Hitotsubashi Journal of Economics 35 (1994) 109-119. © The Hitotsubashi Academy

THE SUSTAINABILITY OF BUDGET DEFICITS IN JAPAN*

SHIN-ICHI FUKUDA AND HIROSHI TERUYAMA

Abstract

This paper empirically investigates whether the Japanese central government before and after World War II could run a budget deficit forever. The methods of our empirical tests are the straightforward extension of those of Hamilton-Flavin and cointegration. The basic idea is that the ever-growing government debt through perpetual deficit financing has a mathematical parallel in a self-fulfilling speculative bubble. Thus, empirical tests that have been developed for the speculative bubble can be applied to study the limits of government borrowing. The results of this paper show that both the Hamilton-Flavin test and the modified cointegration test cannot reject the sustainability of the budget deficit in postwar Japan. However, they also indicate that when we use the data of the Japanese budget deficit before World War II, neither tests can support the hypothesis of the budget deficit's sustainability. In particular, the results do not change even if we exclude the period of World War II.

I. *Introduction*

This paper empirically investigates whether the Japanese central government before and after World War II could run a budget deficit forever. The reason for studying the budget deficit before World War II is to explore whether the Japanese government which went to war was still subject to the limits of government borrowing or not. The reason for studying the budget deficit after World War II is to examine whethere the recent huge budget deficit in Japan is still sustainable.

The methods of our empirical tests are the straightforward extension of those of Hamilton and Flavin (1986) and cointegration.[1] The basic idea is that the ever-growing government debt through perpetual deficit financing has a mathematical parallel in a self-fulfillng speculative bubble. Thus, empirical tests that have been developed for the speculative bubble can be applied to study the limits of government borrowing.

The test of Hamilton-Flavin is an application of Flood and Garber's (1980) price bubble

* We would like to thank Lincoln Owens for his editorial assistance in English.

[1] The idea of the cointegration test was applied to the sustainability of the U.S. budget deficit by Kremers (1989), Hakkio and Rush (1991) and Trehan and Walsh (1988, 1991).

test. It directly estimates a bubble term and examines whether it is significant or not.[2] The cointegration test is, on the other hand, an indirect test to examine the existence of a bubble term. Its basic idea is that without a bubble term the accumulated budget deficit should be stationary. Thus, as long as both government expenditures and revenues have a unit root, government expenditures and revenues should be cointegrated with each other.[3]

In the following empirical tests, we allow for various real interest rates in the Hamilton-Flavin's test. This is because the ex post real interest rate, which was negative in the mid-1970s, is not a good proxy for the actual real interest rate in Japan. On the other hand, in the cointegration test, we allow for a structural break through the institutional change in public debt issues. In postwar Japan, there have been several institutional changes of public debt issues. In particular, it was after 1975 that both construction and deficit public debts were issued. Hence, it is natural to take into account the existence of a structural break when executing the cointegration test. In this paper, we apply the method of Perron (1989) to the cointegration test and examine whether the accumulated budget deficit is still stationary even after excluding the effects of the structural break at 1975.

The main results of this paper are summarized as follows. First, if no structural break is taken into account, the cointegration test cannot reject the hypothesis that the government budget deficit is not sustainable after World Wat II. However, once we allow the structural break in 1975, the cointegration test can reject the hypothesis that the government budget deficit was not sustainable after World War II. In addition, regardless of the choice of real interest rates, the test of Hamilton-Flavin can reject the same hypothesis, implying that interest on the current public debt can be paid forever. Second, regardless of the choice of estimation methods, we cannot reject the hypothesis that the government budget deficit was not sustainable before World War II. In particular, the result of non-sustainability still holds true even if we exclude the period 1937–1944. The latter result implies that even before World War II began, the government might have violated the limits of government borrowing constraint and accumulated ever-growing debt through perpetual deficit financing in prewar Japan.

