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Macroeconomic Uncertainty, Precautionary Savings and the Current Account

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Abstract

The relationship between current account developments and changes in the macroeconomic environment remains a key issue in open economy macroeconomics. This paper extends the standard intertemporal optimizing model of the current account to incorporate the effects of macroeconomic uncertainty on private savings behavior. It is shown that the greater the uncertainty in national cash flow, defined as output less investment less government expenditure, the greater is the precautionary demand for savings and, other things equal, the larger is the current account surplus. Empirical support for the model is found using quarterly data from four large industrial countries.

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C32, E21, F32

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I. Introduction

The relationship between current account developments and changes in the macroeconomic environment remains a key issue in open economy macroeconomics. Modern theories of current account determination (see, for example, Sachs [1982]) have tended to view the latter as a mechanism for smoothing the path of consumption in the face of a variety of shocks, be they to productivity, government spending, or foreign demand. In the absence of capital mobility, a temporary increase in government spending or a negative productivity shock that temporarily reduced real income would require full crowding out of private absorption to ensure external balance. Once intertemporal trade is allowed, however, the path of consumption can be smoothed relative to the path of income by borrowing in the international capital market. What matters for the current account, according to this view, is permanent income. When some shock causes the level of real income to be temporarily depressed, that is below its permanent value, consumption will be maintained, and the current account will tend to be in deficit. Permanent shocks, on the other hand, will tend to result in full adjustment of private consumption, with little impact on the current account.

Although this line of reasoning has provided many insights into the impacts of a variety of disturbances in an open economy--be they in the realm of fiscal policies, commercial policies, or terms of trade shocks, the models have generally embodied the assumption of perfect foresight, implying that there is no ex ante uncertainty regarding the future values of various macroeconomic variables (income, government spending) that affect consumption and saving decisions today. 1/ While this assumption may have been justified by considerations of analytical simplicity, it is argued in what follows that the assumption of certainty equivalence leads one to ignore some potentially important channels through which macroeconomic shocks affect the current account. For this reason, adopting the certainty equivalence assumption may lead one to make inappropriate inferences regarding the dynamics followed by the current account as a function of changes in the macroeconomic environment. To the extent that prescriptions regarding the appropriate extent of adjustment to disturbances affecting the current account are derived from models that ignore the role of uncertainty, the results that follow may be regarded as having considerable policy relevance as well.

At the level of the individual agent, an increase in the variability of uninsurable labor income is known to raise savings and reduce current

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1/ Indeed, the term "shock" in these models refers merely to a one-time change in the exogenous variables--events to which agents are assumed to have assigned a zero probability.

consumption (see Caballero [1990]). 1/ Quite simply, individuals with uncertain income will want to "save for a rainy day." Indeed, under the plausible assumptions of time separable utility and convex marginal utility, the greater the variance of the stochastic process for labor income, the higher will be the level of savings and the growth rate of consumption.

While labor income uncertainty at the microeconomic level is increasingly being cited as an important determinant of aggregate consumption and saving behavior in the context of closed-economy macroeconomic models, it is perhaps surprising that the implications for macroeconomic variables in an open economy have received virtually no attention at all in the literature. Yet if precautionary savings are a significant component of aggregate savings, as Zeldes [1989] and Caballero [1990] among others have contended, one would expect this to be reflected, in the context of an open economy, by data on the current account, which after all simply measures the economy's national saving net of investment. Assuming that one could identify a suitable measure of macroeconomic uncertainty in an open economy, an implication of the reasoning so far would be that periods in which uncertainty increased would witness an increase in national saving which, other things equal, would be reflected in a larger current account surplus.

This is the main issue examined in this paper. It is first shown, in the context of a fully optimizing model of an open economy, that the current account depends on two factors. The first, which is present in both the certainty and uncertainty versions of the model, is equal to the negative of the discounted sum of expected changes in national cash flow, defined as output (GDP) less investment less government spending. If national cash flow is expected on average to grow over time, this discounted sum will be positive, and the current account will be in deficit today, as agents dissave against resources that they expect to earn in the future. The second term, which is only present in the uncertainty version of the model, is proportional to the variance of the innovation to national cash flow. This term reflects the role of precautionary savings in current account determination. Ceteris paribus, a greater variability of national cash flow will prompt greater external savings for the economy as a whole, and hence

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1/ Early literature on precautionary savings, much of which was inspired by empirical findings of Fisher [1956] and Friedman [1957], focussed on individual labor income uncertainty. Using two-period models, Leland [1968], Sandmo [1970], and Drèze and Modigliani [1972] showed that there would be a precautionary motive for savings as long as marginal utility is convex--a property of utility functions exhibiting decreasing absolute risk aversion. Miller [1976] confirmed these results in a multi-period setting. More recently, Skinner [1988] has argued that precautionary savings account for a significant proportion of total savings in the United States. Zeldes [1989] and Caballero [1990] have tried to explain the observed positive growth in consumption during periods of low or negative real interest rates (see Deaton [1986]) by appealing to the precautionary demand for savings.

a larger current account surplus. The latter is the economy's insurance against future shocks.

Following Campbell [1987] and Ghosh [1990], we estimate the expected changes in national cash flow by means of a vector autoregression. Using data from four large industrial countries, we then test whether a greater variance of innovations to cash flow indeed induces an increase in the current account surplus. 1/ Our results are encouraging. For three of the four countries, we find a statistically significant effect of this measure of macroeconomic uncertainty on the current account.

The remainder of the paper is organized as follows. In order to clarify the role of cash flow variability in determining savings behavior and the current account, section II provides a simple two-period example. With a view toward empirical implementation, section III then extends the model to an infinite horizon setting and derives a closed-form expression for the current account. Section IV describes the data and presents the econometric results. Section V offers some brief concluding remarks.

II. A Two-Period Example

In order to examine the effects of macroeconomic uncertainty on the current account, a theoretical model must be adopted. In line with much of the recent literature on current account determination, the model used here emphasizes not the intratemporal trade balance between exports and imports but the intertemporal trade implied by the divergence of savings and investment. The current account in this model thus serves as a means of smoothing consumption in the face of shocks to output, investment, and government expenditure.

It is useful to define the concept of national cash flow as output (GDP) minus government expenditure minus investment. Then the consumption smoothing motive, induced by the concavity of the utility function, implies that a given fluctuation in national cash flow should only affect consumption by the present value of that fluctuation. The remainder of the shock is reflected in the current account. A temporary, unanticipated fall in output, for example, would be associated with a current account deficit, as the country tries to smooth consumption by borrowing in international capital markets.

Our interest lies not only in the effects of movements in national cash flow on the current account, but also in how changes in the variance of innovations to national cash flow affect the country's external savings.

1/ The goal was to test the model for all Group of Seven (G-7) countries. However, the necessary quarterly national accounts data (in particular as far as GNP is concerned) were unavailable in the cases of Germany, Italy, or France, over a sufficiently long sample.

Intuitively, the greater the uncertainty the larger the current account surplus which the country will wish to maintain, in order to insure itself against adverse shocks. 1/

In this section we illustrate the effects of uncertainty on the current account by means of a simple two-period model of an open economy in which there is a single homogeneous commodity that can be used for consumption (by either the private sector or the government) or investment. There is perfect capital mobility in the sense that the country can borrow and lend in unlimited amounts at a given world interest rate subject only to its lifetime budget constraint. The world interest rate is the yield on a real bond which is the only asset in the model; in particular, complete markets which would allow the country to trade contingent claims for every state of nature are not assumed to exist. Thus, shocks to national cash flow are assumed to be non-diversifiable.

As is well known, the level of investment in such a model is chosen so as to maximize the present value of wealth, given the level of the world (real) interest rate, which is assumed to be exogenous to the home country. 2/ This implies that investment is chosen so as to equate its marginal product with the interest rate, independent of the time path of consumption. Consumers then choose to maximize lifetime expected utility, given the level of their wealth.

Accordingly, the representative agent is assumed to maximize:

$$(1) \qquad u(c_1) + \frac{1}{(1+r)} E(u(c_2))$$

where we assume that $u'(.) > 0$, $u''(.) < 0$, $u'''(.) > 0$. The maximization is subject to the intertemporal budget constraint:

$$(2) \qquad c_1 + \frac{c_2}{(1+r)} = z_1 + \frac{z_2}{(1+r)}$$

1/ Notice that the current account (and not simply the stock of external assets) will be positively related to the degree of uncertainty. In the presence of uncertainty, consumption will be growing over time as the country accumulates foreign assets. The higher the level of consumption, however, the larger will be the stock of assets required to insure that consumption level. Thus the current account will always be an increasing function of the degree of uncertainty.

