IMF WORKING PAPER

WP/93/33

INTERNATIONAL MONETARY FUND

European I Department

Net Foreign Assets and International Adjustment: The United States, Japan, and Germany

Prepared by Paul R. Masson, Jeroen Kremers and Jocelyn Horne 1/

April 1993

Abstract

This paper examines external adjustment in the United States, Japan and Germany from the perspective of net foreign asset positions. It asks two questions: What are, in the long run, the determinants of net foreign asset equilibrium? and: What are, in the short run, some of the adjustment mechanisms sustaining that equilibrium? An analysis of post-war data produces two insights. First, using a cointegration approach, the existence of long-run net foreign asset equilibrium can be identified: it is a function of demographic variables and public debt. Second, deviations from long-run equilibrium give rise to feedback through different components of domestic absorption in the three countries.

JEL Classification Numbers:
F32, F34

1/ This paper is an extensively revised version of WP/89/22, begun when the authors were all on the staff of the IMF; this version reports the underlying data, which have been recalculated and updated, and identifies detailed feedback channels. Jeroen Kremers now works for the Netherlands Finance Ministry as well as being a professor of financial and economic policy at Erasmus University in Rotterdam (OCFEB). Jocelyn Horne is currently a professor at Macquarie University. The paper is to be published in the Journal of International Money and Finance. The authors thank David Hicks, Youkyong Kwon, and Anthony Turner for help in constructing the data base. The paper benefitted from comments by two anonymous referees as well as by Neil Ericsson, Leslie Lipschitz, Ronald MacDonald, Thomas Mayer, Maurice Obstfeld, Torsten Persson, Mark Taylor, and seminar participants at the IMF and at the IFAC/IFORS/SEDC conference in Edinburgh, June 27-29, 1989.

Contents

Summary

This study confirms the presence of mechanisms that stabilized the net foreign asset positions of the three largest industrial countries in the post-World War II period. Persistent and large current account imbalances in the past decade have led to quite dramatic changes in the net international positions of the United States, Japan, and Germany. However, various feedback effects from foreign asset stocks may act as stabilizing mechanisms to prevent a continued increase of these net foreign asset or liability positions and to ensure an eventual return to long-run equilibrium.

Cointegration tests are used to investigate empirically the long-run equilibrium relationship for net foreign assets of the United States, Japan, and Germany using postwar data. These tests suggest the existence of a long-run relationship between the net foreign asset-GNP ratio, the public debt-GNP ratio, and dependency ratios relative to other major industrial countries. Lower public debt divided by GNP and a higher proportion of elderly people in the population are associated with higher net foreign assets divided by GNP.

Developments in the 1980s in the United States differed from those in Japan and Germany in one important respect: the conditional long-run net foreign asset equilibrium of the United States moved sharply downward, reflecting a rapid accumulation of public debt. In contrast, the Japanese and German authorities implemented policies to consolidate the public finances; the net foreign assets of these countries increased strongly.

To identify the channels through which stabilizing feedback occurs, error correction models for components of domestic absorption are also estimated. These results suggest, however, that stabilizing feedback operates through different linkages in different countries. It operates primarily through private investment in the United States and Germany and through government spending in Japan. There is also weaker evidence of consumption feedback in the United States and Japan.

I. Introduction

The international environment of the 1980s was characterized by larger current account imbalances among major countries than at any point since the early post-war period. In 1987, the United States ran a current account deficit equal to about 3 1/2 percent of its Gross National Product (GNP), Japan recorded a surplus of a similar relative size, and the Federal Republic of Germany had a current account surplus that exceeded 4 percent of its GNP. Moreover, sizeable current account positions prevailed throughout most of the decade, leading to massive changes in net foreign assets and liabilities of these countries. The United States, which was the largest net creditor country during most of the post-war period up until the early 1980s, was at the end of 1990 the world's largest net debtor, having net foreign liabilities of $423 billion--larger than the net liability position of the 10 most heavily indebted developing countries combined. Over this period, Japan and Germany accumulated sizeable net foreign claims; at the end of 1990 Japan was a net creditor to the extent of $328 billion, while Germany had net foreign assets of $265 billion at the end of 1989. 1/

Relative to their output levels such claims positions are not unprecedented--for instance, the net foreign liability position of the United States was in 1990 about 8 percent of GNP, while Canada's has long exceeded 20 percent of GNP--but because of the size of the countries concerned, their importance for international credit flows, and the key role of their currencies for the international monetary system, such payments imbalances are potentially cause for concern. An important issue is whether forces exist that bring about smooth adjustment of net foreign assets to equilibrium levels, or whether instead there are tendencies toward increasing asset and liability positions which may result in instability in international credit and foreign exchange markets.

The causes of the imbalances are not the subject of this paper; the extent to which they are related to the relative stance of fiscal policies in the United States, Japan, and Germany since the early 1980s has been discussed extensively elsewhere. 2/ Instead, the analysis will consider stabilizing movements of domestic absorption that result from private and public sector behavior.

It is useful in considering the question to distinguish between two conceptually different but interrelated issues: first, whether a long-run equilibrium exists for net foreign assets (possibly as a function of other variables), and second, what short- or medium-run feedback mechanisms exist to bring about the long-run equilibrium if the latter exists. Long-run factors may include demographics and public debt accumulation, for instance. In order to assess whether a long-run equilibrium exists, we both test

---

1/ German unification since 1990 has reduced the German net position, since the former GDR had a significant amount of foreign debt. In addition, the large German current account surpluses have disappeared due to massive spending in east Germany, limiting prospects for further net foreign asset accumulation.

2/ See for instance Knight and Masson (1988), van Wijnbergen (1988), and Helliwell (1989).

whether deviations from alternative long-run equilibria reverse themselves, and examine whether short-run feedback mechanisms sustaining the long-run equilibrium can be identified within a dynamic model. The existence of a stable long-run equilibrium and of short-run equilibrating feedback can in fact be viewed as facets of the same phenomenon (Hendry, 1986; Engle and Granger, 1987). Since changes in net foreign assets equal the current account (in the absence of valuation changes), and the current account balance equals output minus domestic absorption, some expenditure component should respond to deviations of net foreign assets from equilibrium. We test whether these feedbacks seem to be present in consumption, investment, and government spending.

Our analysis is related to a number of strands in the literature. First, since the article by Feldstein and Horioka (1980), many authors have considered why national saving and investment tend to be highly correlated. We consider not only the level of the current flows, but particularly the extent to which they cause asset stock accumulation. 1/ Even if current accounts are relatively small, they may still bring about excessive accumulations of net claims or indebtedness; we are interested in forces that would prevent this happening. The existence of stabilizing feedbacks of asset stocks on saving and investment may help explain the empirical regularity identified by Feldstein and Horioka.

