**Modeling the U.S. Current Account as the Savings-Investment Balance**

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## Abstract

This paper derives and estimates a current account model from the perspective that the current account balance is the difference between national savings and investment. This approach allows us to include determinants of savings, investment, and capital flows to explain and forecast the evolution of the current account, an advantage not offered by the elasticity approach, which views the current account balance as the sum of net exports and net investment income. The savings-investment approach shows that the three traditional variables—the real exchange rate, domestic activities, and foreign activities—do exert a significant influence on the current account, as postulated by the elasticity approach. More important, it shows that some variables overlooked by the elasticity approach—namely, the share of dependents in the foreign population, real U.S. and foreign interest rates, and U.S. corporate profits—also matter for the current-account adjustment, while the government budget balance does not. The finding that the budget balance is not a significant determinant of the current account suggests that U.S. private savings may have tended to adjust to offset changes in the government budget. Overall, models based on the savings-investment approach track and forecast the U.S. current account much better than models based on the elasticity approach.

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## 1. Introduction

The current account balance has dual identities: (1) the sum of the trade balance and net international investment income; and (2) the difference between income and absorption; or equivalently, the difference between savings and investment. Because each identity can be derived from the other in the framework of the national income and product accounts, they do not pose theoretical conflict with each other. Nevertheless, some economists tend to invoke the first identity—the elasticity approach—to emphasize the role of the exchange rate in the current-account adjustment, while others tend to cling to the second identity—the absorption approach—to emphasize that the exchange rate is unimportant in the current-account adjustment.[1]

Despite the many theoretical appeals of the absorption approach,[2] policymakers and forecasters still tend to use the elasticity approach to construct current-account models for forecasting purposes. In a typical elasticity approach, exports are modeled as a function of foreign income and the terms of trade, imports as a function of U.S. income and the terms of trade.[3] The approach thus has the benefit of giving straightforward

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[1] For example, see Krugman (1987).

[2] For example, the absorption approach offers a broader perspective of the current account than the elasticity approach, recognizing the current account as the outcome of economic agents' intertemporal utility maximization.

[3] A typical U.S. current account model based on the elasticity approach also includes equations for net investment income, with investment income being modeled as a function of foreign interest rates and U.S. international assets, and investment payment a function of U.S. interest rates and U.S. international liabilities. However, net investment income historically has been small relative to the trade balance, which has remained the primary component of the U.S. current account balance.

estimates of the price and income elasticities of exports and imports, making it easy to predict the partial-equilibrium impact on the trade deficit of expected changes in the terms of trade and relative income growth. For those reasons, it is not surprising that the elasticity approach has been the standard approach for building models of the current account.

Nevertheless, estimating current account models based on the absorption approach is worthwhile for at least three reasons.

First, in a world where capital flows dwarf trade flows, modeling the current account based only on the elasticity approach could lead to erroneous conclusions and policy recommendations. In open economies, agents' intertemporal decisions influence both trade and capital flows across national borders. Since the sum of the current account and the financial account must equal zero *ex post* in a flexible exchange rate regime, shocks that occur first in the financial account will affect the current account just as much as shocks that occur first in the current account will affect the financial account. Because the elasticity approach effectively treats financial account transactions as passive responses to current-account transactions, it is incapable of analyzing the impact on the current account of shocks that initially drive only the financial account. Thus, by making it easier to incorporate determinants of financial account transactions into modeling the current account balance, the absorption approach provides a more inclusive, and less misleading, framework to analyze and forecast the current account than does the elasticity approach.

Second, because domestic activity, foreign activity, and the real exchange rate are the three main determinants of the current account in the elasticity approach, the estimation of a current account model based on the elasticity approach is likely to exaggerate the explanatory power of those three variables in the current-account adjustment, failing to show the importance of other possible drivers. As a result, relying exclusively on an elasticity-based current account model has not helped to settle the ongoing debate over the roles of the exchange rate and the budget balance in the current-account evolution. The role of the exchange rate in facilitating countries' external adjustments has been a subject of much debate among economists who emphasize the absorption view and those who stress the elasticity view.[4] Relatedly, economists who emphasize the absorption view have tended to point to the increase in the budget deficit as the main cause for widening the U.S. current account deficit, while those emphasizing the elasticity view are less ready to declare that the budget deficit is the main culprit. Estimating an absorption-based current account model will help shed light on those issues.

Third, over the medium term, an absorption model is likely to generate forecasts that are more accurate than those generated by an elasticity model, for two reasons. First, the forecast performance of an absorption model depends less critically on the accuracy of forecasts of the three main drivers in the elasticity approach—the real exchange rate,

[4] The traditional view maintains that a real exchange rate adjustment is necessary to reduce an external deficit. However, some economists have argued that an exchange rate change is not a necessary element of the adjustment. For example, a decline in government expenditure could reduce aggregate demand sufficiently to restore the trade balance without changing the real exchange rate. This would tend to be true if the foreign and the domestic shares of spending on domestic goods were equal at the margin. See Krugman (1987).

output at home, and output abroad. Because those three variables are harder to predict over the medium term than some of the variables included in the absorption approach—for example, demographic trends at home and abroad—an absorption model could generate more accurate medium-term forecasts. Second, and more important, an elasticity-based model—because it excludes relevant variables that affect savings, investment, and capital flows—is likely to perform worse than an absorption model due to the problems of omitted variables.

This paper derives and estimates a current account model based on the absorption approach. Among its findings are: (1) some variables included in the absorption approach, but excluded by the elasticity approach—such as the foreign dependency ratio, domestic corporate profits, domestic real interest rates, and foreign real interest rates—play a significant role in moving the current account; (2) the real exchange rate exerts a significant influence on the current-account adjustment; (3) the budget balance does not have a long-run impact on the current account; and (4) in forecasting the U.S. current account, models based on the absorption approach outperform those based on the elasticity approach, by a considerable margin.

The remainder of the paper is organized as follows. Section 2 rearranges the current account identity to demonstrate how exogenous shocks that arise from the international financial market can be transmitted into current-account movements. Section 3 derives a reduced-form equation for the current account that includes determinants of savings, investment, and capital flows. Section 4 tests whether the current account is cointegrated with the explanatory variables suggested by the absorption approach and builds an error-correction model of the current account. Section 5 compares the forecasting performances of alternative models of the current account. Section 6 offers some conclusions.

## 2. Current-Account Identities

To distinguish the net effect of autonomous capital flows, let's assume that the world consists of two countries: the United States and Foreign. Now let's imagine a hypothetical world that is identical to the real two-country world in every aspect except those affected by this assumption: there is no capital mobility between the United States and Foreign in the sense that there are no autonomous capital flows.[5] That is, all cross-border capital flows in this hypothetical world would occur only as a result of settling current-account transactions.

We further assume that the real interest rate will adjust to clear the loanable funds market. That is,

$$(1) \quad S(R) + S^{*}(R) = D(R)$$

$$(2) \quad S^{H}(R^{H}) + S^{H*}(R^{H}) = D^{H}(R^{H})$$

Where,

R is the equilibrium real interest rate in the United States in the real world.

D(R) is real demand for funds in the United States at R.

S(R) is real domestic supply of funds in the United States at R.

$S^{*}$(R) is net real foreign supply of funds in the United States at R.

[5] For the purpose of this paper, capital mobility can be thought of as capital-account liberalization.

$R^H$ is the equilibrium real interest rate in the United States in the hypothetical world.

$D^H(R^{\mathbf{H}})$ is real demand for funds in the United States at $R^{\mathbf{H}}$.

$S^{H*}(R^H)$ is net foreign supply of funds in the United States at $R^H$.

$S^H(R^H)$ is real supply of funds to the United States at $R^{\mathbf{H}}$.

