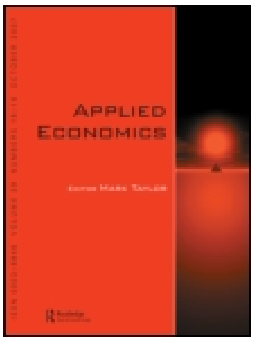

Applied Economics

ISSN: 0003-6846 (Print) 1466-4283 (Online) Journal homepage: http://www.tandfonline.com/loi/raec20

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Applied Economics, 2010, **42**, 2601–2616

Routledge
Taylor & Francis Group

Consumption smoothing, capital controls and the current account in Ghana

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Much of the empirical evidence on developing economies indicates that the basic intertemporal model of the current account fails to predict the dynamics of the actual current account series. This article argues that the model can predict the dynamics of the current account series if it is appropriately adjusted to reflect the nature of capital mobility and exchange rate policies in these countries. Using data on Ghana that span across capital control and liberalized regimes this article reports three finding. First, consistent with the existing empirical evidence, the basic model fails to predict the dynamics of the actual current account. Second, extending the basic model to capture variations in interest rates and exchange rates better explains the path of the actual current account balances only during the liberalized regime. Third, tests of asymmetric access to the international financial market indicate that economic agents in Ghana could not use the international financial market to smooth their consumption during the capital control regime. However, the liberalization program that reduced constraints on capital flows has enabled economic agents to use the international capital market to smooth consumption.

I. Introduction

The intertemporal approach to modelling the current account is derived from the permanent income hypothesis of consumption extended to the open economy. The usual version of this approach is the basic present value model of the current account (PVMCA), which maintains that the current account of a country serves as a buffer for smoothing national consumption against shocks to its national cash flow, defined as gross domestic product less investment and government expenditure. According to this model, a rise (fall) in national cash flow above (below) its expected permanent value will induce individuals to accumulate (decrease) interest-yielding foreign assets as a way of smoothing consumption over future periods. Correspondingly, a country's current account surplus (deficit) should be equal to the present value of the expected future decline (increase) in national cash flow. In deriving these results, the PVMCA combines the assumptions of high capital mobility and the permanent income theory. This basic model does not account for the effect of external shocks (changes in the world interest rates and expected exchange rates) on the current account balances. Sheffrin and Woo (1990), Otto and Voss (1995), Huang (1993) and Ghosh (1995), have used the basic PVMCA, the present value tests originally

http://www.informaworld.com
DOI: 10.1080/00036840801964542

developed by Campbell (1987) and Campbell and Shiller (1987), and data on developed and developing countries to test whether the current account sequence conforms to what the theory predicts. Results have been mixed at best. Bergin and Sheffrin (2000) have used data on small open developed countries to show that the basic PVMCA, extended to include changes in the world interest rate and the expected exchange rates, yields optimal current account series that closely track the actual series. Their results show that allowing for both variable world interest rate and exchange rate can improve the fit of the model for small open economies.

Notable empirical studies on the Ghanaian current account and balance of payments problems are Ghartey (1987), Jebuni *et al.* (1994), Ghosh and Ostry (1995) and Harrigan and Oduro (1997). Among these, the Ghosh and Ostry paper stands out as the only study which includes an application of the basic PVMCA to Ghana. Their findings rejected the basic model.[1] In my opinion, there are three reasons why their empirical analysis did not perform well. First, it did not capture the effect of external shocks on the current account balances in Ghana. Second, it did not pay attention to the implications to the model of the various trade and payment regimes that Ghana followed over the study period. Third, the existence of high capital controls in Ghana prior to 1983 does not conform to the model's assumption of high capital mobility. It is likely that these capital controls imposed asymmetric access to the international financial market on economic agents in Ghana, which needs to be tested empirically. They did not explicitly investigate the possibility. Adedeji *et al.* (2005), and Handa (2005) have attempted to address these limitations by using data on Ghana and Nigeria, and the Bergin and Sheffrin model extended to allow for the possibility of asymmetric access to the international financial market for developing nations. They concluded that the extended model with asymmetric access better explains the current account data, though the basic model was rejected by the data. Once again the drawback of these studies is that attention is not paid to the various trade and payment regimes that Ghana followed during the study period. Hence, their results average out regime specific dynamics which may have different policy implications. In addition, their approach does not provide the framework to determine whether the recent implementation of capital liberalization policies in Ghana, have been effective in terms of allowing economic agents to use the international financial market to smooth consumption.

The Ghanaian economy has evolved through various trade and payment regimes since independence in 1957. The period between independence and 1982 was characterized by a fixed exchange rate regime and high trade and capital controls (the control regime-pre-ERP).[2] However, as part of the Economic Recovery Program (ERP) in 1983, the country has followed a flexible exchange rate system, and the trade and capital accounts of the balance of payments have been significantly liberalized (the liberalized regime-post-ERP). These policies are expected to eliminate the asymmetric access to the international financial market and make the current account responsive to external factors such as changes in the world interest rates and the exchange rates. The two broad policy regimes in Ghana have been characterized by large current account deficits. In particular, current account deficits have occurred every year since the early 1980s. These current account deficits are among the usual suspects referenced for the economic problems of the country.

This article argues that the intertemporal model of the current account can predict the dynamics of the actual current account series if it is appropriately adjusted to reflect the nature of capital mobility and exchange rate policies in these countries. In light of this, there are two principal contributions of this article. First, in contrast to existing literature, it demonstrates empirically that the determinants of the dynamics of the current account differ between the controlled regime (pre-ERP) and the liberalized regime (post-ERP) in Ghana. Second, it is the first study that uses the PVMCA framework to empirically test if the elimination of capital controls, as part of the overall Economic Recovery Program, has enabled economic agents in Ghana to use the international financial market to smooth consumption.

The main results are summarized as follows. First, using data on Ghana over the period 1960–2002 the article finds that irrespective of the degree of capital control, the basic intertemporal model of the current account fails to predict the dynamics of the current account balances in Ghana. This finding is consistent across a battery of formal and informal tests. Second, the article finds that extending the basic model to capture variations in interest rates and exchange rates explain the path of the actual current account

[1] Similar results were found for most of the developing countries they studied.

[2] There were some attempts to liberalize trade during the periods 1966–69 and 1971. However, capital control measures were still in place. Hence, in the empirical analysis, I treated the entire period prior to 1982 as capital control period.

balances only during the liberalized regime when there was a considerable deregulation of capital controls and the exchange rate system. Again, the extended model failed to predict the dynamics of the actual current account balances during the controlled regime. Third, the basic model adjusted to allow for asymmetry in capital flows explains the historic path of the actual current account only during the controlled regime. There was no evidence that economic agents in Ghana were faced with asymmetric access to the international financial market during the liberalized regime. These results indicate that the reduction of capital controls as part of the Economic Recovery Program, has enabled economic agents in Ghana to use the international financial market to smooth consumption.

The rest of this article is organized as follows. Section II discusses in detail the theoretical model of the intertemporal approach to current account. Section III conducts the empirical tests. It starts with the basic model, and then proceeds to discuss the results when the model is extended to incorporate changes in the interest and exchange rates. It also presents the results of a further extension of the model to account for possible asymmetry in the access to the international financial sector. Section IV concludes the article and offers some policy implications.

II. Theoretical Framework

The basic intertemporal model used by Ghosh (1995), Obstfeld and Rogoff (1996) and Sheffrin and Woo (1990) assumes a one tradable good economy and a constant world interest rates. In their work on the PVMCA, Bergin and Sheffrin (2000) have demonstrated that extending the basic model to allow for variations in the interest rate and exchange rate could improve the ability of the model to explain historic episodes of current account imbalances. This extended PVMCA is based on the combination of appropriate Euler equation and log-linearization of the intertemporal budget constraint first developed by Campbell and Mankiw (1989) and Huang and Lin (1993) to derive the empirically testable equation. The model used in this study follows closely the Bergin and Sheffrin extended PVMCA.