This paper is also related to the literature on the transfer problem (see, among others, Johnson, 1956; Frenkel and Razin, 1987). That literature considers whether transfers of wealth between countries have effects on expenditure that feed back onto the current account balance, allowing the transfer to be effected without terms of trade changes. Since accumulations of net foreign claims correspond to transfers of wealth, depending on spending propensities, stabilization of foreign claims may or may not require real exchange rate changes.

The role of the exchange rate as a mechanism of adjustment is not considered explicitly in this paper. To the extent that changes in exchange rates alter current account positions, they operate by changing domestic saving and investment (or absorption relative to output) because of the identity linking the variables. Thus our estimates of the response of absorption to net foreign assets include, among other channels, exchange rate effects. A different question relates to the effects of exchange rate changes on the valuation of net foreign asset stocks. Valuation effects result from aggregation of assets and liabilities in different currencies at varying exchange rates, and require for their calculation a detailed breakdown of those assets and liabilities. Published data on net foreign assets typically take account of valuation effects to some extent (this is the case for the three countries we consider; see Appendix for data

---

1/ The correlation over time of flow effects has been considered by Penati and Dooley (1984). Tobin (1983) made the point that an analysis focusing on long-term current account developments ought to take account of stock variables.

sources), so they do not equal the accumulation of current account flows. However, there is no presumption that exchange rate movements automatically stabilize net foreign asset positions through such valuation effects.

Finally, in the absence of Ricardian Equivalence (Barro, 1974), the existence of a long-run equilibrium for net foreign assets is related to the existence of a long-run equilibrium for the stock of government debt (both as a ratio to GNP). Net foreign liabilities play the same role for the economy's intertemporal budget constraint as public debt for the government's budget constraint. 1/ There have been a number of studies examining the empirical implications of the government's intertemporal budget constraint for the conduct of budgetary policy (Hamilton and Flavin, 1986; and Kremers, 1989), and studying the sustainability of current account positions (Wickens and Uctum, 1990; Trehan and Walsh, 1991; Ahmed and Rogers, 1992). It seems to us that the proper question is not whether the economy ultimately satisfies its intertemporal budget constraint, but rather whether there are feedback mechanisms that operate smoothly to ensure that disruptive adjustment can be avoided.

The plan of the paper is as follows. The long-run determination of net foreign asset positions is discussed in Section II. This is followed by a brief description of the econometric methods in Section III. The empirical results are in Section IV, and Section V concludes.

II. Long-Run Influences on Net Foreign Assets

It is useful to begin by considering the pattern of net foreign claims in a two-country version of the familiar Yaari-Blanchard-Weil model (Yaari, 1965; Blanchard, 1985; Weil, 1985). If birth rates are positive, then, as shown in Weil (1985) and Buiter (1988), Ricardian equivalence does not hold, and the choice between financing government expenditure through taxation or issuing bonds has real effects. As shown by Blanchard (1985), higher government debt in a small open economy is associated with lower net foreign assets.

This model does not take into account the life-cycle nature of saving (Ando and Modigliani, 1965), which, as Blanchard (1985, p. 235) points out, is difficult to handle tractably. However, demographic variables that reflect the age-structure of the population seem to be important determinants of the cross-country variations of saving rates (Modigliani, 1970; Graham, 1987; Masson and Tryon, 1990), and hence should affect net foreign asset positions.

Consider a simple overlapping generations model in which individuals work and save in the first period of their lives, and retire and dissave in

---

1/ Since the economy's net foreign asset position reflects both private sector and government positions, a long-run relationship for government debt (e.g., a stationary debt/GNP ratio) does not necessarily imply that the same equilibrium relationship holds for net foreign assets.

the second period; there are no bequests and the wage rate is constant. In this world, the saving rate will depend on how many workers there are relative to retirees. If the latter are numerically more important (for instance, due to a decline in the birth rate), then the economy's saving rate may even be negative. However, the implications for asset stocks are quite different: if there are more retirees this period, then, since they own the assets (having accumulated them in the previous period), the economy's stock of assets will be larger, ceteris paribus. In this world, asset accumulation only occurs because individuals want to transfer wealth to their retirement years. It should therefore be the case that an economy with an older population has higher net foreign assets in steady state than an identical economy with a younger population (the two economies could have the same population growth, but the former a lower birth rate and mortality rate), since the former economy involves more transfers of wealth between time periods.

Of course, demographic transitions take many decades and we are unlikely to observe economies in steady state with equal population growth rates. Therefore, net foreign assets need not be a constant ratio to GNP, and demographic variables should be important for long-run movements of this ratio. In our empirical work, we examine the effects of the relative ratios of both the young (under 15 years) and the old (65 years and over) to the working-age population, where in each case we compare the home country's age structure to that in other countries. In contrast to the aged dependency ratio, the effect of an increase of the youth dependency ratio is not so clear cut since providing for their current consumption may decrease household saving, but providing for their future needs (e.g., college education) may increase saving.

III. Econometric Methods

The idea underlying cointegration is to study the behavior of variables moving apart in the short run, but which are brought back to an equilibrium relationship by government policy or market forces, or both, in the long run. A variable is defined to be integrated of order one (denoted by I(1)) if it must be differenced once to produce a stationary series (denoted by I(0)), that is, a series with constant mean and constant, finite variance. A set of variables, each I(1), is said to be cointegrated if a linear combination of them is I(0) (i.e., if they "move together in the long run"). 1/ That linear combination is characterized by a cointegrating vector.

The empirical analysis in the next section starts by testing whether the ratio of net foreign assets to GNP is stationary. In the event that non-stationarity of this ratio cannot be rejected, it will subsequently be

---

1/ Provided the variable has no deterministic component. See Granger (1986), Hendry (1986), and Engle and Granger (1987) for introductions to cointegration.

assessed whether the ratio is cointegrated with other non-stationary variables, in particular, government debt and demographic variables.

Given the small available data sample (the postwar period), it is important to follow an approach to testing that has high power to reject non-stationarity. We therefore use the maximum-likelihood approach of Johansen (1988) to test for cointegration rather than the Engle-Granger single-equation procedure. We also estimate dynamic error correction models, using the methodology of Hendry (1987) to go from general specifications to more parsimonious ones; as suggested in Phillips and Loretan (1991), we use non-linear least squares to impose the restrictions implied by the cointegrating vectors.

IV. Empirical Results

1. The long run

The post-war patterns of the ratios of net foreign assets to GNP for the United States, Japan, and Germany are shown in Figure 1. 1/ The graphical evidence suggests no sustained tendency on the part of any of these ratios to return to a constant long-run equilibrium. The net foreign asset positions of Japan and Germany, relative to GNP, have fluctuated along an upward trend, while that of the United States has fallen dramatically in the 1980s after following a more stable pattern in the previous decades.