In the hypothetical world, net foreign supply of funds ($S^{H*}$) is purely a result of settling current-account transactions, independent of developments in the real interest rate and other determinants of the financial account. In the real world, however, changes in net foreign supply of funds ($S^*$) affect, and are affected by, the real interest rate in the United States. Everything else being equal, an increase in R will increase $S^*$. The increase in $S^*$ could in turn mitigate the contractionary effect of the original rise in R. Everything else being equal, if changes in other financial-flow factors cause the $S^*$ schedule to shift downward, R will fall to induce more domestic spending. Consequently, by interacting with the U.S. real interest rate, net foreign supply of funds would in turn affect U.S. savings and investment, thereby affecting the current account.

To illustrate this more clearly, recall that U.S. domestic supply of funds (S) is equal to total domestic savings in each period:

$$(3) \quad S = Y - C - G = Y - C - (T - GB) = S^P + GB$$

where Y is national income, C is consumption, G is total government spending, T is tax revenue, GB is government budget balance, and $S^P$ is private saving. The aggregate demand for funds (D) is equal to private investment (I):

$$(4) \quad D_t = I_t$$

From the definition of the current account balance (CAB) and the national account identity, we can obtain the following relationship between CAB, S, and D:

$$(5) \quad CAB_t = S_t - D_t$$ [6]

To see how much difference capital mobility makes in the current account, let's define $D^X = (D - D^H) - (S - S^H)$ and rewrite the CAB identity from equation (5) as follows:

$$(6) \quad CAB = S - D = S^H - D^H - D^X$$

In this equation, $D^X$ is the difference between additional investment induced by net capital inflows and additional savings induced by net capital inflows; or, the part of net demand for funds that would not have occurred without capital mobility. Equation (6) makes it plain that in the hypothetical world, $D^X = 0$, and $CAB = S^H - D^H$. In the real world, however, CAB critically depends on $D^X$, which is the *ex post* real transfer resulting from capital mobility. Consequently, any shocks that affect $D^X$ will necessarily affect CAB, regardless of the sources of the exogenous shocks.

## 3. Deriving a Reduced-Form Equation of the Current Account

To derive a reduced-form equation of the current account based on equation (6), we need to make assumptions about the determinants of $S^H$, $D^H$, and $D^X$, which are not observable in the real world. To circumvent this data problem, we use the real-world

[6] Let X denote exports of goods and services, including investment income, and M denote imports of goods and services including investment payment. Let C be private consumption, I be private investment, G be government spending, S be total saving, and Y be GNP. Because D = I and CAB = S - D, it follows that CAB = X - M = (C+I+G+X-M) - (C+I+G) = (Y - C - G) - I = S - I.

counterparts of those variables as proxies for those determinants in deriving and estimating the reduced-form equation. This method is justified by the assumption that variations in those variables are mainly driven by forces independent of capital mobility.

Substituting all of the explanatory variables that would prevail only in the hypothetical world with their real-world counterparts removes the first hurdle in the way of building a current-account model from the savings-investment approach. A second hurdle we need to overcome is the heteroskedasticity problem that plagues the estimation of nominal-variable equations. This is a problem here because we do not have readily available and reliable data on "the current account deflator." To tackle this problem, we normalize the current account—as well as all nominal explanatory variables of savings, investment, and the net real effect of capital mobility—by "nominal" potential output ($Y^p$)—that is, the product of potential gross domestic product (GDP) and the GDP deflator.

We therefore use the following variation of equation (6) to derive an equation of the normalized current account:

$$(6)' \quad CAR = SR - IR - DR^X$$

where CAR is the $CAB/Y^p$ ratio, SR is the $S/Y^p$ ratio, IR is the $I/Y^p$ ratio, and $DR^X$ is the $D^X/Y^p$ ratio. To facilitate discussion, we will subsequently refer to CAR as the current account ratio, SR the savings ratio, IR the investment ratio, and $DR^X$ the net effect of capital mobility. We now are ready to discuss the determinants of SR, IR, and $DR^X$.

**Savings.** The savings ratio is a negative function of the real exchange rate (RXR)[7], the dependency ratio (DEP), the output gap (GAP)[8], the private wealth/$Y^p$ ratio (W), and a positive function of the real interest rate (R), the government budget balance/$Y^p$ ratio (GB), and the corporate profits/$Y^p$ ratio (CP), as shown in equation (7).

$$(7)\ SR = SR(\overset{-}{RXR}, \overset{-}{DEP}, \overset{-}{GAP}, \overset{-}{W}, \overset{+}{R}, \overset{+}{GB}, \overset{+}{CP})$$

An increase in the real exchange rate (RXR) will tend to decrease the savings ratio because the terms of trade (that is, export prices relative to import prices) tend to improve as the real exchange rate increases. As the terms of trade improve, U.S. residents are able to buy more volume of imported goods per unit of exported goods. An increase in RXR also means an increase in the dollar's purchasing power abroad relative to its purchasing power at home, thereby encouraging U.S. residents to travel and consume abroad. Both effects would cause the volume of U.S. consumption to rise relative to output, thereby lowering the savings ratio.[9] An increase in the dependency ratio[10] (DEP) will decrease the savings ratio because, according to the life-cycle hypothesis, the young and the old

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[7] The real exchange rate = the U.S. Price x the Nominal Exchange Rate/Foreign Price.

[8] The GDP gap is defined as the GDP/$Y^p$ ratio.

[9] Whether a terms-of-trade deterioration would increase or decrease savings is one of the central controversies in the debate over whether currency devaluation is an effective tool to improve a country's balance of payments. Harberger (1950) and Laursen and Metzler (1950) postulated that savings, and thus the current account, for a given level of income decreases (increases) with a deterioration (improvement) in the terms of trade. Using an intertemporal utility-maximizing framework, however, Obstfeld (1982, 1986) argues that an improvement in the terms of trade will decrease savings and, thus, decrease the current account balance.

[10] The dependency ratio is defined as the share of the dependent population—those at or below 14 years old or those 65 or older—in the total population.

are net consumers while the remainder of the population is net savers. An increase in the output gap (GAP) will reduce the savings ratio because disposable income and the consumption share tend to increase during an expansion. An increase in the private wealth ratio (W) will decrease the savings ratio because of the positive wealth effect on consumption. An increase in the real interest rate (R) will increase the savings ratio because it increases the rate of return on saving. An increase in the government budget ratio (GB) will have a non-negative impact on the savings ratio. It will increase the savings ratio if it does not lead to an offsetting decrease in private savings, but will have no impact on savings in a Ricardian-equivalence world where private savings adjusts to completely offset changes in government savings. Finally, an increase in the corporate profits ratio (CP) will increase the savings ratio because corporate profits are a positive component of total saving.

**Investment.** The I/$Y^p$ ratio (IR) is a positive function of the output gap (GAP), the corporate profits ratio (CP), and the government budget ratio (GB), but a negative function of the real interest rate:

$$(8)\ IR = IR(\overset{+}{GAP}, \overset{+}{CP}, \overset{+}{GB}, \overset{-}{R})$$

An increase in the output gap (GAP) will increase the investment share because consumer demand tends to increase during an expansion, boosting demand-led investment. An increase in the corporate profits ratio (CP) will increase the investment share because it increases incentive to invest while it mitigates the need for external financing. An increase in the real interest rate (R) will decrease the investment share because it decreases expected net profits. An increase in the government budget ratio, everything else being equal, will increase investment by reducing uncertainty over how to finance the increase in government deficit.