Consider a small open economy that can lend and borrow at a variable real world interest rate, r^*. The economy produces both tradable and nontradable goods. The infinitely lived household maximizes the lifetime utility:

$$\max E_0\left\{\sum_{t=0}^{\infty}\beta^t[U(C_{\mathrm{T}t}, C_{\mathrm{NT}t})]\right\},$$
$$U'(C_t) > 0;\ U''(C_t) < 0;\ 0 < \beta < 1 \qquad (2.1)$$

where

$$U(C_{\mathrm{T}t}, C_{\mathrm{NT}t}) = \frac{1}{1-\sigma}\left(C_{\mathrm{T}t}^{\alpha}C_{\mathrm{NT}t}^{1-\alpha}\right)^{1-\sigma}\ \sigma > 0,$$
$$\sigma \neq 1,\ 0 < \alpha < 1$$

where β is the subjective discount factor; E is the expectation operator; $U(\cdot)$ represents the period or temporal utility function; C_{T} is the consumption of the tradable good; and C_{NT} is the consumption of nontradable goods. The above lifetime utility is maximized subject to a dynamic budget constraint of the form:

$$B_t - B_{t-1} = r_t^* B_{t-1} + Y_t - (C_{\mathrm{T}t} + P_t C_{\mathrm{NT}t}) - G_t - I_t \qquad (2.2)$$

where B_t is net foreign assets, Y_t is gross domestic product, G_t is government expenditures, and I_t is the sum of private and government investment, all measured in terms of the traded goods. P_t is the relative price of nontradable goods in terms of tradable goods. Finally, r^* is the net real world interest rate in terms of the traded goods. The right-hand side of the budget constraint may be interpreted as the current account. From Equation 2.2, I have expressed the total consumption expenditure in terms of traded good as $C_t = C_{\mathrm{T}t} + P_t C_{\mathrm{NT}t}$.

Appendix A derives the first-order conditions for the maximization problem and uses them to derive the following optimal consumption profile:

$$E_t\left[\beta\left(1 + r_{t+1}^*\right)\left(\frac{C_t}{C_{t+1}}\right)^{\sigma}\left(\frac{P_t}{P_{t+1}}\right)^{(1-\sigma)(1-\alpha)}\right] = 1$$

Assume joint log normality, constant variances and covariances for the gross real world interest rate $(1 + r_{t+1}^*)$, consumption growth rate $(\Delta c_{t+1} = \log C_{t+1} - \log C_t)$, and for the percentage change in the relative price of nontradable goods $(\Delta p_{t+1} = \log P_{t+1} - \log P_t)$.[3] Based on the assumption of

[3] See Campbell *et al.* (1997), pp. 306–307, for the properties of a random variable that is conditionally lognormal distributed.

lognormal distribution, Equation 2.3 may be rewritten in a log-linearized form as[4]:

$$E_t\Delta c_{t+1} = \gamma E_t\left[r^*_{t+1} + \frac{1-\gamma}{\gamma}(1-\alpha)\Delta p_{t+1}\right] + \frac{1}{2}\left[\begin{array}{l}\sigma_c^2 + \gamma^2\sigma_r^2 + (1-\gamma)^2(1-\alpha)^2\sigma_p^2 \\ +2\gamma\sigma_{c,r} + 2(1-\gamma)(1-\alpha)\sigma_{c,p} \\ +2\gamma(1-\gamma)(1-\alpha)\sigma_{r,p}\end{array}\right] \tag{2.3}$$

where $\gamma = 1/\sigma$ is the elasticity of intertemporal substitution.

Equation 2.3 assumes the approximation of log $(1 + r^*_{t+1})$ as r^*_{t+1}. The first bracket on the right-hand side of the equation specifies the consumption-based real interest rate ($\hat{r}_t$), which is different from the world real rate of interest when there is an expected change in the real exchange rate. This consumption-based interest rate is affected by changes in the world interest rate and the expected changes in the real exchange rate. Since the second and third terms on the right hand are constants, the evolution of the optimal consumption profile written in logs is given by:

$$E_t\Delta c_{t+1} = \gamma E_t\hat{r}_{t+1} \tag{2.4}$$

where, $\hat{r}_t = r^* + [(1-\gamma)/\gamma](1-\alpha)\Delta p_{t+1} + \text{constant}$.[5]

In the basic intertemporal model used by Sheffrin and Woo (1990), Otto and Voss (1995) and Ghosh (1995), the expected change in consumption is zero since the representative consumer always tries to smooth consumption over time by borrowing and lending. When the consumption-based real interest rate is allowed to change over time, as shown in Equation 2.4, the representative consumer is allowed to increase or decrease consumption in some periods because of changes in the world interest rate (r^*_t) and the expected change in real exchange rate. A decrease in the world interest rate (r^*_t) makes current consumption cheaper in terms of future consumption. This induces substitution towards the present with elasticity 'γ'. A change in the relative price of nontradable goods can have similar intertemporal effects. For instance, if the price of nontradable goods is temporarily high and expected to fall, then the future repayment of a loan contracted in the current period in traded goods has a higher cost in terms of the consumption bundle than in terms of tradable goods alone. As a result, the consumption-based interest rate $\hat{r}_t$ rises above the conventional interest rate r^*. This induces a fall in the current total consumption expenditure by elasticity $\gamma(1-\alpha)$.

To complete the optimisation problem of the representative agent, I next proceed to derive the log-linearized intertemporal budget constraint. The dynamic budget constraint in Equation 2.2 can be re-written as:

$$\begin{aligned} CA_t &= Y_t - I_t - G_t - (C_{\mathrm{T}t} + P_tC_{\mathrm{NT}t}) + r^*_tB_{t-1} \\ &= Q_t - C_t + r^*_tB_{t-1} \end{aligned} \tag{2.5}$$

where $Q_t \equiv Y_t - I_t - G_t$ and $C_t = (C_{\mathrm{T}t} + P_tC_{\mathrm{NT}t})$. Define R_s as the market discount factor for date s consumption, so that,

$$R^*_s = \frac{1}{\prod_{j=1}^{s}\left(1 + r^*_j\right)} \tag{2.6}$$

Summing over all periods of the infinite horizon, and imposing the following transversality condition:

$$\lim_{t\to\infty} E_0(R_tB_t) = 0, \tag{2.7}$$

the intertemporal budget constraint (Equation 2.5) could now be written as:

$$\sum_{t=0}^{\infty} E_0\left(R^*_tC_t\right) = \sum_{t=0}^{\infty} E_0\left(R^*_tQ_t\right) + B_0 \tag{2.8}$$

where B_0 is the initial net foreign assets. Following the Huang and Li (1993), and Campbell and Mankiw (1989) procedures, I show in Appendix B that Equation 2.8 may be log-linearized as follows:

$$\begin{aligned} -\sum_{t=1}^{\infty}\rho^t\left[\Delta q_t - \frac{1}{\Omega}\Delta c_t - \left(\frac{\Omega-1}{\Omega}\right)r^*_t\right] \\ = q_0 - \frac{1}{\Omega}c_0 + \left(\frac{\Omega-1}{\Omega}\right)b_0 \end{aligned} \tag{2.9}$$

Taking the expectation of Equation 2.9, and using the optimal consumption profile in Equation 2.4, Equation 2.9 may be written as:

$$\begin{aligned} -E_t\sum_{i=1}^{\infty}\beta^i\left[\Delta q_{t+i} - \frac{\gamma}{\Omega}\hat{r}_{t+i} - \left(\frac{\Omega-1}{\Omega}\right)r^*_t\right] \\ = q_t - \frac{1}{\Omega}c_t + \left(\frac{\Omega-1}{\Omega}\right)b_t \end{aligned} \tag{2.10}$$

The right-hand side of Equation 2.10 is similar to the definition of the current account in Equation 2.5,

[4] Given the condition that the empirical implementation of the model was based on de-meaned variables, the preference parameter, a constant, is dropped from Equation (2.3).

[5] The constant term at the end of the expression will drop out of the empirical model when I later de-mean all the variables including the consumption based interest rates.

except that its components are in log terms. I will refer to the transformed representation of the current account as CA*. Following the convention of choosing the steady state around which we linearize to be the one in which net foreign assets are zero, thereby $\Omega = 1$, Equation 2.10 becomes:

$$\mathrm{CA}_t^* = -E_t \sum_{i=1}^{\infty} \beta^i \left(\Delta q_{t+i} - \gamma \hat{r}_{t+i} \right) \qquad (2.11)$$

where

$$\mathrm{CA}_t^* \equiv q_t - c_t \qquad (2.12)$$

This condition shows how the current account is affected by both domestic and external shocks. It also shows how the current account serves as a conduit for international capital flow. Equation 2.11 states that an expected decrease (increases) in national cash flow would produce a current account surplus (deficit) as the consumption smoothing representative agent accumulates (decreases) interest yielding foreign assets. With respect to external shocks, Equation 2.11 also implies that a rise in the consumption-based interest rate will lead to an improvement in the current account position by inducing the representative household to decrease consumption below its smoothed level. It must be noted that Equation 2.11 differs from the basic model equation used by Sheffrin and Woo (1990) by the additional variable $\hat{r}_t$ (the consumption-based interest rate). Therefore, the restrictions implied by Equation 2.11 can be tested using the framework used by Sheffrin and Woo (1990), but augmented with the additional variable $\hat{r}_t$.

