Why the saving rate has been falling in Japan

Azuma, Yoshiaki and Nakao, Takeo

January 2009

Why the saving rate has been falling in Japan

Yoshiaki Azuma* and Takeo Nakao
(Faculty of Economics, Doshisha University)

Abstract

The paper estimates Japan's household saving rate function for the 1958–1998 period. We find that the contribution of the increase in net financial assets to the fall of the saving rate varies directly with the amount of assets. This has overwhelmed other factors and has caused the saving rate to fall since 1976.

Key words : Japan's Household Saving Rate, Income and Financial Assets, Aging of Population, Cointegration Analysis
JEL classification numbers : E 21, C 22

I. Introduction

Japan's post-war household saving rate rose until the middle of the 1970s, and then has been falling. In order to explain these phenomena, we analyze the determinants of Japan's household saving rate using National Income Accounts data for the 1958–1998 period. This research was originally motivated by the prolonged slump of the Japanese economy since 1990s. The high saving ratio that had been an engine to economic growth has now become the major cause of the prolonged slump.[1] Thus the downward trend that we have now observed in Japan's saving rate could work as a remedy for the slump. The matter in question is whether this downward trend will persist or not. From this view point it is more important than ever to explain why the saving rate has been falling in Japan.

A theoretical prediction of the Life Cycle hypothesis is that the saving rate falls either as the household wealth rises or the population ages, or both. Thus theory alone cannot answer specifically why the saving rate has been falling in Japan. In recent empirical studies the negative impact of an aging population on the saving rate has attracted attention (e.g., Horioka(1997)). We agree that an aging population must be one of the factors that contributes to the decline in the saving rate. However we feel that household saving rate may have already started to fall before the onset of an aging population.

To clarify this point we first estimate Japan's household saving rate function using cointegration analysis. According to the Life Cycle hypothesis we consider disposable income, net financial assets,

*Corresponding author : yazuma@mail.doshisha.ac.jp

and the proportion of non-working population, which is highly correlated with an aging population.[2] Then we use the estimates to calculate the contribution ratios of each explanatory variable to the change in the saving rate. In calculating the contribution ratios we divide the whole sample into the 1958–1976 period, in which the saving rate had risen, and the 1976–1998 period, in which the saving rate has been falling.

The main results are summarized as follows.

- An increase in household disposable income has a direct effect, and an increase in household net financial assets has an inverse effect on the saving rate during the whole 1958–1998 period.
- More importantly, the contribution of net financial assets to the change in the saving rate varies directly with the amount of assets, that is, the higher the amount of household net financial assets, the higher the contribution to the saving rate.
- The proportion of non-working population has an inverse effect on the saving rate, but the contribution is minor compared with either disposable income or net financial assets.

These empirical findings suggest the following explanation for the hump-shaped pattern of Japan's post-war household saving rate: *although an increase in household disposable income has had a positive and significant impact on household saving rate, household net financial assets have become so large that the saving rate has been falling since 1976.*

The remainder of the paper is organized as follows. Section II below explains the data. Section III summarizes the results of the cointegration analysis. Section IV shows the contribution ratios and concludes by explaining why the saving rate has been falling in Japan. Appendix uses alternative measure of assets to check the robustness of our finding summarized in section IV.

II. Data

We use calendar year data for the 1958–1998 period. A household saving rate (SHR) is defined as SH/YD, where SH and YD are the saving and the disposable income, respectively, of households, including private unincorporated non-financial enterprises.[3] As a measure of assets we use the closing balance-sheet account of households, including private unincorporated non-financial enterprises and private non-profit institutions serving households. From this account we take net financial assets (FA), net fixed assets (H) and land (L). FA is defined as financial assets minus liabilities and H consists of mainly residential buildings. SH, YD, FA, H and L are all real magnitude(1985＝100) converted using the price deflator for private final consumption expenditure. All the data above are taken from 68 SNA, "Annual Report on National Accounts."[4] We also use the ratio of working population (LPM), which is defined as the ratio of working male population to total male population of age greater than

15. The remaining fraction is positively and highly correlated with population aging.[5]

III. Cointegration analysis

Studies in empirical macroeconomics almost always involve nonstationary variables, which causes, as revealed by Granger and Newbold(1974), a problem of spurious regressions : conventional linear regression, ignoring serial correlation, of one random walk on another is virtually certain to suggest a significant relationship, even if the two are, in fact, independent. To deal with this problem, we use cointegration analysis that consists of unit root tests, cointegration tests, and the estimation of error correction model.