**Net Effect of Capital Mobility.** The net effect of capital mobility on real expenditure as a share of potential GDP ($DR^X$), which rises and falls as net autonomous capital inflows, is a negative function of the real exchange rate (RXR), the foreign dependency ratio ($DEP^*$), the foreign output gap ($GAP^*$), and U.S. private wealth (W); but it is a positive function of the U.S. output gap (GAP) and the real interest rate differential ($R - R^*$):

$$(9)\ DR^X = D^X(\overset{-}{RXR}, \overset{-}{DEP^*}, \overset{-}{GAP^*}, \overset{-}{W}, \overset{+}{GAP}, \overset{+}{R - R^*})$$

On the negative side, an increase in the real exchange rate (RXR) decreases net autonomous capital inflows because U.S. assets become more expensive for foreigners to acquire while foreign assets become more affordable for U.S. investors to purchase. Therefore, an increase in RXR decreases $DR^X$. An increase in the foreign dependency ratio ($DEP^*$) decreases foreign savings, thereby decreasing net capital inflows. An increase in the foreign output gap ($GAP^*$) reduces net capital inflows for two reasons: (1) it reduces foreign savings, thereby lowering gross capital inflows to the United States; and (2) it increases the attractiveness of foreign economies as destinations for U.S. investment, thereby increasing gross capital outflows. An increase in U.S. private wealth (W) will decrease net capital inflows because wealthier U.S. investors will increase their purchase of foreign assets to diversify their financial portfolio.[11] On the positive side, an increase in the U.S. output gap (GAP) increases net capital inflows because it increases the attractiveness of the United States as a destination for international capital. Finally, an increase in the real interest rate differential (R-R*) will increase net capital inflows by increasing the expected rate of return on U.S. bonds relative to that on foreign bonds.

**The Current Account Ratio** Substituting equations (7)-(9) into (6') results in the following reduced-form equation:

$$(10)\ CAR = CAR(\overset{+}{DEP^*}, \overset{+}{GAP^*}, \overset{+}{R^*}, \overset{-}{DEP}, \overset{-}{GAP}, \overset{+-}{W}, \overset{+-}{R}, \overset{+-}{RXR}, \overset{+-}{GB}, \overset{+-}{CP})$$

The impact on the current account of DEP, DEP*, R*, GAP and GAP* is unambiguous *a priori*. The net impact on the current account of the other five variables—namely, private wealth (W), the real U.S. interest rate (R), the real exchange rate (RXR), the government budget ratio (GB), and the corporate profits ratio (CP)—is less clear. An increase in private wealth could reduce savings and thereby decrease the current account, but it could also increase capital outflows and thereby increase the current account. Similarly, an increase in the real interest rate could increase savings while discouraging investment, thereby increasing the current account; but it could also increase net capital inflows and thereby decrease the current account. An increase in the

[11] Symmetric reasoning would require the inclusion of foreign private wealth in this equation because wealthier foreign investors will purchase additional U.S. assets to diversify their portfolio, thereby increasing net capital inflows. Unfortunately, it is impossible to gather data on foreign wealth. Because data on foreign wealth are not available to be used in the actual regression, foreign wealth is not included in equation (9).

real exchange rate could decrease savings and thus the current account, but it could also decrease capital inflows and thereby increase the current account. An increase in the government budget balance could increase the savings ratio in a non-Ricardian world, but it could also increase investment by reducing uncertainty over how to finance the government deficit. Finally, an increase in corporate profits would increase savings through accounting identity, but it could also increase investment by increasing the incentive to invest while mitigating the need for external financing.

## 4. Estimating an Absorption-Based ECM of the Current Account

A potential pitfall in constructing a time-series model is that spurious inferences may result if nonstationary variables are treated as stationary.[12] To avoid this pitfall, we begin our modeling efforts by conducting unit-root tests of all 11 variables in equation (10). As shown in Table 1, we find that only four of the 11 variables—namely, the current account ratio, the foreign dependency ratio, U.S. private wealth, and the U.S. budget balance—are I(1) variables. This finding appears consistent with casual observations of the histories of these variables since 1970 (Figures 1a & 1b).

We modify the Engle-Granger two-stage method[13] to estimate an error-correction model (ECM) of the current account ratio (CAR). In the first step, we use the

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[12] The assumptions of the classical regression model necessitate that both dependent and independent time-series variables be stationary and the residuals have a zero mean and finite variance. If nonstationary variables are present, what Granger and Newbold (1974) refer to as spurious regression may occur. That is, the regression output could look good with a high $R^2$, but the least-squares estimates would not be consistent and the customary tests of statistical inference would not hold.

[13] See Engle and Granger (1987).

Ordinary Least Squares (OLS) regression to estimate the cointegrated, or long-run, relationship between CAR and the explanatory variables. In the second step, we include the error-correction term—that is, the residual from the estimated cointegrated equation—as an explanatory variable along with first differences of other explanatory variables in the ECM to determine the short-run dynamic adjustment process of the U.S. current account.

The finding that not all explanatory variables are I(1) variables creates a dilemma for us. We could follow Campbell and Perron's (1991) recommendation, ignoring all I(0) explanatory variables in the first step and reintroducing them in the second step. Doing so, however, would be effectively restricting all coefficients of the I(0) variables to zero while they may help explain the stationary component of the CAR over the long run. This method thus would result in biased estimates of long-run coefficients due to omitted variables. Or, we could include all I(1) and I(0) explanatory variables in the first step in estimating the long-run equation and hope that doing so would not significantly distort the cointegrating test. Given the purpose of this paper, we chose the latter approach and include all explanatory variables in the long-run regression.

### 4.1 The Long-Run Cointegrating Equation of the Current Account

To obtain consistent and efficient estimates of the long-run coefficients of equation (10), two problems must be overcome. The first is the simultaneity bias that would arise because some regressors—namely, the real exchange rate, the U.S. GDP gap, the foreign GDP gap, corporate profits, and the budget balance—are endogenous in the system. The second is serial correlation among residuals. The former problem is dealt with by using the one-quarter lagged value of each endogenous regressor as the instrumental variable for that regressor to obtain consistent estimates.[14] The second problem is solved by using the Generalized Least Squared method to correct for serial correlation among residuals to obtain efficient estimates.

The estimated long-run coefficients of absorption-based models are reported in columns (1) and (2) of Table 2. Column (1) includes all of the explanatory variables in equation (10). Column (2) includes only those explanatory variables that are estimated to have a statistically significant coefficient, excluding the three insignificant variables—the U.S. dependency ratio, private wealth, and the budget balance. Because there are only three I(1) regressors in column (1) and only one in column (2), both the ADF statistics and the Phillips-Perron statistics suggest that the CAR and the regressors are cointegrated at the 5 percent significance level.[15] The adjusted $R^2$s for both regressions are reasonably high, suggesting that the overall goodness of fit is satisfactory.

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[14] In theory, if the residuals from the OLS estimation of the long-run equation do not have a unit root (that is, the equation is indeed cointegrated), then the fact that CAR is I(1) means not only that the OLS estimators of the long-run coefficients are consistent, but also that they converge more rapidly to its limiting distribution than is usually the case. If the regressors are endogenous, however, the resulting bias in the estimators can still be substantial in small samples. (We first used the parametric correction suggested by Saikkonen (1991) and Stock and Watson (1990) to obtain consistent estimates for equation (10). However, we found that point estimates of that method were sensitive to the number of leads and lags used for the correction.)

[15] This conclusion is based on the critical values generated by Phillips and Ouliaris (1990) with the Monte Carlo method. The critical value is -4.11 at the 5 percent significance level for equations that have three I(1) explanatory variables, and -3.37 for one I(1) explanatory variable.