To test the restrictions that the current account depends on expected future values of national cash flow and interest rate, I need proxies for these two sets of expected values. This requires knowledge of information utilized by the agent. However, Campbell and Shiller (1987) have showed that under the null hypothesis of Equation 2.11, the current account itself should incorporate all of the consumers' information on future values of the lineal combination of the national cash flow and the interest rate specified in the equation. Assuming that consumers' forecast of the change in national cash flow and the consumption-based interest rate is based on a p-order vector autoregression (VAR) model of the form:

$$\begin{bmatrix} \Delta q_t \\ \mathrm{CA}_t \\ \hat{r}_t \end{bmatrix} = \begin{bmatrix} \psi_{11} & \psi_{12} & \psi_{13} \\ \psi_{21} & \psi_{22} & \psi_{23} \\ \psi_{31} & \psi_{32} & \psi_{33} \end{bmatrix} \begin{bmatrix} \Delta q_{t-1} \\ \mathrm{CA}_{t-1} \\ \hat{r}_{t-1} \end{bmatrix} + \begin{bmatrix} V_{1t} \\ V_{2t} \\ V_{3t} \end{bmatrix} \qquad (2.13)$$

For simplicity I assume $p = 1$ (this may easily be generalized for higher orders of VAR by writing a pth order VAR in first order form). Using Equation 2.13, and the conditions that $E_t[X_{t+j}] = \Psi^j X$, $E(V_{1t}) = E(V_{2t}) = E(V_{3t}) = 0$, and $\Psi =$ matrix $[\psi_{ij}]$, the restrictions on Equation 2.11 can be expressed as:

$$hz_t = -\sum_{i=1}^{\infty} \beta^i (g_1 - \gamma g_2) \Psi^i z_t \qquad (2.14)$$

where $z_t = (\Delta q_t \quad \mathrm{CA}_t \quad \hat{r}_t)'$, $g_1 = [1 \quad 0 \quad 0]$, $g_2 = [0 \quad 0 \quad 1]$, and $h = [0 \quad 1 \quad 0]$. For a given z_t, the right-hand side of Equation 2.14 can be expressed as:

$$\mathrm{CA}_t^* = kz_t \qquad (2.15)$$

where $k = -(g_1' - \gamma g_2')\beta\Psi(I - \beta\Psi)^{-1} = [\Phi_{\Delta q} \; \Phi_{\mathrm{CA}} \; \Phi_{\hat{r}}] = [0 \; 1 \; 0]$.

Equation 2.15 provides the model's prediction for the current account, consistent with the VAR and the restrictions of the intertemporal theory.

To evaluate the model, I have to test the hypothesis that $k = [0 \quad 1 \quad 0]$ in (2.15), so that $\mathrm{CA}_t^* = \mathrm{CA}_t$, by using the delta method to calculate a χ^2 statistic. This is consistent with the null hypothesis of consumption smoothing and the presence of free capital mobility. Let k^* be the difference between the actual k and the hypothesized value. Then, $k^{*\prime}((\partial k/\partial\Psi)V(\partial k/\partial\Psi)')^{-1}k^*$ will be distributed chi-square with three degrees of freedom, where V is the variance–covariance matrix of the VAR parameters and $(\partial k/\partial\Psi)$ is the matrix of derivatives of the k vector with respect to these parameters.

In addition, there are four other testable implications of the extended model. First, the variables included in the VAR are stationary. This is true because the infinite sum in Equation 2.11 converges only when the variables in the VAR are stationary. Second, the optimal current account is stationary. If the change in net output (Δq) is stationary (that is $I(0)$), then by Equation 2.11 the optimal current account CA* must also be stationary since it is a linear combination of $I(0)$ variables. Also, given the null of equality between the actual and optimal current account, the actual current account must be stationary. Third, the variance of the actual current account and the optimal current account are equal. If the actual current account is less volatile than the optimal current account, then capital mobility may be less than perfect. Conversely, if the actual current account is more volatile than the optimal current account, then speculative factors may be important in driving capital flows. Fourth, by Equation 2.11, the actual current account and the optimal current account must be equal.

Asymmetry in access to the international financial markets

One of the main assumptions of the intertemporal model of current account determination is perfect capital mobility. However, in many economies, especially the developing ones, economic policies and political environment do not permit free flow of capital. Sometimes even when capital could find its way out of a developing country, the international community may not feel confident to lend to that economy. This results in asymmetry in access to the international financial market. Earlier empirical studies on developing studies have not explicitly tested the validity of the assumption of perfect capital mobility. It is acknowledged the economies of almost all the countries in the sub-Saharan Africa region were dogged by unfavourable political and economic policies that inhibited the free flow of capital during the period 1960 to early 1980. This implies that economic agents in those economies faced asymmetric access to the international capital market.

In the Ghanaian context, there are two possible sources of asymmetric access to the international financial market. First, the government of Ghana has from time to time attempted to manage the international mobility of capital with measures of capital controls as part of the overall trade regime. The period prior to 1983 had various forms of capital controls to complement the overall control regime followed by various governments. These restrictions prevented economic agents in the Ghanaian economy from having full access to the international financial markets. Second, the political and macroeconomic sources of instability in the Ghanaian economy prior to 1983 reduced the growth potential of the economy and the ability of private agents to pay back funds borrowed on the international financial markets. In such a context, the international financial markets are likely to be reluctant to lend to Ghanaians who want to smooth their consumption, even though the Ghanaians often seem to have managed to find ways to send their excess funds abroad. This suggests that there may have been asymmetric access to the international financial market during the period prior to 1983.

The procedure used to test for asymmetric access follows the Callen and Cashin (1999) procedure of allowing for asymmetric behaviour on the part of economic agents in their responses to temporary shocks to national cash flow. That is, the representative agent is constrained from responding to a temporary expected increase in national cash flow (the agent is not able to borrow from the international financial market to smooth consumption), but is able to respond to a temporary expected reduction in national cash flow (the agent is able to lend on the international financial market). To implement the constrained model, the actual current account CA_t is divided into two main components as follows:

$$\mathrm{CA}_t^h = D_t^h\,\mathrm{CA}_t \quad \text{where } D_t^h = \begin{Bmatrix} 1 & \text{if } \mathrm{CA}_t > 0 \\ 0 & \text{if } \mathrm{CA}_t \leq 0 \end{Bmatrix} \tag{2.16}$$

$$\mathrm{CA}_t^l = D_t^l\,\mathrm{CA}_t \quad \text{where } D_t^l = \begin{Bmatrix} 1 & \text{if } \mathrm{CA}_t < 0 \\ 0 & \text{if } \mathrm{CA}_t \geq 0 \end{Bmatrix} \tag{2.17}$$

where $\mathrm{CA}_t^h(\mathrm{CA}_t^l)$ equals CA_t when CA_t is positive (negative); $\mathrm{CA}_t^h(\mathrm{CA}_t^l)$ is zero otherwise. The variables Δq_t^h and Δq_t^l are defined similarly as:

$$\Delta q_t^h = D_t^h\,\Delta q_t \quad \text{where } D_t^h = \begin{Bmatrix} 1 & \text{if } \Delta q_t > 0 \\ 0 & \text{if } \Delta q_t \leq 0 \end{Bmatrix} \tag{2.18}$$

$$\Delta q_t^l = D_t^l\,\Delta q_t \quad \text{where } D_t^l = \begin{Bmatrix} 1 & \text{if } \Delta q_t < 0 \\ 0 & \text{if } \Delta q_t \geq 0 \end{Bmatrix} \tag{2.19}$$

The relationship between the national cash flow and current account takes two forms when agents are faced with asymmetry access to the international financial market. While CA_t^h(current account surplus) will Granger-cause future changes (reduction) in national cash flow, as defined by Δq_t^l, CA_t^l, (current account deficit) will not Granger-cause future changes (increase) in national cash flow, as defined by Δq_t^h.