The graphical impression is confirmed by the fact that, for this sample, non-stationarity of the ratio cannot be rejected for any of the three countries (Table 1). However, the non-stationarity of its first difference can be rejected, indicating that the ratio is I(1). Hence, if a stationary long-run equilibrium exists, it must be a function of at least one other non-stationary variable.

In order to explore this possibility, we examine the cointegration of F/Y (the ratio of net foreign assets to GNP) with the government debt/GNP ratio and demographic variables. The discussion of Section II suggested that, in equilibrium, higher net foreign assets (scaled by GNP) should be associated with lower government debt at home and higher government debt abroad. Two alternative specifications were tried for the debt variable: the domestic debt/GNP ratio, B/Y, and a relative debt variable B/Y-B*/Y*, with B*/Y* based on data for the six remaining G-7 countries. In practice the domestic debt ratio seemed to work better, possibly because of limited cross-country comparability of debt data; the relative debt variable is therefore not reported. The two demographic variables included in the analysis are the domestic ratio of the population aged under 15 years to that from 15 to 64 years, minus the corresponding ratio for the remaining G-7 countries (RDEM1), and an analogous variable for the ratio of the population aged 65 years and over to that from 15 to 64 (RDEM2).

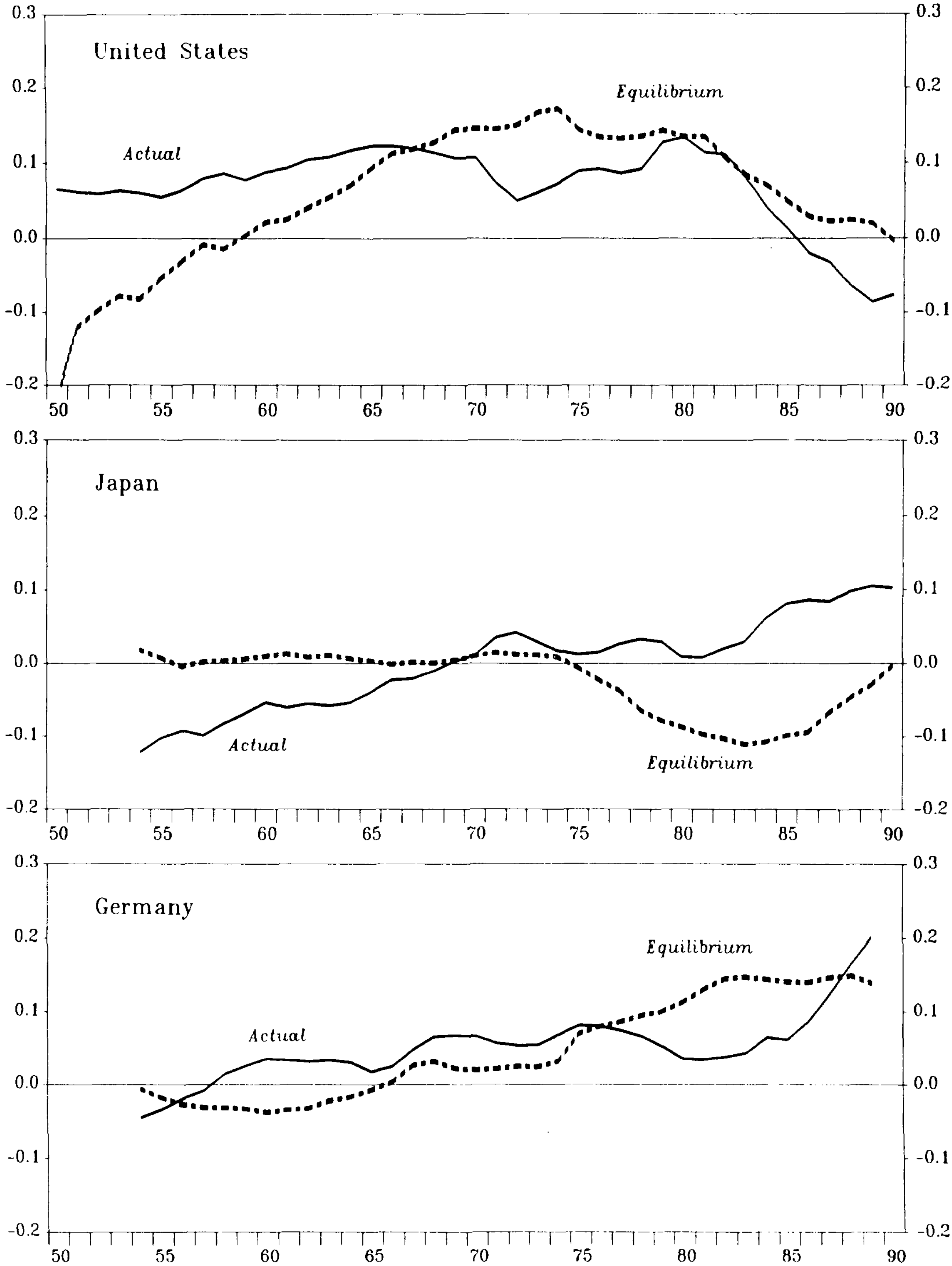
1/ Data sources and tables of data are given in the Appendix.

Table 1. Tests of Order of Integration 1/

Variable	Sample 2/	ADF Statistic	(p - value) 3/
United States			
F/Y	1950-90	-1.44	(0.85)
Δ(F/Y)		-3.65	(0.04)
B/Y	1950-90	-1.49	(0.84)
Δ(B/Y)		-7.73	(0.00)
RDEM1	1950-90	-3.06	(0.13)
ΔRDEM1		-1.07	(0.93)
RDEM2	1950-90	-2.89	(0.18)
ΔRDEM2		-1.78	(0.73)
Japan			
F/Y	1950-90	-2.21	(0.51)
Δ(F/Y)		-8.65	(0.00)
B/Y	1954-90	-2.27	(0.46)
Δ(B/Y)		-1.31	(0.88)
RDEM1	1950-90	-3.07	(0.13)
ΔRDEM1		-0.90	(0.95)
RDEM2	1950-90	-2.06	(0.58)
ΔRDEM2		-1.66	(0.77)
Germany			
F/Y	1950-89	-0.64	(0.97)
Δ(F/Y)		-4.51	(0.00)
B/Y	1954-89	-2.45	(0.37)
Δ(B/Y)		-3.14	(0.11)
RDEM1	1950-90	-2.97	(0.15)
ΔRDEM1		-1.90	(0.67)
RDEM2	1950-90	-1.95	(0.65)
ΔRDEM2		-1.96	(0.64)

1/ A constant and a time trend were included in the regressions, and the lagged change in the variable if there was evidence of residual serial correlation.
2/ Truncated as necessary to account for lags.
3/ The calculation of p-values in TSP is based on MacKinnon (1991).