As Engle and Granger(1987) showed, cointegration is a particularly appropriate way to deal with this problem. Suppose that two nonstationary sequences are cointegrated, namely, they are integrated of the same order and the residual sequence is stationary. In this case, even if the two variables are nonstationary, the model represents a long-run relationship between these two variables. A short-run adjustment process from the long-run relationship is also derived by taking the residual from the model of cointegration and by using it as "error correction" terms in the dynamic first-difference equation. This model is called an error correction model.

Our interest is to analyze the long-run relationship between the saving rate and its explanatory variables. As shown in the Granger representation theorem, however, the same assumption that we make to produce the cointegration implies and is implied by the existence of an error correction model.[6] Thus we will also show the results of error correction model in Step 3.

Step 1 : Unit root tests

The first step of the cointegration analysis is to examine the time-series properties of the data. Specifically we conduct several unit root tests to see if all variables have unit roots in their levels and are stationary in their first differences. In table 1 we summarize the results (p-values in parentheses) on the augmented Dickey-Fuller test [Dickey and Fuller(1979)], which is the most widely used, the augmented Weighted Symmetric Tau test [Pantula, Gonzalez-Farias and Fuller(1994)], which is the most powerful, and the Phillips-Perron test [Phillips and Perron(1988)]. In this table p-values are in parentheses and the first differences are expressed by adding △ to the top of the variable names. All these tests include constant term and trend as explanatory variables. Taking first differences of SHR, YD, FA and LPM produces stationary processes, meaning that all these variables are integrated of order one, denoted by I(1). At the p-value of p＝0.05, we see that, although H is close to being an I(1) variable, it fails the test in every case. Therefore we have treated H, as well as L, as a non-I(1) vari-

Table 1 Tau-Values in the Unit Root Tests
(A) Level

	SHR	LPM	YD	FA	H	L
Wtd. Sym.	−1.14	−1.80	−0.88	−1.21	−0.52	−2.19
	(0.95)	(0.76)	(0.98)	(0.95)	(0.99)	(0.51)
Dickey-F	−1.71	−2.28	−2.33	−2.14	−1.52	−2.78
	(0.74)	(0.44)	(0.41)	(0.51)	(0.82)	(0.20)
Phillips	−4.64	−6.58	−6.00	−4.87	−6.35	−7.34
	(0.84)	(0.69)	(0.74)	(0.83)	(0.71)	(0.63)

(B) First Differences

	△SHR	△LPM	△YD	△FA	△H	△L
Wtd. Sym.	−3.06	−3.44	−3.04	−3.80	−2.70	−2.27
	(0.07)	(0.02)	(0.07)	(0.00)	(0.18)	(0.44)
Dickey-F	−2.77	−3.50	−3.91	−3.49	−2.56	−1.95
	(0.20)	(0.03)	(0.01)	(0.03)	(0.29)	(0.62)
Phillips	−39.47	−23.05	−14.66	−35.77	−20.38	−12.95
	(0.00)	(0.03)	(0.19)	(0.00)	(0.06)	(0.26)

able.

Step 2 : Cointegration tests and the estimation of the saving rate function

The next step of the cointegration analysis is to test whether these I(1) variables are cointegrated. For that purpose we obtain an estimate using the cointegration regression suggested by Engle and Granger(1987). This simply means to estimate household saving rate function using the method of ordinary least squares. Given that all variables are I(1), if the error terms are stationary, then the variables are cointegrated. In this case the estimation result shown in equation (1) is stable in the long-run and could be interpreted as a model for household saving rate. Notice that, although t-values are reported in parentheses, we have to be careful in applying t-tests because the residual variance is not finite.

$$
\text{(1)}\quad \underset{(-1.94)}{SHR = -47.00} + \underset{(9.32)}{0.98\,YD} - \underset{(-10.97)}{0.33\,FA} + \underset{(2.33)}{0.66\,LPM},
$$

Adjusted $R^2 = 0.777$, and CRDW$= 0.87$.

Banerjee, Dolado, Hendry and Smith(1986) [pp. 259–62] showed that, although the estimated coefficients have large biases when the data sample is small, the bias in the coefficients as a whole becomes small if adjusted R^2 is large. In case that the adjusted R^2 might be small in this estimation, we show in appendix an alternative estimation in which we replace net financial assets with the balance of postal savings and add some other explanatory variables to obtain cointegrated combination of variables. In that estimation the adjusted R^2 is 0.875 and the main results of the paper still holds. Hence we assure the small bias in the estimated coefficients.