The paper proceeds as follows. Section 2 explains a basic theoretical framework for the determination of the public debt. In examining the sustainability of budget deficits, the Hamilton-Flavin's test is applied to the Japan's deficit in section 3 and so is the cointegration test in section 4. Section 5 summarizes our main results and refers to their implications.

II. *The Determination of the Public Debt*

This section presents a basic theoretical framework to be applied in the following

[2] Hamilton and Flavin (1986) conclude that there is no basis in the U.S. data for expecting a violation of the present-value borrowing constraint. However, extending the test of Hamilton and Flavin, Wilcox (1989) concludes that the current U.S. budget deficit is not sustainable.

[3] The results of the cointegration test are, however, mixed on the U.S. budget deficit sustainability. For instance, the Trehan and Walsh (1988, 1991) results were favorable to the hypothesis of intertemporal budget balance in the United States. By contrast, Hakkio and Rush (1991) concluded that the postwar U.S. data are inconsistent with this hypothesis.

empirical studies. The analysis is based on the following government's budget constraint:

$$(1)\quad G_t+(1+r)B_{t-1}=R_t+B_t.$$

where G_t = real government expenditures (excluding interest payments on the debt), R_t = real government revenues, B_t = real public debt, and r = net real interest rate.

This budget constraint is an identity which always holds for any type of government. The general solution of this identity is:

$$(2)\quad B_t=E_t\sum_{i=1}^{\infty}\left(\frac{1}{1+r}\right)^{i}(R_{t+i}-G_{t+i})+E_t\lim_{N\to\infty}\left(\frac{1}{1+r}\right)^{N}B_N,$$

where E_t denotes the conditional expectations based on information available at date t.

If the real supply of bonds held by the public is expected to grow no faster on average than the real rate of interest, it holds that:

$$(3)\quad E_t\lim_{N\to\infty}\left(\frac{1}{1+r}\right)^{N}B_N=0.$$

Hence, equation (2) becomes:

$$(4)\quad B_t=E_t\sum_{i=1}^{\infty}\left(\frac{1}{1+r}\right)^{i}(R_{t+i}-G_{t+i}).$$

Equation (4) is the present-value borrowing constraint of the government. As McCallum (1984) showed, equation (4) does not necessarily imply that the national debt must eventually be paid off. However, equation (4) requires that interest on the national debt must be paid with future government surpluses.

One interesting class of alternative hypothesis is obtained by assuming that:

$$(5)\quad E_t\lim_{N\to\infty}\left(\frac{1}{1+r}\right)^{N}B_N=A>0.$$

This assumption implies that a certain annual amount of real government expenditures need never be paid for with government surpluses. Under this assumption, equation (2) leads to:

$$(6)\quad B_t=E_t\sum_{i=1}^{\infty}\left(\frac{1}{1+r}\right)^{i}(R_{t+i}-G_{t+i})+A(1+r)^{t}$$

Equation (6) is mathematically equivalent to the models of speculative bubbles. Thus, various tests on speculative bubbles can be applied to the test of the hypothesis (5). Assuming that both G_t and T_t are exogenous, the following two sections examine the hypothesis (5) by two alternative tests: the Hamilton-Flavin's test and the cointegration test.

III. *Hamilton-Flavin Test*

Equation (6) derived in section 2 is mathematically equivalent to the model of speculative bubbles proposed by Flood and Garber (1980) for studying self-fulfilling hyperinflations. If expectations of future surpluses are conditioned in part on past surpluses, then equation (6) takes the form:

$$(7)\quad B_t=\sum_{j=1}^{\infty} d_j S_{t-j}+A(1+r)^t$$

where S_t is the budget surplus (i.e. R_t-G_t) at time t.