To conduct the formal test of the constrained consumption-smoothing model, I estimate a five-variable VAR of the form:

$$\begin{bmatrix} \Delta q_t^h \\ \Delta q_t^l \\ \mathrm{CA}_t^h \\ \mathrm{CA}_t^l \\ \hat{r}_t \end{bmatrix} = \begin{bmatrix} \psi_{11} & \psi_{12} & \psi_{13} & \psi_{14} & \psi_{15} \\ \psi_{21} & \psi_{22} & \psi_{23} & \psi_{24} & \psi_{25} \\ \psi_{31} & \psi_{32} & \psi_{33} & \psi_{34} & \psi_{35} \\ \psi_{41} & \psi_{42} & \psi_{43} & \psi_{44} & \psi_{45} \\ \psi_{51} & \psi_{52} & \psi_{53} & \psi_{54} & \psi_{55} \end{bmatrix} \begin{bmatrix} \Delta q_{t-1}^h \\ \Delta q_{t-1}^l \\ \mathrm{CA}_{t-1}^h \\ \mathrm{CA}_{t-1}^l \\ \hat{r}_{t-1} \end{bmatrix} + \begin{bmatrix} V_{1t} \\ V_{2t} \\ V_{3t} \\ V_{4t} \\ V_{5t} \end{bmatrix} \tag{2.20}$$

From Equation 2.20, the restrictions on the optimal current account (with asymmetry in access to the international financial market) are given by:

$$hz_t = -\sum_{i=1}^{\infty} \beta^i (g_1 - \gamma g_2)\Psi^i z_t \qquad (2.21)$$

where $z_t = (\Delta q_t^h \; \Delta q_t^l \; \mathrm{CA}_t^h \; CA_t^l \; \hat{r}_t)'$, $g_1 = [1 \;\; 1 \;\; 0 \;\; 0 \;\; 0]$, $g_2 = [0 \;\; 0 \;\; 0 \;\; 0 \;\; 1]$, and $h = [0 \;\; 0 \;\; 1 \;\; 1 \;\; 0]$. (This can also be generalized for a larger number of lags). For a given z_t, the right hand side of Equation 2.21 can be expressed as:

$$\mathrm{CA}_t^{**} = kz_t \qquad (2.22)$$

where $k = -(g_1^{/} - \gamma g_2^{/})\beta\Psi(I - \beta\Psi)^{-1} = [\Phi_{\Delta q_h} \; \Phi_{\Delta q_l} \; \Phi_{\Delta \mathrm{CA}_h} \; \Phi_{\Delta \mathrm{CA}_l} \; \Phi_{\hat{r}}] = [0\;0\;1\;1\;0]$. This is consistent with the null hypothesis of consumption smoothing and the absence of asymmetric access to the international financial market. This restriction implies that the dynamics of the actual current account series reflects those of the unconstrained optimal current account. Hence, CA_t^{**} is the optimal current account balance without credit constraints. The alternative hypothesis is that credit constraints on capital inflows generated asymmetries in the ability of the economic agents in Ghana to smooth consumption. That is $\Phi_{\Delta q_h} \neq \Phi_{\Delta q_l} \neq 0$; $\Phi_{\Delta \mathrm{CA}_h} = 1$; $\Phi_{\Delta \mathrm{CA}_l} \neq 1$; and $\Phi_{\hat{r}} = 0$. Hence, the dynamics of the actual current account series reflect those of the constrained optimal current account.

III. Estimation and Results

This section reports the empirical analysis of Ghana's current account based on the intertemporal model of the current account developed in the previous section. The analysis seeks to demonstrate that the intertemporal model of the current account can predict the dynamics of the current account series if the model is appropriately adjusted to reflect the nature of capital mobility and exchange rate policies in Ghana. For this purpose, the empirical tests are implemented in the following manner. First, the basic model that does not consider external shock is tested. Second, the model that includes external shock (the extended model) is tested to determine if the current account balances in Ghana responded to changes in the world interest rates and the expected exchange rates. Finally, the model that explicitly incorporates asymmetric access to the international financial market is tested. To render the results of this study comparable to previous studies, all the tests are conducted for the overall period, and the two sub periods (pre-ERP period and the post-ERP).

Data and parameter values

The PVMCA is tested using annual data from the International Financial Statistics (IFS) for Ghana for the period 1960–2002. The data on private consumption, government spending, investment and gross domestic product (GDP) are converted to real per capita by dividing the nominal variables by the GDP deflator ($1995 = 100$) and population. The national cash flow variable (q_t) was constructed by subtracting investment and government spending from GDP. The series for the current account (CA_t) of the balance of payments was constructed by subtracting the sum of consumption, investment and government spending from GDP. To obtain the change in the national cash flow (Δq_t), I took the log and first difference of the national cash flow series. Following the method of Barro and Sala-i-Martin (1990), I calculated the world real interest rate as follows. I collected short-term nominal interest rates (Treasury bill rates or its equivalent) on the G-7 countries. To obtain the *ex-ante* real interest rate, I adjusted the nominal interest rate by the expected inflation, which is forecasted using a five-annual autoregression. An average real interest rate is computed using time-varying weights for each country based on its share of real GDP in the G-7 data.

Given that the available real exchange rate data for Ghana from the IFS starts from 1975, I computed a proxy series in the following manner. First, I computed the bilateral exchange rates between Ghana and its six largest trading partners (United Kingdom, Germany, USA, Japan, France and the Netherlands). Then, using the calculated nominal exchange rates and the consumer price indices for Ghana and the relevant trading partner ($1995 = 100$), I constructed the weighted real exchange rate index for each country. The weight assigned to a trading partner is based on the extent of trade flows between Ghana and the relevant trading partner. The *ex ante*/expected change in the exchange rate is computed using a 3-year autoregression. To compute the consumption-based interest rates, $\hat{r}$, I adjusted the world interest rate for the expected change in the exchange rate. The procedure for the adjustment was specified in Section II. Since I am interested in the dynamic implications of the intertemporal model, the three series (CA, Δq_t and $\hat{r}$) were all demeaned.

The test for the optimal current account derived from the PVMCA requires the use of other parameters such as the intertemporal substitution variable 'γ', the share of tradable goods in the total consumption 'α', and the preference parameter 'β'. Following Ostry and Reinhart (1992), I used 0.45 for the intertemporal substitution variable 'γ' and 0.85 for the share 'α' of tradable goods in total consumption. Using the sample mean of our series on G-7 real interest rates, the calculated preference parameter 'β' was equal to 0.96.

Results

In order to use the VAR setup, there is the need to test for the stationarity of the variables entering the VAR (CA, Δq and $\hat{r}$). Two commonly suggested tests for stationarity, namely the Augmented-Dickey Fuller (ADF) test and the Phillips–Perron (PP) test were implemented. I conducted the test for three sample periods (the pre-ERP, the post-ERP and the overall periods). Table 1 summarizes the results of the ADF and PP tests for the pre-ERP (controlled), post-ERP (liberalized) and overall periods, respectively. All reported test statistics are greater than the 5% critical value of 1.95 for both tests which indicate that all the variables entering the VAR are stationary. According to the theory, the optimal current account must also be stationary since it must be the same as the actual current account. For the extended model, the optimal current account series is stationary for all three sub-periods. However, this is not the case with the basic model. The ADF and the PP tests indicate that the optimal current account is stationary at the 1% significance level for only the pre-ERP period.

Test of the basic PVMCA model

I started the empirical analysis by testing the basic model. In order to test for the $[\Phi_{\Delta q} \quad \Phi_{\mathrm{CA}}] = [0 \quad 1]$ restriction, I need to estimate a VAR in Δq and CA. Appendix Table C1 reports the VAR equations estimated by OLS. The Akaike Information Criterion (AIC) and the Schwartz Criterion (SC) were used to select the optimal lag, which proved to be one. The test results for the basic model are presented in Table 2. The estimated values of $[\Phi_{\Delta Q} \quad \Phi_{\mathrm{CA}}]$ are $[-1.439 \quad 1.087]$, $[-0.263 \quad -0.124]$, $[-0.247 \quad 0.574]$ for the pre-ERP, post-ERP and the overall period, respectively. The coefficients of both the current account and national cash flow for all the periods are not significantly different from zero, so that the null hypothesis of consumption smoothing and free capital mobility is rejected by the data. The χ^2 of the Wald test of the parameter restrictions on the VAR also rejects the model with a p-value of zero for all three periods. Finally, the ratio of the

Table 1. Unit root tests

	Pre-ERP (1960–1982)		Post-ERP (1983–2002)		Overall (1960–2002)	
Variables (deviations from the mean)	ADF	PP	ADF	PP	ADF	PP
Change in net output	−3.54**	−4.01**	−3.89**	−3.02**	−5.18**	−5.21**
Actual current account	−3.91**	−5.25**	−4.21**	−4.43**	−5.83**	−3.91**
Optimal current account (basic)	−2.89**	−2.64**	−1.34	−1.01	−1.93	−1.65
Optimal current account (extended)	−2.96**	−2.54*	−3.05**	−5.59**	−3.32**	−2.58*
Consumption-based Interest rate	−2.61**	−3.27**	−2.72**	−3.32**	−3.25**	−4.71**

Notes: ADF indicates the augmented Dickey–Fuller test; PP indicates Phillips–Perron. The critical value for 5% significance level is 1.95 for both tests.
* and **indicates the test statistic is significant at the 5% and 1% significance levels, respectively. Regressions do not include a constant or time trend.

