950-99)		Thailand (1950-99)	
	ΔZ_t	CA_t	ΔZ_t	CA_t	ΔZ_t	CA_t	ΔZ_t	CA_t	ΔZ_t	CA_t
ΔZ_{t-1} (t-stat)	0.352 (2.36)**	-0.045 (-0.278)	0.525 (3.85)***	0.102 (0.949)	0.821 (5.01)***	0.584 (2.78)***	0.395 (2.68)**	-0.391 (-1.84)*	0.92 (10.45)***	0.575 (4.12)***
ΔZ_{t-2} (t-stat)	0.598 (3.92)***	-0.023 (-0.14)			0.171 (1.04)	-0.36 (-1.74)*	0.393 (2.75)***	0.09 (0.43)		
CA_{t-1} (t-stat)	0.315 (1.91)*	0.55 (3.09)***	0.03 (0.229)	1.043 (10.03)***	-0.395 (-2.88)***	0.578 (3.29)***	-0.56 (-2.64)**	1.63 (5.26)***	-0.17 (-3.59)***	0.822 (10.95)***
CA_{t-2} (t-stat)	-0.47 (-2.96)***	-0.08 (-0.45)			0.39 (2.77)***	0.409 (2.26)**	0.315 (1.42)	-1.09 (-3.43)***		
R^2	0.31	0.25	0.06	0.70	0.44	0.83	0.03	0.38	0.49	0.79
DW	2.23	1.91	1.98	1.63	2.03	2.08	2.33	1.48	2.501	1.49

Column variables regressed on row variables with $\Delta Z_t = \Delta(q_t - i_t - g_t)$.
*, **, *** indicate statistically significant at 10%, 5% and 1% levels respectively.

Fig 1: Actual and predicted (optimal) current account.

Fig 1.1 : Bangladesh.

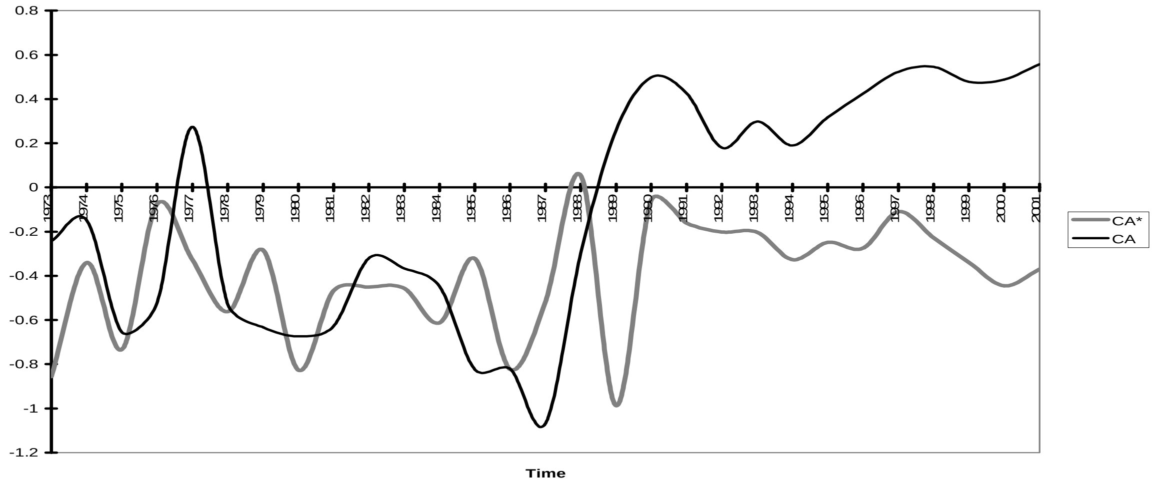

Fig 1.2: Indonesia.