Figure 1. Net Foreign Assets to GNP Ratios: Actual and Equilibrium Values



The first step of the empirical analysis is to ascertain that the variables to be used in the cointegration regressions are indeed I(1). The non-stationarity of B/Y cannot be rejected but that of Δ(B/Y) can be with fairly high confidence (Table 1), confirming that B/Y is I(1) for all countries except Japan. However, there may be grounds for questioning whether B/Y is in fact I(1); see Kremers (1989). In any case, one should be cautious of inference with such relatively short samples. For the sample under investigation, the tests suggest that the two demographic variables may be integrated of different order. While the relative youth dependency ratio (RDEM1) seems to be stationary for all three countries (at least at a 15 percent significance level), the relative elderly dependency ratio (RDEM2) is not. In fact, the data suggest that RDEM2 may not even be I(1). However, demographic ratios suffer from the fact that the underlying census data are not available on a yearly basis, and hence involve some interpolation. We therefore do not place too great a weight on tests of their apparent order of integration, and we include RDEM2 in the cointegrating equations for all three countries.

The tests for cointegration of the set of variables comprising F/Y, B/Y, and RDEM2 are presented in Table 2. For the United States and Japan, there is a clear rejection of the hypothesis of no cointegrating vectors; moreover, that vector, reported in Table 2, is unique. It implies that a higher domestic debt ratio lowers, and an older population raises, net foreign assets in the long run, as suggested in Section II.

For Germany, in contrast, the picture is less clear: these three variables do not seem to be cointegrated, and, moreover, debt has the wrong sign. We proceeded to include other variables in the cointegrating vector for Germany, since it appears that the debt ratio, which rises over the sample period, may be proxying for them. We separately included the real oil price, the terms of trade, and the government spending to GNP ratio; however, there was still no evidence of cointegration. An alternative specification containing both demographic variables is reported in Table 2. RDEM1 is included, despite appearing to be I(0), partly because of our concern about the reliability of order of integration tests when applied to these interpolated variables, and partly because it seems logical that the two variables should be of the same order of integration since they depend on the same mortality and fertility factors. The inclusion of RDEM1 allows rejection of the hypothesis of no cointegration, and also reverses the sign of B/Y. However, the coefficient values are unreasonably large for the two demographic variables--and sensitive to sample period--no doubt because of collinearity between them. Therefore, in our subsequent work we use the simpler specification which includes only RDEM2 for all three countries, despite the test result for Germany suggesting lack of cointegration for this specification.

Taken together, this evidence--though not yet very firm--nevertheless suggests that, for the three countries under investigation, a stationary long-run equilibrium relationship for the F/Y ratio may exist, and that it is a function of demographic factors as well as the public debt/GNP ratio. In order to help an understanding of the implications of these equations for

Table 2. Cointegration Tests for Net Foreign Assets, Debt, and Dependency Ratios

Tests of Number of Cointegrating Vectors				Largest	
r = 0	r = 1	r = 2	r = 3	Eigenvalue	Corresponding Eigenvector
United States (1950-90)					
51.2*	19.4	2.9	--	0.56	F/Y = 0.32 -0.77 B/Y + 0.71 RDEM2
Japan (1954-90)					
37.2*	18.4	8.6	--	0.43	F/Y = 0.11 -0.50 B/Y + 1.76 RDEM2
Germany (1954-89)					
25.6	13.8	6.2	--	0.29	F/Y = -0.18 + 0.67 B/Y + 1.36 RDEM2
54.6*	28.4	14.5	5.2	0.54	F/Y = -4.03 -0.31 B/Y -20.6 RDEM1 + 59.9 RDEM2

* Significant at 5 percent level. See Johansen and Juselius (1990), Table A.3.

long-run equilibrium, we compare their actual and fitted values in Figure 1. It is notable that trend movements of net foreign assets seem to follow their calculated long-term equilibrium path, but there are substantial short-run deviations. For instance, in the early 1950s, actual F/Y was in the United States considerably above its equilibrium, and in Japan and Germany, below it--perhaps a legacy of the war.

It appears that the U.S. net foreign asset equilibrium, conditional on the paths of B/Y and RDEM2 (and assuming that any possible I(0) influences are zero), sharply declined in the 1980s. This primarily reflects the change in stance of U.S. fiscal policy. The long-run equilibrium of the Japanese net foreign asset position has shown an upward movement since 1985, reflecting both the aging of the population and fiscal consolidation. In Germany, there has been a gradual, but steady rise in the estimated net foreign asset equilibrium, where the debt ratio is no doubt capturing the effects of other variables (including RDEM1) that contribute to the positive trend.

2. The dynamics

In this sub-section, dynamic error correction models are estimated for components of absorption in order to shed some light on the dynamic forces underlying the long-run equilibrium, i.e., the feedback mechanisms through absorption. First note that in the absence of valuation changes, the first difference of net foreign assets (F) can be written:

(1) $$\Delta F = Y - A$$

where Y is nominal GNP and A is domestic absorption, which is equal to the sum of consumption (C), investment (I), and government spending (G). Therefore,

(2) $$\Delta(F/Y) = 1 - A/Y - (F_{-1}/Y_{-1})\Delta Y/Y$$

The existence of cointegration implies an error correction model for F/Y, and if nominal income growth $\Delta Y/Y$ is given in the long-run by other factors (e.g., money supply growth), then this feedback mechanism should operate through one or several components of A. 1/

Standard models suggest several mechanisms by which net foreign assets may affect absorption. 1) Since it is a component of wealth, higher F/Y

1/ Note that equation (1) does not imply that A must be I(0) for F/Y to be I(1). Suppose that $\Delta(F/Y)=\epsilon$ where ϵ is white noise and $\Delta Y/Y=n$, a constant;

then $\frac{A}{Y} = 1 - nF/Y - \epsilon(1-n)$ so that F/Y and A/Y will be cointegrated, and both

be I(1). In fact, ADF tests (not reported) suggest that C/Y, I/Y, and G/Y are all I(1); hence adjustment equations in first-difference form are estimated for them below.

should raise consumption, thereby increasing imports and lowering $\Delta(F/Y)$. 2) If there is a risk premium on interest rates on foreign borrowing that depends on the net foreign liability position, then higher F/Y should lower domestic interest rates and stimulate investment (and perhaps also consumption). 3) The government may vary its fiscal policy instruments to prevent the current account or net foreign assets from diverging too much from some desired level (Summers, 1988).

These three feedback mechanisms operate through different components of absorption; thus, it is of interest to discover whether deviations of F/Y from its long-run equilibrium affect consumption, investment, or government spending.

