Money and Intertemporal Current Accounts among Industrialized Countries

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"Save for a rainy day", a well known theory proposed by Campbell (1987), indicates that the current consumption depends on the rational prospect of future economy. Nevertheless, within a highly developed economy, individual's consumption is often affected by various factors, for instance, inflation, the rate of time preference, and interest rates ... *etc*. Therefore, a rational representative individual should take all possible information available into consideration in making decisions regarding optimal consumption; meanwhile, this will in turn affect current accounts and domestic credits. In this paper, we modify Ghosh's (1995a) methodology to incorporate one of the most influential macroeconomic variables, money, into the intertemporal model of the current account to explore its importance in predicting the current accounts. Five major industrialized countries, Japan, Canada, Germany, the US and UK (G-5 hereafter), are revisited as in Ghosh (1995a). According to the empirical findings, not only the national cash flow (output minus investment and government expenditure) as stated in the literatures but also money does play crucial roles in determining the current account dynamics. As a whole, for these five major industrialized countries, the current accounts indeed act as a buffer to smooth consumption in facing fluctuations to national cash flow and money stock.

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I. INTRODUCTION

"Save for a rainy day", a well known theory proposed by Campbell (1987), indicates that the current consumption depends on the rational prospect of future economy. Nevertheless, within a highly developed economy, individual's consumption is often affected by various factors, for instance, inflation, the rate of time preference, and interest rates ... *etc*. Therefore, a rational representative individual should take all possible information available into consideration in making decisions regarding optimal consumption; meanwhile, this will in turn affect current accounts and domestic credits. Therefore, we would like to incorporate one of the key variables – money that puzzled economists quite a long time, into Ghosh's (1995a) model to revisit the dynamic behavior of the current accounts for Canada, Germany, Japan, the UK, and the US (hereafter G-5 countries), and to provide a more persuasive modification of the intertemporal approach to the current account.

Economists in 18th century already found out that money stock in the economy should be appropriate to make the economy function normally. If there are too much money in the economy, it would generate inflation; on the contrary, the insufficient money will not be able to fulfill the economic needs, and will result in redundant capital, and hence loss of production and encounter recession. Therefore, a country's central bank should appropriately manage and control its money supply to pursue the steadiness and normality of the economic activities.

In order to capture the importance of money to the economy, we modify the traditional intertemporal approach to the current account first proposed in the 80's by Buiter (1981), Sachs (1981), Svensson and Razin (1983), Obstfeld (1986), ... *etc*, by applying the money-in-utility setup originally due to Sidrauski (1967) and considering money in the intertemporal budget constraint. The econometric treatments on the empirical tests of the present-value model

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originally developed by Campbell (1987), Campbell and Shiller (1987) then allows us to map the actual current account to the theory oriented prediction of the current account and to justify the performance of this modification.

The intertemporal model views that the current account embodies a mixture of dynamic savings and investment decisions of the government and private sectors, as well as the lending decisions of foreign investors. This approach has been well applied to several areas of research, for instance in discussing capital mobility amongst developing and developed countries by Feldstein and Horioka (1980), Ghosh (1995a), Ghosh and Ostry (1995), Reinhart and Smith (1997), and in analyzing the consumption-smoothing or validity of theoretical forecasts on actual current accounts, *e.g.*, Sheffrin and Woo (1990a), Otto (1992), Agenor *et al.* (1999), Bergin and Sheffrin (2000), or in investigating the sustainability of the current account such as Cashin and McDermott (1998), Yan (1999, 2000). Other extensions of this approach can also be found in studying stock prices in Campbell and Shiller, Froot and Obstfeld (1991), or in dealing with tax smoothing/government deficits, *e.g.*, Huang and Lin (1993), Ghosh (1995b).

In accordance with our empirical findings, this modification does provide strong evidences that money plays a crucial role in explaining the long-run adjustments of current account for the G-5 countries being investigated. Therefore, further implication of how well a country's central bank can do to improve its external debt or to make it sustainable will produce valuable and practical suggestions. However, this part of policy implication is beyond our study for now.

This paper is organized as follows: Section 1 briefly introduces the preliminary, motivation, and purposes of this study. Section 2 presents our monetary modification of the theoretical model of the intertemporal current account followed a brief derivation of the associated econometric procedures in testing the present-value model. Section 3 reports both the original and our monetary VAR estimations of the model using the quarterly data of G-5 countries over 1960Q1-2000Q4, except for the UK: 1982Q3-2000Q4 (due to the data availability) and Germany: 1969Q1-1989Q4 (because of the structure shock due to the reunification of West and East Germany in 1990). Section 4 concludes our findings.

II. THE MODEL AND ECONOMETRIC PROCEDURES

Consider a small open economy[1] inhabited by a single, infinitely-lived, representative individual whose lifetime utility, *U*, at time 0 is given by,

$$U = \underset{0}{\mathrm{E}}\left\{ \sum_{t=0}^{\infty} \beta^t u\left(C_t, M_t\right) \right\}, \tag{1}$$

where $u(\cdot)$, the instantaneous preference, is assumed to be increasing and concave in consumption, C, and real money balance, M, *i.e.*, u_C, $u_M > 0$, u_{CC}, $u_{MM} < 0$, and $u_{CC}\, u_{MM} - u_{CM}^2 > 0$. This money-in-utility function is originally due to Sidrauski (1967), and it has been used widely to study a variety of issues in monetary economics. β, the subjective discount factor, ranging from 0 to 1, means that utilities are valued less the later they are received. Subscript t denotes time t. E indicates the expectation of a rational individual based on all information available to date.

This economy also produces and consumes a single composite good and trades freely with the rest of the world. Free trade includes the international exchange of assets. We assume that the only traded asset is a consumption-indexed bond with fixed face value that pays net interest at the world interest rate r. Labor is assumed internationally immobile. In per capita terms, then, the

[1] The empirical findings of Sheffrin and Woo (1990a), Otto, Ghosh (1995a), and Ghosh and Ostry (1997), suggest that this assumption is also reasonable in explaining developments in the current accounts for large industrialized countries, such as the U.S. and Japan.

identity linking total asset accumulation— that is, the current account, $CA_t = F_{t+1} - F_t$, and domestic credit increment — to the saving-investment balance is[2]

$$CA_t + \Delta M_t = (F_t - F_{t-1}) + (M_t - M_{t-1}) = rF_{t-1} + Y_t - C_t - G_t - I_t - \pi M_{t-1}$$
$$= rF_{t-1} + TB_t - \pi M_{t-1} = S_t - I_t - \pi M_{t-1}, \quad (2)$$

where F_t denotes the economy's stock of net foreign claims at time t. $\Delta M_t \equiv M_t - M_{t-1}$, Y_t is the net domestic product, *i.e.*, GDP, G_t is government consumption, I_t is the net investment,[3] π is the rate of inflation, TB_t is the trade balance and S_t is the national saving.[4] Equation (2) describes how the change of total assets can be interpreted either by the sum of interest received by the domestic agent on its net foreign assets plus a trade surplus, or on the other hand, the difference between national saving and investment. The left hand side of equation (2) is the accumulation of total assets, the other side is national cash flow (Following Ghosh (1995a), we define the national cash flow as $Q_t \equiv Y_t - G_t - I_t$) nets consumption and inflation seigniorage (πM_{t-1}) plus interest income on the outstanding stock of foreign assets (rF_{t-1}). It also means that we must undertake the loss of inflation tax (πM_{t-1}) when holding M_{t-1} at time t-1 for transaction, security precautions and over-debt prevention. In other words, the changes in domestic credit can be utilized to smooth consumption just like the current accounts. Furthermore, if the real money balances stay constant overtime, equation (2) will be the same as that of Ghosh (1995a). Therefore, the current account in equation (2) we call it the seigniorage-adjusted current account to be distinguished from the one in conventional setup.