Allowing for lagged debts to eliminate the serial correlation of the error term in (7), Hamilton and Flavin (1986) estimated the following equation:

$$(8)\quad B_t=c_0+A(1+r)^t+c_1B_{t-1}+\cdots+c_pB_{t-p}+d_0S_t+d_1S_{t-1}+\cdots+d_pS_{t-p}$$

In their estimation, Hamilton and Flavin set real interest rate, r, to be 0.0112, the average ex post real interest rate over 1960–84 in the United States. However, to the extent that there was a risk premium, the value of 0.0112 may be too small. In addition, the average ex post real interest in postwar Japan is negative because of high inflation rates in 1970's. Hence, allowing for various real interest rates, we estimated equation (8) for six alternative values of real interest rate r: 0.01, 0.02, 0.03, 0.04, 0.05, and 0.06. The estimation periods in Japan are from 1965 to 1992 for the postwar period and from 1888 to 1944 (or from 1888 to 1936) for the prewar period. For comparison, we also estimated (8) by using the U.S. data from 1948 to 1992.

In estimating equation (8), all data were deflated by the GDP deflator (see footnotes of Table 1 for data sources). In addition, we set the lag length, p, to be two in all cases.

Table 1 reports the estimation results. Three results are summarized as follows. First, in postwar Japan, the estimated coefficients of $(1+r)^t$ were close to zero and were statistically insignificant for any real rate r. This clearly indicates that the government debt has no tendency to be growing at real rate r in Japan after World War II. Second, in the United States after World War II, the estimated coefficients of $(1+r)^t$ were positive but statistically insignificant for any real rate r, although those for higher real interest rates were statistically significant at 10% level. This result implies that once we allow for higher real interest rates, the Hamilton and Flavin's conclusion on the substainability of the U.S. budget deficit becomes ambiguous. It also throws us some (weak) doubt on the sustainability of budget deficit in the current U.S. economy. Third, in prewar Japan, the estimated coefficients of $(1+r)^t$ were positive and statistically significant in any real interest rate. In particular, the result did not change even if we exclude the period 1937–1944. This indicates that the government debt in prewar Japan had a tendency to be growing at a non-sustainable rate r, even before World War II began.

TABLE 1

Dependent variable $=B_t$								
const.	$(1+r)^t$	S_t	S_{t-1}	S_{t-2}	B_{t-1}	B_{t-2}	D.W.	adj.R^2
Japan								
Sample period: 1965—1992								
$r=0.01$								
−1232	1726	−0.673	0.041	−0.204	1.260	−0.230	2.08	0.99
(−0.08)	(0.12)	(−3.87)**	(0.14)	(−1.10)	(6.07)**	(−1.06)		
$r=0.02$								
475	73.4	−0.683	0.041	−0.199	1.261	−0.229	2.07	0.99
(0.07)	(0.01)	(−3.87)**	(0.14)	(−1.07)	(6.08)**	(−1.02)		
$r=0.03$								
1127	−520	−0.695	0.041	−0.193	1.261	−0.224	2.06	0.99
(0.09)	(−0.12)	(−3.90)**	(0.41)	(−1.03)	(6.08)**	(−1.02)		
$r=0.04$								
1483	−818	−0.710	0.038	−0.184	1.257	−0.215	2.05	0.99
(0.65)	(−0.44)	(−4.14)**	(0.09)	(−0.83)	(5.91)**	(−0.80)		
$r=0.05$								
1674	−960	−0.727	0.034	−0.172	1.249	−0.201	2.03	0.99
(0.65)	(−0.44)	(−4.14)**	(0.12)	(−0.90)	(6.00)**	(−0.90)		
$r=0.06$								
1737	−990	−0.745	0.027	−0.159	1.237	−0.183	2.01	0.99
(0.88)	(−0.62)	(−4.14)**	(0.09)	(−0.83)	(5.91)**	(−0.80)		
United States								
Sample period: 1948–1992								
$r=0.01$								
−107	65.3	−0.953	0.245	0.006	1.046	−0.414	1.56	0.99
(−2.08)**	(1.56)	(−6.59)**	(0.23)	(0.04)	(10.50)**	(−2.73)**		
$r=0.02$								
−68.2	28.7	−0.947	0.244	0.009	1.455	−0.413	1.56	0.99
(−2.43)**	(1.64)	(−6.55)**	(1.07)	(0.06)	(10.52)**	(−2.74)**		
$r=0.03$								
−53.5	16.6	−0.941	0.243	0.012	1.452	−0.411	1.56	0.99
(−2.55)**	(1.72)*	(−6.46)**	(1.06)	(0.09)	(10.53)**	(−2.76)**		
$r=0.04$								
−44.5	10.7	−0.935	0.241	0.014	1.447	−0.410	1.56	0.99
(−2.47)**	(1.79)*	(−6.46)**	(1.06)	(0.09)	(10.53)**	(−2.76)**		
$r=0.05$								
−37.7	7.27	−0.929	0.240	0.015	1.443	−0.409	1.57	0.99
(−2.26)**	(1.86)*	(−6.42)**	(−1.06)	(0.10)	(10.51)**	(−2.77)**		
$r=0.06$								
−31.7	5.10	−0.924	0.238	0.015	1.439	−0.408	1.57	0.99
(−1.95)*	(1.91)*	(−6.37)**	(1.06)	(0.10)	(10.47)**	(−2.77)**		
Japan								
Sample period: 1888–1944								
$r=0,01$								
−1669	1622	0.134	−1.066	0.546	1.030	−0.079	1.93	0.99
(−2.11)**	(2.14)**	(2.05)**	(−5.45)**	(2.82)**	(6.97)**	(−0.59)		
$r=0.02$								
−703	696	0.130	−1.057	0.526	1.011	−0.073	1.93	0.99
(−2.17)**	(2.35)**	(2.01)*	(−5.46)**	(2.73)**	(6.84)**	(−0.55)		