Column (2) shows that 6 out of the 10 stochastic explanatory variables in equation (10)—the real exchange rate, U.S. output gap, foreign output gap, foreign dependency ratio, corporate profits, and the real U.S. interest rate—have coefficient estimates that are statistically significant and can be explained by theory.

- A 1 percent increase in the real dollar exchange rate lowers the CAR by about 0.03 percentage points over time, suggesting that a real dollar appreciation decreases savings by more than it decreases net capital inflows.
- A 1 percentage-point increase in the U.S. output gap lowers the CAR by 0.43 percentage points over time. Almost symmetrically, a 1 percentage-point increase in the foreign GDP gap increases the CAR by 0.42 percentage points over time.[16]
- A 1 percentage-point increase in the foreign dependency ratio gap increases the CAR by about 0.38 percentage points over time.
- A 1 percentage-point increase in the U.S. corporate profits ratio increases the CAR by about 0.32 percentage points over time, suggesting that its positive impact on savings more than offsets its positive impact on investment.
- A 1 percentage-point increase in the real U.S. interest rate raises the CAR by about 0.08 percentage points over time, suggesting that an increase in the real interest rate lowers domestic demand by more than it raises net capital inflows.

Quantitatively, those coefficient estimates are within reasonable ranges.

[16] These results may appear surprising at first, since researchers have tended to find that U.S. (goods) import demand has a greater income elasticity than foreign demand for U.S. exports does. The novelty of this result fades, however, when one recalls that the share of services trade in the current account has increased substantially since the late 1980s, and that the income elasticity of U.S. demand for services imports has been found to be smaller than that of foreign demand for U.S. exports of services.

Coefficient estimates on the U.S. budget balance are not significant, suggesting that U.S. private savings have tended to adjust to offset changes in the government budget. Likewise, the insignificant coefficient estimate on U.S. private wealth suggests that opposing impacts of private wealth on the current account roughly cancel each other out, resulting in an insignificant net impact over the long run. The coefficient estimate on the U.S. dependency ratio is also statistically insignificant, suggesting that U.S. aggregate savings are not driven significantly by the share of dependents in the total population.

It is harder to explain the coefficient estimates on the real foreign interest rate within our framework. The coefficient estimate on the foreign interest rate is significant with the wrong sign: over time, a 1 percentage-point increase in the foreign interest rate lowers the CAR by about 0.09 percentage points. This apparent contradiction to theory may be due to the risk premium imbedded in the measured inflation-adjusted foreign interest rate. If the increase in the foreign interest rate mainly reflects an increase in investors' unwillingness to invest in foreign countries, it would not make foreign assets more attractive for international investors.

To assess the combined contribution of the nontraditional explanatory variables introduced by the absorption approach, we also estimate an admittedly overly simplified elasticity-based equation of the current account over the same sample period. The estimated long-run coefficients of this elasticity-based equation are reported in column (3) of Table 2. Both the ADF statistics and the Phillips-Perron statistics suggest that the current account ratio is not cointegrated with the three explanatory variables included in the elasticity equation—U.S. output gap, foreign output gap, and the real exchange rate.

This is not surprising, given that the CAR is a I(1) variable while all three regressors are I(0) variables. The adjusted $R^2$s indicate that the goodness-of-fit of the elasticity-based equation is inferior to that of an absorption-based equation. In contrast to the absorption approach, the real exchange rate has no significant and stable long-run relationship with the current account, while the coefficient estimates of U.S. output gap and foreign output gap are all considerably greater than those in the absorption equations.

### 4.2 The Error-Correction Model

We follow the "general-to-specific" method to find the ECM of the current account. In addition to the traditional variables included in the right-hand side of the equation—that is, the lagged residual from the long-run equation (the equilibrium error), and lags of the first difference of the dependent and all independent variables in the long-run equation—we also include the first differences of foreign portfolio holdings of U.S. assets.[17] Variables with statistically insignificant coefficients were dropped sequentially.

We estimate two versions of the Absorption-ECM of the current account ratio. The Full Model includes all 10 explanatory variables in the long-run equation, while the Parsimonious Model includes only those 7 significant explanatory variables. In estimating both models, we use data from 1974 through 1996 so that the coefficient estimates can be used to perform out-of-sample forecasts over the 1997-1999 period.

[17] If foreign assets are held constant, increases in foreign holdings of U.S. assets are likely to increase foreigners' desire to diversify away from U.S. assets, thereby lowering net capital inflows to the United States and increasing the current account balance.

Table 3a reports the results of the Full Model, while Table 3b reports results of the Parsimonious Model. Together, Table 3a, Table 3b, and Table 2 indicate that long-run coefficient estimates remained reasonably stable across the two different sample periods—1974 through 1996 and 1974 through 1999.

In both Tables 3a and 3b, the adjusted $R^2$s for ECM are near 0.30, which is reasonably good for this type of regression. Reassuringly, the coefficient estimate on the lagged equilibrium error ($\mu_{t-1}$)—the deviation of the actual CAR from the long-run equilibrium CAR—is statistically significant and negative. This finding indicates that the gap between the actual and the long-run equilibrium CAR will be eliminated over time if everything else is held constant. However, the fact that the coefficient estimates are moderate (-0.24 and -0.25) suggests that the adjustment toward the long-run equilibrium does not occur quickly. The fact that the coefficient estimate on the equilibrium error is statistically significant and has the right sign also means that increases in any of the explanatory variables will always have dynamic effects on CAR through changes in the equilibrium error, even though not all of their lagged first differences enter significantly in the ECM.

In addition to the lagged equilibrium error, the lagged first difference of real exchange rate, U.S. output gap, U.S. interest rates, and foreign interest rates also have significant coefficients in the ECM. An increase in the lagged first difference of the real exchange rate (that is, a real dollar appreciation) or the U.S. output gap lowers CAR. An increase in the lagged first difference of the real U.S. interest rate lowers CAR, while that of the foreign interest rate raises CAR.

## 5. Comparing Forecast Performances of Alternative Current-Account Models

To ascertain how well absorption-based current account models fare relative to elasticity-based models, this section estimates and compares four additional models of the current account: (1) an ECM of CAR based on the elasticity approach; (2) a first difference (FD) equation of CAR based on the elasticity approach; (3) a parsimonious first difference equation of CAR based on the absorption approach; and (4) a full-scale first difference equation of CAR based on the absorption approach. The latter three models use the first difference, instead of the level, of the explanatory variables and impose an Almon-lag structure on the first differences of the explanatory variables.

Theoretically, forecast performances of a cointegration-ECM method should be superior to those of a first-difference (FD) method because the latter does not take advantage of level information. This is indeed what we find. For in-sample forecasts, we use coefficient estimates obtained from regressions using data from 1974 through 1999 to generate dynamic forecasts over the 1974-1999 period for all six models under comparison. For out-of-sample forecasts, we use coefficient estimates obtained from regression using data from 1974 through 1996 to generate dynamic forecasts of all six models for the 1997-1999 period. For ECM models, we use long-run coefficient estimates obtained from regressions over the 1974-1996 sample period and historical data for all right-hand-side variables to forecast the long-run equilibrium CAR from 1997 through 1999, and then use the first differences of explanatory variables and the ECM coefficient estimates to generate dynamic out-of-sample forecasts.

Estimation results of the elasticity-based ECM are reported in Table 4. In-sample forecasts of the three ECMs are plotted in Figure 2a, and their out-of-sample forecasts are plotted in Figure 2b. Estimation results of the three FD equations are reported in Table 5. In-sample forecasts of the three FD equations are plotted in Figure 3a, and their out-of-sample forecasts are plotted in Figure 3b.