2/ The real interest rate is assumed to be a known constant here, and for convenience set equal to the rate of time preference in what follows. In the empirical implementation of the model, however, we allow for a divergence between the interest rate and time preference rate.

where z is national cash flow, $z \equiv q - i - g$, and can be taken to be exogenous. 1/ The budget constraint also embodies the assumption of perfect capital mobility, since the country is assumed to be able to borrow or lend at the exogenous interest rate, r. Because the constraint (2) is required to hold for all states of nature, it reflects our assumption that complete markets for state contingent claims do not exist. The first-order condition for an optimum is:

$$(3) \qquad u_c(c_1) = E(u_c(c_2))$$

Suppose, initially, that there is no uncertainty about the evolution of national cash flow and, in particular, that cash flow is constant over time: $z_1 = z_2 = \bar{z}$. The first-order condition then implies:

$$(4) \qquad u_c(c_1) = u_c(c_2) \Rightarrow c_1 = c_2$$

From the intertemporal budget constraint, it follows that:

$$(5) \qquad c_1 = c_2 = z_1 = z_2 = \bar{z}$$

The current account is equal to GNP minus absorption, and since the country is assumed to have no initial foreign assets or liabilities, GNP is equal to GDP (q) in period 1. Therefore the current account is equal to zero:

$$(6) \qquad ca_1 = z_1 - c_1 = 0$$

This result is scarcely surprising, and follows from the intertemporal symmetry which has been assumed. The equilibrium described by equation (6) is illustrated in Figure 1, where A represents the initial point of equilibrium.

Now suppose that, instead of the certain cash flow in period 2, $\bar{z}$, the consumer faces two possible outcomes (which, for simplicity, will be assumed to occur with equal probability), $\bar{z}+\epsilon$, or $\bar{z}-\epsilon$. Corresponding to these two possible outcomes would be the two dashed budget lines in Figure 1. The

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1/ As mentioned previously, the assumption that the world interest rate is exogenous implies that we can also treat z as exogenous to the consumption decision (even though investment, and therefore output, may be chosen optimally).

question now is, where will the agent choose to consume, and specifically, under what conditions will it be optimal for her to reduce consumption (increase saving) in period 1, in order to compensate for the (increase in) uncertainty of cash flow in period 2? 1/

Suppose the consumer chooses the same consumption level, $\bar{z}$, in period 1 as in the full certainty case. Then in period 2, consumption will simply be equal to the period 2 level of cash flow, so that the equilibrium will be either at B or at C, with equal probability. Consider now a small reduction in the level of period 1 consumption, to a point such as $\bar{z}'$ in Figure 1. The indifference curve passing through B intersects the perpendicular through $\bar{z}'$ at E, and that drawn through C intersects the perpendicular at D. Thus, by construction, the consumer is indifferent to the following two alternatives: Consuming the bundles represented by B and E (with equal probability); or consuming the bundles D and C (with equal probability). Both alternatives yield identical expected utility. 2/

But notice that by choosing to consume $\bar{z}'$ in period 1, the consumer will wind up with bundles F or G with equal probability. Clearly, the <u>variance</u> of period 2 consumption is lower in this alternative than in the case where the agent winds up with either D or E (which yield the same levels of expected utility as the B or C outcomes obtained by consuming $\bar{z}$ in period 1). By this token, therefore, a risk-averse agent will always choose to reduce consumption in the first period relative to the certainty case. Of course, the consumer does not care about variance alone, but also about the <u>mean</u> of consumption in the two cases. However, as is shown rigorously immediately below, as long as marginal utility is convex the presumption that, by increasing saving in period 1, the consumer increases her expected utility is completely valid. 3/ We conclude from this simple diagramatic example that in response to an increase in uncertainty regarding national cash flow, consumers will reduce their consumption in the first period, thereby generating a surplus on current account.

To see this more formally, suppose that there is some more general form of <u>ex ante</u> uncertainty about future cash flow, z_2; specifically, assume that:

(7) $$z_2 = \bar{z} + \zeta$$

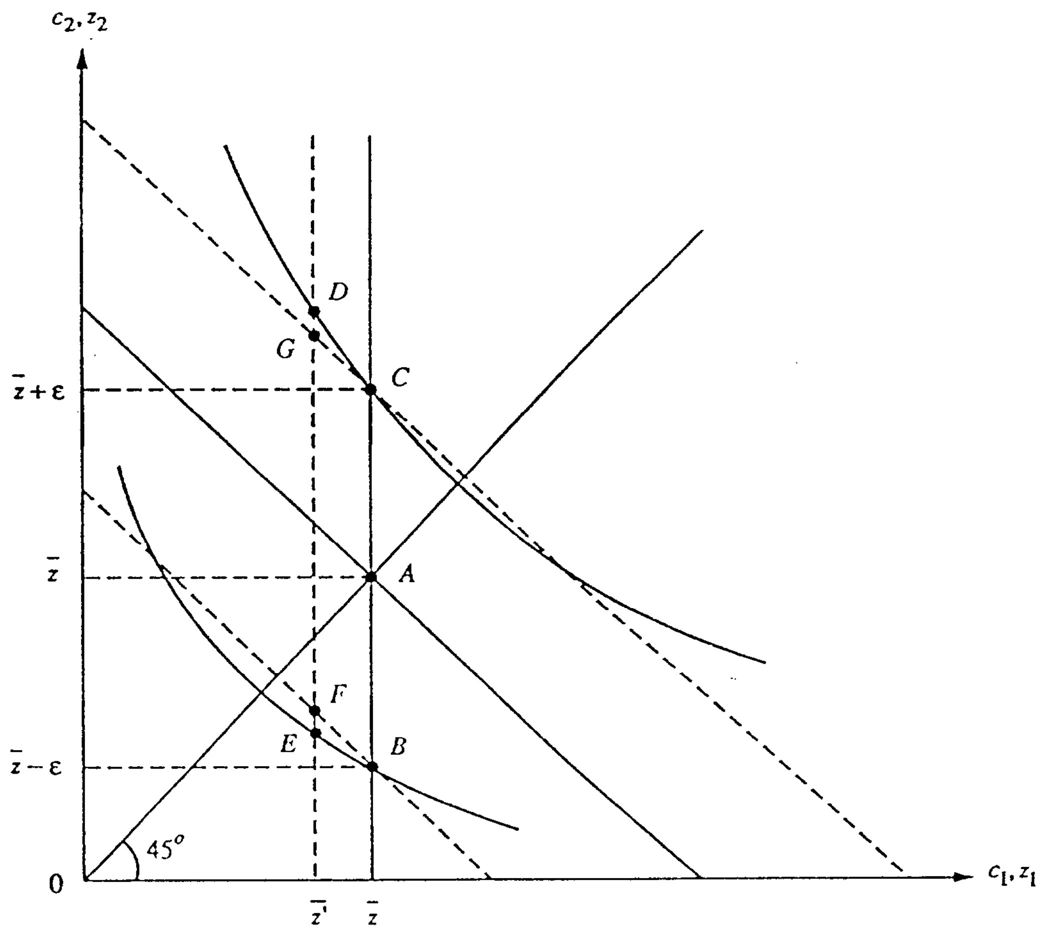
1/ The agent must make her decision before the value of ϵ is known.

2/ Note that the indifference curves in Figure 1 correspond to the Bernouilli rather than the von Neumann-Morgenstern utility functions.

3/ In fact, it can be shown that the mean of second-period consumption cannot be lower by virtue of the increase in saving in the first period as long as marginal utility is convex (see Drèze and Modigliani [1972]).

Figure 1

Effect of Uncertainty on the Current Account



where ζ has mean zero, and variance σ_ζ^2. Defining $v(.) = u_c(.)$, it follows from the first-order condition, and from Jensen's inequality, that

$$(8) \qquad c_1 = v^{-1}(E(v(c_2))) < E(c_2)$$

Since $c_1 < E(c_2)$, and $E(z_2) = z_1$, it follows from the intertemporal budget constraint that $c_1 < z_1$ and, therefore, that the country runs a current account surplus in period 1, as claimed in Figure 1. Thus the presence of risk itself (and convex marginal utility) suffices to induce a current account surplus.

Although this two-period model clearly illustrates the effect of uncertainty on the current account, two assumptions of the model need to be relaxed before it can be tested empirically. First, the horizon must be extended; second, the assumption of a constant expected profile of national cash flow needs to be relaxed.

III. The Model

Following Sachs [1982], we use the standard, infinite horizon, small open economy model of international borrowing and lending as our theoretical framework. This has the advantage of analytic simplicity, and allows us to exploit some of the econometric techniques adopted in Ghosh [1990]. While the assumption of a small open economy model may appear suspect for our sample of countries, ultimately the adequacy of the model is an empirical issue. The results reported below, and the findings of Ghosh [1990], suggest that this model is capable of explaining developments in the current accounts of the major industrial countries. These empirical results suggest that even for large industrial countries, the general equilibrium feedback effects, operating through changes in an endogenous world interest rate, are not large.

The economy is assumed to be populated by a single, infinitely-lived, representative agent whose preferences are given by:

$$(9) \qquad \sum_{t=0}^{\infty} \frac{1}{(1+r)^t} E(u(c_t))$$

where $u(.)$ is the instantaneous utility function, and c_t denotes consumption of the single good. With a view to empirical implementation, the utility function is assumed to take the form:

$$(10) \qquad u(c_t) = -(1/\alpha)e^{-\alpha c_t}$$

where α is the Arrow-Pratt measure of (absolute) risk-aversion.

It is simplest to work in terms of the social planner's problem, although the competitive equilibrium yields equivalent results. The planner maximizes (9) subject to the economy's dynamic budget constraint:

$$(11) \qquad b_{t+1} = (1+r)b_t + q_t - c_t - i_t - g_t$$

where b is the level of foreign bonds held by the economy, r is the fixed world interest rate, q is the level of output (GDP), i is the level of investment, and g is the level of government expenditure.