Table 2. Test of the basic model

	Pre-ERP		Post-ERP		Overall	
k vector						
ΔQ_t	−1.439	(0.957)	−0.263	(0.583)	−0.247	(0.453)
CA_t	1.087	(1.328)	−0.124	(0.371)	0.574	(0.726)
χ^2-statistic	156.41		162.78		328.91	
p-value	0.000		0.000		0.000	
var(CA*)/var(CA)	2.64		0.15		0.33	

Note: Standard errors in parentheses.

variances of the optimal current accounts to that of the actual current accounts also indicates that the variance of the optimal current account is significantly different from that of the actual. Consistent with the results from the Wald test, Figs 1, 2 and 3 show that the basic PVMCA model does not provide a satisfactory fit for the actual current account data. This is especially worse during the post-ERP period where the model fail to capture the increasing current account deficits. These results are consistent with those of Ghosh and Ostry (1995s).

One of the possible reasons for the rejection of the basic PVMCA model is its failure to capture factors important to the determination of Ghana's current account. In particular, shifts in the trade and exchange regimes in Ghana over the sample period are likely to have been instrumental in determining the general direction of the current account data. It is also likely that the assumption of free capital flows may not be appropriate in the case of Ghana where capital controls have been an integral part of the overall external policies, especially during the pre-ERP era. Next, I attempt to address these issues by testing the basic PVMCA extended to include other important variables, namely changes in the world interest rate and exchange rate. I also adjust the PVMCA to allow for asymmetry in access to the international financial market.

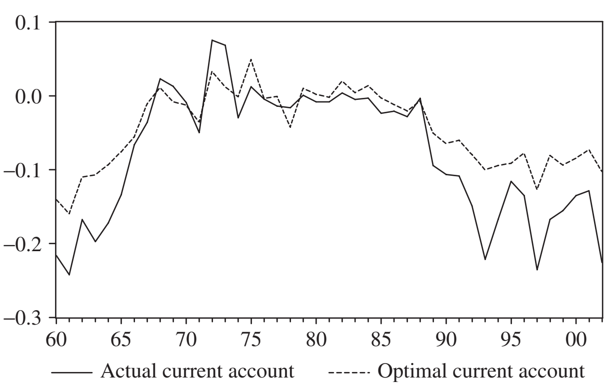

Fig. 1. Actual and optimal current account balances (overall): the basic model

Test of the extended PVMCA model

Bergin and Sheffrin (2000) concluded that the exclusion of external shocks from the basic PVMCA could explain why the basic PVMCA is often rejected by studies that use data from small open economies. In this study, I sought to determine if their findings applied to Ghana. To obtain the consumption-based interest rate as defined in Equation 2.4, I follow Ostry and Reinhart (1992) by using 0.45 for the intertemporal elasticity and 0.85 for the share of tradable goods. As discussed earlier in Table 1, the variables (Δq_t, CA_t, $\hat{r}_t$) entering the VAR are all stationary at the 5% significant level. According to the extended PVMCA, the optimal current account must also be stationary if the change in the national cash flow, the consumption-based interest rate and the actual current account series are stationary. This is also confirmed for the Ghanaian data by the ADF and the PP tests, which indicate that the optimal current account is, in fact, stationary at the 5% significance level.

The VAR parameters used in calculating the optimal current account are reported in appendix Table C2. On the basis of the AIC and the Schwartz Criterion, I chose one lag length. The present value test results are reported in third column of Table 3. For the overall period (which is reported in the third column of the table), the estimates of the k-vector are $[-0.27 \quad 0.92 \quad -0.01]$, which is close to the theoretically expected value of $[0 \quad 1 \quad 0]$ and show a significant improvement over the corresponding

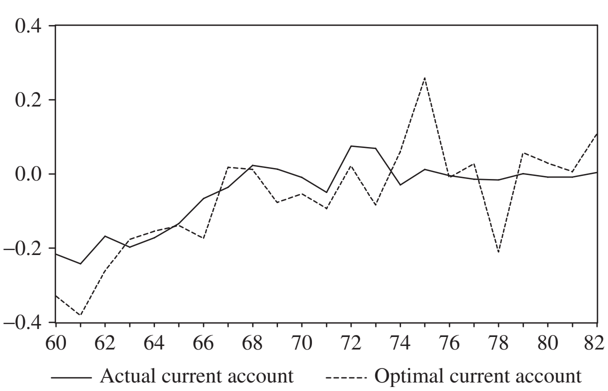

Fig. 2. Actual and optimal current account balances (pre-ERP): the basic model

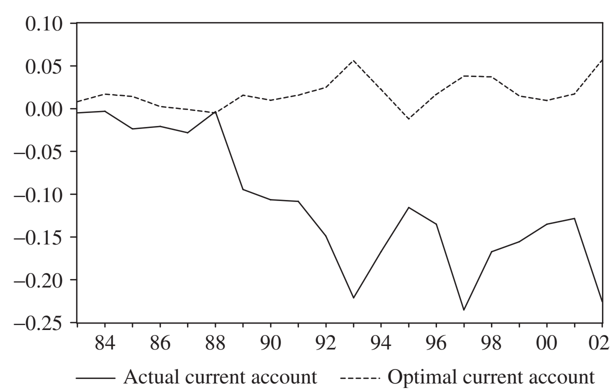

Fig. 3. Actual and optimal current account balances (post-ERP): the basic model

Table 3. Test of the extended model

	Pre-ERP		Post-ERP		Overall	
k vector						
ΔQ_t	−0.213	(0.294)	−0.501	(0.765)	−0.275	(0.376)
CA_t	0.194	(0.751)	1.039	(0.481)	0.923	(0.328)
$\hat{r}_t$	0.008	(0.937)	0.270	(0.416)	−0.012	(0.416)
χ^2-statistic	78.513		2.94		3.617	
p-value	0.000		0.135		0.184	
var(CA*)/var(CA)	0.07		0.98		0.91	

Note: Standard errors in parentheses.

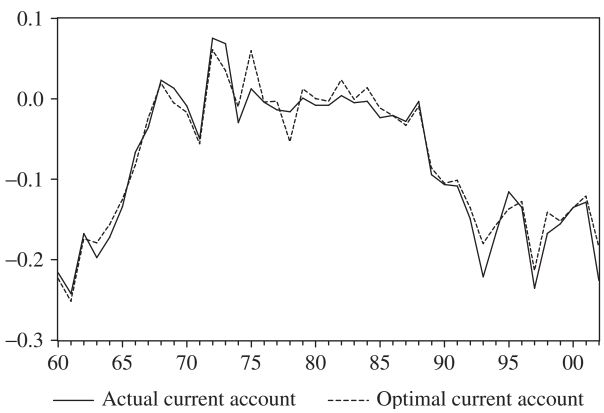

Fig. 4. Actual and optimal current account balances (overall): the extended model

result for the basic PVMCA. The coefficient on the current account variable is close to its theoretical value of unity and significantly different from zero. All other coefficients are not significantly different from zero. With the p-value of 0.18 the null hypothesis of consumption smoothing and free capital mobility cannot be rejected. Finally, the variability in the predicted current account is 91% of the actual data. Figure 4 shows the actual current account and the predicted current account derived from the model that includes variations in interest rates and exchange rates, over the entire period (1960–2002). It shows that the extended model does well in predicting the general direction of the actual current account balances. This result is consistent with that of Adedeji *et al.* (2005).