Do absorption-based models really outperform elasticity-based models? A casual observation of Figures 2a-3b suggests that the answer is yes. Overall, forecasts of absorption-based models appear to track the actual current account reasonably well over the 26-year span from 1974 through 1999 and considerably better than those of elasticity-based models. This finding is confirmed by all three indicators of forecast performance—the root-mean-square error (RMSE), the root-mean-square percent error (RMS%E), and the Theil's U—reported at the bottom of Tables 3a, 3b, 4, and 5.

## 6. Data

**GDP Gaps:** Both U.S. and foreign output gaps are measured as the ratio of actual GDP to potential GDP. The Congressional Budget Office's estimate of potential GDP is used to measure the U.S. GDP gap. The foreign GDP gap is a geometric trade-weighted average of GDP gaps of 18 major U.S. trading partners—Japan, Germany, France, Italy, the Netherlands, Belgium, the United Kingdom, Canada, Switzerland, Sweden, Australia, Mainland China, Taiwan, Korea, Hong Kong, Singapore, Mexico, and Brazil. Estimates of GDP gaps for individual foreign countries are from the Board of Governors of Federal Reserve Banks.

**Real Interest Rates:** Both U.S. and foreign real interest rates are proxied by inflation-adjusted nominal interest rates. Real foreign interest rates are obtained by subtracting the trade-weighted consumer price inflation of 10 major U.S. trading partners from the trade-weighted nominal interest rates of those same countries. Nominal foreign interest rates are "long-term government bonds" of 10 major U.S. trading partners obtained from International Financial Statistics, which is published by the International Monetary Fund.[18]

**U.S. Private Wealth:** U.S. private wealth is measured by the net worth (= assets - liabilities) of U.S. households and nonprofit organizations in the United States. The data are obtained from "Flow of Funds Accounts of the United States," which is published by the Board of Governors of Federal Reserve Banks.

**Dependency Ratios:** Both U.S. and foreign dependency ratios are the ratio of the dependent population (those under the age of 15 years or over the age of 65 years) to the total population. For both the United States and all 18 foreign countries except Taiwan, annual data up to and including 1994 are from the World Bank Savings Database. Data from 1995 through 1997 are taken from *Demographic Yearbook*, which is published by the United Nations. Foreign data, with the exception of Taiwan, for 1998 and 1999 are

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[18] In constructing the "long-term" interest rate on foreign government bonds, we confronted two issues: (1) different countries issue government debt securities that mature at different rates, and (2) some countries do not issue long-term government debt or issue such debt for a few years but then discontinue the practice. We settled on interest rates of government bonds with maturity of or near 10 years from 10 foreign countries—France, Germany, Japan, the United Kingdom, Canada, Australia, Belgium, Korea, the Netherlands, and Switzerland—to obtain a continuous times-series from 1974 through 1999.

our own forecasts.[19] U.S. data from 1998 through 1999 are taken from the Census Bureau's Population Estimates. Data for Taiwan are taken from its web site (www.dgbassey.gov.tw).

**U.S. Government Budget:** Federal, state, and local government budget balances were obtained from the Bureau of Economic Analysis.

**Corporate Profits:** After-tax corporate profits were obtained from the Bureau of Economic Analysis.

**Real Exchange Rate:** The real exchange rate is calculated as *U.S. consumer price x trade-weighted nominal dollar exchange rate/trade-weighted foreign consumer price*. The nominal exchange rate and consumer price for each of the 16 major U.S. trading partners[20] are indexed to 1 in 1996 before they are collapsed into the trade-weighted indexes.

## 7. Conclusion

Little work has focused on building a forecasting model of the current account from the absorption perspective that the current account balance is the difference between domestic savings and investment. We believe that the rapid growth of capital flows

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[19] First, the number of people who were age 15 or younger, or age 60 or older, in 1998 and 1999 in each country (except Taiwan) was obtained from the U.N. Statistics Division Web site. The historical relationship between the number of individuals older than 65 and that older than 60 was then estimated for each country. (The *UN Demographic Yearbook* reports population in five-year age brackets as far back as 1971.) Finally, dependency ratios for 1998 and 1999 were developed by assuming that the historical relationship between those older than 65 and those older than 60 held for 1998 and 1999.

[20] They are Japan, Germany, France, Italy, the Netherlands, Belgium, the United Kingdom, Canada, Switzerland, Australia, China, Taiwan, Korea, Singapore, Hong Kong, and Mexico.

across national borders makes it essential to construct a current account model that lends itself to analyzing the impact of developments that affect the current account through financial flows. The traditional elasticity approach is poorly equipped to fulfill this role and has fallen short in its ability to forecast the current account and to shed light on important policy issues such as the role of the exchange rate and the government budget balance in shaping the current-account development.

In this paper, we derive and estimate alternative current account models based on the absorption, or the savings-investment, approach. This approach shows that the three traditional variables—the real exchange rate, domestic activities, and foreign activities—do exert a significant influence on the current account, as postulated by the elasticity approach. More important, it shows that some variables overlooked by the elasticity approach—namely, the share of dependents in the foreign population, real U.S. and foreign interest rates, and U.S. corporate profits—also matter for the current-account adjustment, while the government budget balance does not. The finding that the budget balance is not a significant determinant of the current account suggests that U.S. private savings may have tended to adjust to offset changes in the government budget.

Overall, models based on the absorption approach track and forecast the U.S. current account much better than simple models based on the elasticity approach. To be sure, in reality elasticity-based models of the current account are much more sophisticated than the simple ones constructed here for comparison purposes. Nevertheless, the finding of this paper suggests that, at the very least, forecasters should consult absorption-based models in forming current-account forecasts.

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## Figure 1a. Variables in the Current Account Models