CRDW is the Cointegration Regression Durbin−Watson statistic introduced by Sargan and Bhargava(1983). The critical value of 1% level for cointegration is about 0.51, and thus the reported CRDW value of 0.87 indicates the existence of cointegration. We also performed the cointegration test proposed by Engle and Granger(1987). For the existence of cointegration, p-value should be more than 0.1, and the actual p-value is 0.63. The most useful cointegration test is the trace test in the maximum likelihood procedure developed by Johansen(1988) and Johansen and Juselius(1990). Table 2 summarizes the test result in which r denotes the number of cointegrating vectors. This table shows that the hypothesis that there is one cointegrating vector or less ($r \leqq 1$) is not rejected, whereas we can safely reject the hypothesis that there is no cointegrating vector where $r=0$. Hence we conclude that there is a unique cointegrating vector and that equation (1) represents this cointegrating vector.

Table 2　Johansen's Maximum Likelihood Trace Test

Hypothesis	r＝0	r≦1	r≦2	r≦3
Trace	80.54	18.36	9.83	3.11
P-value	(0.00)	(0.74)	(0.48)	(0.07)

Step 3 : The estimation of error correction model

Our interest is to analyze the long-run relationship between the saving rate and its explanatory variables. As shown in the Granger representation theorem, however, the same assumption that we make to produce the cointegration implies and is implied by the existence of an error correction model, which is supposed to express the short-run adjustment process.[7] As one of the explanatory variables, the error correction model has a one-period lagged residual (RES_[t−1]) taken from equation (1).[8] In deciding the specification of error correction model we use a t-test. Note that, although we cannot use a standard t-test for RES_{t-1}, Hendry(1986) shows that t-value is still applicable for RES_{t-1} and the critical value is about 3 in absolute value. In addition, the coefficient of the residual term should be negative and larger than −1. The estimated result shown in equation (2) satisfies all of these conditions.[9]

$$\text{(2)}\ \Delta SHR_t = +\underset{(2.82)}{0.43}\,\Delta SHR_{t-1} + \underset{(3.20)}{0.41}\,\Delta SHR_{t-3} + \underset{(2.08)}{0.29}\,\Delta SHR_{t-4}$$

$$+\underset{(2.25)}{0.11}\,\Delta FA_{t-2} + \underset{(3.74)}{1.90}\,\Delta LPM - \underset{(-3.37)}{2.10}\,\Delta LPM_{t-1} + \underset{(2.66)}{1.36}\,\Delta LPM_{t-1} - \underset{(-3.90)}{0.54}\,RES_{t-1},$$

$R^2=0.55$, and Adjusted $R^2=0.45$.

IV. Summary and conclusion : why the saving rate has been falling

We observe that Japan's household saving rate rose until the middle of the 1970s, and then has been falling. The estimation result in equation (1) clarifies the factors that affect the saving rate but it does not by itself explain the rise and fall of the saving rate. Thus we use the estimation result in equation (1) to calculate the contribution ratios of each explanatory variable to the change in the saving rate. Table 3 summarizes the results. Note that, in calculating the contribution ratios, we divide the whole sample into the 1958–1976 period, in which the saving rate was rising, and the 1976–1998 period, in which the saving rate was falling (as it has continued to fall to date). Also note that, when the adjusted R^2 is not large enough, the contribution ratios calculated using the fitted values of the saving rate might not properly explain the actual change in the saving rate. Thus, in parentheses, we also replace the fitted value of the saving rate with the actual value.

Table 3 Contribution Ratios

	YD	FA	LPM	SUM
1958–1976	2.29(1.27)	−0.88(−0.49)	−0.41(−0.22)	1.00(0.55)
1976–1998	1.56(1.28)	−2.24(−1.84)	−0.31(−0.25)	−1.00(−0.81)

Table 3 suggests the following explanation for the hump-shaped pattern of Japan's post-war household saving rate. The rise in household disposable income during the 1958–1976 period contributed greatly to the rise of the saving rate, overwhelming the negative effects of the rise of net financial assets. However, during the 1976–1998 period, the positive effect of the disposable income was still strong, but was more than offset by the strong negative effect of rising net financial assets. The key finding here is that the contribution of the increase in net financial assets to the fall of the saving rate varies directly with the amount of assets, that is, the higher the amount of household net financial assets, the higher the contribution to the fall of the saving rate. Table 3 also clarifies that the contribution of the aging population to the fall of the saving rate is minor compared with either disposable income or net financial assets.