We further assume that uncovered real interest parity holds at all time. Therefore, this small

2 Please refer to Obstfeld and Rogoff (1996, pp.532).
3 For simplicity, we assume that capital does not depreciate.
4 Defined as $S_t \equiv Y_t + rF_{t-1} - C_t - G_t$.

open economy in the world capital markets will exhibit the important property of Fisherian separability: investment should be chosen to maximize the discounted present value of the country's wealth, regardless of the consumption profile. This in turn says that investment is undertaken until the marginal product of capital equals the world interest rate as pointed out by Cooper and Sachs (1985), so that the investment schedule is independent of consumption. This implies that investment and output may be treated as exogenous when optimizing agent's lifetime utility. Likewise, the government expenditure is also assumed to be exogenous.

The optimization problem faced by the representative individual is to maximize U in equation (1), subject to the intertemporal budget constraint of equation (2). With "no Ponzi-game" [5] assumption and a CRRA form of utility function, *i.e.*, $u(C_t, M_t) = (1-\alpha)\ln C_t + \alpha \ln M_t$, $0 < \alpha < 1$,[6] it turns out the consumption necessarily follows:

$$\widetilde{C}_t = \frac{r}{\theta}\left\{F_{t-1} + \frac{1}{1+r}\mathrm{E}_t\left[\sum_{i=0}^{\infty}\frac{1}{(1+r)^i}(Q_{t+i} - M_{t+i} + (1-\pi)M_{t+i-1})\right]\right\},\quad \theta \equiv \frac{r}{(1+r)(1-\beta)}, \tag{3}$$

where $\widetilde{C}_t$ denotes the optimal path for consumption, and θ reflects the consumption-tilting effect. Equation (3) states that the optimal consumption is proportional to permanent national cash flow netting the gross change of domestic credits, and its endowment. From θ, we know

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[5] The ability of any person to roll over its debt perpetually brings to mind the notorious Boston financier Charles Ponzi who used to pay exorbitant interest to lenders out of an ever-expanding pool of deposits, without ever "investing" one penny. Mr. Ponzi was indicted in Federal Court in November 1920, and his bank eventually collapsed. The depositor's refusal to finance a Ponzi game means that he will demand that the net present value of his deposit position to be zero, *i.e.,* full repayment of his investment. O'Connell and Zeldes (1988) offer a theoretical study of "Ponzi games."

[6] See Prescott (1986), and Cooley (1995). The CRRA function type proposed is written as $u(C_t, M_t) = \dfrac{(C_t^{1-\alpha}M_t^{\alpha})^{1-\sigma} - 1}{1-\sigma}$, when $\sigma = 1$, it becomes $u(C_t, M_t) = (1-\alpha)\ln C_t + \alpha \ln M_t$.

that if $\beta \gtreqless 1/(1+r)$ or equivalently writing $\rho \lesseqgtr r$, where ρ is the rate of time preference, this implies $\theta \gtreqless 1$, which in turn states that the discrepancy between the objective world rate of interest, r, and subjective rate of time preference, ρ, determines whether an individual chooses a pattern of per capita consumption tilting towards the present $(\theta < 1)$ or the future $(\theta > 1)$. If $\theta = 1$ there is no consumption tilting component to the current account. We then define the seigniorage-adjusted optimal consumption-smoothing current account, without consumption-tilting effect, as:

$$\widetilde{CA}_t^m \equiv rF_{t-1} + Y_t - G_t - I_t - \Delta M_t - \pi M_{t-1} - \theta \widetilde{C}_t$$

$$= \mathrm{GNP}_t - G_t - I_t - \Delta M_t - \pi M_{t-1} - \theta \widetilde{C}_t \equiv X_t^m - \theta \widetilde{C}_t \,, \qquad (4)$$

where the gross national product is $\mathrm{GNP}_t \equiv Y_t + rF_{t-1}$, and the seigniorage-adjusted national disposal income is defined as $X_t^m \equiv \mathrm{GNP}_t - G_t - I_t - \Delta M_t - \pi M_{t-1}$. From equations (2), (3) and (4), with some manipulation we end up with

$$\widetilde{CA}_t^m = -\mathop{\mathrm{E}}_t \left(\sum_{i=1}^{\infty} \frac{1}{(1+r)^i} \left[\Delta Q_{t+i} - \eta \Delta M_{t+i} \right] \right), \qquad (5)$$

where $\Delta Q_{t+i} = Q_{t+i+1} - Q_{t+i}$, and $\eta = 1 - [(1-\pi)/(\beta(1+r))]$. We called η "the monetary effect". $\eta \lesseqgtr \pi$ is exactly equivalent to $\rho \gtreqless r$ as long as $\pi < 1$, where π is the rate of inflation. $\eta < \pi$ says, the representative agent excepts to undertake less inflation cost in the future through this monetary effect when people would like to spend more money to tilt consumption towards the present ($\rho > r$) and vice versa. However, if $\eta = \pi$ (*i.e.*, $\rho = r$), the cost of holding money equals the inflation tax. Moreover, $\eta \lesseqgtr 0$ is approximately equivalent to $\rho \gtreqless R$ (the nominal interest rate, which equals $r + \pi$). Therefore, equation (5) expresses the seigniorage-adjusted current account as negative sum of discounted present value of expected "future changes of seigniorage-adjusted national cash flow", $\Delta Q_{t+i} - \eta \Delta M_{t+i}$. This means that a country will run for a current account surplus (deficit) only if it expects its seigniorage-adjusted national cash flow to be falling (rising) in the future, analogous to what Campbell addressed that a rational individual will "save for a rainy day" when expecting his or her permanent income to decline, and vice versa. Therefore, the current account serves as a good predictor of future seigniorage-adjusted national cash flow.

In order to estimate this optimal current account, we then utilize the techniques developed by Campbell to first estimate an unrestricted p-th order of VAR in ΔQ_t, ΔM_t and $\widetilde{CA}_t^m$ as follows, for simplicity we assume $p = 1$,

$$\begin{bmatrix} \Delta Q_t \\ \Delta M_t \\ \widetilde{CA}_t^m \end{bmatrix} = \begin{bmatrix} \phi_{11} & \phi_{12} & \phi_{13} \\ \phi_{21} & \phi_{22} & \phi_{23} \\ \phi_{31} & \phi_{32} & \phi_{33} \end{bmatrix} \begin{bmatrix} \Delta Q_{t-1} \\ \Delta M_{t-1} \\ \widetilde{CA}_{t-1}^m \end{bmatrix} + \begin{bmatrix} \upsilon_{1t} \\ \upsilon_{2t} \\ \upsilon_{3t} \end{bmatrix}, \quad \text{or } Z_t = \Phi Z_{t-1} + V_t, \tag{6}$$

where $\widetilde{CA}_t^m$ is the actual seigniorage-adjusted consumption-smoothing component of the current account as in equation (4). For simplicity, we assume $p = 1$ for later derivation of econometric procedures for the present-value model. υ_1, υ_2 and υ_3 are disturbances with conditional means of zero, $Z_t = [\Delta Q_t \ \ \Delta M_t \ \ \widetilde{CA}_t^m]'$ and Φ are the transition matrices of the first order VAR. We can now discuss the Granger causalities of equation (6) for the VAR system based on the expression of equation (5). First, $\widetilde{CA}_{t-1}^m$ must negatively Granger-cause ΔQ_t, *i.e.*, $\phi_{13} < 0$. Secondly, $\widetilde{CA}_{t-1}^m$ will positively Granger-cause ΔM_t, *i.e.*, $\phi_{23} > 0$, as long as the nominal interest is greater than the rate of time preference, *i.e.*, $R \equiv r + \pi > \rho$. Otherwise, if $R \equiv r + \pi < \rho$,