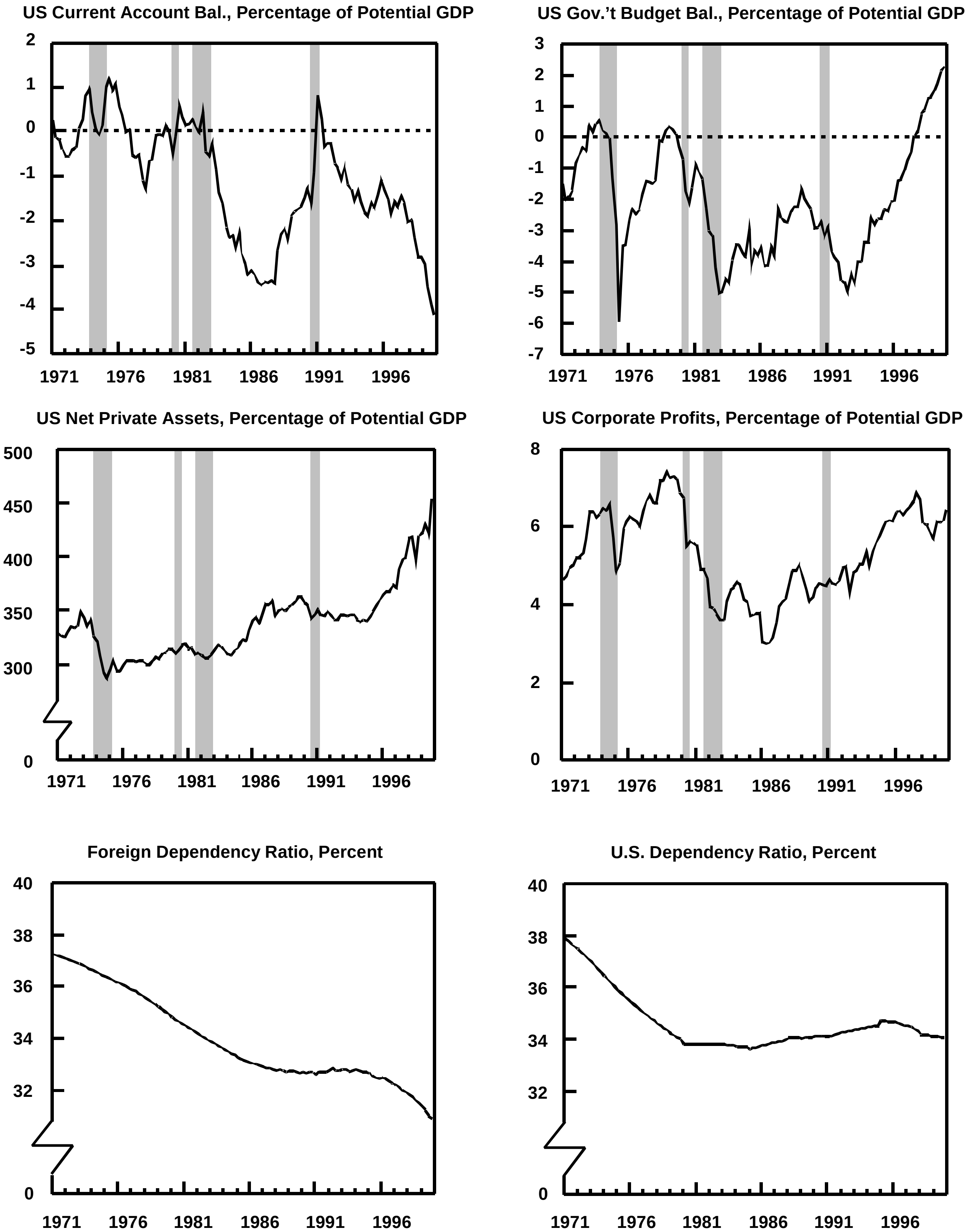
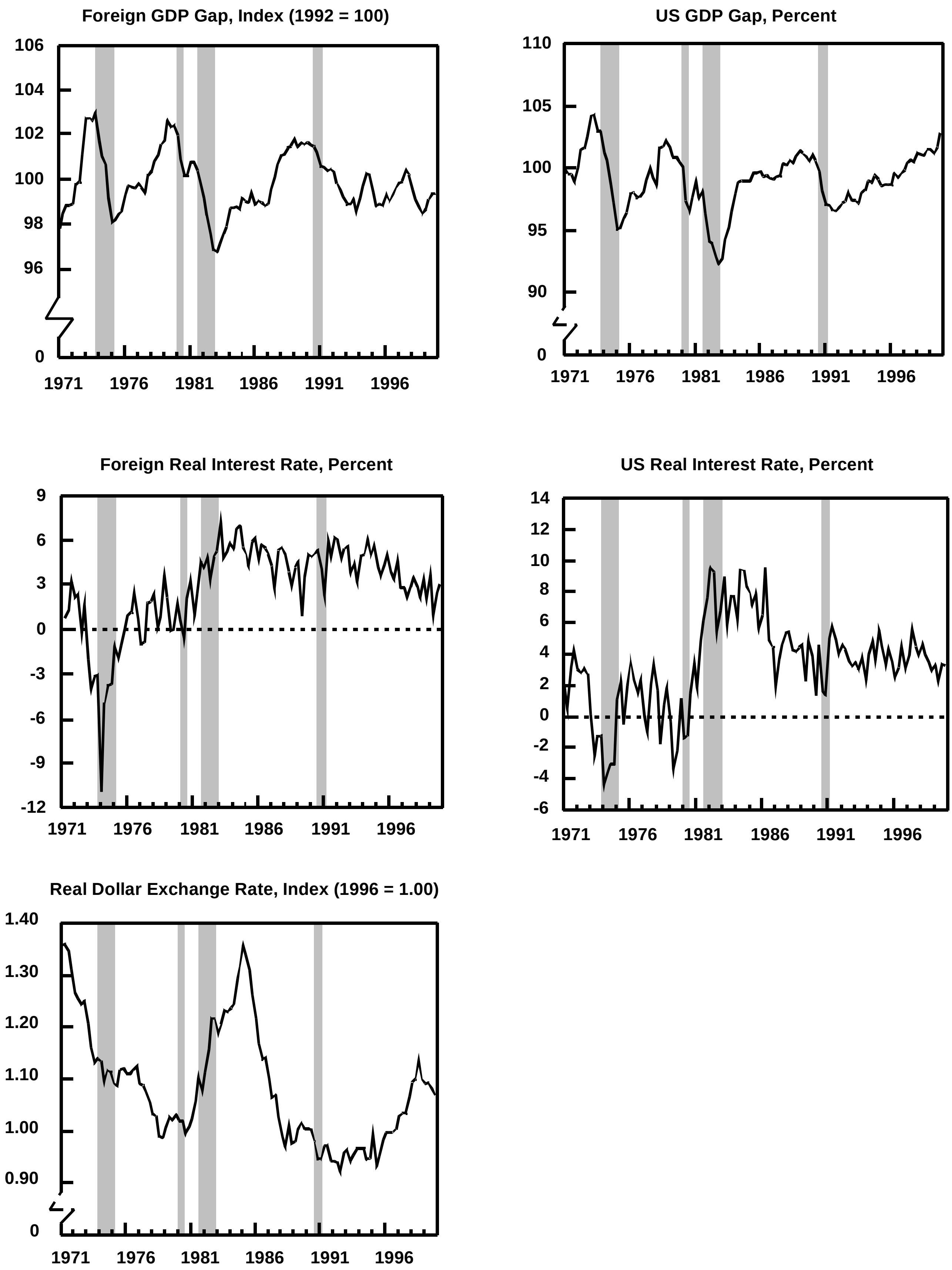


**Figure 1b. Variables in the Current Account Models**




Note: US GDP Gap = (Actual GDP x 100) / Potential GDP

## Table 1. Time-Series Property of Variables in the Current Account Model

| VARIABLES | PROPERTY |
|---|---|
| Current Account Ratio | I(1) |
| Log (Real Exchange Rate) | I(0) |
| U.S. GDP Gap | I(0) |
| Foreign GDP Gap | I(0) |
| U.S. Dependency Ratio | I(0) |
| Foreign Dependency Ratio | I(1) |
| U.S. Private Wealth | I(1) |
| U.S. Corporate Profits | I(0) |
| U.S. Budget Balance | I(1) |
| U.S. Inflation-Adjusted Interest Rate | I(0) |
| Foreign Inflation-Adjusted Interest Rate | I(0) |

Note: These results are based on augmented Dickey-Fuller unit root tests for the 1971 through 1999 period. Lags were chosen based on the Akaike information criteria.

## Table 2. Long-Run Equations of the Current Account Ratio

(Estimation method: OLS, Sample period 1974-1999)
(Absolute value of t-statistics in parenthesis)

**Dependent Variable: CAR (**The Current Account/Potential GDP Ratio**)**

| [1] **Regressor** | **(1) Absorption Full Model** | **(2) Absorption Parsimonious Model** | **(3) Elasticity Approach** |
|---|---|---|---|
| **Constant** | **-24.54** *(3.13)* | **-14.82** *(3.29)* | -25.25 (3.34) |
| [2] **Log (RER)$_{t-1}$** | **-0.030** (3.92) | **-0.032** (4.83) | -0.007 † (0.89) |
| **GDP Gap $_{t-1}$** | **-0.45** *(12.86)* | **-0.43** *(12.46)* | -0.53 (12.46) |
| **GDP Gap*$_{t-1}$** | **0.45** *(6.97)* | **0.42** *(6.65)* | 0.77 (9.65) |
| **Dependency Ratio** | **0.173 †** (1.36) | | |
| **Dependency Ratio*** | **0.44** *(3.39)* | **0.38** *(6.67)* | |
| [3] **Private Wealth** | **0.002 †** (0.54) | | |
| [3] **Corporate Profits $_{t-1}$** | **0.26** *(3.46)* | **0.32** *(5.99)* | |
| [3] **Budget Balance $_{t-1}$** | **0.057 †** (0.89) | | |
| [4] **Real Interest Rate** | 0.075 (2.87) | 0.078 (2.94) | |
| [4] **Real Interest Rate*** | -0.043 † (1.12) | -0.093 (3.38) | |
| [5] **Dummy 1991Q1** | **1.43** *(10.26)* | **1.34** *(9.74)* | 0.64 (4.68) |
| **Adjusted $R^2$** | **0.88** | **0.88** | **0.54** |
| **ADF Statistics** | **-4.59** | **-4.42** | **-2.54** |
| **Phillips-Perron Stat.** | **-4.88** | **-4.88** | **-2.94** |