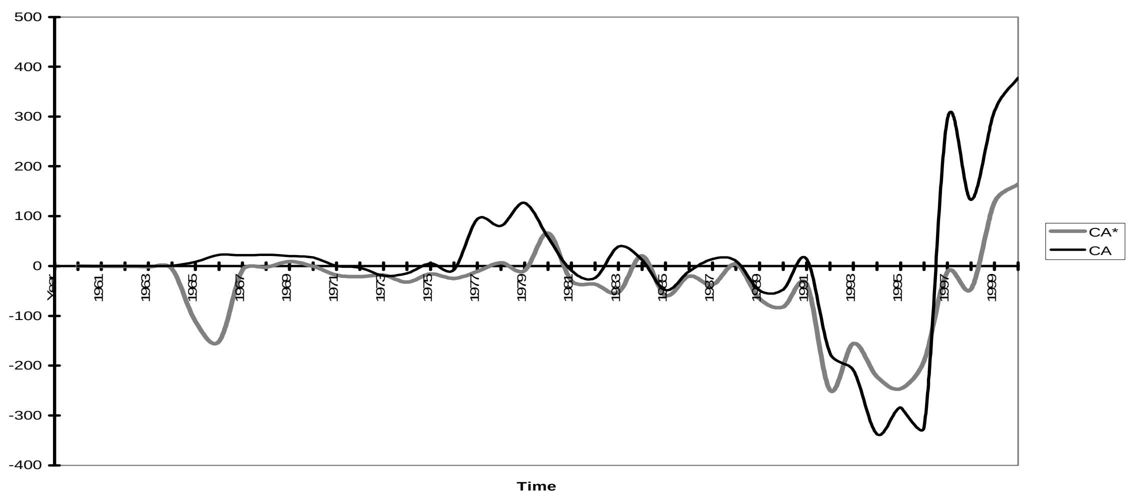

Fig1.3: Malaysia.

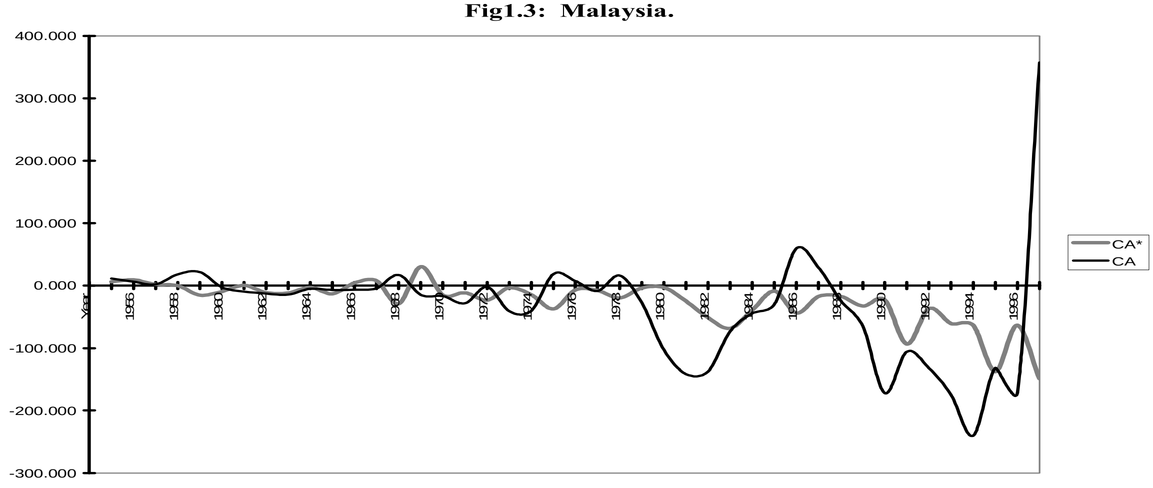

Fig1.4: Myanmar.

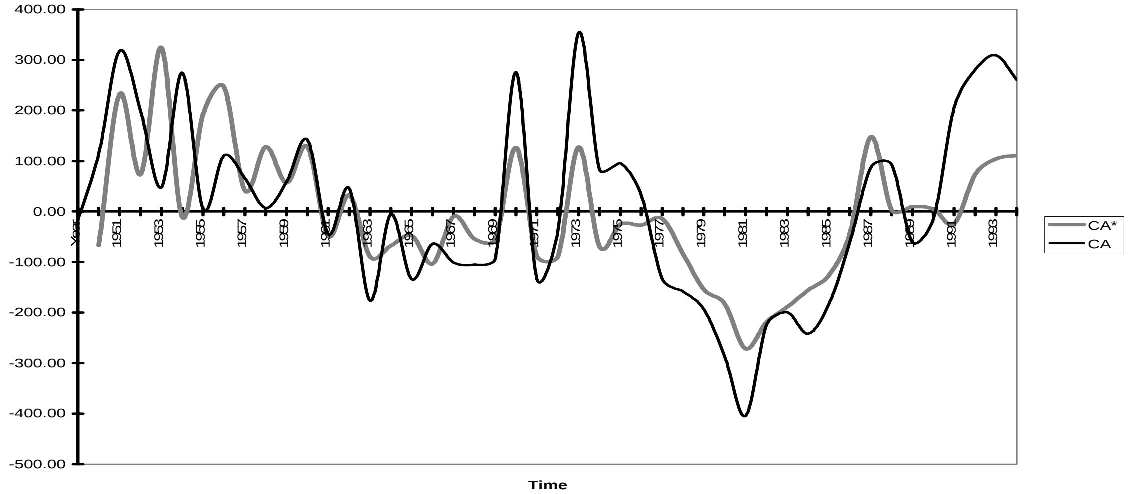

Fig1.5: Nepal.