TABLE 1
(continued)

const.	$(1+r)$	S_t	S_{t-1}	S_{t-2}	B_{t-1}	B_{t-2}	D.W.	adj.R^2
r=0.03								
−347	382	0.127	−1.044	0.512	0.997	−0.070	1.93	0.99
(−1.91)*	(2.53)**	(1.96)*	(−5.44)**	(2.68)**	(6.79)**	(−0.53)		
r=0.04								
−150	227	0.123	−1.028	0.506	0.988	−0.071	1.93	0.99
(−1.16)	(2.68)**	(1.92)*	(−5.40)**	(2.68)**	(6.79)**	(−0.54)		
r=0.05								
−23.0	140	0.120	−1.009	0.507	0.986	−0.074	1.93	0.99
(−0.20)	(2.79)**	(1.88)*	(−5.33)**	(2.72)**	(6.86)**	(−0.57)		
r=0.06								
63.3	87.0	0.118	−0.990	0.513	0.989	−0.081	1.93	0.99
(0.54)	(2.87)**	(1.85)*	(−5.24)**	(2.79)**	(6.98)**	(−0.63)		
Sample period: 1888–1936								
r=0.01								
−1212	1226	−0.648	−0.149	0.312	1.324	−0.374	1.72	0.98
(−2.26)**	(2.37)**	(−3.57)**	(−0.55)	(1.61)	(9.36)**	(−2.63)**		
r=0.02								
−442	485	−0.634	−0.156	0.316	1.318	−0.370	1.71	0.98
(−2.00)*	(2.39)**	(−3.49)**	(−0.57)	(1.63)	(9.25)**	(−2.59)**		
r=0.03								
−179	246	−0.620	−0.160	0.324	1.316	−0.368	1.69	0.98
(−1.41)	(2.36)**	(−3.40)**	(−0.58)	(1.68)*	(9.18)**	(−2.57)**		
r=0.04								
−49.0	137	−0.606	−0.162	0.336	1.318	−0.369	1.68	0.98
(−0.53)	(2.30)**	(−3.31)**	(−0.59)	(1.75)*	(9.16)**	(−2.57)**		
r=0.05								
25.2	79.2	−0.594	−0.162	0.351	1.323	−0.373	1.67	0.98
(0.30)	(2.23)**	(−3.21)**	(−0.59)	(1.84)*	(9.18)**	(−2.59)**		
r=0.06								
69.7	46.9	−0.584	−0.166	0.367	1.331	−0.377	1.67	0.98
(0.82)	(2.14)**	(−3.13)**	(−0.58)	(1.92)*	(9.22)**	(−2.61)**		

Notes: B=real public debt.