ϕ_{23} needs to be negative. The intuitive explanation is that $\widetilde{CA}_t^m$ is an optimal forecast of a weighted sum of expected future changes in seigniorage-adjusted national cash flow, $\Delta Q_{t+i} - \eta \Delta M_{t+i}$, conditional on agent's full information set. This again reflects the consumption-smoothing behavior of "save for a rainy day". Then the *i*-period-ahead expectation on Z_t is simply

$$\underset{t}{\mathrm{E}}\left(Z_{t+i}\right) = \Phi^i Z_t .$$

Therefore, $\mathrm{E}_t\left(\Delta Q_{t+i}\right) = \begin{bmatrix}1 & 0 & 0\end{bmatrix} \mathrm{E}_t\left(Z_{t+i}\right) = \begin{bmatrix}1 & 0 & 0\end{bmatrix} \Phi^i Z_t$. The infinite sum in equation (5) is thus

$$\begin{aligned} \widehat{CA}_t^m &= -\begin{bmatrix}1 & -\eta & 0\end{bmatrix}\left[\frac{1}{1+r}\Phi\right]\left[I_3 - \frac{1}{1+r}\Phi\right]^{-1}\begin{bmatrix}\Delta Q_t \\ \Delta M_t \\ \widetilde{CA}_t^m\end{bmatrix} \\ &\equiv \begin{bmatrix}\Gamma_{\Delta Q} & \Gamma_{\Delta M} & \Gamma_{CA}\end{bmatrix}\begin{bmatrix}\Delta Q_t \\ \Delta M_t \\ \widetilde{CA}_t^m\end{bmatrix}, \end{aligned} \tag{7}$$

where I_3 is a (3×3) identity matrix. $\widehat{CA}_t^m$ is our model's prediction of the seigniorage-adjusted current account[7] that we compare to the actual seigniorage-adjusted consumption-

[7] If the constant term and time trend are added into our empirical studies of VAR estimation, the above formula has to be modified as:

$$\widehat{CA}_t^m = -\begin{bmatrix}1 & -\eta & 0\end{bmatrix}\left\{\begin{matrix}\left[\frac{1}{1+r}\Phi\right]\left[I_3 - \frac{1}{1+r}\Phi\right]^{-1}\left(Z_t - [I_3 - \Phi]^{-1}(A + B\cdot t)\right) + \frac{1}{r}[I_3 - \Phi]^{-1}(A + B\cdot t) + \\ \left(\frac{1+2r}{r^2}I_3 - \frac{1}{r}[I_3 - \Phi]^{-1} + \left[\frac{1}{1+r}\Phi^2\right]\left[I_3 - \frac{1}{1+r}\Phi\right]^{-1}[I_3 - \Phi]^{-1}\right)[I_3 - \Phi]^{-1}\cdot B\end{matrix}\right\},$$

where A and B are coefficient matrices of constant term and time trend, respectively.

smoothing component of current account, $\tilde{CA}_t^m$, in equation (4). Therefore, to evaluate the performance of VAR model, we test the null hypothesis, $\begin{bmatrix}\Gamma_{\Delta Q} & \Gamma_{\Delta M} & \Gamma_{CA}\end{bmatrix} = \begin{bmatrix}0 & 0 & 1\end{bmatrix}$, in equation (7), so that $\hat{CA}_t^m = \tilde{CA}_t^m$. As emphasized by Ghosh (1995a), we also need to compare the standard deviation of predicted and actual (consumption-smoothing) current accounts to quantify the mobility of capital.

The remaining test procedures are analogous to those in the literature. In our monetary model of intertemporal current accounts, we are expecting to gain more predicting power than that of Ghosh (1995a) on the dynamics of current accounts for the five major industrialized economies. All variables are in real terms to avoid getting mixed up from the effects of nominal prices or exchange rates.

III. EMPIRICAL EVIDENCES

The five industrialized countries are Canada, Germany, Japan, the UK, and the US. The quarterly sample period investigated ranges from 1960Q1 to 2000Q4, except for the UK: 1982Q3-2000Q4 (due to the data availability) and Germany: 1969Q1-1989Q4 (because of the structure shock due to the reunification of West and East Germany in 1990). All data are from the International Financial Statistics (IFS) expressed in per capita terms. An annual world interest rate of 4%, *i.e.*, 1% quarterly, was used to compute the expected current accounts. The national cash flow series was conducted by subtracting the sum of private investment and government expenditures from GDP and deflating by the CPI (consumer price index) and by population in all countries. Further details on the construction of all series will be specified whenever needed in the proceeded discussion.

The first step in the analysis is to verify if both $X_t^m \equiv \text{GNP}_t - G_t - I_t - \Delta M_t - \pi M_{t-1}$ and C_t are $I(1)$ and cointegrated. Table 1 shows unit-root test statistics for several series being used in the estimation procedure. Next, following Ghosh (1995a), and Agenor *et al.*, we have to obtain an estimate of θ in equation (4) in order to construct the (stationary) seigniorage-adjusted consumption- smoothing component of the current account by removing the non-stationary component of the actual series associated with consumption tilting.

[Table 1 here]

From Table 1, the seigniorage-adjusted national disposable income, *i.e.*, X_t^m, and C_t series exhibit nonstationarity in all countries except in Germany. The Germany cointegrated relationship, therefore, was estimated using OLS, and the others are estimated with Phillips and Hansen's FM correction method; the results were tabulated in Table 2. The advantage of their FM procedure (over use of OLS) for nonstationary regression is that hypothesis tests based on the FM regression are asymptotically normal. Thus we can formally test if $\theta = 1$ to justify the consumption-tilting effect. The simple t tests of $\theta = 1$ for Japan ($\hat{\theta}^{JP} = 1.063$), and the US ($\hat{\theta}^{US} = 0.926$) are significant, but can't be rejected for the others, which means that there exists no consumption tilting in Canada, Germany and the UK, but Japan has consumed less than its permanent cash flow for the sake of expecting future rainy days, and the US, on the contrary, has been so optimistic about its future as to consume more than its permanent cash flow.

[Table 2 here]

Next, the LC test statistics of Hansen (1992) in Table 2 for null hypothesis of cointegration between X_t^m and C_t are 0.248 and 1.340 for Japan and the US respectively, which indicate the cointegration may exist in the US only but not in Japan. Hansen's stability tests of constant parameter in the FM cointegrating regression, $\hat{\theta}^{JP} = 1.063$ for Japan, and $\hat{\theta}^{US} = 0.926$ for the US, show the consistent inference with the LC tests, the mean-F and sup-F tests for the null of stable θ were rejected at 10% level of significance for Japan. For Canada, Germany, and the UK, since there exist no consumption-tilting effect in these economies, Hansen's LC test, Mean-F, and Sup-F also confirm previous inference about the nonexistence of consumption tilting.

The estimation results shown above now enable us to take the residuals from the cointegrating regression of X_t^m on C_t as the actual seigniorage-adjusted consumption-smoothing component of the current account, $\widetilde{CA}_t^m$, for both Japan and the US. On the other hand, $\widetilde{CA}_t^m$ for Canada, Germany, and the UK are just the difference between their respective seigniorage-adjusted national disposable income and consumption according to the non-rejectable t values for the null of $\theta = 1$. Having the actual seigniorage-adjusted consumption-smoothing component of the current accounts ($\widetilde{CA}_t^m$), the national cash flow (Q_t), and real money series (M_t) in hand,[8] we are able to run the VAR estimation described in equation (6). Moreover, Table 1 reports that ΔQ_t, ΔM_t, and $\widetilde{CA}_t^m$ are all stationary for these five countries, we then are qualified for doing VAR estimation.

Another problem in doing VAR is the choice of its optimal order, we refer the Schwarz Bayesian Criterion (SBC) to select the optimal VAR orders in each country. Table 3 indicates quite consistent selection of VAR(1) for these countries except for Japan's VAR(2).

[Table 3 here]

From equation (5), we know that current account acts as a buffer to smooth consumption in the face of shocks to national cash flow and money stock, that is, the determination of current account depends not only on changes in national cash flow but changes in money stocks as well.

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[8] As stated in Otto (1992), it follows from equation (5) that in the steady state $CA^m = (\Delta Q + \Delta M)/r$. In our analysis if we substitute CA^m, ΔQ, and ΔM with the means of CA^m, ΔQ, and ΔM series, respectively for all countries, the real interest rates implied by the model's steady-state restriction is implausibly large or even negative. Therefore, we follow Otto's methodology to replace CA^m, ΔQ, and ΔM by their deviations from respective means in empirical studies.