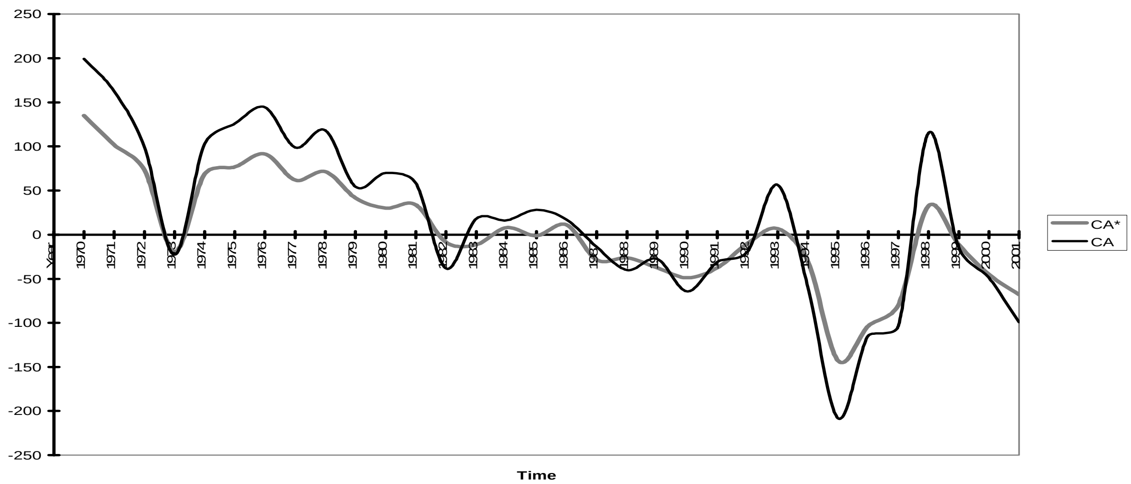

Fig1.6 : Pakistan.

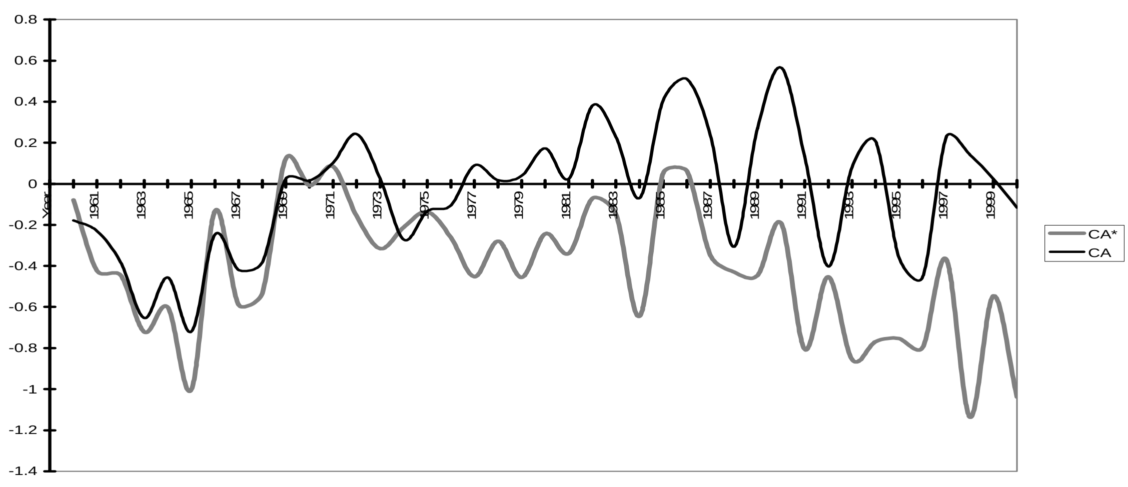

Fig1.7: Philippines.