We assume that uncovered real interest parity holds at all times. Therefore, as mentioned in the previous section, the assumption that the country is small in the world capital market means that Fisherian separability will hold here: Investment will be chosen so as to maximize the economy's expected wealth, regardless of the consumption profile. As discussed by Cooper and Sachs [1985], in a small open economy, investment is undertaken until the marginal product of capital equals the world interest rate, so the investment rule is indeed independent of consumption. In turn, this implies that investment and output may be treated as exogenous when choosing the optimal path for consumption. More generally, when investment is subject to costs of installation, investment depends upon Tobin's *q*, so that the entire future path of discounted marginal products of capital enters the investment decision. Nonetheless, the separability between consumption and investment remains, because the interest rate is exogenous to the country. Investment, i_t, should be interpreted as total investment expenditure, inclusive of installation costs. 1/

Maximizing (9) subject to (11) yields the first-order condition:

$$(12) \qquad e^{-\alpha c_t} = E_t e^{-\alpha c_{t+1}}$$

From Hall's [1978] work on the consumption function, we know that the first difference in consumption will equal the lifetime innovation in income. If the variance in national cash flow is to have a positive effect on the current account, moreover, the growth in consumption should be an

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1/ Notice that the separability between the consumption and investment decisions lets us write output as exogenous to the consumption decision, but not (necessarily) to the investment decision.

increasing function of this variance. A judicious guess, therefore, is that consumption will follow a process given by: 1/

(13) $$c_t - c_{t-1} = \xi_t + \Lambda$$

where ξ_t is the life-time innovation in national cash-flow,

$$\xi_t = \frac{r}{(1+r)} \sum_{j=0}^{\infty} \frac{1}{(1+r)^j} \{E_t(q_{t+j} - i_{t+j} - g_{t+j})\}$$

(14) $$- \frac{r}{(1+r)} \sum_{j=0}^{\infty} \frac{1}{(1+r)^j} \{E_{t-1}(q_{t+j} - i_{t+j} - g_{t+j})\}$$

and Λ is a constant which (presumably) depends positively upon the variance of the lifetime innovation in national cash-flow, σ_ξ^2. Substituting (14) into (13) yields:

(15) $$\Lambda = (1/\alpha)\log(E_t e^{-\alpha\xi_{t+1}})$$

If the innovations to national cash-flow are Normally distributed (with zero mean), then ξ will also follow a Normal distribution. Evaluating the expectation in (15) then gives:

(16) $$\Lambda = \frac{\alpha\sigma_\xi^2}{2}$$

Once Λ has been obtained, we can guess a final form of the consumption function:

(17) $$c_t^* = \frac{r}{(1+r)} \sum_{j=0}^{\infty} \frac{1}{(1+r)^j} \{E_t(q_{t+j} - i_{t+j} - g_{t+j})\} + rb_t - \Lambda/r$$

Thus, in any period, consumption is equal to the present discounted value of national cash flow minus a term in the variance of national cash flow. To check our guess, we need to show that (17) satisfies (13). Note that the budget constraint (11) implies:

1/ Hall [1978] showed that marginal utility follows a random walk; this translates into a random walk for consumption when, as is assumed below, innovations to national cash flow are Normally distributed. Our discussion here draws on Caballero [1990] who derives the optimal savings function for an individual under labor-income variability.

(18) $$rc_{t-1} = rz_{t-1} + r(1+r)b_{t-1} - rb_t$$

Adding and subtracting $(1+r)c_{t-1}$ from the (lhs) of (13) gives:

(19) $$c_t^* - (1+r)c_{t-1}^* + rc_{t-1}^* = \xi_t + \Lambda$$

Substituting (18) into this expression yields:

(20) $$c_t^* - (1+r)c_{t-1}^* + rc_{t-1}^* = \xi_t + \Lambda + r[b_t-(1+r)b_{t-1}+c_{t-1}^*-z_{t-1}]$$

where the term in square brackets is equal to zero by (18). Substituting (17) into the LHS of (20) and using (18), we see that the consumption function (17) does indeed obey (13).

By definition, the current account is equal to the change in foreign assets, $ca_t = b_{t+1} - b_t$. Therefore, the optimal current account is given by:

(21) $$ca_t^* = y_t - i_t - g_t - c_t^*$$

where y_t is GNP (GDP plus interest income on existing foreign assets, $q_t + rb_t$). Substituting for c_t^* into (21) gives a simple expression for the current account as the present value of expected changes in national cash flow plus a term in the variance of the innovations to national cash flow:

(22) $$ca_t^* = -\sum_{j=1}^{\infty} \frac{1}{(1+r)^j} \{E_t\Delta(q_{t+j}-i_{t+j}-g_{t+j})\} + \frac{\alpha\sigma_\xi^2}{2r}$$

where Δ is the (backward) difference operator, $\Delta x_t = x_t - x_{t-1}$. Finally, it is useful to note that straightforward manipulation of (22) yields:

(23) $$ca_t^* - \Delta(q_t-i_t-g_t) - (1+r)ca_{t-1}^* = -\xi_t + \frac{\alpha\sigma_\xi^2}{2}$$

To test whether increases in the variance of the innovation to national cash flow have indeed been reflected in larger current account surpluses, we create the expression:

(24) $$\widetilde{ca}_t = -\sum_{j=1}^{\infty} \frac{1}{(1+r)^j} \{E_t\Delta(q_{t+j}-i_{t+j}-g_{t+j})\}$$

Then from (22) the actual (optimal) current account should equal $\tilde{ca}$ plus a term in the variance of ξ.

We begin by estimating a first-order VAR in $[\Delta(q_t-i_t-g_t), ca_t]$, 1/

$$\begin{bmatrix}\Delta(q_t-i_t-g_t)\\ CA_t\end{bmatrix} = \begin{bmatrix}\Psi_{11} & \Psi_{12}\\ \Psi_{21} & \Psi_{22}\end{bmatrix}\begin{bmatrix}\Delta(q_{t-1}-i_{t-1}-g_{t-1})\\ CA_{t-1}\end{bmatrix} + \varepsilon_t \tag{25}$$

Or,

$$\mathbf{x}_t = \Psi\mathbf{x}_{t-1} + \varepsilon_t \tag{26}$$

The k-step ahead expectation is simply:

$$E_t(\mathbf{x}_{t+k}) = \Psi^k\mathbf{x}_t \tag{27}$$

and the expression for $\tilde{ca}$ is given by:

$$\tilde{ca}_t = -[1\ 0][\Psi/(1+r)][I - \Psi/(1+r)]^{-1}\mathbf{x}_t \equiv \Gamma\mathbf{x}_t \tag{28}$$

Under the null hypothesis that the true model of the current account is given by ca_t^*, a regression of the current account on $\tilde{ca}_t$ and $\sigma^2_{\xi t}$ should yield a unit coefficient on the former, and a positive coefficient on the variance, $\sigma^2_{\xi t}$, where over any time period, $\sigma^2_{\xi t}$ can be found as the variance of the left-hand-side of (23). 2/

IV. Data and Estimation

The analysis described above was undertaken using quarterly data from four major industrial countries (the United States, Japan, the United Kingdom, and Canada), over the period from 1955 to 1990. The data are taken from the International Monetary Fund's International Finance Statistics, are

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1/ It is simple to generalize this expression for higher order VARs by writing a pth order VAR in first order form. When estimating the VARs we started with a third-order system and truncated insignificant lags. First-order VARs generally sufficed so only those results are reported.

2/ That is, $var(\xi_t) = var(ca_t^* - \Delta(q_t-i_t-g_t) - (1+r)ca_{t-1}^*)$ where, under the null. actual data for the current account can be used for ca^*. The coefficient on σ^2_ξ will be positively related to both the degree of risk aversion and the degree of persistence of the shocks to national cash flow.

quarterly deseasonalised data, and are expressed in billions of 1985 local currency. 1/

The main problem in implementing the test described above lies in choosing the time span for calculating the variance of the innovation to cash flow, ξ_t. If too short a span is chosen, we are likely to obtain an inaccurate estimate of the true degree of uncertainty. Conversely, too long a time span results in too little variation in $\sigma^2_{\xi t}$ to examine the effects on the current account. Since we have no a priori information on the appropriate span, we report the results for time spans ranging from 2 years (8 quarters) to 5 years (20 quarters), which yield between 17 and 7 different observations for $\sigma^2_{\xi t}$.

Since the current account enters the VAR in levels (while the national cash flow variable enters in first difference form), the current account must be detrended. We consider two forms of detrending. First, we simply regress the current account on a time trend and work with the residual, which is referred to as $\bar{ca}1$, below. 2/ Second, we follow Ghosh [1990] in first estimating a cointegrating regression between consumption and national cash flow defined inclusive of net factor payments (i.e., GNP is used instead of GDP for q_t in the definition of cash flow). The detrended current account is then defined by $\bar{ca}2_t = y_t - i_t - g_t - \theta c_t$ where θ is the cointegrating parameter from a regression of national cash flow on consumption. By construction such a series is stationary as long as national cash flow is no more than I(1), and captures the main elements of the consumption smoothing behavior implied by the intertemporal model. 3/

Table 1 reports Augmented Dickey-Fuller test statistics for the two current account measures and for the national cash flow variable. Either method of detrending the current account appears to yield a stationary variable in the case of the United States and Japan (the evidence is more mixed for the United Kingdom and Canada), while in all cases the national cash flow variable is clearly non-stationary in levels, and needs to be differenced.