$S=R-G$, where R=real government revenues, G=real government expenditures (excluding interest payments on the debt).

Real series are computed by dividing the nominal series by the GNP deflator.

t-values are in parentheses. Asterisks denote significance levels: **5%, *10%.

Data sources:

B: Kokusai Tokei Nenpo (Government Bonds Statistics Annual), various issues (Japan). *Economic Report of the President,* various issues (US).

R, G: Emi and Shionoya (eds.), *Choki Keizai Tokei (Estimates of Long-term Economic Statistics of Japan),* vol. 7, Toyo Keizai, 1966; *Zaisei Kinyu Tokei Geppo (Fiscal Monetary Statistics Monthly),* various issues (Japan). *Economic Report of the President,* various issues (US).

GNP deflator: Okawa, Takamatsu, and Yamamoto (eds.), *Choki Keizai Tokei (Estimates of Long-term Economic Statistics of Japan),* vol. 1, Toyo Keizai, 1974; *Keizai Tokei Nenpo (Economic Statistics Annual),* various issues (Japan). *Survey of Current Business,* various issues (US).

IV. *The Cointegration Test*

Unless the government can accumulate ever-growing debt through perpetual debt financing, the government debt should be mean-reverting and stationary under the solvency constraint (3). Hence, to the extent that both real government expenditures ($G_t+(1+r)B_{t-1}$) and real government revenues (R_t) have a unit root, one will be cointegrated with the other. The purpose of this section is to focus on this and to apply the cointegration tests to the Japan's government expenditures and government revenues.

Before applying the cointegration tests, we first examined the hypothesis that both real government expenditures and real government revenues have a unit root.[4] We applied the unit root test of Phillips and Perron (1986) to the log of real government expenditures and to the log of real government revenues. The estimation periods in Japan are from 1950 to 1992 for the postwar period and from 1885 to 1944 (or from 1885 to 1936) for the prewar period. For comparison, we also estimated (8) by using the U.S. data from 1950 to 1992.[5] Table 2 shows the test results. For all cases, the test cannot reject the hypothesis that both real government expenditures and revenues have a unit root.

TABLE 2

$Z(\alpha^*)$		
$l=1$	$l=2$	$l=4$
Japan		
Sample period: 1885–1944		
G		
2.33	2.66	3.11
R		
−1.09	−1.00	−1.10
R+Seigniorage		
0.19	0.55	0.49
Sample period: 1885–1936		
G		
−5.31	−4.74	−4.12
R		
−3.26	−3.10	−3.13
R+Seigniorage		
−3.66	−3.19	−3.27
Japan		
Sample period: 1965–1992		
G		
−1.50	−1.51	−1.50
R		
−1.13	−1.12	−1.03
R+Seigniorage		
−1.70	−1.66	−1.50

[4] In the following analysis, all data were deflated by the GDP deflator.
[5] See footnotes of Table 2 for data sources.

TABLE 2
(continued)

	$Z(a^*)$	
$l=1$	$l=2$	$l=4$
United States		
Sample period: 1950–1992		
G		
−1.28	−1.25	−1.09
R		
−2.20	−2.17	−2.10
R+Seigniorage		
−3.41	−3.43	−3.35

Notes:
$Z(a^*)$ denotes the Phillips-Perron (1986) statistic. The null hypothesis is that the variable has a unit root.
l is lag the length in the Newey-West estimator. See Perron (1988).
Seigniorage$=(M_t-M_{t-1})/p_t$, where $p=$GNP deflator, $M=$ cash currency for the prewar periods; high powered money for the postwar periods.
Data Sources:
M: Asakura and Nishiyama, *Nihonkeizai no Kaheiteki Bunseki (A Monetary Analysis and History of the Japanese Economy)*, Sobunsya, 1974; *Keizai Tokei Nenpo (Economic Statistics Annual)*, various issues (Japan). *Federal Reserve Bulletin*, various issues (US).
See also footnotes of Table 1.