Appendix

In this appendix we show an alternative estimation in which adjusted R^2 is much higher but a narrower measure of financial assets is used. Specifically we use the balance of the postal savings as a measure of financial assets.[10] Data on the postal deposit of households are taken from "Monthly Statistics on Postal Services" compiled by Ministry of Posts and Telecommunications.

In this estimation we consider two more explanatory variables： an unemployment rate and a real interest rate. We consider an unemployment rate as a proxy for liquidity constraints in an aggregate consumption function.[11] A high unemployment rate decreases the chance of getting new jobs with higher wages and increases the possibility of being fired. Since both of these effects result in a lower expected future income, people would increase their saving for future consumption.[12] If this channel is not negligible, then an increasing unemployment rate after the collapse of the bubble economy has had an adverse effect on the downward trend of the saving rate. As for a real interest rate, an intertemporal choice of a rational consumer between consumption and saving as well as the Life Cycle hypothesis implies that the effect of the real interest rate on the saving rate depends on the magnitude of both income effects and substitution effects.

As for data, unemployment rate (U) is defined as the ratio of totally unemployed persons to the labor force. The data on both the ratio of non-working male persons to total male population with age larger than 15 and the ratio of totally unemployed persons to the labor force are taken from "Monthly Report on the Labor Force Survey" by the Statistic Bureau, Management and Coordination Agency. Real interest rate (R) is defined as nominal interest rate minus inflation rate. The provisional dividend rate of loan trust (5 years) is used as the nominal interest rate and is taken from "Economic Statistics Annual." The inflation rate is measured as the rate of change in the price deflator for private final consumption expenditure.

We use calendar year data for the 1957–1997 periods. The results of unit root tests are reported in

Table A 1　Tau-Values in the Unit Root Tests
(A) Level

	SHR	YD	PS	LPM	U	R
Wtd. Sym.	−1.06	−1.12	1.43	−1.37	−2.47	−1.87
	(0.96)	(0.96)	(0.99)	(0.92)	(0.30)	(0.73)
Dickey-F	−1.58	−2.27	−0.01	−2.82	−3.07	−2.36
	(0.79)	(0.44)	(0.99)	(0.18)	(0.11)	(0.39)
Phillips	−4.18	−6.20	0.16	−6.79	−8.19	−13.49
	(0.87)	(0.72)	(0.99)	(0.68)	(0.56)	(0.24)

(B) First Differences

	△SHR	△YD	△PS	△LPM	△U	△R
Wtd. Sym.	−3.12	−2.82	−3.56	−3.57	−3.14	−4.15
	(0.05)	(0.13)	(0.01)	(0.01)	(0.05)	(0.00)
Dickey-F	−2.85	−3.80	−3.24	−3.60	−3.04	−3.86
	(0.17)	(0.01)	(0.07)	(0.02)	(0.11)	(0.01)
Phillips	−38.31	−15.24	−37.22	−22.42	−24.60	−42.43
	(0.00)	(0.17)	(0.00)	(0.04)	(0.02)	(0.00)

table A 1, which shows that all variables are I(1).

An alternative estimation to equation (1) is as follows.

$$\text{(A 1)}\ SHR = -\underset{(-1.65)}{34.50} + \underset{(7.46)}{0.79}\ YD - \underset{(-11.09)}{0.12}\ PS + \underset{(2.01)}{0.49}\ LPM + \underset{(4.26)}{2.39}\ U - \underset{(-4.83)}{0.36}\ R,$$

Adjusted $R^2 = 0.875$, and CRDW $= 1.17$.

Table A 2 shows the trace test in the maximum likelihood procedure developed by Johansen(1988) and Johansen and Juselius(1990). In table A 2 we can safely reject the hypothesis that there is no co-integrating vector, implying that equation (A 1) represents a cointegrating vector.

Table A 2 Johansen's Maximum Likelihood Trace Test

Hypothesis	r=0	r≦1	r≦2	r≦3	r≦4	r≦5
Trace	110.02	63.85	39.65	16.23	5.26	0.03
P-value	(0.02)	(0.35)	(0.48)	(0.83)	(0.82)	(0.62)

Table A 3 shows the contribution ratios of each explanatory variable to the change in the saving rate. These results are consistent with our main results summarized in section IV.