However, the effect of changes in money stocks is ambiguous. This implies a weakly positive Granger causality of future changes in national cash flow on current account, and an uncertain sign (depending on $\eta \lesseqgtr 0$) of Granger causality of future changes in money stock on current account.

For the purpose of making comparison between original model (Ghosh, 1995a) and our monetary one, we run VAR in original setup as well. A summary of VAR results is reported in Tables 4~8. For the coefficients of each VAR estimation, their respective standard errors are in parentheses. The null hypothesis that no Granger causality of ΔQ_t on $\widetilde{CA_t}$ (the current account without seigniorage adjustment) can not be rejected except for Japan, Germany and the US. On the other hand, the only Granger causality implied by our monetary model can be found in Japan's $\widetilde{CA_t^m}$ on ΔM_t with a positive sign. This finding seems not consistent with our model prediction. However, though these estimates ($\hat{\phi}_{13}$ and $\hat{\phi}_{23}$) are not as significant with the same signs as theoretical prediction, our monetary VAR estimation does provide better prediction about current account dynamics (shown in Figures 1~5), since we make use of more important information available to the agent in the extensive model.

[Tables 4~8 here]

Theoretically, the monetary effect, η, equals $[1-{}^{1-\pi}\!/_{\beta(1+r)}]$, and $\rho \gtreqless r$ implies $\eta \lesseqgtr \pi$ as long as $\pi \le 1$. But the VAR results shown above are not precise to reflect the influence of changes in money stock. Our estimation then considers a range of values for this effect. Mechanically, we search for η such that the SSE (sum of squared errors) between the actual and predicted current accounts is minimized. Campbell and Shiller (1989) demonstrate this can be interpreted as a method of moment estimation. However, when we eventually use the minimized SSE to evaluate a test of the over-identified restrictions, a penalty must be imposed by reducing the degrees of freedom for the distribution by one. Table 9 presents the optimal η that minimized SSE for each country.

[Table 9 here]

In Table 9, all η's are positive except for Germany. According to our monetary model, η plays an important role reflecting changes in money stocks on the consumption- smoothing current account, especially in Canada and the UK, and a weak effect in Japan and the US.

The final goal in our study is to investigate whether the movement of actual current account is consistent of that predicted by the theory, that is to test $\hat{CA_t} = \tilde{CA_t}$ in the original setup and $\hat{CA_t^m} = \tilde{CA_t^m}$ in our monetary model. Wald statistics for the formal tests of the coefficient restrictions implied by the present-value relationship equation (7) are reported in Table 10. [9] For the original model, the Wald statistics for Japan, the US and UK reject the hypothesis of good performance of the VAR estimation. Canada's result is quite weird, even its Wald statistics failed to reject the null hypothesis of good performance, the fitting of theoretical, $\hat{CA_t}$, is far away from its actual series, $\tilde{CA_t}$, as shown in upper panel of Figure 1. From the Wald statistics and Figures 1~5, we conclude that our monetary approach does outperform Ghosh's (1995a) estimation for these five industrialized countries.

[Figures 1~5 here]

In our monetary approach, only Japan and Canada fail to accept the null hypothesis of good performance, the others show non nonrejectible test statistics at 5% significance level. However

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[9] More details of the econometric procedures on this test can also be found in Campbell (1987).

the correlation coefficients between the actual and predicted current accounts are far better than those of original model for Japan and Canada meaning that our monetary approach still weakly outperforms. That is in general our new estimations do much better for all cases, saying that the VAR estimation with money included tracks the dynamic behavior of the current accounts fairly closely. The correlations between actual and predicted current accounts shown in Table 10 are also consistent with findings from previous VAR estimations.

[Table 10 here]

Finally, we examine if capital mobility has been too limited to allow consumption-smoothing behavior, the results were in the last column of Table 10. In our theoretical model, we assume a small open economy with perfect capital mobility, *i.e.*, the ratio of standard error of actual current account to that of predicted current account has to equal one theoretically. In other words, we required that capital moves perfectly in reality as model’s assumption. On the contrary, if this ratio is less than one, meaning that capital moves imperfectly, however if this ratio is greater than one, there may exist “hot money” in the economy resulting in capital moving too fast and volatile . For the original setup, the ratios for these industrialized countries are either too high (in Canada, and the UK) or too low (in Germany, Japan, and the US) to be considered as perfect capital mobility. However, our new approach shows that all countries exhibit perfect capital mobility, and Japan may even suffer an abnormally rapid capital movement.

As a whole, from Table 10 and Figures 1~5, the monetary approach does provide better fitness than the original one. Therefore, money really plays a key role in explaining dynamic behavior of current accounts which implies that monetary policy should be taken into serious consideration in conducting a country's trade policies.

IV. CONCLUSIONS

In this study, we try to find out if money helps to predict current accounts more precisely, and to offer a more persuasive explanation to the original model in which it can not fully capture the actual scenario. Beyond doubt, money does play a crucial factor in explaining the dynamics of current accounts overtime according to our empirical findings. Individual need of money is affected by monetary policies, and as the policy is under taken, individuals also take their predictable actions to comply. Therefore, we apply the money-in-utility setup originally due to Sidrauski (1967) and a creditor/debtor balanced budget to be closer to the real world economy.

According to our empirical studies, the VAR estimation implied by the Ghosh's (1995a) original setup can not fully describe the tendency of current accounts in the G-5 economies (Canada, Japan, Germany, the UK, and the US). Nevertheless, our monetary approach does capture much tendency of the current accounts for G-5. In the estimation of the consumption-tilting effects, Japan's number, $\hat{\theta}^{JP} = 1.063$, is higher than 1 meaning her people have saved too much for future consumption, which is also consistent with Ghosh (1995a), and Yan (2000). The estimated US consumption-tilting effect, $\hat{\theta}^{US} = 0.926$, on the contrary, is less than 1, *i.e.*, American tends to consume now, which is different from some existing studies. This is due to the seigniorage effect being considered in this study. For the other countries, Canada, Germany and the UK, there exists no significant evidence of consumption tilting.

Then, we turn to the Granger-causalities. According to previous discussion, there is little evidence of weak Granger-causalities in G-5 for both the original and our monetary VAR estimations, this result is not as good as theory predicted. However, in accordance with our monetary approach, Japan's coefficient for the Granger-causality is significant, meaning that in observing a current account surplus (deficit) now, we may expect there will be a growing (decreasing) money stock in the future, and hence Japan will suffer for a more (less) serious inflation tax problem at that time.

For the model performance, Wald statistics of the formal tests for Japan, the UK, and the US, can not approve the original theory, and even Canada and Germany's numbers are acceptable, merely Germany has good fitness when the graphic comparison proceeds. Yet, with our monetary methodology, all countries' Wald statistics, except for those of Canada and Japan, accept the null hypothesis of good model, and show a closer fit of actual and predicted current accounts in the figures. Moreover, even the Wald tests for Canada and Japan both reject the null, the figures and correlation between actual and theoretical prediction of current accounts still provide better results than Ghosh's (1995a) original approach.

Finally, ratios of relative volatility between the actual and predicted current accounts for these G-5 countries seem too far away beyond the reality in the original model. Nevertheless, our monetary extension provides credible measures of perfect capital mobility for all G-5 countries.

According to what we got in all aspects of the comparison between Ghosh (1995a) and our monetary approaches, there is no doubt that "money" here does offer a powerful explanation to the dynamic behavior of the current accounts. We once again provide strong evidence for policymakers to be more punctilious to consider the monetary effect in making trade policies.