Hence, assuming the existence of unit roots, we next tested the hypothesis that the log of real government expenditures is cointegrated with the log of real government revenues. As the first step, we applied a standard cointegration method without any structural break during the sample periods. Table 3 reports the estimation results. First, for the postwar U.S. economy, we can reject the hypothesis that the log of real government expenditures is not cointegrated with the log of real government revenues. This result may imply that an ambiguous result in our Hamilton-Flaivn should be interpreted as rejecting the hypothesis of no intertemporal budget balance. Second, we cannot reject the hypothesis that the log of real government expenditures is not cointegrated with the log of real government revenues in the prewar Japanese economy. This result is consistent with our results of Hamilton-Flavin test, supporting the hypothesis of no intertemporal budget balance in the prewar Japanese economy. Third, we cannot reject the hypothesis that the log of real government expenditures is not cointegrated with the log of real government revenues for the postwar Japanese economy.

The third result is not only inconsistent with our results in the last section, but also implies that the current budget deficit in Japan is more serious than that in the United States. This is less intuitive and might be caused by a methodological problem in the cointegration test which did not take into account the existence of a structural break. Hence, we next reconsidered the result of this cointegration test by allowing for a structural break. In the previous literature, Perron (1990) has shown that a standard unit root test may lead to the opposite conclusion if there is a structural break in the sample period. Since the above

TABLE 3

$Z(\alpha^*)$		
$l=1$	$l=2$	$l=4$
Japan		
Sample period: 1885–1944		
Between G and R		
−11.28	−9.99	−9.19
Between G and R+Seigniorage		
−17.35	−15.90	−17.65
Sample period: 1885–1936		
Between G and R		
−15.96	−14.74	−13.48
Between G and R+Seigniorage		
−17.79	−16.72	−18.11
Japan		
Sample period: 1965–1992		
Between G and R		
−4.77	−4.95	−5.38
Between G and R+Seigniorage		
−6.56	−6.75	−6.75
United States		
Sample period: 1950–1992		
Between G and R		
−27.73**	−26.13**	−23.01**
Between G and R+Seigniorage		
−25.78**	−24.68**	−22.04**

Notes:
$Z(\alpha^*)$ denotes the Phillips-Ouliaris (1990) statistic. The null hypothesis is that two variables are not co-integrated.
Asterisks denote significance levels: **5%, *10%.
See also foottnoes of Table 2.

cointegration test is based on a standard unit root test, it is quite possible that a structural break in the postwar Japan's fiscal policy might have led to the wrong conclusion in the above analysis.

In Japan, there have been several institutional changes of public debt issues since World War II. In particular, it was after 1975 that both construction and deficit public debts were issued.[6] Thus, when executing the cointegration test, we had better take into account the existence of a structural break in 1975. Applying the method of Perron (1990), we examined whether the accumulated budget deficit is still stationary even after excluding the effects of the structural break in 1975.

Table 4 shows the estimation results. In the table, the t-statistics can reject the hypothesis that the log of real government expenditures is not cointegrated with the log of real government revenues in the postwar Japanese economy. This implies that once we allowed for the existence of a structural break in Japan's fiscal policy, the cointegration test yields no indication that government debt tends to be growing forever in postwar Japan.

[6] In postwar Japan, no public debt issue was not permitted before 1964; Only construction public debt was issued between 1965 and 1974. See, for example, Asako et al. (1991) for details.

TABLE 4

Sample period: 1965–1992	$l=1$	$l=2$	$l=4$
		$T(a-1)$	
(1)	−23.55	−22.92	−20.98
		t_a	
(1)	−4.35**	−4.12**	−3.36*
		$T(a-1)$	
(2)	−23.50	−22.87	−20.96
		t_a	
(2)	−4.32**	−4.10**	−3.35*

Notes:

$T(a-1)$ and t_a in (1) are the statistics of the Perron's (1989) unit root test on $u=\log R-\log G$. $T(a-1)$ and t_a in (2) are those on the residuals u estimated by the equation: $\log R=const.+\beta\log G+u$.