Tables 2 and 3 report the VAR parameters for the system $\mathbf{x}_{t+1} = \Psi \mathbf{x}_t + \varepsilon_t$. One implication of the intertemporal smoothing model is that the current account should, in general, Granger-cause changes in national cash flow. From (13), ca^* is equal to the expected present discounted value of

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1/ Private consumption, c, line 96f; Government expenditure, g, line 91ff; Investment, i, lines 93ee+93i; GNP, y, 99a; GDP, q, line 99b; $ca \equiv y - c - i - g$; all data are converted into real terms by dividing by the implicit GDP deflator.

2/ We regress the current account on a linear and quadratic time trend; $\bar{ca}1$ is the residual from this regression.

3/ It corresponds to the consumption smoothing component exactly in the case of quadratic utility (see Ghosh [1990]).

Table 1. Augmented Dickey-Fuller Tests for Unit Roots

Country	$\bar{ca}1$	$\bar{ca}2$	(q-i-g)
US	-3.90	-3.28	1.90
Japan	-3.67	-3.29	2.02
UK	-3.11	-3.02	1.59
Canada	-3.41	-2.94	2.32

$\bar{ca}1$: Current Account with deterministic trend removed.

$\bar{ca}2$: Current Account $\bar{ca}2 = y - i - g - \theta c$ where θ is the cointegrating parameter between $y - i - g$ and c.

Table 2. VAR Parameters: $\overline{cal}$ 1/

	$\Delta(q_{t-1}-i_{t-1}-g_{t-1})$	$\overline{cal}_{t-1}$
United States		
$\Delta(q_t-i_t-g_t)$	-0.009	-0.186
(t)	(0.105)	(4.091)
$\overline{cal}_t$	-0.170	0.860
(t)	(2.235)	(20.080)
Japan		
$\Delta(q_t-i_t-g_t)$	0.047	-0.013
(t)	(0.357)	(0.197)
$\overline{cal}_t$	-0.045	0.948
(t)	(0.714)	(29.900)
United Kingdom		
$\Delta(q_t-i_t-g_t)$	-0.408	-0.035
(t)	(5.216)	(0.724)
$\overline{cal}_t$	-0.107	0.867
(t)	(1.496)	(19.549)
Canada		
$\Delta(q_t-i_t-g_t)$	-0.175	-0.066
(t)	(2.029)	(1.095)
$\overline{cal}_t$	-0.237	0.832
(t)	(3.133)	(15.699)

1/ Coefficients are row variables regressed on column variables. (Absolute values of) t-statistics are given in parentheses below the corresponding coefficients. $\overline{cal}$ is the current account with the deterministic trend removed.

Table 3. VAR Parameters: $\bar{c}\bar{a}2$ 1/

	$\Delta(q_{t-1}-i_{t-1}-g_{t-1})$	$\bar{c}\bar{a}2_{t-1}$
United States		
$\Delta(q_t-i_t-g_t)$	0.004	-0.145
(t)	(0.047)	(2.612)
$\bar{c}\bar{a}2_t$	-0.173	0.888
(t)	(2.351)	(24.560)
Japan		
$\Delta(q_t-i_t-g_t)$	0.050	-0.031
(t)	(0.393)	(0.531)
$\bar{c}\bar{a}2_t$	-0.037	0.947
(t)	(0.586)	(33.108)
United Kingdom		
$\Delta(q_t-i_t-g_t)$	-0.409	-0.029
(t)	(5.199)	(0.578)
$\bar{c}\bar{a}2_t$	-0.110	0.859
(t)	(1.554)	(18.785)
Canada		
$\Delta(q_t-i_t-g_t)$	-0.193	-0.024
(t)	(2.245)	(0.437)
$\bar{c}\bar{a}2_t$	-0.265	0.886
(t)	(3.493)	(18.548)

1/ Coefficients are row variables regressed on column variables. (Absolute values of) t-statistics are given in parentheses below the corresponding coefficients. $\bar{c}\bar{a}2 = y - i - g - \theta c$ where θ is the cointegrating parameter between y - i - g and c.

$\Delta(q-i-g)$, where the expectation is conditional on agents' <u>entire</u> information set. If agents have more information about the evolution of national cash flow than is contained in its own past values, then the current account ought to Granger-cause changes in cash flow. It is noteworthy that the current account indeed Granger-causes subsequent changes in national cash flow in the case of the United States, but not for the other countries in the sample.

Tables 4-7 report our results for the regression of the current account on $\tilde{c}a$ and $\sigma^2_{\xi t}$. 1/ The results are encouraging. In three of the four countries in the sample (the United States, Japan, and the United Kingdom), we find statistically significant evidence of an effect of the variability of national cash flow on the current account. The intertemporal model of the current account works best for the United States (Table 4), where the point estimate of the coefficient on $\tilde{c}a$ is close to unity. 2/ For the other countries, the coefficient on $\tilde{c}a$ is well above unity. This implies that capital flows have been larger and more volatile than would be necessary to smooth consumption in the face of shocks to national cash flow. One interpretation, suggested by Ghosh [1990], is that short-term speculative capital flows--which are not absorbed by changes in reserves--are being reflected in the current account. Thus, speculative capital flows may be "wagging" the current account, rather than the latter inducing capital flows to act as a buffer for smoothing consumption.

Turning to the effects of uncertainty on the current account, we see that for the United States the coefficient on $\sigma^2_{\xi t}$ is positive and highly significant in all eight cases; that is, independent of the method of detrending or of the size of the blocks used in constructing the time series for the variance. 3/ In the case of Japan (Table 5), although the intertemporal model does not work as well, using the four year blocks (first method of detrending) or the three, four or five year blocks (second detrending method) in constructing the variance measure does indeed produce a significantly positive effect of $\sigma^2_{\xi t}$ on the current account. 4/ In the case of the United Kingdom (Table 6), the measures of $\sigma^2_{\xi t}$ that work best are based on three, four and five year blocks, using the second method of detrending the current account, or four and five year blocks using the first detrending method. Evidence that the intertemporal model does not perform

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1/ Since by construction $\tilde{c}a$ will be correlated with the error term in these regressions, an instrumental variables procedure was used. The instruments consisted of the first difference of national cash flow, and two lags of the current account.

2/ Recall also that the United States was the only country for which the current account Granger-caused subsequent movements in national cash flow, as implied by the intertemporal model.

3/ A typical value for the coefficient on the variance would imply a value of the intertemporal elasticity of substitution of about 5.0.

4/ Recall that we have no priors as far as the "correct" time span to use in constructing the variance blocks.

Table 4. Regression of ca on $\bar{c}a$ and σ_ξ^2: United States 1/

	$\bar{c}a$	t-stat 2/	$\sigma_\xi^2 \times 10^{-3}$	t-stat 2/	DW	R^2
$\bar{c}\bar{a}1$						
2 year σ_ξ^2	0.92	85.27*	1.27	2.52*	2.12	0.99
3 year σ_ξ^2	0.92	85.60*	1.29	2.59*	2.13	0.99
4 year σ_ξ^2	0.93	85.64*	1.09	2.52*	2.17	0.99
5 year σ_ξ^2	0.92	81.61*	1.04	2.12*	2.11	0.99
$\bar{c}\bar{a}2$						
2 year σ_ξ^2	0.97	98.06*	1.51	2.75*	2.15	0.99
3 year σ_ξ^2	0.96	88.20*	1.48	2.56*	2.15	0.99
4 year σ_ξ^2	0.97	99.02*	1.42	2.93*	2.20	0.99
5 year σ_ξ^2	0.96	87.76*	1.44	2.37*	2.14	0.99

1/ The data on σ_ξ^2 were transformed by taking natural logarithms to minimize problems of heteroscedasticity; similar results were obtained using untransformed data.

2/ *indicates significance at the 95% level; White- (heteroscedastic-consistent) standard errors have been used in computing t-values.

Table 5. Regression of ca on $\tilde{c}a$ and σ_ξ^2: Japan 1/

	$\tilde{c}a$	t-stat 2/	$\sigma_\xi^2 \times 10^{-5}$	t-stat 2/	DW	R^2
$\bar{c}\bar{a}1$						
2 year σ_ξ^2	5.64	64.51*	1.24	1.24	1.98	0.98
3 year σ_ξ^2	5.64	65.02*	1.05	0.96	1.96	0.98
4 year σ_ξ^2	5.63	60.65*	2.56	2.22*	2.03	0.98
5 year σ_ξ^2	5.61	59.15*	1.82	1.82	2.01	0.98
$\bar{c}\bar{a}2$						
2 year σ_ξ^2	2.57	130.78*	0.64	1.34	1.95	0.99
3 year σ_ξ^2	2.58	127.33*	1.10	2.45*	1.99	0.99
4 year σ_ξ^2	2.58	124.70*	1.39	2.64*	2.01	0.99
5 year σ_ξ^2	2.57	121.38*	0.94	2.01*	1.99	0.99

1/ The data on σ_ξ^2 were transformed by taking natural logarithms to minimize problems of heteroscedasticity; similar results were obtained using untransformed data.