Table 1: Tests for Unit Roots (ADF)

Variables	CA	GM[a]	JP	UK	US
X_t^m	-0.29	-1.89 *	-1.18	-0.04	-0.78
C_t	-1.12	-1.87 *	-1.11	-0.66	-0.61
Q_t	-0.42	-1.99 **	-1.35	-0.39	-0.73
$\Delta Q_t \equiv Q_t - Q_{t-1}$	-3.59 ***	-1.89 *	-3.15 ***	-2.36 **	-3.42 ***
M_t	0.12	-1.88 *	0.39	-1.98 **	-2.10 **
$\Delta M_t \equiv M_t - M_{t-1}$	-3.93 ***	-2.09 **	-3.27 ***	-4.70 ***	-3.82 ***
$\widetilde{CA}_t^m$ [b]	-2.04 **	-2.07 **	-3.53 ***	-2.67 ***	-2.00 **
1% critical value	-2.59	-2.60	-2.59	-2.53	-2.59
5% critical value	-1.94	-1.94	-1.94	-1.95	-1.94
10% critical value	-1.62	-1.59	-1.62	-1.63	-1.62

CA: Canada, GM: Germany, JP: Japan, UK: United Kingdom, US: United States .
[a] The sample period for GM is over 1969Q1~1989Q4.
[b] Consumption-tilting effect has been removed from current accounts.
"*", "**", "***": test statistics are significant at the 10%, 5%, and 1% significance levels, respectively.
Note: both constant and time trend are excluded in estimation.

Table 2: Fully-Modified Estimation for Consumption-Tilting Effect (θ)

	CA	GM	JP	UK	US
θ	0.975	1.073	1.063 *	0.989	0.926 *
t-statistics	-0.753	1.218	7.073	-0.292	-3.748
std error	0.033	0.060	0.009	0.037	0.020
LC test [1]	0.379	0.424	0.248	0.458	1.340 *
Mean-F [2]	2.097	2.389	1.299	2.309	7.468
Sup-F [3]	3.430	5.153	5.713	4.375	10.762

[1] H_0: existence of the cointegrated relationship (5% and 1% critical values are 0.575 and 0.898, respectively).
[2,3] H_0: cointegrating vector is stable (5% and 1% critical values for Mean-F are 4.57, 6.78, and Sup-F are 12.4, 16.2, respectively).
"*","**": test statistics are significant at 5%, and 1% significance levels, respectively.

Table 3: Determination of Optimal VAR Lag Order (SBC)[1]

Lag	CA	GM	JP	UK	US
1	44.2685 *	42.6031 *	72.7469	32.8088 *	41.8296 *
2	44.4585	42.9515	72.6645 *	33.0774	41.9390
3	44.6828	43.3126	72.7664	33.3947	42.0768
4	44.8303	43.5057	72.8762	33.7416	42.0560
5	45.0081	43.8542	73.0441	34.1227	41.9650
6	45.2811	44.1445	73.2764	34.4453	42.2185

[1] SBC is the Schwarz's Bayesian Criterion.
"*": Minimum value of SBC amongst all lags.

Table 4: Canada's VAR Estimation

Original: VAR(1)			Monetary: VAR(1)			
	ΔQ_{t-1}	$\widetilde{CA}_{t-1}$		ΔQ_{t-1}	ΔM_{t-1}	$\widetilde{CA}_t^m$
ΔQ_t	-0.0773	0.0292	ΔQ_t	-0.1040	0.0557	0.0316
	(0.0803)	(0.0465)		(0.0818)	(0.0340)	(0.0465)
			ΔM_t	0.0789	0.0227	0.1723
				(0.1985)	(0.0825)	(0.1130)
$\widetilde{CA}_t$	-0.0186	0.9493	$\widetilde{CA}_t^m$	-0.0877	0.2491	0.9143
	(0.0599)	(0.0347)		(0.0752)	(0.0313)	(0.0428)

"*", "**", "***": test statistics are significant at the 10%, 5%, and 1% significance levels, respectively.
Note: standard errors in parentheses, ( ), under estimates.

Table 5: Germany's VAR Estimation

Original: VAR(1)			Monetary: VAR(1)			
	ΔQ_{t-1}	$\widetilde{CA}_{t-1}$		ΔQ_{t-1}	ΔM_{t-1}	$\widetilde{CA}_t^m$
ΔQ_t	-0.3221	-0.199***	ΔQ_t	-0.2508	0.0239	-0.0701
	(0.1118)	(0.1089)		(0.2468)	(0.0320)	(0.1124)
			ΔM_t	-0.3276	-0.0074	-0.9586
				(2.0260)	(0.2630)	(0.9228)
$\widetilde{CA}_t$	0.0186	0.9650	$\widetilde{CA}_t^m$	-0.3612	0.0547	0.7049
	(0.0439)	(0.0427)		(0.2155)	(0.0280)	(0.0981)

"*", "**", "***": test statistics are significant at the 10%, 5%, and 1% significance levels, respectively.
Note: standard errors in parentheses, ( ), under estimates.

Table 6: Japan's VAR Estimation

	Original: VAR(1)			Monetary: VAR(2)		
	ΔQ_{t-1}	$\tilde{CA}_{t-1}$		ΔQ_{t-1} $i=1, 2$	ΔM_{t-1} $i=1, 2$	$\tilde{CA}^m_{t-1}$ $i=1, 2$
ΔQ_t	-0.0926	0.164 ***	ΔQ_t	-0.2571	0.0617	0.2178 ***
	(0.0798)	(0.0661)		(0.1320)	(0.0344)	(0.0768)
			ΔM_t	-0.5865	0.6952	0.7549 *
				(0.3941)	(0.1026)	(0.2295)
$\tilde{CA}_t$	0.0392	0.9267	$\tilde{CA}^m_t$	0.1294	0.0249	0.7848
	(0.0337)	(0.0279)		(0.1033)	(0.0269)	(0.0601)

"*", "**", "***": test statistics are significant at the 10%, 5%, and 1% significance levels, respectively.
Note: standard errors in parentheses, ( ), under estimates.

Table 7: UK's VAR Estimation

	Original: VAR(1)			Monetary: VAR(1)		
	ΔQ_{t-1}	$\tilde{CA}_{t-1}$		ΔQ_{t-1}	ΔM_{t-1}	$\tilde{CA}^m_t$
ΔQ_t	0.0139	-0.0486	ΔQ_t	0.0351	-0.0212	-0.0426
	(0.1202)	(0.0608)		(0.1224)	(0.0189)	(0.0601)
			ΔM_t	0.8585	-0.2900	0.1345
				(1.1843)	(0.1825)	(0.5812)
$\tilde{CA}_t$	-0.3199	0.8526	$\tilde{CA}^m_t$	-0.5625	0.2968	0.8193
	(0.1253)	(0.0634)		(0.3029)	(0.0467)	(0.1487)

"*", "**", "***": test statistics are significant at the 10%, 5%, and 1% significance levels, respectively.
Note: standard errors in parentheses, ( ), under estimates.

Table 8: US's VAR Estimation

Original: VAR(1)			Monetary: VAR(1)			
	ΔQ_{t-1}	$\widetilde{CA}_{t-1}$		ΔQ_{t-1}	ΔM_{t-1}	$\widetilde{CA}^m_t$
ΔQ_t	0.2012	-0.1017 *	ΔQ_t	0.0058	0.0644	-0.0444
	(0.0765)	(0.0530)		(0.0988)	(0.0268)	(0.0487)
			ΔM_t	-0.7107	0.5494	-0.3066
				(0.3829)	(0.1040)	(0.1886)
$\widetilde{CA}_t$	-0.0850	0.9796	$\widetilde{CA}^m_t$	-0.0333	0.0435	0.9692
	(0.0342)	(0.0237)		(0.0882)	(0.0240)]	(0.0434)

"*", "**", "***": test statistics are significant at the 10%, 5%, and 1% significance levels, respectively.
Note: standard errors in parentheses, ( ), under estimates.