For each of the three countries, we estimated a system of dynamic equations for the annual change in the three components of domestic absorption scaled by GNP, including the lagged deviations from the respective long-run cointegrating relationships as representations of disequilibrium feedback (these deviations will be denoted by u). 1/ The cointegrating vectors are reestimated here, and the appropriate cross-equation restrictions are imposed. 2/ Initially, the same general standard equation was run for each country, including all the variables listed in the left margin of Table 3. In order to gain precision on this relatively limited sample, the general equations were subsequently simplified to a more specific lag structure for each country. The step from "general to specific" was guided by the diagnostic tests, though in each case the error correction term and the constant were retained. 3/

The dynamic analysis confirms the existence of a long-run relationship in which the net foreign asset ratio is negatively related to the government debt ratio and positively related to the aged dependency ratio. Table 3 presents evidence of positive error correction feedback from foreign asset disequilibrium onto some expenditure component in each of the three countries. Feedback onto consumption is positive for two of the three countries, the United States and Japan, though t-ratios are only about 1.5. For investment, feedback is positive for the United States and Germany, and significant for the former. For government spending, the feedback is positive and significant for Japan, while for the other two countries

---

1/ If $\hat{u}$ were non-stationary (as seems to be the case for Germany, based on Table 2, when only F/Y, B/Y, and RDEM2 are included), then its coefficient should not be significantly different from zero in a regression explaining an I(0) variable. However, $\hat{u}$ is highly significant for German consumption.

2/ This permits a proper test of the significance of the disequilibrium feedback; we are grateful to a referee for this suggestion.

3/ Residual serial correlation seems to be present in a few of the equations; and the residuals of the $\Delta(G/Y)$ equation are not normal. However, the equations are otherwise satisfactory, and due to concern for degrees of freedom we did not estimate an even more general dynamic specification.

Table 3. Error Correction Models for Consumption, Investment, and Government Spending

(Standard errors in parentheses)

	United States (1952-90)			Japan (1957-90)			Germany (1957-89)		
Cointegrating	F/Y = -0.55 B/Y + 2.64 RDEM2			F/Y = -0.11 B/Y + 5.91 RDEM2			F/Y = -0.58 B/Y + 3.17 RDEM2		
Vector	(0.11) (1.02)			(0.22) (2.28)			(0.59) (1.68)		
Coefficients 1/	Δ(C/Y)	Δ(I/Y)	Δ(G/Y)	Δ(C/Y)	Δ(I/Y)	Δ(G/Y)	Δ(C/Y)	Δ(I/Y)	Δ(G/Y)
$\hat{u}_{-1}$	0.024	0.074	-0.028	0.050	-0.046	-0.037	-0.020	0.080	-0.024
	(0.018)	(0.024)	(0.022)	(0.038)	(0.041)	(0.010)	(0.018)	(0.053)	(0.017)
Δ(B/Y)	0.296	-0.170	0.197				0.513	-0.162	0.215
	(0.049)	(0.051)	(0.058)				(0.057)	(0.103)	(0.045)
$\Delta(B/Y)_{-1}$		0.164	-0.260			-0.041	-0.235		-0.276
		(0.036)	(0.044)			(0.016)	(0.054)		(0.042)
Δ(F/Y)	0.095	-0.076			-0.346			-0.400	
	(0.056)	(0.055)			(0.114)			(0.130)	
$\Delta(F/Y)_{-1}$		-0.072		-0.345	0.678	-0.134	0.104		
		(0.053)		(0.157)	(0.169)	(0.038)	(0.068)		
ΔRDEM2		-1.284						0.851	
		(0.574)						(0.626)	
Lagged dependent variable	-0.205	0.230	0.272	0.207	0.340			0.144	
	(0.083)	(0.095)	(0.080)	(0.092)	(0.086)			(0.147)	
Statistics 2/									
R^2	0.478	0.551	0.607	0.249	0.460	0.435	0.764	0.529	0.695
$\hat{\sigma}$	0.0053	0.0047	0.0058	0.0099	0.0105	0.0024	0.0039	0.0069	0.0031
ARCH (1)	0.57	1.12	0.27	0.99	1.13	1.61	0.29	0.11	0.02
AR (1)	2.23	4.83*	4.97*	0.62	0.56	0.09	1.72	1.66	0.84
AR (1 to 4)	1.94	9.62*	13.2*	8.92	4.99	2.60	13.2*	3.40	1.68
NORM	0.90	0.32	67.8**	0.67	0.44	1.04	0.58	0.02	1.39

* Indicates rejection of the null hypothesis of absence of serial correlation, homoscedasticity, or normality at 5 percent significance level.
** Indicates rejection of null at 1 percent significance level.

1/ Constant was included but is not reported.
2/ Statistics are the explained sum of squares and standard error of the regression, and tests for autoregressive conditional heteroscedasticity, residual auto correlation for lags 1 to n, and normality, respectively. The ARCH, AR, and NORM test statistics are distributed as $\chi 2$. See Spanos (1986) for a description of the tests, including appropriate degrees of freedom.

coefficients are negative. Thus, the results suggest some support for each of the three linkages for stabilizing the net foreign asset ratio, depending on the country. Though the equations suggest considerable diversity across countries, other tentative conclusions also emerge. There is evidence of significant stabilizing feedback of lagged government debt on government spending in the three countries, and of contemporaneous crowding out of investment by increases in government debt in the United States and Germany, for which $\Delta(B/Y)$ has a negative sign in the investment equation.

V. Conclusion

This study has sought to confirm the presence of stabilizing mechanisms for the net foreign asset positions of the three largest industrial countries in the post-World War II period. Persistent and large current account imbalances have led to quite dramatic changes in the net international positions of the United States, Japan, and Germany. However, various feedback effects from foreign asset stocks may act as stabilizing mechanisms to prevent a continued increase of these net foreign asset or liability positions, and to ensure an eventual return to long-run equilibrium.

Cointegration tests were used to investigate empirically the nature of the long-run equilibrium relationship for net foreign assets of the United States, Japan and Germany using postwar data. These tests suggest the existence of a long-run relationship between the net foreign asset/GNP ratio, the public debt/GNP ratio, and dependency ratios relative to other G-7 countries.

Developments in the 1980s seem to have differed between the United States on the one hand and Japan and Germany in an important respect: the conditional long-run net foreign asset equilibrium of the United States moved sharply downward, reflecting a rapid accumulation of public debt. In contrast, the Japanese and German authorities implemented policies to consolidate the public finances; the net foreign assets of these countries increased strongly.

The evidence of these long-run relationships is supported by error correction models of components of domestic absorption. These results suggest, however, that stabilizing feedback operates through different linkages in different countries: primarily through private investment in the United States and Germany and through government spending in Japan, though there is also weaker evidence of a consumption feedback in the United States and Japan.

Data Sources

This Appendix provides the sources of data used in this study; the data are given in Tables 4-6.