2/ *indicates significance at the 95% level; White- (heteroscedastic-consistent) standard errors have been used in computing t-values.

Table 6. Regression of ca on $\bar{c}a$ and σ_ξ^2: United Kingdom 1/

	$\bar{c}a$	t-stat 2/	$\sigma_\xi^2 x10^{-3}$	t-stat 2/	DW	R^2
$\bar{c}\bar{a}1$						
2 year σ_ξ^2	2.60	8.29*	-0.51	-0.75	1.27	0.66
3 year σ_ξ^2	2.60	8.29*	-0.50	-0.71	1.27	0.66
4 year σ_ξ^2	2.48	7.78*	1.82	2.76*	1.27	0.67
5 year σ_ξ^2	2.53	8.07*	2.44	2.33*	1.27	0.67
$\bar{c}\bar{a}2$						
2 year σ_ξ^2	2.60	7.07*	-0.48	-0.62	1.01	0.55
3 year σ_ξ^2	2.51	6.67*	2.06	2.67*	1.07	0.58
4 year σ_ξ^2	2.40	6.44*	2.67	3.77*	1.05	0.59
5 year σ_ξ^2	2.53	6.73*	2.87	2.58*	1.02	0.57

1/ The data on σ_ξ^2 were transformed by taking natural logarithms to minimize problems of heteroscedasticity; similar results were obtained using untransformed data.

2/ *indicates significance at the 95% level; White- (heteroscedastic-consistent) standard errors have been used in computing t-values.

Table 7. Regression of ca on $\bar{c}a$ and σ_ξ^2: Canada 1/

	$\bar{c}a$	t-stat 2/	$\sigma_\xi^2 \times 10^{-3}$	t-stat 2/	DW	R^2
$\bar{c}\bar{a}1$						
2 year σ_ξ^2	3.17	47.27*	-0.28	-1.51	1.76	0.96
3 year σ_ξ^2	3.17	47.26*	-0.28	-1.52	1.76	0.96
4 year σ_ξ^2	3.15	46.42*	-0.09	-0.40	1.71	0.96
5 year σ_ξ^2	3.16	46.11*	-0.16	-0.83	1.74	0.96
$\bar{c}\bar{a}2$						
2 year σ_ξ^2	4.44	27.48*	-0.51	-1.31	1.44	0.86
3 year σ_ξ^2	4.41	26.33*	-0.15	-0.33	1.40	0.85
4 year σ_ξ^2	4.40	26.13*	-0.07	-0.16	1.39	0.85
5 year σ_ξ^2	4.39	25.41*	0.47	0.11	1.38	0.85

1/ The data on σ_ξ^2 were transformed by taking natural logarithms to minimize problems of heteroscedasticity; similar results were obtained using untransformed data.

2/ *indicates significance at the 95% level; White- (heteroscedastic-consistent) standard errors have been used in computing t-values.

as well in the case of the United Kingdom as in some of the other countries in the sample (also found by Ghosh [1990]) is suggested by the relatively low Durbin-Watson statistics, which imply the presence of some residual serial correlation. The results for Canada (Table 7) are weaker, with the data suggesting that a variance measure based on five or more years could perform better than one based on a shorter time span.

The conclusions from the regression analysis are also supported by simple time-series plots of the current account and our estimate of the degree of macroeconomic uncertainty, $\sigma^2_{\xi t}$ (denoted σ(NCF) in the graphs): see figures 2-9. It should be noted that the figures are only suggestive since, unlike the regressions, they do not control for the effects of expected changes in national cash flow (so that one would not, a priori, expect a perfect correlation between the current account and our measure of the variance). Finally, as far as Canada is concerned (figures 8 and 9), the graphs suggest that the relationship between the variance measure and the current account holds reasonably well through the mid-1980s, at which point the relationship seems to break down. This conclusion is supported also by running the regressions reported in Table 7 over the restricted sample.

V. Conclusion

The relationship between the macroeconomic environment and the dynamics followed by the current account remains one of the most important issues in open economy macroeconomics. This paper has developed a simple optimizing model of an open economy in order to investigate the role of macroeconomic uncertainty in affecting the current account. With the aid of a simple two-period example in which national cash flow was expected to be constant over time, we showed that in the absence of uncertainty the country's current account would be in balance in each period. In contrast, once uncertainty about future cash flow was introduced, it was shown that the country's need to insure itself against possible adverse cash flow shocks in the future caused it to run a current account surplus in the first period.

This finding was then generalized in the context of an infinite horizon model in which the assumption of a constant expected profile for national cash flow was relaxed. The resulting model of the current account was tested against data from four large industrial countries, and despite some evidence of excess volatility in the current account, the intertemporal model adopted in this paper appears to fit the data reasonably well. Even with the incorporation of uncertainty, expectations of future changes in national cash flow continue to play a central role in the evolution of the current account.

Turning to the effects of macroeconomic uncertainty, we found that the variance of innovations in national cash flow was a statistically significant determinant of the current account in three of the four countries in our sample. Taking explicit account of uncertainty may thus improve our understanding of current account dynamics.

The model developed here may be extended in a number of interesting directions. First, our treatment has focussed on the role of precautionary savings and its implications for the current account. Uncertainty can also affect the current account through investment behaviour, particularly when such investment is irreversible. In addition, the model adopted here assumed the existence of a single composite good. This assumption could also be relaxed in order to examine the relationship between terms of trade shocks and the current account--a particularly relevant issue for the developing countries.

Figure 2

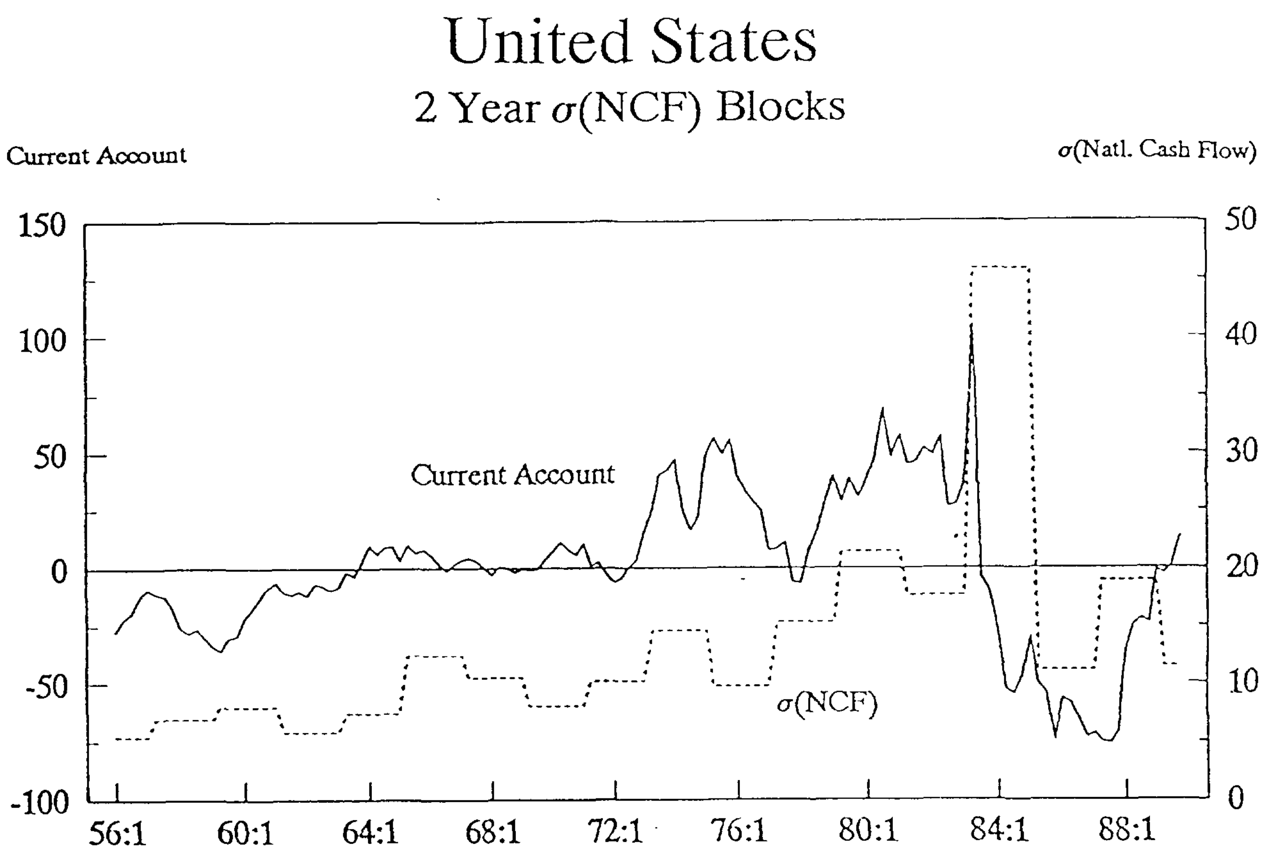

United States
2 Year σ(NCF) Blocks
Current Account
σ(Natl. Cash Flow)
150
100
50
0
-50
-100
50
40
30
20
10
0
Current Account
σ(NCF)
56:1
60:1
64:1
68:1
72:1
76:1
80:1
84:1
88:1