Table A 3 Contribution Ratios

	YD	PS	LPM	U	R	SUM
1958–1976	1.40	–0.59	–0.22	0.00	0.41	1.00
1976–1997	1.03	–2.12	–0.16	0.33	–0.07	–1.00

An estimation of an error correction model is shown in equation (A 2). Since the residual term is statistically significant, negative, and larger than –1, the equation (A 1) is likely to be a valid cointegrating vector.

$$\text{(A 2)}\ \triangle SHR_t = -\underset{(-2.42)}{0.26}\ \triangle SHR_{t-3} + \underset{(4.35)}{0.49}\ \triangle SHR_{t-4} + \underset{(3.73)}{1.40}\ \triangle YD_{t-3} - \underset{(-3.36)}{1.55}\ \triangle YD_{t-4}$$

$$-\underset{(-1.88)}{0.053}\ \triangle W_{t-4} + \underset{(4.52)}{1.42}\ \triangle LPM - \underset{(-4.79)}{1.54}\ \triangle LPM_{t-1} + \underset{(3.81)}{1.46}\ \triangle LPM_{t-3} - \underset{(-3.91)}{1.50}\ \triangle LPM_{t-4}$$

$$+\underset{(3.95)}{3.09}\ \triangle U + \underset{(3.39)}{1.80}\ \triangle U_{t-3} - \underset{(-3.34)}{1.80}\ \triangle U_{t-4} - \underset{(-5.96)}{0.26}\ \triangle R - \underset{(-4.63)}{0.26}\ \triangle R_{t-3} - \underset{(-4.23)}{0.64}\ RES_{t-1},$$

$R^2 = 0.88$, and Adjusted $R^2 = 0.80$.

ACKNOWLEDGMENT

We are grateful to Charles Horioka for valuable comments on earlier drafts. We also benefited from discussions with conference participants in the spring 2004 meetings of the Japanese Economic Association. We also acknowledge financial support from the "Academic Frontier" Project, 2004–2008, by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) and from a special research grant for the promotion of the advancement of education and research in graduate schools provided in 2004 by MEXT and the Promotion and Mutual Aid Corporation for Private Schools of Japan.

Notes

1 Adjusting to a number of conceptual differences and deficiencies in Japan's National Accounts data, we observe a substantial reduction of Japan's household saving rate. Even so Japan's household saving rate is relatively higher than the comparable U.S. saving rate. This result obtains however the aggregate saving rate is defined. See Hayashi(1986, 1997) for detail.

2 In appendix we also consider an unemployment rate and a real interest rate. There are many other factors that might explain the behavior of Japan's aggregate household saving rate. Cigno and Rosati(1997), for example, finds that, for a given number of people covered, an increase in the average pension level reduces saving in Japan. See Horioka(1992) for a theoretical discussion of a variety of factors that may influence on the downward trend of Japan's household saving rate.

3 We use household disposable income as an income measure. In lieu of household disposable income, household labor income might be preferable if household total wealth is included as a separate explanatory variable. It is because household disposable income includes capital income accruing to household total wealth. Horioka(1996) uses both measures and obtains qualitatively similar results on household consumption function.

4 The data on Japan's household saving rate is also available from "household surveys." The consistency of the data between "National Income Accounts" and "household surveys", however, is still an ongoing issue. See, for example, Hayashi(1992) for more discussion.

5 Alternatives to the ratio of non-working population such as the sum of the population under the age of 20 and over the age of 60, which we call the number of population not in labor force, or such as the population over the age of 60, which we call an aging population, are not I(1) variables. Using the data from 1960 to 1997, however, we show that the correlation between LPM and the number of population not in labor force is −0.94. The correlation between LPM and an aging population is −0.90. Besides, if the data on female workers are included in LPM, the correlations fall to −0.73 and −0.65 respectively. In Japan there is a substantial fraction of female workers who work as part-timers and thus we conjecture that the labor force participation rate of female workers has not been stable.

6 For the detail of the Granger representation theorem see Engle and Granger(1987).

7 As shown by Salmon(1982) and Nickell(1985), the error correction model can be derived from the intertemporal optimization behavior of consumers if we assume the existence of adjustment costs and/or imperfect information.

8 If the long-run relationship in equation (1) represents a valid cointegrating vector, then RES_{t-1} shows what proportion of the disequilibrium in household saving rate is corrected in the next period.