1. Net foreign assets (F)

United States: Stock data defined as total U.S. investments abroad minus total foreign investments in the United States (billions of U.S. dollars). Sources: data for 1950-69 from Historical Statistics of the United States, Colonial Times to 1970, U.S. Department of Commerce; data for 1969-90 from Survey of Current Business (June issues), U.S. Department of Commerce. Since 1976, the data "at current cost" was used, and earlier data were adjusted to be consistent in that year. Gold netted out from both series using IMF International Financial Statistics (IFS) gold series (line 1a,n,d).

Japan: 1950-70: stock data derived by decumulating current account balances from the 1971 value (in billions of yen) of net foreign assets. Sources: current account balances (1950-1970) from IMF World Economic Outlook, and K. Ohkawa, Estimates of Long-Term Economic Statistics of Japan Since 1868, National Income, Vol. 1; 1971-90: stock data from Bank of Japan Balance of Payments Monthly (converted from millions of U.S. dollars at end-of-period exchange rates). Gold netted out using IFS series (line 1a,n,d).

Germany: Stock data defined as external assets less liabilities (billions of deutsche mark). Source: Monthly Report, Deutsche Bundesbank. Gold netted out using same source.

2. Nominal gross national product (Y), consumption (C), investment (I), and government spending (G)

Source: IMF World Economic Outlook (WEO) databank. (For Germany, data prior to 1960 scaled up in order to compensate for the absence in the data of Saarland and Berlin.)

3. Net government debt (B)

United States: Central government debt less central bank holdings. Source: IFS, line 88.

Germany: Public authorities' total indebtedness. Source: Monthly Report, Deutsche Bundesbank.

Japan: Net liabilities of general government sector. Source: Annual Report on National Accounts, Japan Economic Planning Agency.

4. Demographic variable (RDEM1)

Ratio of the young (under 15 years) to working-age (15-64 years) population for the domestic country minus the ratio for partner countries (total country group: United States, Japan, Germany, France, Italy, the United Kingdom, and Canada). Source: International Labor Office.

5. Demographic variable (RDEM2)

Ratio of the old (65 years and over) to working-age population for the domestic country minus the corresponding ratio for partner countries. Source: as for RDEM1.

Table 4. Data for the United States

Year	F/Y	B/Y	RDEM1	RDEM2	C/Y	I/Y	G/Y
1950	0.0656	0.6984	-0.0116	-0.0046	0.6665	0.1675	0.1346
1951	0.0616	0.5738	0.0035	-0.0027	0.6241	0.1506	0.1811
1952	0.0592	0.5460	0.0184	-0.0007	0.6230	0.1434	0.2155
1953	0.0632	0.5216	0.0330	0.0012	0.6261	0.1466	0.2227
1954	0.0602	0.5289	0.0474	0.0032	0.6438	0.1497	0.2042
1955	0.0550	0.4934	0.0617	0.0051	0.6353	0.1578	0.1854
1956	0.0640	0.4657	0.0723	0.0067	0.6320	0.1589	0.1860
1957	0.0799	0.4372	0.0826	0.0083	0.6326	0.1544	0.1936
1958	0.0864	0.4460	0.0927	0.0099	0.6451	0.1425	0.2088
1959	0.0778	0.4237	0.1027	0.0114	0.6400	0.1501	0.1991
1960	0.0884	0.4017	0.1124	0.0129	0.6435	0.1462	0.1932
1961	0.0936	0.3965	0.1148	0.0121	0.6415	0.1401	0.1999
1962	0.1046	0.3755	0.1172	0.0113	0.6328	0.1421	0.2029
1963	0.1079	0.3574	0.1195	0.0106	0.6323	0.1443	0.2012
1964	0.1168	0.3352	0.1218	0.0098	0.6316	0.1481	0.1966
1965	0.1226	0.3062	0.1241	0.0091	0.6278	0.1529	0.1925
1966	0.1225	0.2781	0.1146	0.0064	0.6215	0.1505	0.2011
1967	0.1195	0.2577	0.1054	0.0038	0.6213	0.1434	0.2141
1968	0.1137	0.2532	0.0965	0.0013	0.6244	0.1461	0.2139
1969	0.1065	0.2291	0.0880	-0.0013	0.6252	0.1507	0.2090
1970	0.1066	0.2253	0.0798	-0.0038	0.6358	0.1453	0.2092
1971	0.0731	0.2237	0.0680	-0.0057	0.6340	0.1513	0.2031
1972	0.0499	0.2154	0.0566	-0.0076	0.6318	0.1607	0.1988
1973	0.0608	0.1916	0.0457	-0.0094	0.6229	0.1651	0.1893
1974	0.0730	0.1839	0.0352	-0.0113	0.6295	0.1566	0.1956
1975	0.0896	0.2186	0.0250	-0.0132	0.6413	0.1444	0.2011
1976	0.0921	0.2295	0.0214	-0.0143	0.6407	0.1504	0.1913
1977	0.0869	0.2313	0.0181	-0.0155	0.6375	0.1672	0.1845
1978	0.0928	0.2256	0.0150	-0.0167	0.6304	0.1801	0.1790
1979	0.1277	0.2144	0.0121	-0.0179	0.6283	0.1854	0.1779
1980	0.1344	0.2248	0.0940	-0.0191	0.6375	0.1740	0.1849
1981	0.1137	0.2267	0.0147	-0.0164	0.6287	0.1738	0.1831
1982	0.1110	0.2668	0.0199	-0.0137	0.6476	0.1633	0.1911
1983	0.0797	0.2977	0.0250	-0.0111	0.6573	0.1608	0.1899
1984	0.0402	0.3190	0.0300	-0.0085	0.6472	0.1704	0.1843
1985	0.0131	0.3496	0.0349	-0.0060	0.6580	0.1702	0.1905
1986	-0.0199	0.3745	0.0407	-0.0066	0.6664	0.1657	0.1947
1987	-0.0321	0.3810	0.0465	-0.0072	0.6716	0.1591	0.1940
1988	-0.0646	0.3787	0.0522	-0.0078	0.6716	0.1584	0.1872
1989	-0.0859	0.3841	0.0579	-0.0084	0.6703	0.1527	0.1851
1990	-0.0766	0.4142	0.0635	-0.0090	0.6775	0.1453	0.1888