Figure 3

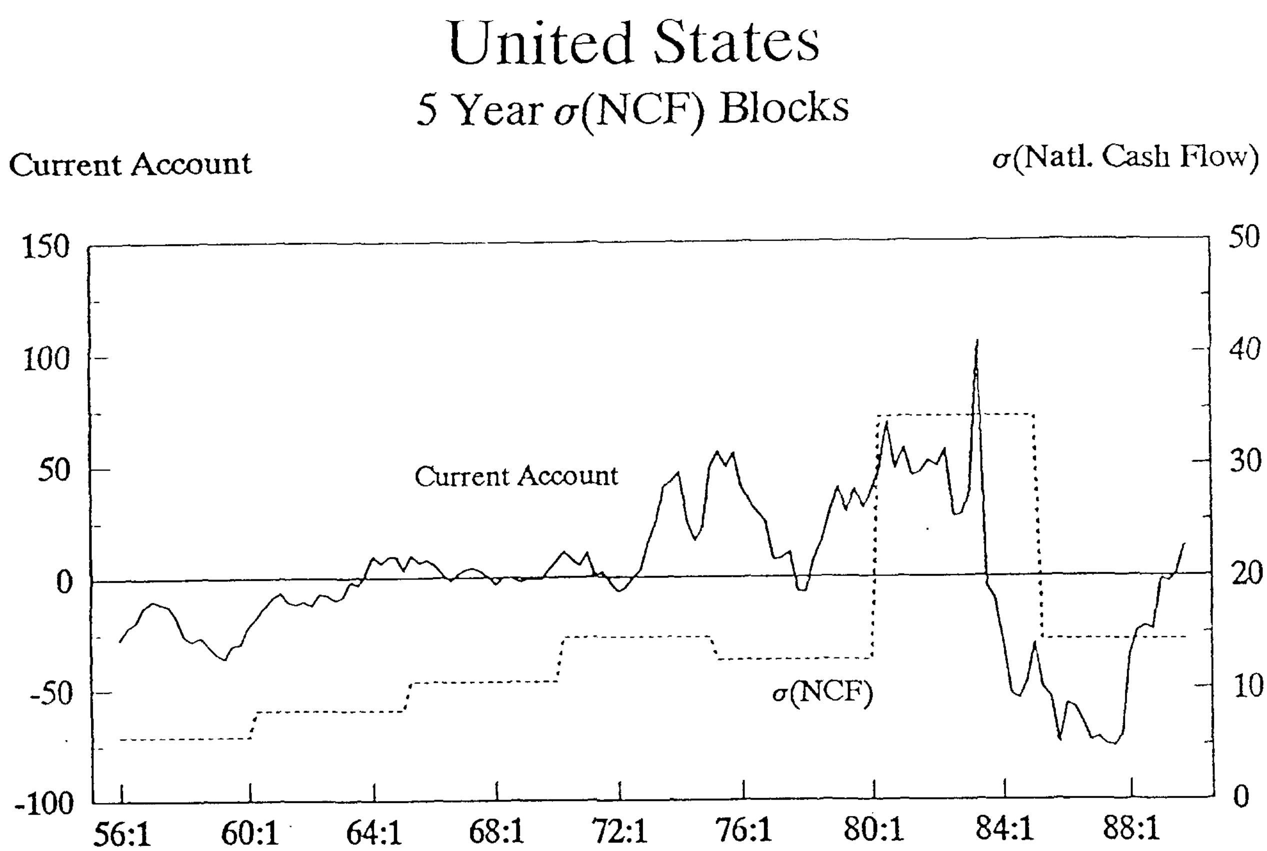

United States
5 Year σ(NCF) Blocks
Current Account
σ(Natl. Cash Flow)
150
100
50
0
-50
-100
50
40
30
20
10
0
Current Account
σ(NCF)
56:1
60:1
64:1
68:1
72:1
76:1
80:1
84:1
88:1

Figure 4

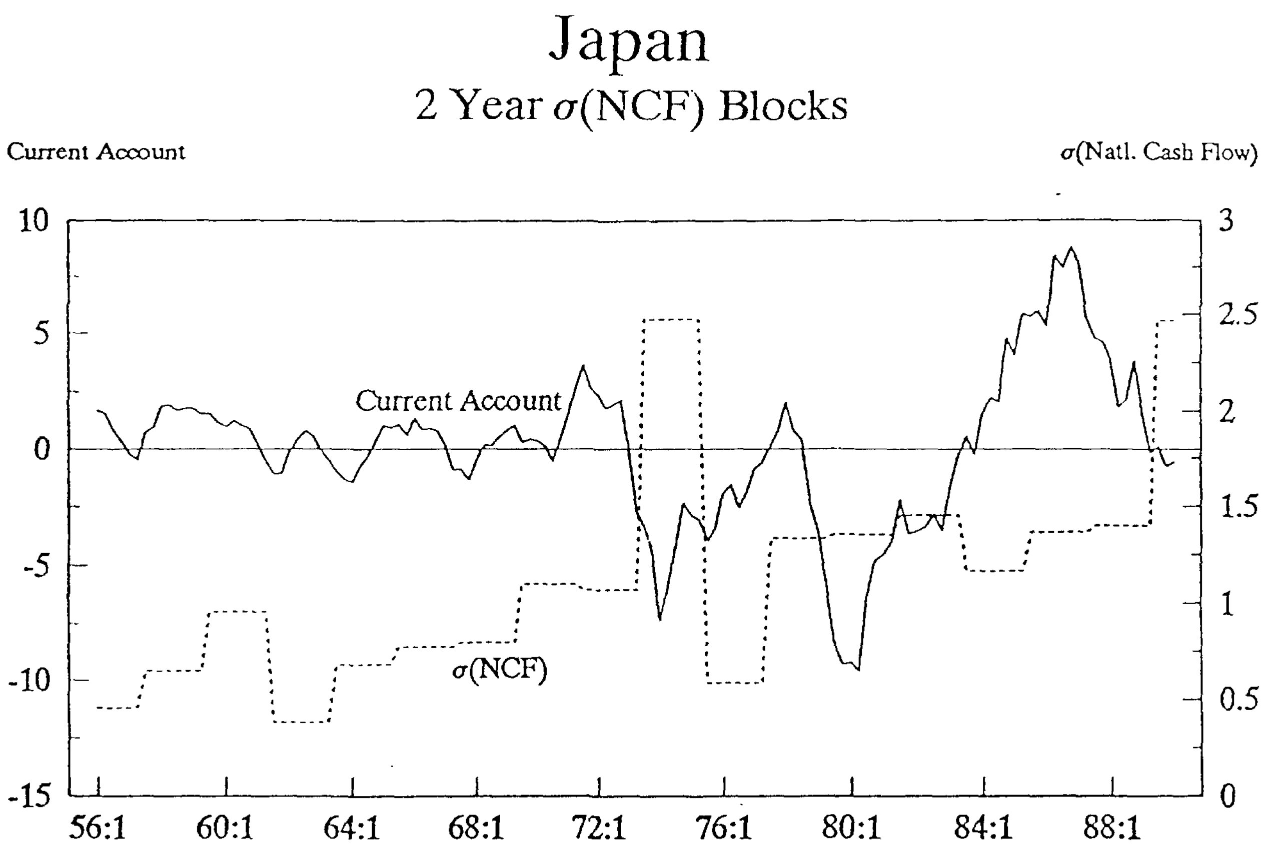

Japan
2 Year σ(NCF) Blocks
Current Account
σ(Natl. Cash Flow)
10
5
0
-5
-10
-15
3
2.5
2
1.5
1
0.5
0
Current Account
σ(NCF)
56:1
60:1
64:1
68:1
72:1
76:1
80:1
84:1
88:1