**NOTES**

1. Foreign variables are denoted by "*".
2. Real Exchange Rate = (U.S. prices)*(nominal exchange rate)/(foreign prices).
3 These variables are normalized by nominal potential GDP (= potential GDP x GDP deflator).
4. These are inflation-adjusted interest rates.
5. Dummy 1991Q1 is intended to capture the effect of the large increase in U.S. net unilateral transfers that resulted from the Gulf War.
6. Coefficient estimates with significant level higher than 10 percent are indicated by "†".

## Table 3a. The Absorption-ECM of the Current Account: Full Model

(Estimation method: OLS; sample period: 1974-1996)
(Absolute value of t-statistics in parenthesis)

| Dependent variable: CAR | | Dependent variable: **Δ(CAR)** | |
|---|---|---|---|
| [1] **Regressor** | **1974-96** | **Regressor** | **1974-96** |
| **Constant** | **-29.31** *(3.47)* | [2] **$\mu_{t-1}$** | -0.24 (2.78) |
| **Log (RER)$_{t-1}$** | **-0.028** (3.51) | **Δlog(RER)** | -0.031 (2.06) |
| **GDP Gap $_{t-1}$** | **-0.47** *(12.76)* | **Δ(GDP Gap)** | -0.17 (4.22) |
| **GDP Gap*$_{t-1}$** | **0.51** *(7.16)* | **Δ(Real Interest Rate)$_{t-1}$** | -0.075 (3.45) |
| **Dependency Ratio** | **0.19 †** (1.43) | **Δ(Real Interest Rate )$_{t-2}$** | -0.062 (2.82) |
| **Dependency Ratio*** | **0.44** *(3.21)* | **Δ(Real Interest Rate*)$_{t-1}$** | 0.058 (2.35) |
| **Private Wealth** | **-0.002 †** (0.35) | **Δ(Real Interest Rate*)$_{t-2}$** | 0.049 (2.01) |
| **Corporate Profits $_{t-1}$** | **0.28** *(3.54)* | | |
| **Budget Balance $_{t-1}$** | **0.024†** (0.33) | | |
| **Real Interest Rate** | 0.078 (2.80) | | |
| **Real Interest Rate*** | -0.039 (-1.00) | | |
| **Dummy 1991Q1** | **1.39** *(9.44)* | | |
| **Adjusted $R^2$** | **0.86** | **Adjusted $R^2$** | **0.28** |
| | | **Out-of-sample Theil's U (1997-1999)** | **0.423** |
| **ADF Statistics** | **-4.43** | **Out-of-sample RMS%E (1997-1999)** | **0.168** |
| **Phillips-Perron Stat.** | **-4.87** | **Out-of-sample RMSE (1997-1999)** | **0.416** |

**NOTES**

1. See Table 2 for definitions of variables.
2. This variable is the residual from the long-run regression.

## Table 3b. The Absorption-ECM of the Current Account: Parsimonious Model

(Estimation method: OLS; sample period: 1974-1996)
(Absolute value of t-statistics in parenthesis)

| Dependent variable: CAR | | Dependent variable: **Δ(CAR)** | |
|---|---|---|---|
| [1] **Regressor** | **1974-96** | **Regressor** | **1974-96** |
| **Constant** | **-19.20** *(3.85)* | [2] **$\mu_{t-1}$** | -0.25 (2.94) |
| **Log $(RER)_{t-1}$** | **-0.036** (4.79) | **$\Delta \log(RER)_{t-1}$** | -0.032 (2.13) |
| **GDP Gap $_{t-1}$** | **-0.44** *(13.22)* | **$\Delta$(GDP Gap)$_{t-1}$** | -0.18 (4.31) |
| **GDP Gap*$_{t-1}$** | **0.45** *(8.11)* | **$\Delta$(Real Interest Rate)$_{t-1}$** | -0.077 (3.51) |
| **Dependency Ratio*** | **0.44** (5.77) | **$\Delta$(Real Interest Rate )$_{t-2}$** | -0.063 (2.84) |
| **Corporate Profits $_{t-1}$** | **0.28** *(4.47)* | **$\Delta$(Real Interest Rate*)$_{t-1}$** | 0.063 (2.55) |
| **Real Interest Rate** | 0.080 (2.92) | **$\Delta$(Real Interest Rate*)$_{t-2}$** | 0.051 (2.11) |
| **Real Interest Rate*** | -0.077 (-2.38) | | |
| **Dummy 1991Q1** | **1.33** *(9.45)* | | |
| **Adjusted $R^2$** | **0.87** | **Adjusted $R^2$** | **0.29** |
| | | **Out-of-sample Theil's U (1997-1999)** | **0.362** |
| **ADF Statistics** | **-4.18** | **Out-of-sample RMS%E (1997-1999)** | **0.165** |
| **Phillips-Perron Stat.** | **-4.73** | **Out-of-sample RMSE (1997-1999)** | **0.356** |

**NOTES**

1. See Table 2 for definitions of variables.
2. This variable is the residual from the long-run regression.

## Table 4. The Elasticity-ECM of the Current Account

(Estimation method: OLS; sample period: 1974-1996)
(Absolute value of t-statistics in parenthesis)

| Dependent variable: CAR | | Dependent variable: **Δ(CAR)** | |
|---|---|---|---|
| [1] **Regressor** | **1974-96** | **Regressor** | **1974-96** |
| **Constant** | **-26.57** *(3.50)* | [2] $\mu_{t-1}$ | -0.095 (2.20) |
| **Log (RER)$_{t-1}$** | **-0.007 †** (0.81) | **Δlog(RER)$_{t-1}$** | -0.035 (2.16) |
| **GDP Gap $_{t-1}$** | **-0.55** *(9.44)* | **Δ(GDP Gap)$_{t-1}$** | -0.14 (3.30) |
| **GDP Gap*$_{t-1}$** | **0.79** *(8.64)* | | |
| **Dummy 1991Q1** | **0.62** *(4.44)* | | |
| **Adjusted $R^2$** | **0.44** | **Adjusted $R^2$** | **0.17** |
| | | **Out-of-sample Theil's U (1997-1999)** | **0.576** |
| **ADF Statistics** | **-2.37** | **Out-of-sample RMS%E (1997-1999)** | **0.193** |
| **Phillips-Perron Stat.** | **-2.78** | **Out-of-sample RMSE (1997-1999)** | **0.561** |

**NOTES**

1. See Table 2 for definitions of variables.
2. This variable is the residual from the long-run regression.

**Table 5. First-Difference Equations of the Current Account Ratio**
(Estimation Method: OLS; sample period: 1974-1996)
(Absolute value of t-statistics in parenthesis)