The above result must be interpreted with caution. As an integral part of the overall external policies, the exchange rates in Ghana were fixed for a considerable period during the pre-ERP period. Therefore, the consumption-based interest rate could not have been an important determinant of the current account balances during that period. Also the existence of capital controls over the same period prevented economic agents from using the international capital market to smooth consumption. If these claims are true, then the factors determining the dynamics of the current account will differ between the controlled and liberalized regimes. To explicitly investigate this proposition, I estimated the extended model separately for the pre-ERP and the post-ERP periods.

The test results for the two sub-periods are also reported in the first and second columns of Table 3. The estimated values of the k-vector for the pre-ERP period are [−0.21 0.19 0.01], which are not close to their theoretical values of [0 1 0] except the consumption based interest rate. The t-statistics suggest that all the variables are not significantly different from zero. The χ^2 of the Wald test of the parameter restrictions on the VAR rejects the model with a p-value of zero, hence the extended model is rejected by the data for the pre-ERP period. The ratio of the variance of the optimal current account to that of the actual current account also indicates that the variance of the optimal current account is only 7% of the actual current account. These results indicate that changes in the interest rates and the exchange rates may not explain the current account balances during the pre-ERP period. However, the conditions that influenced the current account during the period still remain to be captured. Consistent with the results from the Wald test, Fig. 5 shows that the extended model does not provide a satisfactory fit for the actual current account data.

On the other hand, the result for the post-ERP period reported in the second column of the table implies that with the introduction of changes in the world interest rate and the exchange rate, the extended model's prediction is fairly consistent with the theory. The estimated values of the k-vector for the pre-ERP period are [−0.50 1.04 0.27]. The coefficient on the change national cash flow (−0.50) and the consumption-based interest rate (0.27) are not significantly different from zero. The coefficient on the current account variable is significant and close to its theoretical value of unity. The reported χ^2 statistic and its p-value indicate that the model extended to

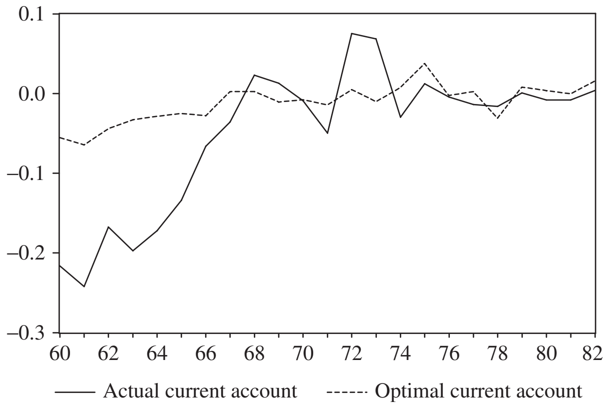

Fig. 5. Actual and optimal current account balances (pre-ERP): the extended model

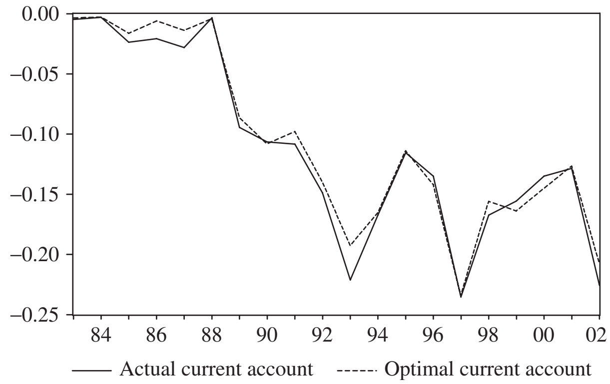

Fig. 6. Actual and optimal current account balances (post-ERP): the extended model

include changes in the consumption-based interest rate cannot be rejected for the post-ERP period. Hence, the trend devaluation of the Ghanaian currency and the variations in the world interest rates help explain the increasing current account deficits over the post-ERP period. These results are consistent with the shift in policy regimes. During the ERP period, the government of Ghana embarked on increasing liberalization of the capital account of the balance of payments and moved away from a fixed exchange rate system to a freely floating exchange rate regime. Hence changes in the exchange rates and the world interest rates affected the current account balances through intertemporal consumption smoothing. Finally, the volatility of the optimal current account is almost the same as the variability of the actual current account. Figure 6 shows that the extended model does provide a satisfactory fit for the actual current account data. It is able to capture the increasing current account deficits from the late 1980s until the end of the period.

Test of asymmetry in capital flows

In this section, I explicitly imposed asymmetric access to the international financial market on the PVMCA and tested for its effect on consumption smoothing in Ghana. Specifically, I conducted the following tests. For the pre-ERP period, I tested if the capital controls imposed during the period were binding and whether the optimal current account with asymmetric access to the international financial market closely tracks the actual current account balances. For the post-ERP period, I tested the effectiveness of the liberalization of the capital account of the balance of payment since the implementation of the Economic Recovery Program in 1983.

I conducted the test by imposing asymmetric access on the extended model for all three periods (overall, pre-ERP and post-ERP). The estimated values of the k vector are reported in Table 4. For the overall period, the estimates [0.37 −0.12 1.17 1.29 −0.01], are quite different from the expected theoretical values. The χ^2 of the Wald test of the parameter restrictions is 98.63 with a *p*-value of 0.04. Hence, the null hypothesis is overwhelmingly rejected. This suggest that the capital controls associated with the control regimes and the political and macroeconomic sources of instability in the Ghanaian economy prevented private economic agents from using the international financial market to smooth consumption. Figure 7 below graphs the actual current account and the optimal one under asymmetric access to international financial markets. The optimal current account is relatively close to the actual current account, though not as close as that of the extended model without the imposition of asymmetric access.

The results for the two sub-periods differ markedly. From Table 4, the null hypothesis is rejected for the pre-ERP period. The χ^2 of the Wald test of the parameter restrictions is 109.28 with a *p*-value of 0.03. Figure 8 shows that for the pre-ERP period, the prediction of the model is improved over that of the extended model without asymmetric access. On the other hand, the null hypothesis is accepted for the post-ERP. The χ^2 of the Wald test of the parameter restrictions is 2.16 with a *p*-value of 0.18, implying the absence of asymmetric access during the period. Figure 9 shows that the optimal current account with asymmetric access misses the dynamics of the actual current account for the post-ERP period. The unit root tests reported in Table 5 indicate that the optimal current account series for all the three data set are stationary.

Table 4. Test of asymmetry in capital flows

	Pre-ERP		Post-ERP		Overall	
k vector						
ΔQ_t^h	0.206	(0.641)	−0.425	(0.826)	0.367	(0.126)
ΔQ_t^l	0.185	(0.063)	−1.148	(0.638)	−0.119	(0.539)
CA_t^h	1.18	(0.563)	1.051	(0.513)	1.17	(0.478)
CA_t^l	1.252	(0.524)	1.076	(.0524)	1.29	(0.501)
$\hat{r}_t$	−0.261	(0.245)	0.141	(0.484)	−0.012	(0.416)
χ^2 statistic	109.28		2.16		98.63	
p-value	0.03		0.18		0.04	
Var(CA*)/var(CA)	0.83		1.12		1.11	

Note: Standard errors in parentheses.

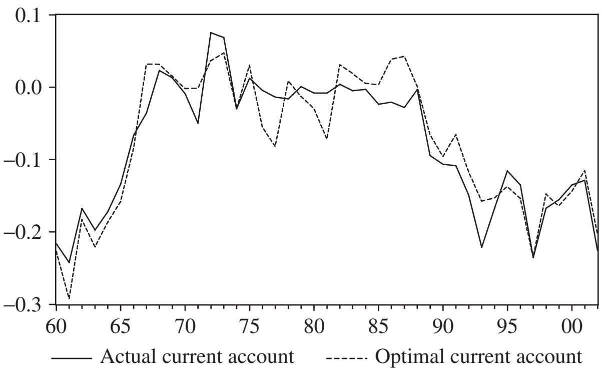

Fig. 7. Actual and optimal current account balances (overall): extended model with asymmetry in capital flows

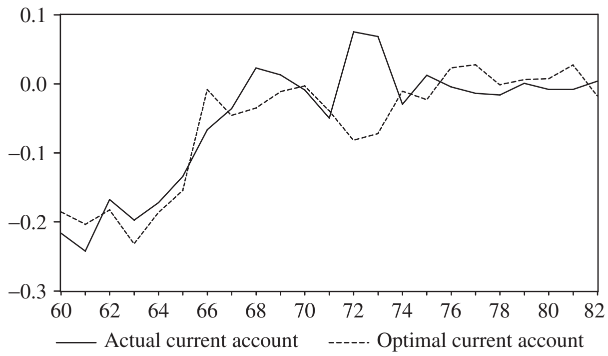

Fig. 8. Actual and optimal current account balances (pre-ERP): extended model with asymmetry in capital flows