Table 5. Data for Japan

Year	F/Y	B/Y	RDEM1	RDEM2	C/Y	I/Y	G/Y
1950	-0.2808		0.2093	-0.0551			
1951	-0.1675		0.1940	-0.0568			
1952	-0.1357		0.1791	-0.0585			
1953	-0.1313		0.1647	-0.0602			
1954	-0.1220	-0.0434	0.1507	-0.0620			
1955	-0.1026	-0.0271	0.1371	-0.0636	0.6550	0.1935	0.1006
1956	-0.0928	-0.0082	0.1146	-0.0649	0.6416	0.2276	0.0925
1957	-0.0995	-0.0258	0.0929	-0.0662	0.6242	0.2572	0.0868
1958	-0.0828	-0.0330	0.0718	-0.0675	0.6303	0.2484	0.0885
1959	-0.0684	-0.0425	0.0514	-0.0688	0.6180	0.2559	0.0846
1960	-0.0534	-0.0548	0.0316	-0.0700	0.5872	0.2898	0.0801
1961	-0.0607	-0.0636	0.0126	-0.0710	0.5713	0.3194	0.0768
1962	-0.0551	-0.0582	-0.0549	-0.0719	0.5777	0.3225	0.0797
1963	-0.0580	-0.0669	-0.0228	-0.0728	0.5896	0.3164	0.0826
1964	-0.0540	-0.0607	-0.0395	-0.0738	0.5782	0.3179	0.0798
1965	-0.0396	-0.0581	-0.0555	-0.0747	0.5870	0.2984	0.0820
1966	-0.0223	-0.0468	-0.0588	-0.0743	0.5815	0.3036	0.0802
1967	-0.0206	-0.0526	-0.0620	-0.0740	0.5692	0.3201	0.0764
1968	-0.0103	-0.0484	-0.0650	-0.0736	0.5484	0.3325	0.0744
1969	0.0315	-0.0558	-0.0680	-0.0733	0.5365	0.3454	0.0734
1970	0.0117	-0.0656	-0.0708	-0.0731	0.5237	0.3558	0.0745
1971	0.0355	-0.0729	-0.0605	-0.0723	0.5364	0.3429	0.0796
1972	0.0427	-0.0652	-0.0504	-0.0716	0.5400	0.3411	0.0815
1973	0.0301	-0.0610	-0.0405	-0.0709	0.5359	0.3638	0.0829
1974	0.0180	-0.0538	-0.0309	-0.0702	0.5441	0.3484	0.0913
1975	0.0126	-0.0210	-0.0215	-0.0695	0.5720	0.3248	0.1004
1976	0.0153	0.0190	-0.0130	-0.0676	0.5755	0.3121	0.0986
1977	0.0272	0.0547	-0.0482	-0.0657	0.5771	0.3017	0.0983
1978	0.0334	0.1125	0.0032	-0.0639	0.5767	0.3039	0.0966
1979	0.0298	0.1486	0.0110	-0.0621	0.5864	0.3163	0.0968
1980	0.0088	0.1727	0.0187	-0.0602	0.5886	0.3157	0.0981
1981	0.0085	0.2067	0.0177	-0.0562	0.5827	0.3065	0.0993
1982	0.0206	0.2317	0.0168	-0.0521	0.5942	0.2945	0.0990
1983	0.0301	0.2614	0.0158	-0.0482	0.6015	0.2796	0.0992
1984	0.0619	0.2692	0.0149	-0.0443	0.5933	0.2765	0.0978
1985	0.0814	0.2643	0.0140	-0.0405	0.5870	0.2737	0.0954
1986	0.0861	0.2610	0.0057	-0.0391	0.5835	0.2718	0.0964
1987	0.0844	0.2119	-0.0023	-0.0377	0.5837	0.2829	0.0940
1988	0.0978	0.1760	-0.0103	-0.0363	0.5756	0.2972	0.0914
1989	0.1050	0.1467	-0.0181	-0.0350	0.5725	0.3076	0.0909
1990	0.1024	0.0982	-0.0258	-0.0337	0.5697	0.3200	0.0906

Table 6. Data for Germany

Year	F/Y	B/Y	RDEM1	RDEM2	C/Y	I/Y	G/Y
1950	-0.0450		-0.0859	0.0130	0.6412	0.1906	0.1448
1951	-0.0187		-0.0983	0.0125	0.6091	0.1908	0.1466
1952	0.0020		-0.1105	0.0120	0.5927	0.1956	0.1518
1953	-0.0593		-0.1225	0.0116	0.6005	0.2065	0.1448
1954	-0.0447	0.2310	-0.1341	0.0112	0.5964	0.2150	0.1406
1955	-0.0339	0.2143	-0.1455	0.0107	0.5849	0.2353	0.1334
1956	-0.0189	0.1986	-0.1463	0.0117	0.5885	0.2364	0.1281
1957	-0.0082	0.1904	-0.1471	0.0127	0.5881	0.2233	0.1276
1958	0.0145	0.1882	-0.1479	0.0137	0.5907	0.2232	0.1335
1959	0.0255	0.1837	-0.1487	0.0147	0.5794	0.2353	0.1345
1960	0.0356	0.1741	-0.1494	0.0157	0.5670	0.2425	0.1333
1961	0.0334	0.1722	-0.1377	0.0194	0.5682	0.2519	0.1385
1962	0.0313	0.1674	-0.1262	0.0231	0.5678	0.2579	0.1464
1963	0.0332	0.1755	-0.1149	0.0268	0.5671	0.2559	0.1554
1964	0.0305	0.1759	-0.1039	0.0305	0.5568	0.2665	0.1480
1965	0.0174	0.1825	-0.0931	0.0341	0.5618	0.2618	0.1523
1966	0.0246	0.1909	-0.0834	0.0376	0.5644	0.2546	0.1547
1967	0.0482	0.2191	-0.0740	0.0412	0.5725	0.2313	0.1622
1968	0.0657	0.2194	-0.0646	0.0448	0.5634	0.2235	0.1549
1969	0.0672	0.1972	-0.0554	0.0484	0.5536	0.2322	0.1556
1970	0.0661	0.1863	-0.0463	0.0521	0.5459	0.2545	0.1576
1971	0.0559	0.1867	-0.0447	0.0532	0.5445	0.2607	0.1685
1972	0.0532	0.1891	-0.0433	0.0544	0.5480	0.2534	0.1710
1973	0.0538	0.1859	-0.0420	0.0556	0.5390	0.2385	0.1774
1974	0.0677	0.1951	-0.0408	0.0568	0.5414	0.2155	0.1928
1975	0.0806	0.2490	-0.0396	0.0581	0.5685	0.2035	0.2041
1976	0.0793	0.2634	-0.0452	0.0579	0.5616	0.2004	0.1969
1977	0.0734	0.2738	-0.0507	0.0578	0.5695	0.2020	0.1960
1978	0.0658	0.2870	-0.0563	0.0577	0.5643	0.2059	0.1959
1979	0.0511	0.2964	-0.0619	0.0576	0.5621	0.2172	0.1958
1980	0.0345	0.3155	-0.0674	0.0575	0.5661	0.2235	0.2007
1981	0.0337	0.3541	-0.0740	0.0517	0.5741	0.2150	0.2067
1982	0.0375	0.3868	-0.0804	0.0461	0.5761	0.2034	0.2053
1983	0.0425	0.4011	-0.0867	0.0405	0.5729	0.2035	0.2009
1984	0.0636	0.4072	-0.0930	0.0350	0.5679	0.1987	0.1989
1985	0.0607	0.4137	-0.0991	0.0296	0.5641	0.1936	0.1990
1986	0.0859	0.4130	-0.0968	0.0293	0.5502	0.1926	0.1973
1987	0.1235	0.42351	-0.0946	0.0290	0.5532	0.1925	0.1982
1988	0.1647	0.42864	-0.0924	0.0287	0.5476	0.1945	0.1957
1989	0.2010	0.41386	-0.0903	0.0285	0.5389	0.2011	0.1866
1990		0.43373	-0.0882	0.0283	0.5348	0.2102	0.1823