**(Dependent Variable: ΔCAR)**
**(Coefficient Estimates are the sum of coefficients on the distributed lags.[1])**

| [2]Regressor | Absorption FD (A) | Absorption FD (B) | Elasticity FD Eq. |
|---|---|---|---|
| **Δ CAR $_{t-1}$** | -0.20<br>(1.71) | -0.08<br>(0.68) | -0.001<br>(0.009) |
| **Δ log (RER)$_{t-0\ to\ 3}$** | -0.06<br>(2.09) | -0.06<br>(1.99) | -0.05<br>(1.75) |
| **ΔGDP Gap $_{t-0\ to\ 3}$** | -0.32<br>(2.48) | -0.18<br>(1.38) | -0.17<br>(1.33) |
| **Δ GDP Gap*$_{t-0\ to\ 3}$** | 0.48<br>(2.06) | 0.18<br>(0.79) | 0.10<br>(0.47) |
| **Δ Dependency Ratio $_{t-0\ to\ 3}$** | 0.8<br>(1.00) | | |
| **Δ Dependency Ratio*$_{t-0\ to\ 3}$** | 0.35<br>(0.40) | 0.74<br>(1.08) | |
| **Δ Private Wealth $_{t-0\ to\ 3}$** | -0.00<br>(0.26) | | |
| **Δ Corporate Profits $_{t-0\ to\ 3}$** | -0.28<br>(0.91) | -0.19<br>(067) | |
| **Δ Budget Balance $_{t-0\ to\ 3}$** | 0.09<br>(0.47) | | |
| **Δ Real Interest Rate $_{t-0\ to\ 1}$** | 0.10<br>(2.60) | 0.11<br>(2.67) | |
| **Δ Real Interest Rate* $_{t-0\ to\ 1}$** | -0.01<br>(0.22) | -0.06<br>(1.36) | |
| **Adjusted $R^2$** | **0.23** | **0.09** | **0.04** |
| **Out-of-sample Theil's U (1997-1999)** | **0.511** | **0.442** | **0.790** |
| **Out-of-sample RMS%E (1997-1999)** | **0.164** | **0.122** | **0.215** |
| **Out-of-sample RMSE (1997-1999)** | **0.506** | **0.460** | **0.760** |

**Note**
1. The same polynominal lag restrictions are used for all regressions reported here.
2. See Table 2 for definitions of variables.

Figure 2a. Actual vs Fitted Current Account Ratio

In-sample Forecasts of ECM

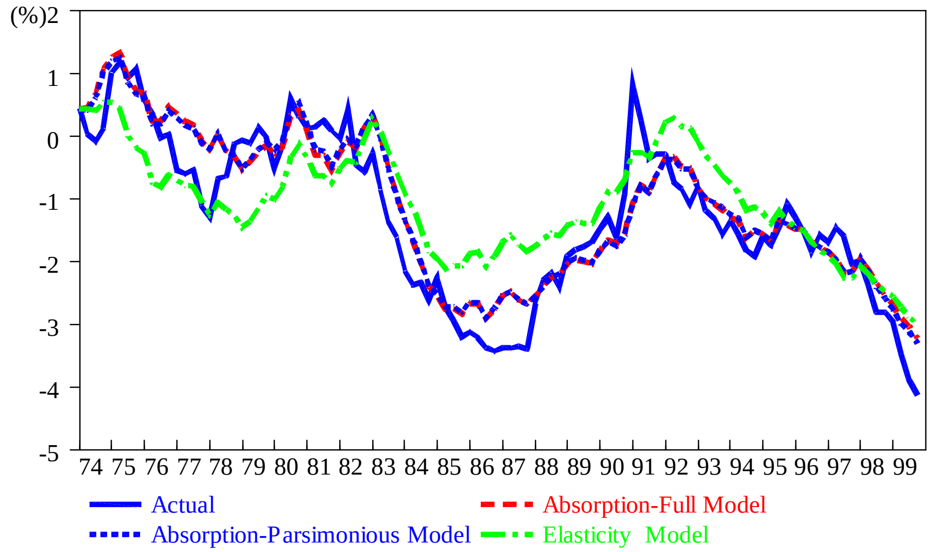



Figure 2b. Actual vs Fitted Current Account Ratio

Out-of-sample Forecasts of ECM

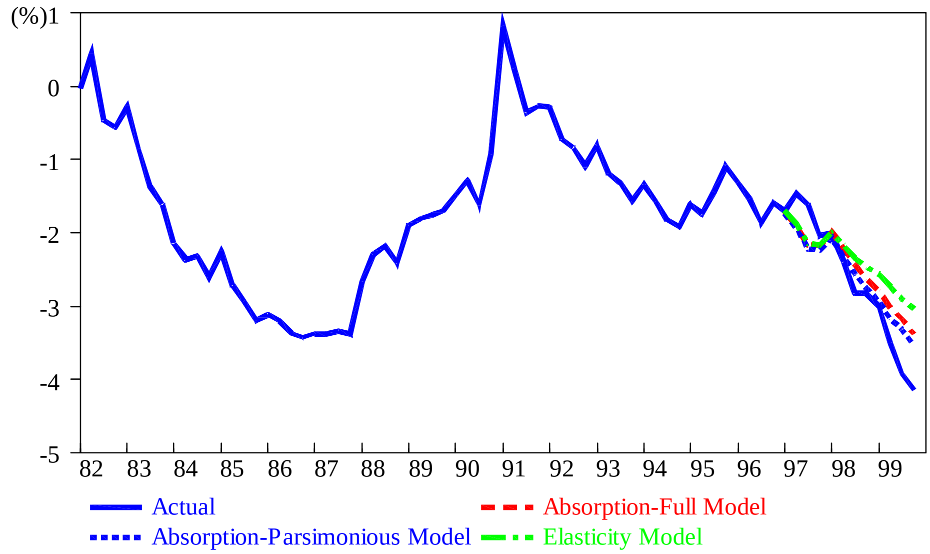


Figure 3a. Actual vs Fitted Current Account Ratio

In-sample Forecasts of First Difference Equations

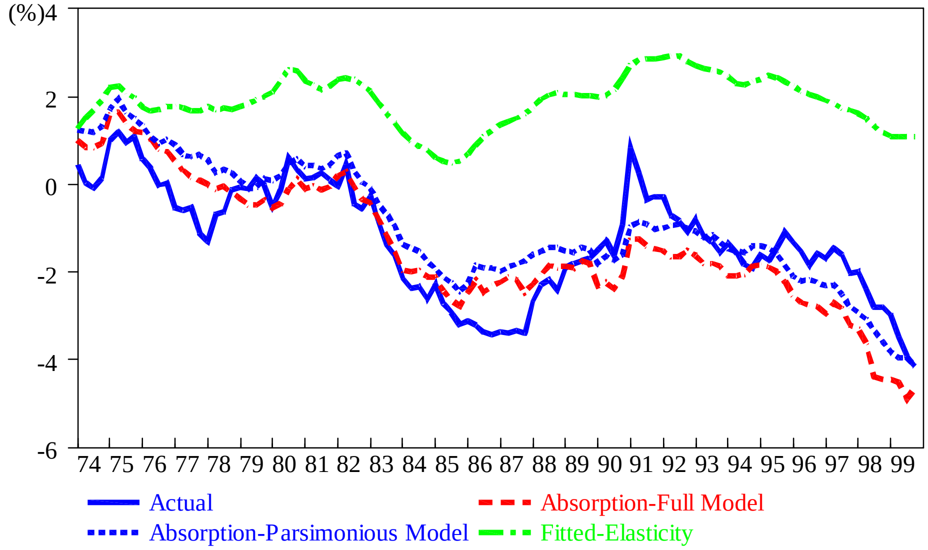



Figure 3b. Actual vs Fitted Current Account Ratio

Out-of-sample Forecasts of First Difference Equations