The null hypothesis is that $u_t=\mu+u_{t-1}+d(TB_t)+(\mu_2-\mu_1)\times(DU_t)+e_t$, where $TB_t=1$ if $t=T_B+1$, otherwise 0; $DU_t=1$ if $t>T_B$, otherwise 0. Hence, T_B refers to the time of break. The alternative hypothesis is that $u_t=\mu+\beta_1 t+(\mu_2-\mu_1)(DU_t)+(\beta_2-\beta_1)(DT_t)+e_t$, where $DT_t=t$ if $t>T_B$, otherwise 0. We assume that a one-time change in structure occurred at 1975.

Asterisks denote significance levels: **5%, *10%.

See also footnotes of Table 3.

V. *Conclusion*

This paper empirically investigated whether the Japan's central government could run a budget deficit forever in Japan before and after World War II. The results showed that both the Hamilton-Flavin test and the modified cointegration test were consistent with the sustainability of the Japan's budget deficit after World War II. However, when we used the data before World War II, neither tests could support the hypothesis of the sustainability in the Japan's budget deficit. The results were less ambiguous than what was found for the U.S. budget deficits in previous studies.

In the 1980s, the sustainability of the Japan's budget deficit came into one of hot policy issues because the accumulated deficit became huge. Our empirical results, however, indicate that this huge deficit is still sustainable at the current stage and that the current public debt will eventually be paid off in the future.

HITOTSUBASHI UNIVERSITY AND KYOTO UNIVERSITY

REFERENCES

Asako, Kazumi, Takatoshi Ito, and Kazunori Sakamoto (1991), "The Rise and Fall of Deficit in Japan, 1965–1990," *Journal of Japanese and International Economies* 5, pp. 451–472.

Flood, Robert P., and Peter M. Garber (1980), "Market Fundamentals Versus Price Level Bubbles: The First Tests," *Journal of Political Economy* 88, pp. 745–770.

Hakkio, Craig S., and Mark Rush (1991), "Is the Budget Deficit 'Too Large?' " *Economic Inquiry* 24, pp. 429–445.

Hamilton, James D. and Marjorie A. Flavin (1986), "On the Limitations of Government Borrowing: A Framework for Empirical Testing," *American Economic Review* 76, pp. 808–816.

Kremer Jereon M. (1989), "U.S. Federal Indebtedness and the Conduct of Fiscal Policy," *Journal of Monetary Economics* 23, pp. 219–238.

Perron, Pierre (1988), "Trends and Random Walks in Macroeconomic Time Series: Further Evidence from a New Approach," *Journal of Economic Dynamics and Control* 12, pp. 297–332.

Perron, Pierre (1989), "The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis," *Economerica* 57, pp. 1361–1402.

Phillips, Peter C.B., and Sam Oulialis (1990), "Asymptotic Properties of Residuals Based Tests for Cointegration," *Economerica* 58, pp. 165–193.

Phillips, Peter C.B., and Pierre Perron (1988), "Testing for a Unit Root in Time Series Regression," *Biometrica* 75, pp. 335–346.

Trehan, Bharat and Carl E. Walsh (1988), "Common Trends, the Government Budget Constraint, and Revenue Smoothing," *Journal of Economic Dynamics and Control* 12, pp. 425–446.

Trehan, Bharat and Carl E. Walsh (1991), "Testing Intertemporal Budget Constraints: Theory and Applications to U.S. Federal Budget and Current Account Deficits," *Journal of Money Credit and Banking* 23, pp. 206–223.

Wilcox, David W. (1989), "The Sustainability of Government Deficits: Implications of the Present-Value Borrowing Constraint," *Journal of Money Credit and Banking* 21, pp. 291–306.