9 The general form of the error correction model, when four lags of each explanatory variable are taken from equation(1), is

$$\triangle SHR_t = \Sigma_{i=1}\beta_i \triangle SHR_{t-i} + \Sigma_{i=0}\alpha_{1i}\triangle YD_{t-i} + \Sigma_{i=0}\alpha_{2i}\triangle FA_{t-i} + \Sigma_{i=0}\alpha_{3i}\triangle LPM_{t-i} + \gamma RES_{t-i}.$$

10 From 1964 to 1998, the data for personally held total financial assets including postal savings are available from the stock data in Flow of Funds Accounts Based on 68 SNA compiled by the Bank of Japan. Using these data we show that the correlation between postal savings and total financial assets including postal savings is 0.99. This result implies that, during this period, postal savings are good proxy for total financial assets held by household.

11 See Flavin(1985) and Craigwell and Rock(1995) for the related empirical analyses.

12 A higher unemployment rate not only lowers the expected future income but also raises the variance of the future income. Hence a higher unemployment rate may increase the saving rate by precautionary saving motive.

Reference

Banerjee, A., Dolado, J. J., Hendry, D. E., Smith, G. W., 1986. Exploring Equilibrium Relationships in Econometrics through Static Models : Some Monte Carlo Evidence. Oxford Bulletin of Economics and Statistics 48, 253–77

Cigno, A., Rosati, F. C., 1997. Rise and fall of the Japanese saving rate : The role of social security and intra-family transfers. Japan and the World Economy 9, 81–92

Craigwell, R. C., Rock, L. L., 1995. An aggregate consumption function for Canada : a cointegration approach. Applied Economics 27, 239–249

Dickey, D. A., Fuller, W. A., 1979. Distribution of the Estimators for Autoregressive Time Series With a Unit Root. Journal of the American Statistical Association 74, 427–431

Engle, R. F., Granger, C. W. J., 1987. Co-Integration and Error Correction : Representation, Estimation, and Testing. Econometrica 55, 251–276

Flavin, M., 1985. Excess Sensitivity of Consumption to Current Income : Liquidity Constraints or Myopia? The Canadian Journal of Economics / Revue canadienne d'Economique 18, 117–136

Granger, C. W. J., Newbold, P., 1974. Spurious regressions in econometrics. Journal of Econometrics 2, 111–120

Hayashi, F., 1986. Why Is Japan's Saving Rate So Apparently High? NBER Macroeconomics Annual 1, 147–210

Hayashi, F., 1992. Explaining Japan's Saving : A Review of Recent Literature. Monetary and Economic Studies (Bank of Japan) 10, 63–78

Hayashi, F., 1997. Understanding Saving : Evidence from the U. S. and Japan. MIT Press.

Hendry, D. F., 1986. Econometric Modelling with Cointegrated Variables : An Overview. Oxford Bulletin of Economics and Statistics 48, 201–12

Horioka, C. Y., 1992. Future trends in Japan's saving rate and the implications thereof for Japan's external imbalance. Japan and the World Economy 3, 307–330

Horioka, C. Y., 1996. Capital Gains in Japan : Their Magnitude and Impact on Consumption. The Economic Journal 106, 560–577

Horioka, C. Y., 1997. A Cointegration Analysis of the Impact of the Age Structure of the Population on the Household Saving Rate in Japan. The Review of Economics and Statistics 79, 511–516

Johansen, S., 1988. Statistical analysis of cointegration vectors. Journal of Economic Dynamics and Control 12, 231–254

Johansen, S., Juselius, K., 1990. Maximum Likelihood Estimation and Inference on Cointegration––With Applications to the Demand for Money. Oxford Bulletin of Economics and Statistics 52, 169–210

Nickell, S., 1985. Error Correction, Partial Adjustment and All That : An Expository Note. Oxford Bulletin of Economics and Statistics 47, 119–29

Pantula, S. G., Gonzalez-Farias, G., Fuller, W. A., 1994. A Comparison of Unit-Root Test Criteria. Journal of Business & Economic Statistics 12, 449–459

Phillips, P. C. B., Perron, P., 1988. Testing for a unit root in time series regression. Biometrika 75, 335–346

Salmon, M., 1982. Error Correction Mechanisms. The Economic Journal 92, 615–629

Sargan, J. D., Bhargava, A., 1983. Testing Residuals from Least Squares Regression for Being Generated by the Gaussian Random Walk. Econometrica 51, 153–174