Table 9: The Monetary Effects

Country	CA	GM	JP	UK	US
η (chosen to minimize SSE)	0.5	-0.3	0.168	1.105	0.036

Table 10: Wald Test and Other Statistics

Country	Approach	Wald statistics (d.f.)[1]	Corr (Actual, Predicted CA)	$\sigma_{actual} / \sigma_{predicted}$
CA	Original	4.2907 (2)	-0.9952	2.2967
	Monetary	46.8426 (2)*	0.9580	1.0571
GM	Original	2.0386 (2)	0.9962	0.3165
	Monetary	0.3497 (2)	0.9778	1.0221
JP	Original	14.6594 (2)*	-1.0000	0.5184
	Monetary	80.3511 (5)*	0.3231	1.0176
UK	Original	12.2740 (2)*	0.9828	2.9260
	Monetary	0.1201 (2)	0.9914	1.0239
US	Original	17.8573 (2)*	0.9954	0.1533
	Monetary	0.4435 (2)	0.9990	1.0018

[1] Chi-square degree of freedom in ( ).
"*": test statistic is significant at 5% significance level.

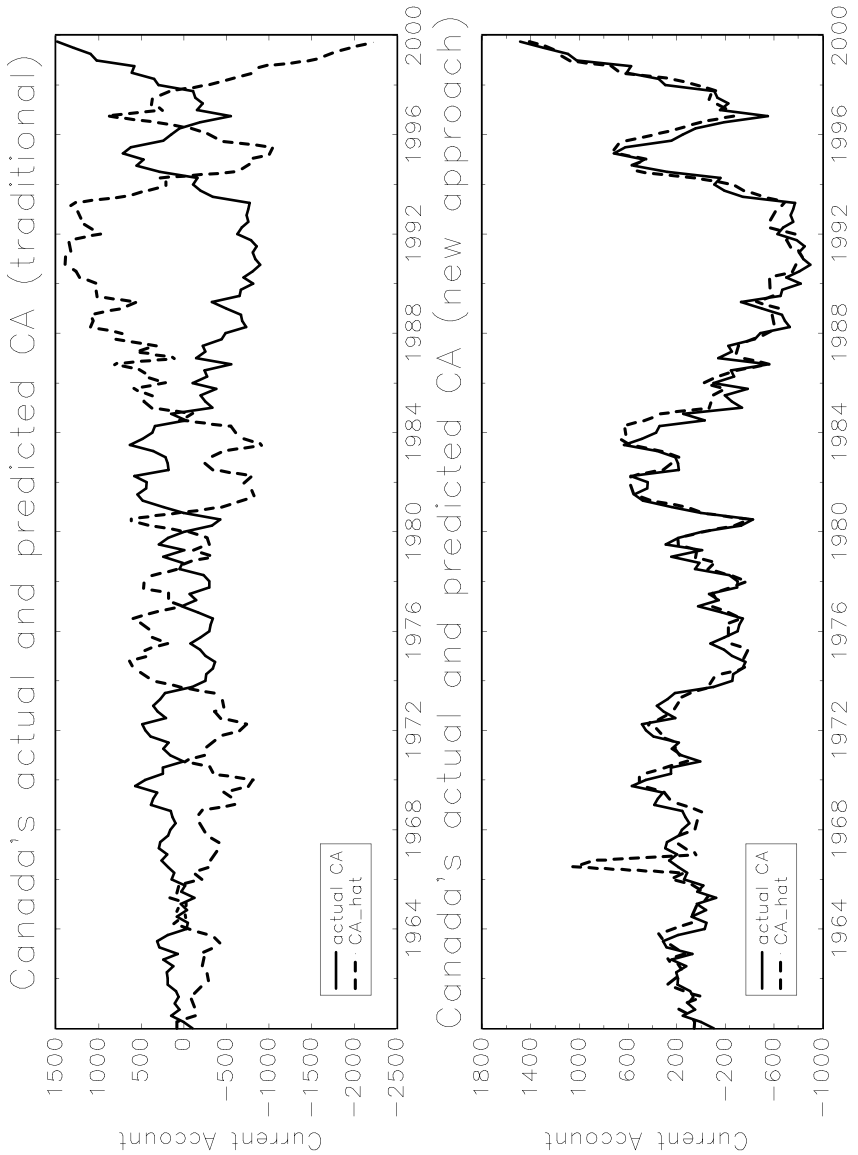

Figure 1: Canada's actual and predicted current accounts under original and monetary approaches

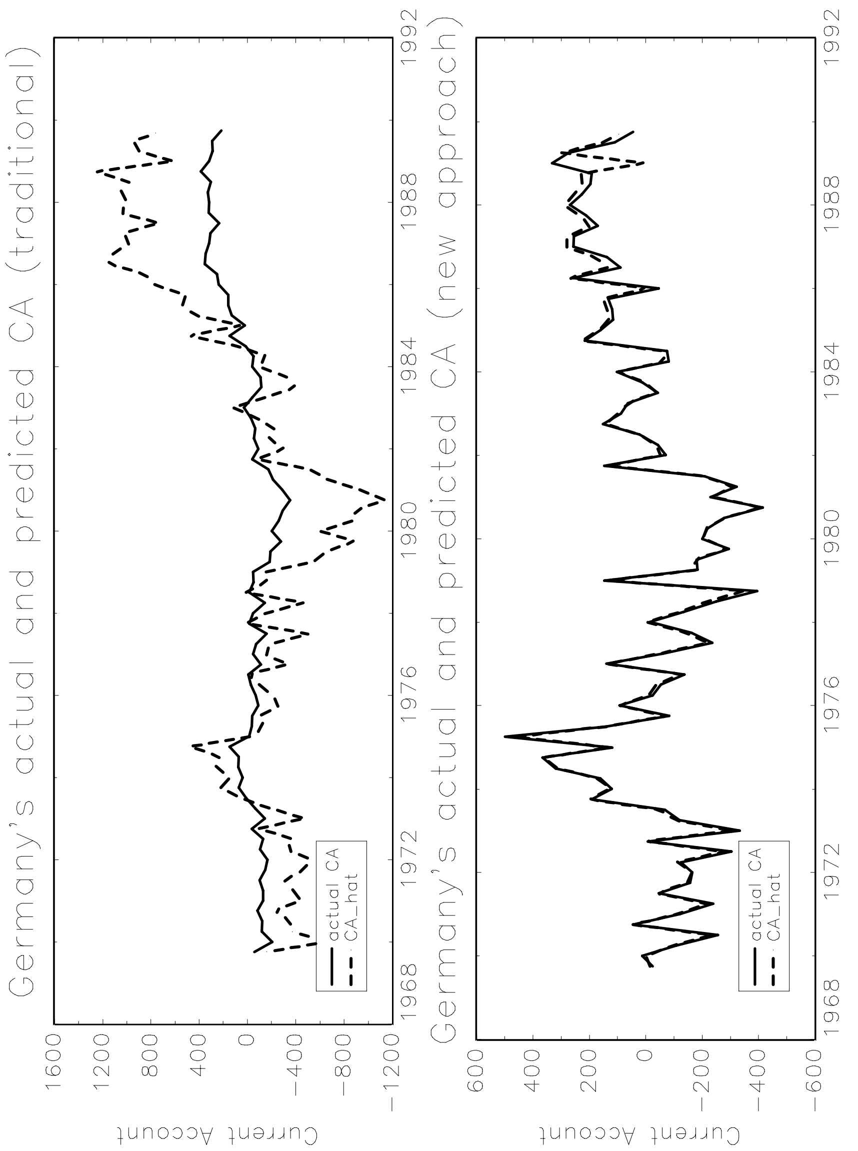

Figure 2: Germany's actual and predicted current accounts under original and monetary approaches