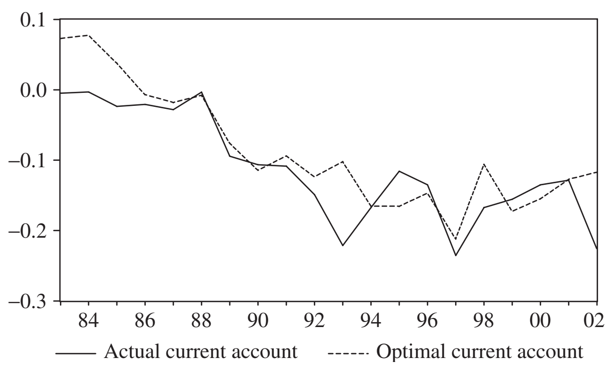

Fig. 9. Actual and optimal current account balances (post-ERP): extended model with asymmetry in capital flows

It must be recalled that, in the previous test, the extended model was rejected for the pre-ERP period. As previously mentioned, this may imply that the excessive capital and exchange controls that occurred during the period did not permit agents to respond to changes in the world interest rate nor allow sufficient variations in the exchange rate. As a result, I further tested for asymmetric access over the pre-ERP period using the basic PVMCA model that does not include variations in interest rates and exchange rates. The results are much better than the one with variations in interest rates and exchange rates. The estimated values of the k vector are [0.27 −0.13 0.99 1.27], which is different from the expected theoretical values of [0 0 1 1]. The χ^2 of the Wald test of the parameter restrictions is 243 and its p-value of zero implies a stronger rejection of the null hypothesis. Figure 10 shows that the dynamics of the actual current account series reflects those of the constrained optimal current account. In other words, the policies followed during the control regime prevented changes in the world interest rates and the exchange rates from affecting the current account series. The ADF and the PP tests from Table 5 indicate that the optimal current account is stationary at the 5% significance level.

The analysis above strongly suggests that the gradual reduction of the constraints on capital flows in Ghana has enabled economic agents to use the international financial market to smooth consumption. It also implies that the determinants of the dynamics of the current account series differ across different policy regimes. Hence, empirical application of the PVMCA model to data on developing

Table 5. Unit root tests-asymmetric access

	Pre-ERP (1960–1982)		Post-ERP (1983–2002)		Overall (1960–2002)	
Variables	ADF	PP	ADF	PP	ADF	PP
Optimal current account (Extended Model)	−3.27**	−2.88**	−3.64**	−3.09**	−3.99**	−3.85**
Optimal current account (Basic Model)	−3.34**	−3.91**	–	–	–	–

Notes: ADF indicates the augmented Dickey–Fuller test; PP indicates Phillips–Perron. The critical value for 5% significance level is 1.95 for both tests.
**Indicates the 1% significance level. Regressions do not include a constant or time trend.

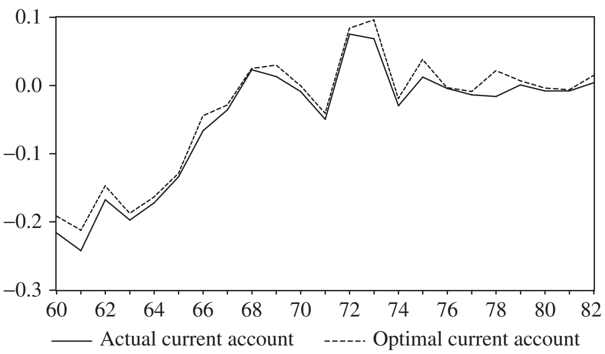

Fig. 10. Actual and optimal current account balances (pre-ERP): basic model with asymmetry in capital flows

countries should pay attention to the different external policy regimes that those countries followed over the study period.

Granger causality test

According to the intertemporal models of the current account, an expected rise in future income over that of current income leads to an increase in current consumption and a reduction in saving, so that if investment and government expenditure does not change, the current account must deteriorate. Conversely, if private agents expect a decline in future income from that in the current period, they will reduce current consumption, so that, with present income unchanged, saving will increase. If investment and government expenditure remain constant, the representative agent will lend part of this saving abroad, which will improve the current account. With asymmetric access to the international market, the relationship between the expected rise in output and the deterioration in the current account weakens because the representative agent is not able to borrow from abroad to increase consumption.

If the assumption of asymmetric access to international financial market is binding, then CA_t^h will Granger-cause Δq_t^l, but CA_t^l will not Granger-cause Δq_t^h. To test for this effect, I estimated a one lag, five-variable VAR including $\Delta q_t^h, \Delta q_t^l, CA_t^h, CA_t^l$ and $\hat{r}$ variables for the overall and the post-ERP periods. Our estimations show that for the overall period, the null hypothesis of no Granger-causality between CA_t^h and Δq_t^l is rejected at the 5% significance level. The F-statistic is 3.26 and the p-value is 0.02. Further, the null hypothesis of no Granger-causality between CA_t^l and Δq_t^h is not rejected at the 5% significance level, with an F-statistic of 0.77 and a p-value of 0.57. Once again, these results confirm the existence of asymmetric access to the international financial markets for the overall period. Correspondingly, the null hypothesis of no Granger-causality between CA_t^h and Δq_t^l is rejected at the 5% significance level with an F-statistic of 2.03 and a p-value of 0.04. Furthermore, the null hypothesis of no Granger-causality between $CA^l{}_t$ and Δq_t^h is rejected at the 5% significance level for the post-ERP period. The F-statistic is 4.30 and the p-value is 0.02. Hence, there is no asymmetry in capital flows during the post-ERP period.

Consistent with our results from the test of asymmetry in capital flows, we estimated a one lag, four-variable VAR including $\Delta q_t^h, \Delta q_t^l, CA_t^h$ and CA_t^l, for the pre-ERP period. The null hypothesis of no Granger-causality between CA_t^h and Δq_t^l is rejected at the 5% significance level for the pre-ERP period with the F-statistics equal to 3.44 and the p-value of 0.04. Further, the null hypothesis of no Granger-causality between CA_t^l and Δq_t^h is not rejected at the 5% significance level, with an F-statistic of 0.11 and a p-value of 0.98. This result strongly supports the proposition that the presence of the capital and the exchange controls prevented economic agents in Ghana from using the international financial market to smooth their consumption path during the period prior to the implementation of the Economic recovery program in 1983.

IV. Conclusion and Policy Implication

The intertemporal model of the current account, which maintains that the current account of a country serves as a buffer for smoothing national consumption against shocks to its net output, has increasingly been used to determine the current account balances in both developed and developing countries. However, in general, the results from the basic version of this model, especially for developing countries, have not been encouraging. One important reason for the failure of the basic model for developing countries is that the key assumption of perfect capital mobility does not apply over a considerable period during which these economies implemented capital controls as part of their overall external policies. These capital controls generated conditions of asymmetry in capital flows whereby domestic economic agents could sometimes easily lend abroad but could not easily borrow from abroad. This requires an explicit imposition of asymmetric access to the international capital market on the model in order to identify the true dynamics of the current account balances during the period of capital control. Another reason for the failure of the model is that different external policy framework may have different determinants of the dynamics of the current account series. This article, therefore, has demonstrated that the model can predict the dynamics of the actual current account series if it is appropriately adjusted to reflect the nature of capital mobility and exchange rate policies in these countries.

In this article, I have used the basic PVMCA and another version that explicitly incorporates external shocks and asymmetry in capital flows to examine the dynamics of the current account data of Ghana. I showed that the basic intertemporal model of the current account (the version which does not allow changes in the interest rate, exchange rates and asymmetry in capital flows) fails to satisfactorily explain movements in Ghana's current account irrespective of the sample period. These results are consistent with those of Ghosh and Ostry (1995). Furthermore, I found that for the liberalized trade and payment regime, the model is capable of explaining the dynamics of the actual current account provided that changes in the interest rate and the exchange rate are incorporated into the model. Finally, I found support for the proposition that there existed asymmetry in access to the international financial market during the controlled regime: the basic PVMCA which explicitly incorporate such asymmetry performed better for the controlled regime than the version without it. I interpreted this as a confirmation that the actual current account series during the pre-ERP period were optimal given the constraints on capital flows. However, there is no evidence that economic agents faced asymmetry in access to the international financial market during the liberalized regime period. The policy implication is that the government of Ghana should continue to pursue policies aimed at integrating the Ghanaian economy into the world economy so that the current account series will continue to respond to external shocks while reflecting consumers' unconstrained optimized choices.