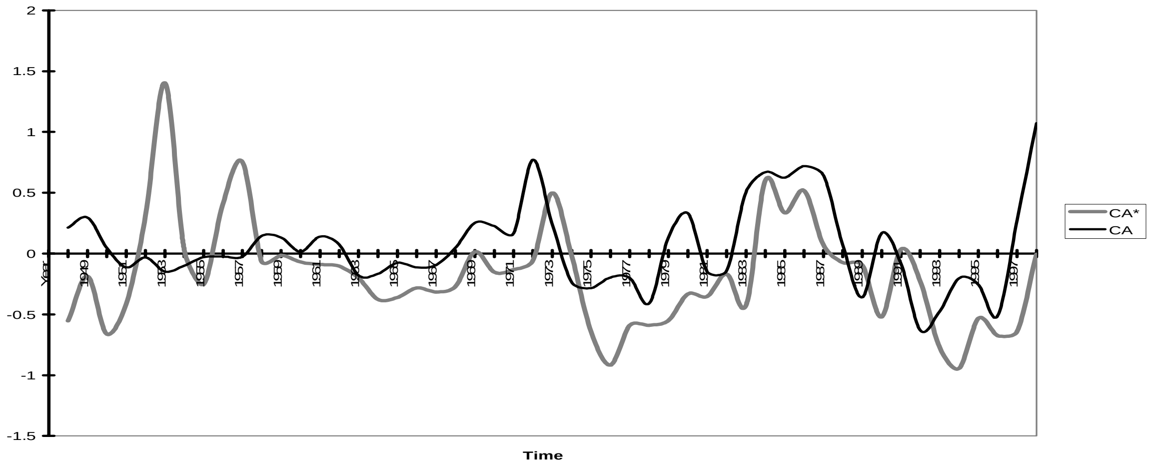

Fig1.8: Singapore.

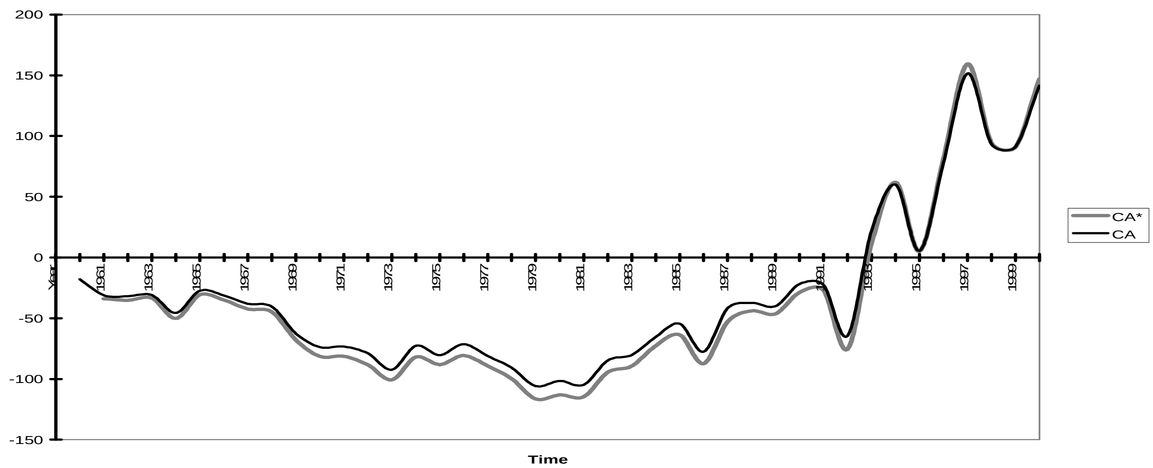

Fig1.9: Sri Lanka.

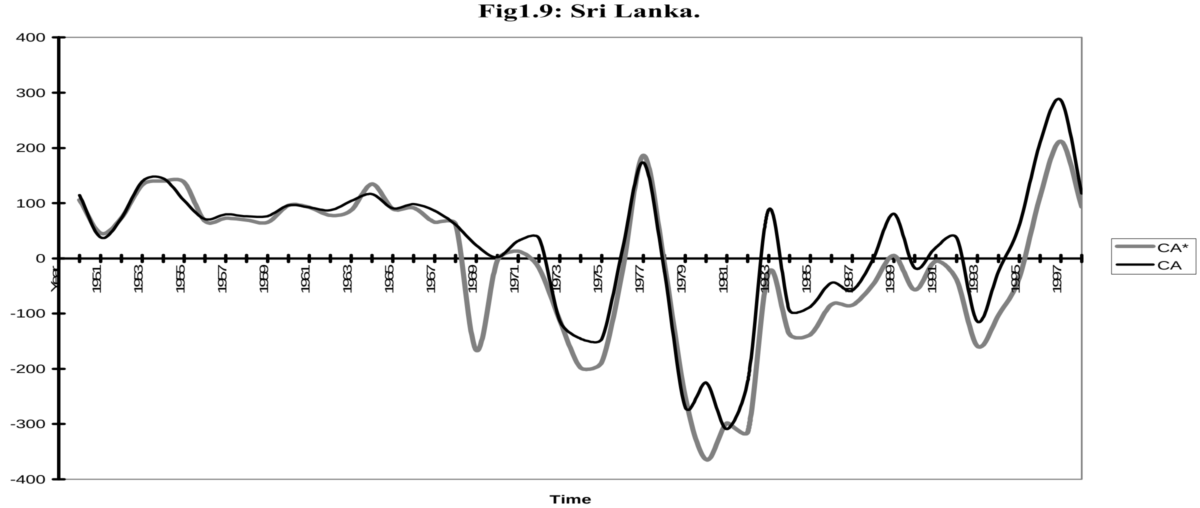

Fig1.10: Thailand.