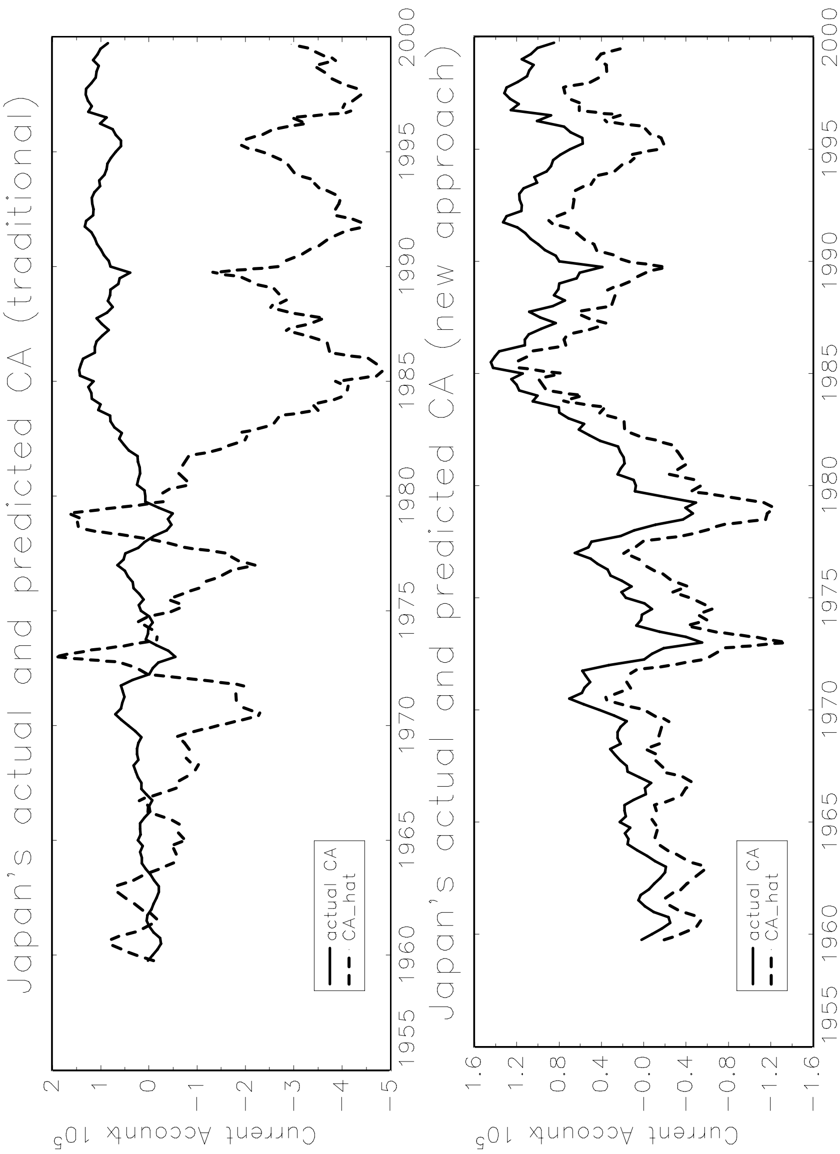

Figure 3: Japan's actual and predicted current accounts under original and monetary approaches

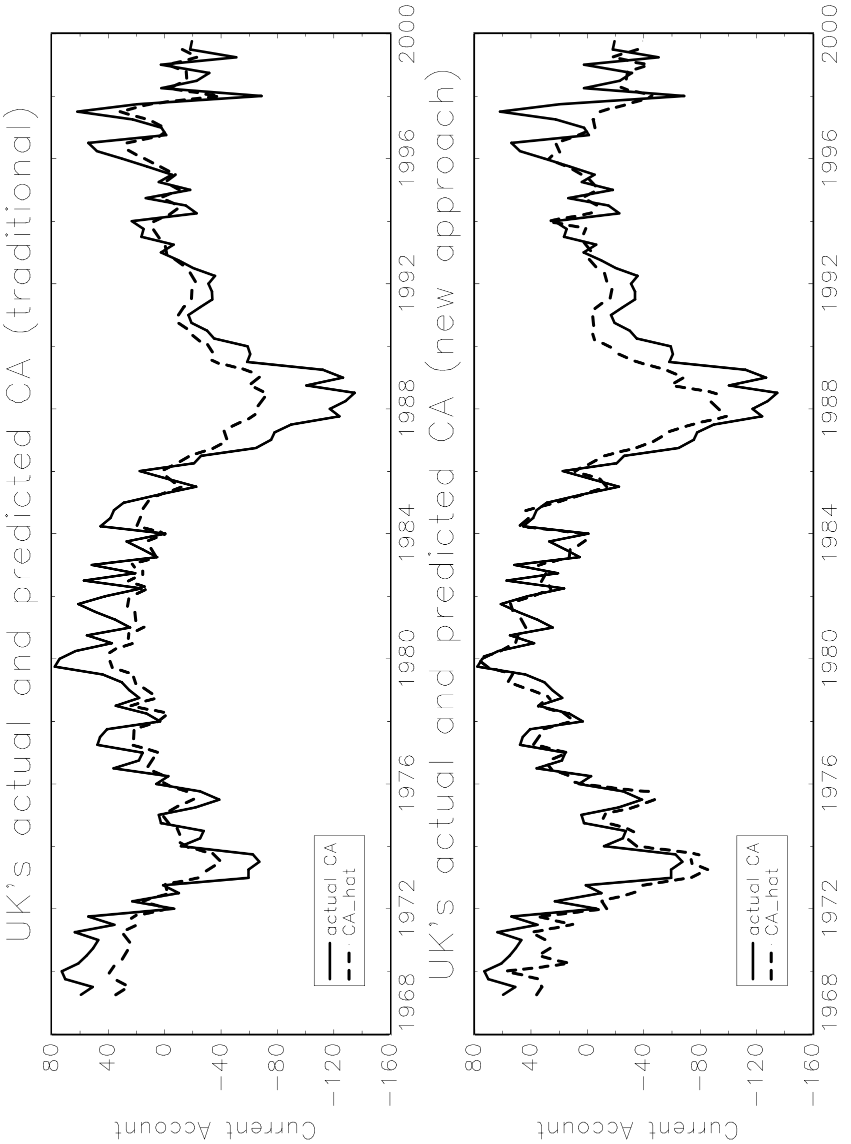

Figure 4: UK's actual and predicted current accounts under original and monetary approaches