The results of the study suggest that economic agents in Ghana did optimize their consumption path during both the capital control and the liberalized regimes. The only difference is that consumption was optimized in the presence of constraints on capital inflow during the control regime (pre-ERP period), whereas consumption was optimized without any constraints on capital flows during the liberalized regime (post-ERP period). Given that these two broad policy regimes were characterized by large current account deficits, there is therefore, the need for future empirical work to investigate whether the path of the current account imbalances in Ghana were sustainable during both regimes. This should be done by projecting into the future the macroeconomic policy stance and private sector behaviour at the beginning of each policy regime to determine if the resulting path of the current account imbalances does not breach the country's intertemporal budget constraint. This approach is particularly important because it will provide insights into why Ghana's debt increased unsustainably to levels where the country had to join the enhanced HIPC (heavily indebted poor countries) program in 2001.

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Appendix A

Deriving the optimal consumption profile

I follow Dornbusch (1983) and Obstfeld and Rogoff (1996) in deriving the optimal consumption profile. Define an index of total consumption expenditure in terms of traded goods as$C_t^* = C_{\mathrm{T}t}^{\alpha} C_{\mathrm{NT}t}^{1-\alpha}$. Define also the consumption-based price index, P_t^* as the minimum amount of consumption expenditure $C_t = C_{\mathrm{T}t} + P_t C_{\mathrm{NT}t}$ such that $C_t^* = 1$ given P_t. Traded goods are the numeraire. Differentiating Equation 2.1 using Equation 2.2, with respect to consumption of tradables and nontradable goods yields:

$$U_{\mathrm{NT}t} = P_t U_{\mathrm{T}t} \tag{A1}$$

hence the following optimal allocation of expenditure between tradables and nontradables:

$$C_{\mathrm{T}t} = \alpha C_t \quad \text{and} \quad C_{\mathrm{NT}t} = (1-\alpha)\frac{C_t}{P_t} \tag{A2}$$

Substitute the optimal values of tradables and nontradables into the definition of C_t^*.

$$C_t^* = (\alpha C_t)^{\alpha}\left[(1-\alpha)\frac{C_t}{P_t}\right]^{1-\alpha} \tag{A3}$$

Now use the condition that P^* is defined such that $C_t^* = 1$. This produces:

$$\left(\alpha P_t^*\right)^{\alpha}\left[(1-\alpha)\frac{P_t^*}{P_t}\right]^{1-\alpha} = 1. \tag{A4}$$

Solving Equation A4 for the consumption-based price index, P_t^*, yields:

$$P_t^* = P_t^{1-\alpha}\left[\alpha^{-\alpha}(1-\alpha)^{-(1-\alpha)}\right] \tag{A5}$$

I then used Equation A5 to rewrite the budget constraint of the optimization problem Equation 2.2 as

$$P_t^* C_t^* = Y_t + \left(1 + r_t^*\right)B_{t-1} - B_t - I_t - G_t \tag{A6}$$

and the period utility function as

$$U\left(C_t^*\right) = \frac{1}{1-\sigma}\left(C_t^*\right)^{1-\sigma} \tag{A7}$$

This implies an intertemporal Euler equation:

$$E_t\left[\beta\left(1 + r_{t+1}^*\right)\left(\frac{P_t^*}{P_{t+1}^*}\right)\left(\frac{C_t^*}{C_{t+1}^*}\right)^{\sigma}\right] = 1 \tag{A8}$$

To ensure empirical implementation, I rewrite Equation A8 in terms of consumption expenditure and the relative price of nontradable goods:

$$E_t\left[\beta\left(1+r^*_{t+1}\right)\left(\frac{C_t}{C_{t+1}}\right)^{\sigma}\left(\frac{P_t}{P_{t+1}}\right)^{(1-\sigma)(1-\alpha)}\right]=1 \quad \text{(A9)}$$

Appendix B

Deriving the log-linearized intertemporal budget constraint

The intertemporal budget constraint Equation 2.8 can be rewritten as:

$$X_0 - \Gamma_0 = B_0 \quad \text{(B1)}$$

where $X_0 = C_o + \Sigma^{\infty}_{t=1} R^*_t C_t$ and $\Gamma_0 = Q_o + \Sigma^{\infty}_{t=1} R^*_t Q_t$. Following the Huang and Li (1993) and Campbell and Mankiw (1989) procedures, the present value of current and future consumption defined by $X_0 = \Sigma^{\infty}_{t=0} E_0(R^*_t C_t)$ was log-linearized to obtain:

$$c_0 - x_0 = \sum_{t=1}^{\infty} \rho^t \left(r^*_t - \Delta c_t\right) \quad \text{(B2)}$$

where $c_0 = \ln C_0$, $x_0 = \ln X_0$, $\Delta c_t = c_t - c_{t-1}$, and $\rho = 1-(\bar{c}/x)$ where $\bar{c}$is the steady-state value of the log of consumption.[6] Similarly, the present value of current and future national cash flow defined by $\Gamma_0 = \Sigma^{\infty}_{t=0} E_0(R^*_t Q_t)$ was log-linearized to obtain:

$$q_0 - \varphi_0 = \sum_{t=1}^{\infty} \rho^t \left(r^*_t - \Delta q_t\right) \quad \text{(B3)}$$

where $q_0 = \ln Q_0$, $\varphi_0 = \ln \Gamma_0$, and $\Delta q_t = q_t - q_{t-1}$. Now a further log-linearization of the intertemporal budget constraint, $X_0 - \Gamma_0 = B_0$ yields:

$$x_0 - \varphi_0 = \left(1 - \frac{1}{\Omega}\right)[b_0 - \varphi_0] \quad \text{(B4)}$$

where $b_0 = \ln B_0$, $\Omega = 1-(\bar{B}/X_0)$, is less than unity, and $\bar{B}$ is the steady-state value of the net foreign assets. Substituting for x_0 and φ_0 respectively from (B2) and (B3) into (B4), produces the following log-linearized intertemporal budget constraint reported in the text:

$$-\sum_{t=1}^{\infty} \rho^t \left[\Delta q_t - \frac{1}{\Omega}\Delta c_t - \left(\frac{\Omega-1}{\Omega}\right) r^*_t\right] = q_0 - \frac{1}{\Omega} c_0 + \left(\frac{\Omega-1}{\Omega}\right) b_0 \quad \text{(B5)}$$

Appendix C

Table C1. VAR estimates (The basic model)

Period	ΔQ_{t-1}		CA_{t-1}	
Pre-ERP				
ΔQ_t	0.089	(0.225)	−0.075	(0.142)
CA_t	−0.136	(0.142)	0.786	(0.089)
Post-ERP				
ΔQ_t	0.207	(0.252)	−0.021	(0.122)
CA_t	−0.207	0.256)	1.028	(0.095)
Overall				
ΔQ_t	0.158	(0.161)	0.016	(0.080)
CA_t	−0.105	(0.128)	0.917	(0.064)

Note: Standard errors in parentheses.

Table C2. VAR estimates (The extended model)

Period	ΔQ_{t-1}	CA_{t-1}	$\hat{r}_{t-1}$
Pre-ERP			
ΔQ_t	0.116 (0.249)	−0.073 (0.145)	−0.067 (0.235)
CA_t	−0.224 (0.148)	0.781 (0.086)	0.221 (0.140)
$\hat{r}_t$	0.172 (0.253)	0.064 (0.147)	0.118 (0.239)
Post-ERP			
ΔQ_t	0.162 (0.260)	0.054 (0.097)	−0.108 (0.128)
CA_t	−0.229 (0.268)	1.017 (0.101)	−0.053 (0.133)
$\hat{r}_t$	−0.799 (0.431)	−0.040 (0.162)	0.309 (0.213)
Overall			
ΔQ_t	0.169 (0.161)	−0.001 (0.082)	−0.114 (0.115)
CA_t	−0.107 (0.130)	0.921 (0.066)	0.019 (0.019)
$\hat{r}_t$	−0.201 (0.212)	−0.042 (0.108)	0.338 (0.152)

Note: Standard errors in parentheses.

[6] Note that $\bar{c}/x$ is less than unity.