Figure 5

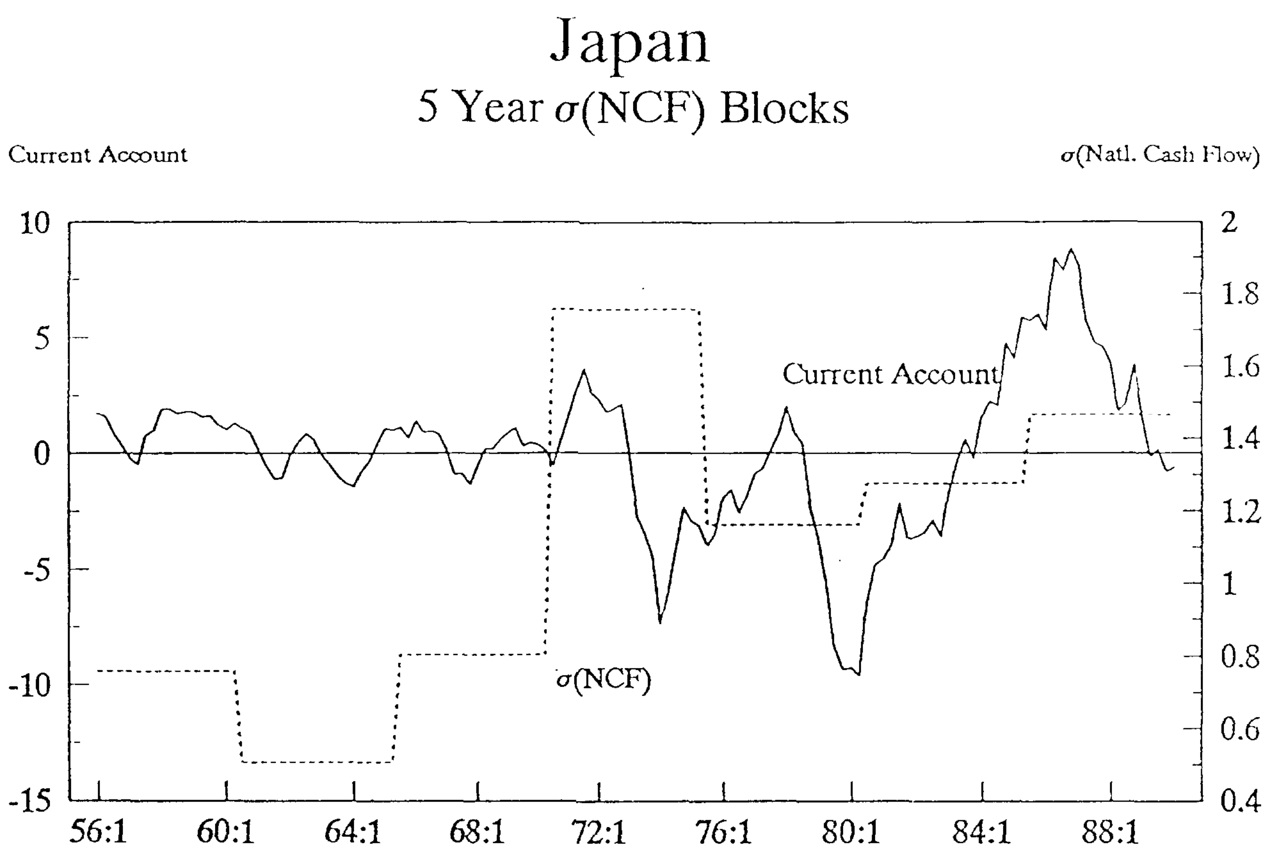

Japan
5 Year σ(NCF) Blocks
Current Account
σ(Natl. Cash Flow)
10
5
0
-5
-10
-15
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
Current Account
σ(NCF)
56:1
60:1
64:1
68:1
72:1
76:1
80:1
84:1
88:1

Figure 6

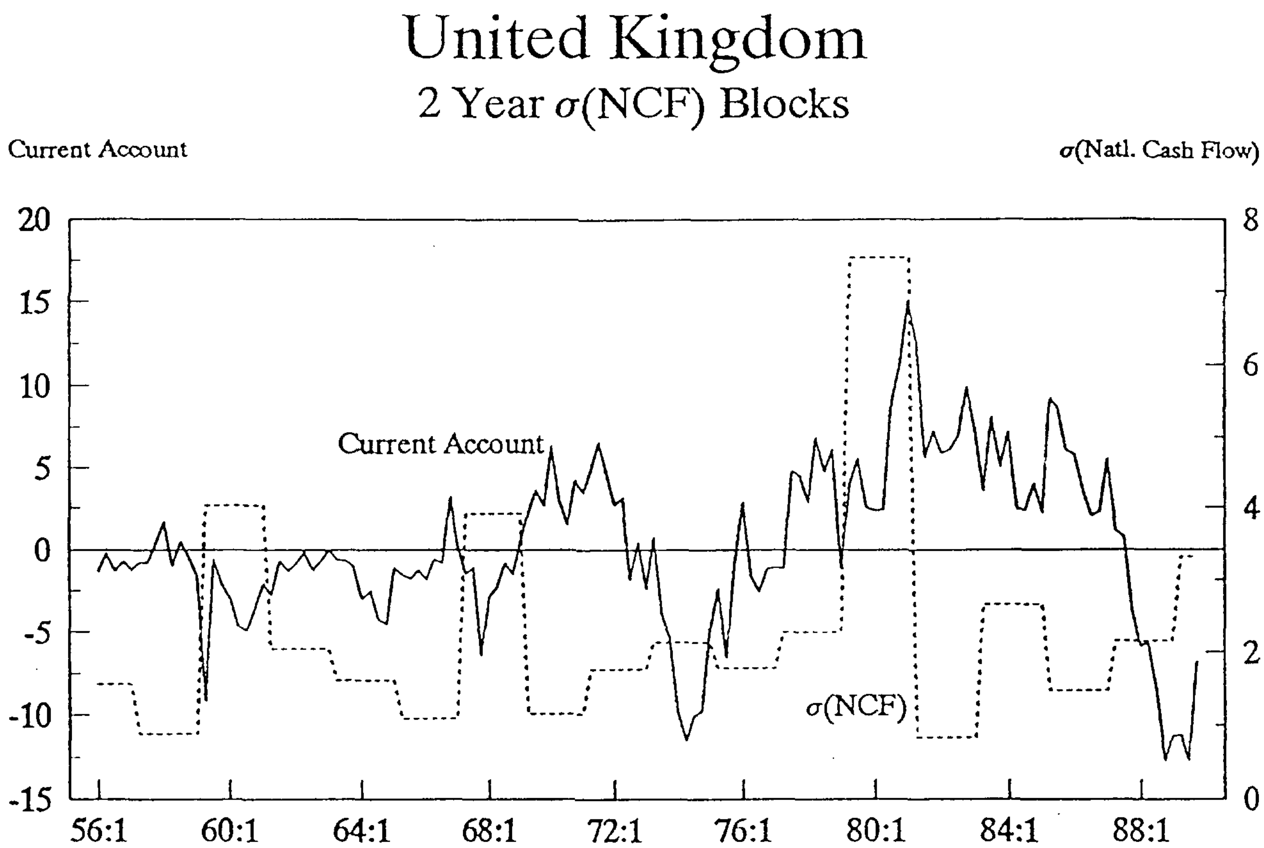

United Kingdom
2 Year σ(NCF) Blocks
Current Account
σ(Natl. Cash Flow)
20
15
10
5
0
-5
-10
-15
8
6
4
2
0
Current Account
σ(NCF)
56:1
60:1
64:1
68:1
72:1
76:1
80:1
84:1
88:1