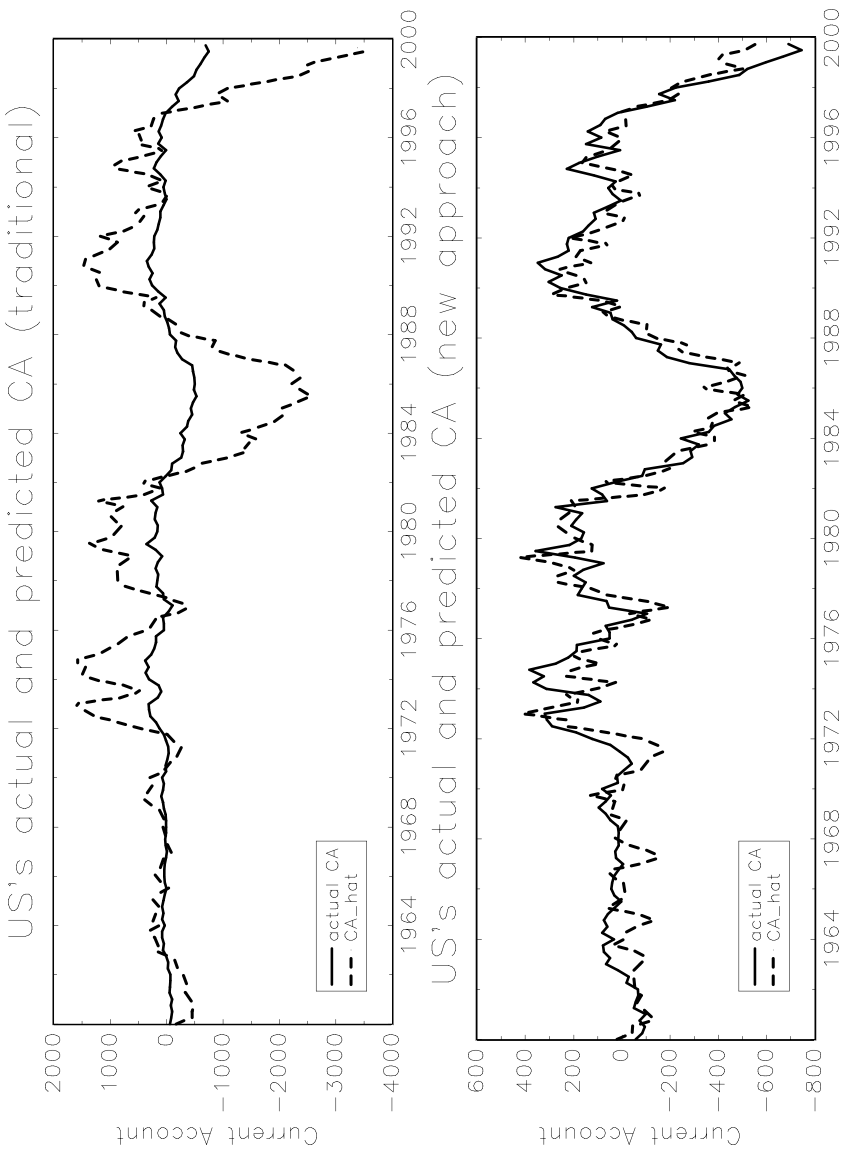

Figure 5: US's actual and predicted current accounts under original and monetary approaches

APPENDIX

Equation (5) is derived from the following process:

$$\max_{\{C_t\}_{t=0}^{\infty}} U = \mathop{\mathrm{E}}_0\left\{\sum_{t=0}^{\infty}\beta^t u(C_t, M_t)\right\}, \quad \text{where } u(C_t, M_t) = (1-\alpha)\ln C_t + \alpha \ln M_t\,, \tag{1}$$

$$\text{s.t.} \;\; (F_t - F_{t-1}) + (M_t - M_{t-1}) = rF_{t-1} + Y_t - C_t - G_t - I_t - \pi M_{t-1} \tag{2}$$

Rewrite the above maximization by Bellman equation, and define the value function as:

$$V(F_{t-1} + M_{t-1}) = \max_{C_t} \; u(C_t, M_t) + \beta \mathop{\mathrm{E}}_0\left[V(F_t + M_t)\right]$$

$$\text{s.t.} \;\; F_t + M_t = (1+r)F_{t-1} + (1-\pi)M_{t-1} + Q_t - C_t, \quad Q_t \equiv Y_t - G_t - I_t\,.$$

Therefore, the first-order condition (F.O.C.) and Benveuiste-Scheinkman condition (B-S.C.) can be derived as:

$$\text{F.O.C.} \;\; (C_t): \quad u_c = \beta \mathop{\mathrm{E}}_0\left[V'(F_t + M_t)\right] \;\; \ldots\ldots \tag{A1}$$

$$\text{B-S.C.} \;\; (F_{t-1}): \quad V'(F_{t-1} + M_{t-1}) = (1+r)\beta \mathop{\mathrm{E}}_0\left[V'(F_t + M_t)\right] \;\; \ldots\ldots \tag{A2}$$

$$\text{B-S.C.} \;\; (M_{t-1}): \quad V'(F_{t-1} + M_{t-1}) = u_m + (1-\pi)\beta \mathop{\mathrm{E}}_0\left[V'(F_t + M_t)\right] \;\; \ldots\ldots \tag{A3}$$

Combining (A1), (A2) and (A3), we can end up with the Euler equations as:

$$C_{t+i} = \left[\beta(1+r)\right]^i C_t \tag{A4}$$

$$M_{t+i} = \left[\beta(1+r)\right]^i M_t \tag{A5}$$

Re-expressing the budget constraint and with (A4) and (A5) gives:

$$\widetilde{C}_t = \frac{r}{\theta}\left[F_{t-1} + \sum_{i=1}^{\infty}\left(\frac{1}{1+r}\right)^i Q_{t+i-1} - \sum_{i=1}^{\infty}\left(\frac{1}{1+r}\right)^i M_{t+i-1} + (1-\pi)\sum_{i=1}^{\infty}\left(\frac{1}{1+r}\right)^i M_{t+i-2}\right], \tag{A6}$$

where $\theta \equiv {}^{r}\!/\!_{(1+r)(1-\beta)}$ is the coefficient of consumption-tilting effect. Thus, we may derive the seigniorage-adjusted optimal consumption-smoothing current account, without consumption-tilting effect, as $\widetilde{CA}_t^m \equiv rF_{t-1} + Y_t - G_t - I_t - \Delta M_t - \pi M_{t-1} - \theta \widetilde{C}_t$. Further, from (A6) we may decompose the seigniorage-adjusted optimal consumption-smoothing current account as:

$$\widetilde{CA}_t^m = \left[Q_t - r\sum_{i=1}^{\infty} Q_{t+i-1} \right] + \underbrace{\left[r\sum_{i=1}^{\infty} \left(\frac{1}{1+r} \right)^i M_{t+i-1} - M_t \right]}_{A_1} - \underbrace{(1-\pi)\left[r\sum_{i=1}^{\infty} \left(\frac{1}{1+r} \right)^i M_{t+i-2} - M_{t-1} \right]}_{A_2}. \tag{A7}$$

Then, solve for A_1 and A_2.

(1) A_1:

$$A_1 = r\sum_{i=1}^{\infty} \left(\frac{1}{1+r} \right)^i M_{t+i-1} - M_t$$

$$= \frac{r}{1+r}\sum_{i=0}^{\infty} \left[\left(\frac{1}{1+r} \right)(M_{t+1} - M_t) + \left(\frac{1}{1+r} \right)^2 (M_{t+2} - M_t) + \cdots \right], \text{ then} \tag{A8}$$

$$\frac{1}{1+r}A_1 = \frac{r}{1+r}\left[\left(\frac{1}{1+r} \right)^2 (M_{t+1} - M_t) + \left(\frac{1}{1+r} \right)^3 (M_{t+2} - M_t) + \cdots \right]. \tag{A9}$$

Subtracting (A9) from (A8) gives the following:

$$A_1 = \sum_{i=1}^{\infty} \left(\frac{1}{1+r} \right)^i (M_{t+i} - M_{t+i-1}). \tag{A10}$$

(2) A_2:

$$\because \quad A_2 = r(1-\pi)\sum_{i=1}^{\infty} \left(\frac{1}{1+r} \right)^i M_{t+i-2} - (1-\pi)M_{t-1}$$

$$= \frac{r(1-\pi)}{1+r}\sum_{i=0}^{\infty} \left[\left(\frac{1}{1+r} \right)(M_t - M_{t-1}) + \left(\frac{1}{1+r} \right)^2 (M_{t+1} - M_{t-1}) + \cdots \right], \text{ then} \tag{A11}$$

$$\frac{1}{1+r}A_2 = \frac{r(1-\pi)}{1+r}\left[\left(\frac{1}{1+r} \right)^2 (M_t - M_{t-1}) + \left(\frac{1}{1+r} \right)^3 (M_{t+1} - M_{t-1}) + \cdots \right]. \tag{A12}$$

Subtracting (A12) from (A11) gives the following:

$$A_2 = (1-\pi)\sum_{i=1}^{\infty}\left(\frac{1}{1+r}\right)^i \left(M_{t+i-1} - M_{t+i-2}\right). \tag{A13}$$

Next, from (A5), (A10) and (A13), we can derive the following, equation (5)

$$\widetilde{CA}_t^m = -\underset{t}{\mathrm{E}}\left(\sum_{i=1}^{\infty}\frac{1}{(1+r)^i}\left[\Delta Q_{t+i} - \eta\Delta M_{t+i}\right]\right), \tag{5}$$

where $\Delta Q_{t+i} \equiv Q_{t+i} - Q_{t+i-1}$, $\Delta M_{t+i} \equiv M_{t+i} - M_{t+i-1}$ and $\eta \equiv 1 - {}^{1-\pi}\!/_{\beta(1+r)}$.

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