References

Ahmed, Shagil, and John Rogers, "Government Budget Deficits: Are Present Value Constraints Satisfied in Long-Run Data?" Pennsylvania State University, Department of Economics Working Paper No. 10-9-3, June 1992

Ando, Albert and Franco Modigliani, "The 'Life Cycle' Hypothesis of Saving," American Economic Review, March 1965, Vol. 55: 55-84.

Barro, Robert, "Are Government Bonds Net Wealth?" Journal of Political Economy, November/December 1974, Vol. 82: 1095-1117.

Blanchard, Olivier Jean, "Debt, Deficits and Finite Horizons," Journal of Political Economy, April 1985, Vol. 93: 223-47.

Buiter, Willem, "Death, Birth, Productivity Growth and Debt Neutrality," Economic Journal, June 1988, Vol. 98: 279-93.

Engle, Robert F. and Clive W.J. Granger, "Cointegration and Error Correction: Representation, Estimation and Testing," Econometrica, March 1987, Vol. 55: 251-76.

Feldstein, Martin and Charles Horioka, "Domestic Savings and International Capital Flows," The Economic Journal, June 1980, Vol. 90: 314-29.

Frenkel, Jacob and Assaf Razin, Fiscal Policies and the World Economy, Cambridge, Mass.: MIT Press, 1987.

Graham, John W., "International Differences in Saving Rates and the Life Cycle Hypothesis," European Economic Review, 1987, Vol. 31: 1509-29.

Granger, Clive W.J., "Developments in the Study of Cointegrated Economic Variables," Oxford Bulletin of Economics and Statistics, August 1986, Vol. 48: 213-28.

Hamilton, James D. and Majorie A. Flavin, "On the Limitations of Government Borrowing: A Framework for Empirical Testing," American Economic Review, November 1986, Vol. 76: 808-19.

Helliwell, John F., "Reducing International Imbalances: Evidence form Multi-Country Models," American Economic Review Papers and Proceedings, May 1989, Vol. 79: 258-63.

Hendry, David F., "Econometric Modelling with Cointegrated Variables: An Overview," Oxford Bulletin of Economics and Statistics, August 1986, Vol. 48: 201-12.

_____ ,"Econometric Methodology: A Personal Perspective," in T.F. Bewley, ed., Advances in Econometrics, Vol. 2, Cambridge: Cambridge University Press, 1987.

Johansen, Soren, "Statistical Analysis of Cointegration Vectors," Journal of Economic Dynamics and Control, 1988, Vol. 12: 231-54.

_____ and Katarina Juselius, "Maximum Likelihood Estimation and Inference on Cointegration -- with Applications to the Demand for Money," Oxford Bulletin of Economics and Statistics, May 1990, Vol. 52: 169-210.

Johnson, Harry G., "The Transfer Problem and Exchange Stability," Journal of Political Economy, June 1956, Vol. 59: 212-25.

Knight, Malcolm D. and Paul R. Masson, "Fiscal Policies, Net Saving, and Real Exchange Rates: The United States, the Federal Republic of Germany, and Japan," in J. Frenkel, ed., International Aspects of Fiscal Policies, Chicago: University of Chicago Press, 1988, pp. 21-61.

Kremers, Jeroen J.M., "U.S. Federal Indebtedness and the Conduct of Fiscal Policy," Journal of Monetary Economics, March 1989, Vol. 23: 219-38.

Mackinnon, James, "Critical Values for Cointegration Tests," in R.F. Engle and C.W. Granger, eds, Long-Run Economic Relationships: Readings in Cointegration, Oxford: Oxford University Press, 1991, Chapter 13.

Masson, Paul R. and Ralph W. Tryon, "Macroeconomic Effects of Population Aging in Industrial Countries," IMF Staff Papers, September 1990, Vol. 37: 453-85.

Modigliani, Franco, "The Life Cycle Hypothesis and Intercountry Differences in the Saving Ratio," in W.A. Eltis, M.F.G. Scott, and J.N. Wolfe, eds., Induction Growth and Trade: Essays in Honour of Sir Roy Harrod, Oxford: Clarendon Press, 1970, pp. 197-226.

Penati, Alessandro and Michael Dooley, "Current Account Imbalances and Capital Formation in Industrial Countries, 1949-81," IMF Staff Papers, March 1984, Vol. 31: 1-24.

Phillips, Peter C.B., and Mico Loretan, "Estimating Long-Run Equilibria," Review of Economic Studies, May 1991, Vol. 58: 407-36

Spanos, Aris, Statistical Foundations of Econometric Modelling, Cambridge: Cambridge University Press, 1986.

Summers, Lawrence H., "Tax Policy and International Competitiveness, in J. Frenkel, ed., International Aspects of Fiscal Policies, Chicago: University of Chicago Press, 1988, pp. 349-75.

Tobin, James, "Comment on 'Domestic Saving and International Capital Movements in the Long Run and the Short Run' by M. Feldstein," European Economic Review, 1983, Vol. 21: 153-156.

Trehan, Bharat and Carl E. Walsh, "Testing Intertemporal Budget Constraints: Theory and Applications to U.S. Federal Budget and Current Account Deficits," Journal of Money, Credit and Banking, May 1991, Vol. 23: 206-23.

Van Wijnbergen, Sweder, "Fiscal Policy, Trade Intervention, and World Interest Rates: An Empirical Analysis," in J. Frenkel, ed., International Aspects of Fiscal Policies, Chicago: University of Chicago Press, 1988, pp. 273-300.

Weil, Philippe, Essays on the Valuation of Unbacked Assets, unpublished Ph.D. Thesis, Harvard University, Cambridge, Mass., 1985.

Wickens, M.R. and Merih Uctum, "National Insolvency: A Test of the U.S. Intertemporal Budget Constraint," CEPR Discussion Paper No. 437, London, August 1990.

Yaari, M.E., "The Uncertain Lifetime, Life Insurance and the Theory of the Consumer," Review of Economic Studies, 1965, Vol. 32: 137-50.