Figure 7

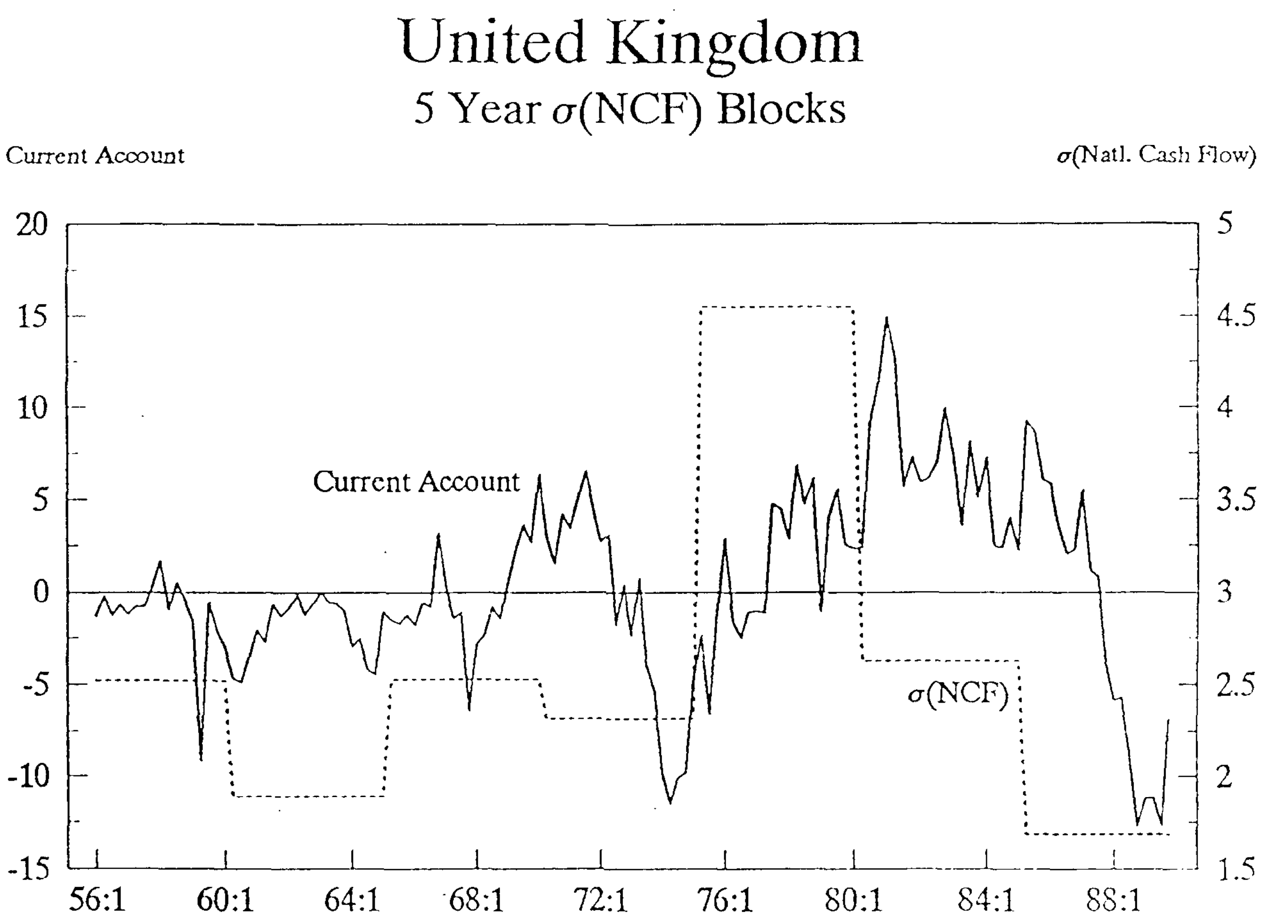

United Kingdom
5 Year σ(NCF) Blocks
Current Account
σ(Natl. Cash Flow)
20
15
10
5
0
-5
-10
-15
5
4.5
4
3.5
3
2.5
2
1.5
Current Account
σ(NCF)
56:1
60:1
64:1
68:1
72:1
76:1
80:1
84:1
88:1

Figure 8

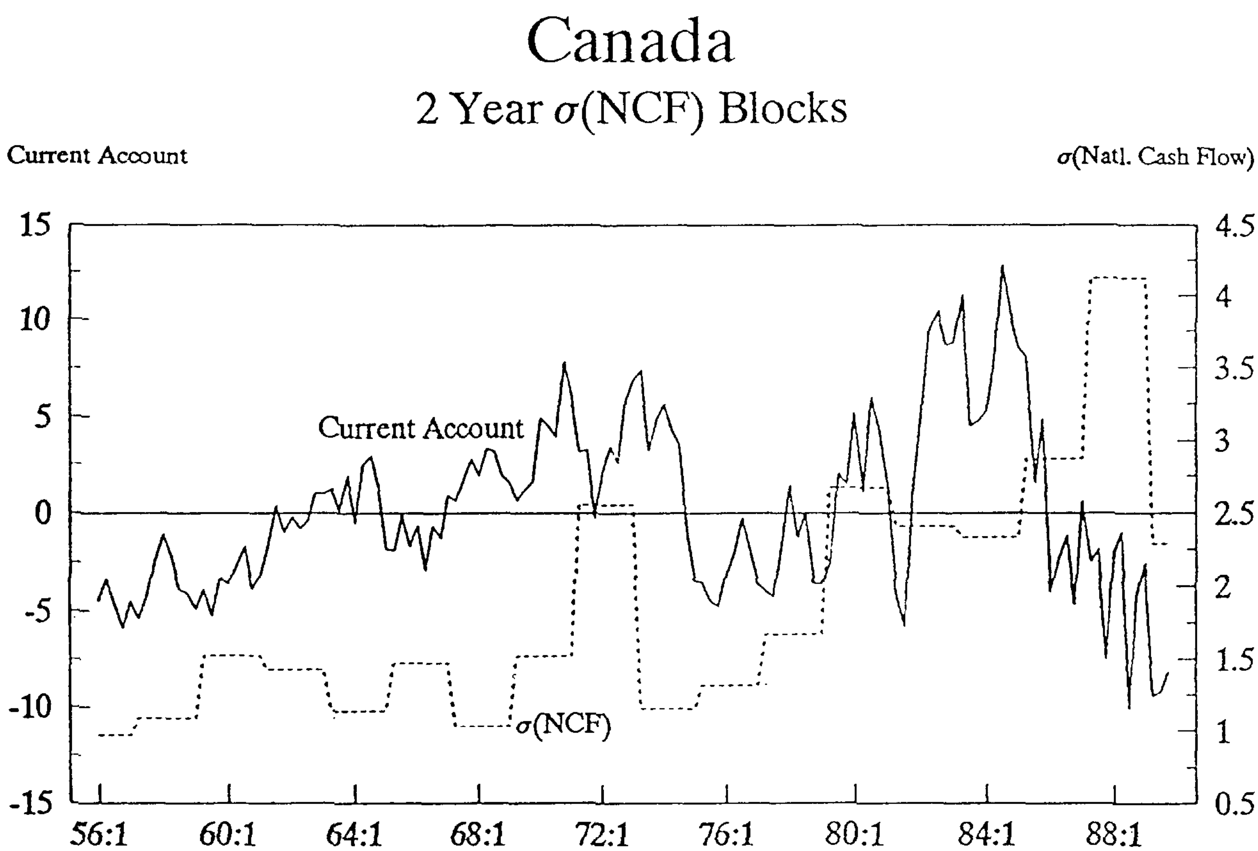
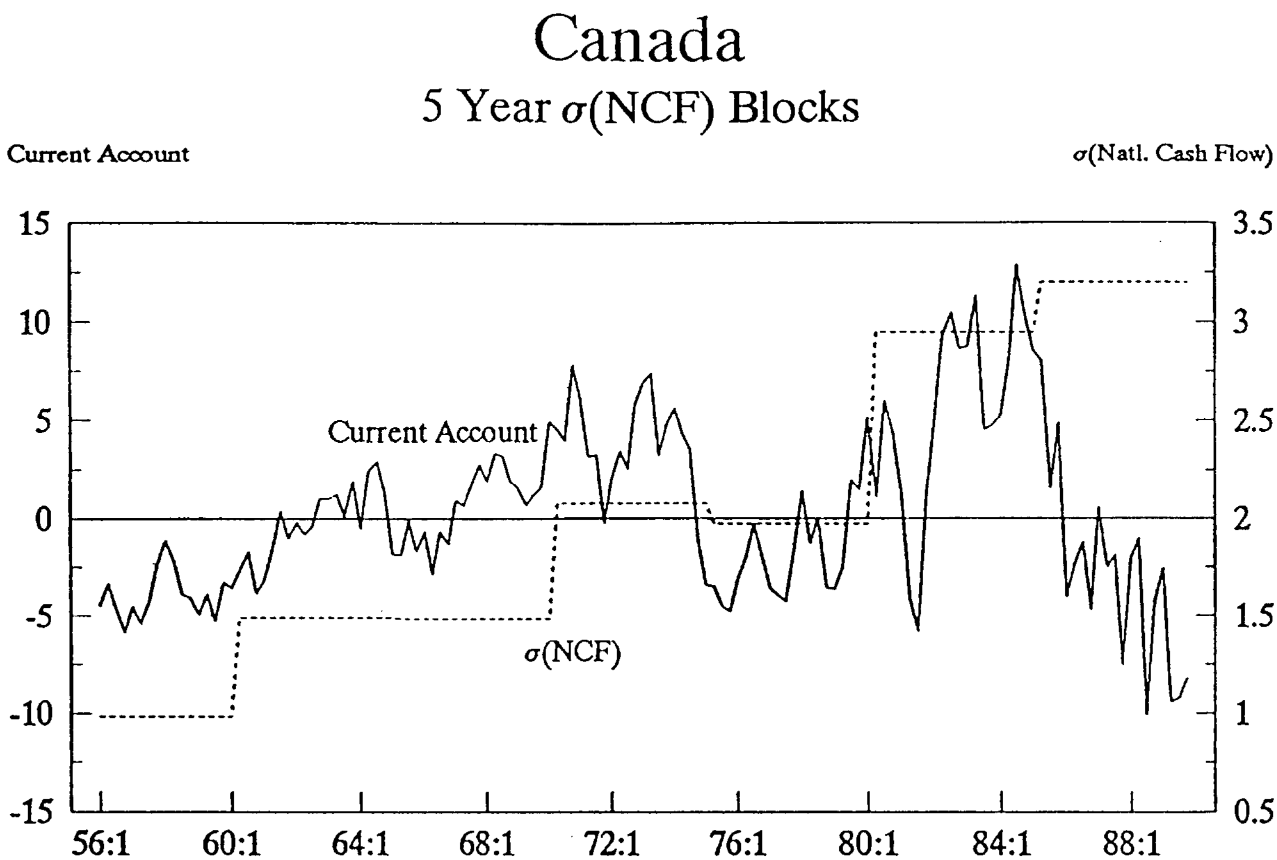

Canada
2 Year σ(NCF) Blocks
Current Account
σ(Natl. Cash Flow)
15
10
5
0
-5
-10
-15
4.5
4
3.5
3
2.5
2
1.5
1
0.5
Current Account
σ(NCF)
56:1
60:1
64:1
68:1
72:1
76:1
80:1
84:1
88:1

Figure 9


Canada
5 Year σ(NCF) Blocks
Current Account
σ(Natl. Cash Flow)
15
10
5
0
-5
-10
-15
3.5
3
2.5
2
1.5
1
0.5
Current Account
σ(NCF)
56:1
60:1
64:1
68:1
72:1
76:1
80:1
84:1
88:1

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