# The Long-Run Relation Between The Personal Savings Rate And Consumer Sentiment

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*This study examined the long run relationship between the personal savings rate and the index of consumer sentiment in the United States over the 1959-1997 period using cointegration analysis. We find that consumer sentiment and the personal savings rate share a long run equilibrium. The results suggest that households reduce their savings rate when consumer sentiment is high, but the two variables do not drift arbitrarily far apart. The results have implications for long term savings plans and are particularly important for financial counselors and planners.*

Key Words: *Saving, Economic well-being, Economic model*

From a financial planner's point of view, the importance of understanding household behavior as it pertains to personal savings cannot be understated. Most clients of financial advisers have in mind some long term savings goals such as retirement, a child's college tuition, or purchase of a second home. The ability to save today and/or set up a plan to save over a long horizon depends, in part, on the economic outlook for the individual saver (van Raaij & Gianotten, 1990). To at least some extent, current consumer sentiment reflects future expectations of economic prosperity and well-being (Matsusaka & Sbordone, 1995). Thus, it is quite natural to be concerned with the long run relationship between consumer sentiment and the personal savings rate. This study examines the long run relationship between the personal savings rate and the index of consumer sentiment in the United States over the 1959:01-1997:07 period. Given our focus on saving over a long horizon, we utilize recently developed cointegration analysis, a technique that is specifically designed to examine long run relationships.

One reason that consumer sentiment and personal savings might be related is based on the notion that household actions today may be in response to what they expect to happen to them in the future. Milton Friedman (1983) suggested that when conditions are such that there is greater uncertainty about the future course of the economy, people will tend to hold more of their financial assets in the form of money, as it is a very liquid asset. For a given amount of household assets, a shift into money will reduce the proportion of financial assets that are held in conventional savings and lower the percentage of wealth that is allocated to personal savings.

On the other hand, if uncertainty about the course of the future is reflected in consumer sentiment today, then an increase (decrease) in consumer sentiment (i.e., less uncertainty about one's personal economic future) may be associated with a lower (higher) personal savings rate, all else equal. For instance, people may postpone saving for the long term reasoning that "I'll be making a lot of money down the road, so I'll save later when I can afford it." Insight into the linkages between consumer sentiment and the personal savings rate can be gained by performing empirical tests.

The consumption and savings decisions of households are constrained by real disposable income. The life-cycle hypothesis of Ando and Modigliani (1963) and the permanent income hypothesis of Friedman (1957) relate current consumption, and therefore saving, not only to current disposable income but also to anticipated future income. A change in current income is predicted to have a greater impact on current consumption (and saving) if it is perceived as being permanent rather than temporary. In terms of the marginal propensity to save, these hypotheses imply that the marginal propensity to save is higher for income changes that are considered transitory in nature and lower for income changes that are considered permanent. Thus, both the life-cycle and permanent income hypotheses suggest that we should expect a stable long-run relationship between the index of consumer sentiment (a proxy for anticipated future

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income and/or economic well-being) and the personal savings rate.

Our results suggest that people behave such that when consumer sentiment is high (a reflection of future good times and prosperity), they reduce their savings rate. However, the two variables do not drift arbitrarily far apart. Consistent with both the life-cycle hypothesis and the permanent income hypothesis, we find that consumer sentiment and the personal savings rate are cointegrated, meaning that they share a long run equilibrium relation. This long run relationship holds when we control for real disposable income and the interest rate. As expected, a higher interest rate is associated with higher personal savings rates. An additional finding is that increases in real disposable income are associated with declines in the savings rate, suggesting that households may continue to save the same amount (e.g., they continue to budget $100 a month to savings) even when their real disposable income goes up. Personal financial counselors and planners need to be aware of this household saving behavior as the good times ahead that are reflected in higher current consumer sentiment do not always last or materialize. The paper proceeds by outlining past research, discussing the data and empirical methodology, presenting the results, and discussing implications for practitioners. Concluding remarks close the paper.

## Past Research

The impact and forecasting power of consumer sentiment (as well as consumer confidence) on spending and macroeconomic conditions has been examined by a number of researchers. Carroll, Fuhrer and Wilcox (1994) provided some evidence that consumer sentiment may help predict future changes in consumer spending. Matsusaka and Sbordane (1995) contended that consumer sentiment accounts for some of the fluctuations in aggregate economic activity. Fuhrer (1993) suggested that consumer sentiment contains very little information about what might happen to the economy in the future and primarily reflects current conditions. Throop (1992) argued that while consumer sentiment is most likely influenced by current conditions, it does provide useful information about future consumer expenditures. Earlier work on the forecasting ability of consumer sentiment and it's relationship with spending can be found in Angevine (1974) and Mishkin (1978). Issues pertaining to the measurement of consumer sentiment and expectations formation were addressed by van Raaij (1989) and van Raaij and Gianotten (1990).

Others have examined the determinants of personal savings and it's relationship with other economic variables. Bovenberg and Evans (1989) examined trends and measurement issues in personal savings, while Rogers (1990) discussed technical perspectives on measuring personal savings. Cullison (1990) provided a survey of literature which typically concludes that savings in the U.S. is quite low, but provides evidence that suggests it may not be as low as is popularly believed. Bunting (1991) argued that household savings depends more on the size and level of current income as opposed to lifecycle factors. Earlier studies on personal savings and its relationship with retirement, taxes, and growth were conducted by Apilado (1972), Feldstein (1978), and Sandmo (1981).

Surprisingly, the issue of whether or not consumer sentiment impacts savings rates has been neglected. None of the studies cited have used cointegration techniques which are specifically designed to yield insights into long run relationships between variables. This study examines financial and macroeconomic variables over time. Properly specifying regression models which utilize these types of data requires that the individual variables in question have certain properties. Each variable in the regression model should be a stationary series. A stationary series is one that has constant mean, variance, and covariance (i.e., these descriptive statistics do not depend on time). Several procedures, called unit root tests, exist to determine if these properties hold or not. Variables that are not stationary are called nonstationary. There are several reasons the univariate time series properties of the variables should be addressed. First, using nonstationary variables in a regression may lead to the problem of spurious regression, in which case the conclusions are suspect. A model that suffers from this problem may fail to produce similar results for even minor changes in the sample period. However, all is not lost if the variables are nonstationary. In fact, most financial and macroeconomic time series data are found to be nonstationary. In these cases, researchers typically compute the change in the variable, called the first-difference, and use this new variable in the regression. Of course, the unit root tests should be conducted on the first-differences of the variables to ensure that they are indeed stationary. Second, inferences can be drawn from the application of unit root tests as to the impact of shocks being permanent or transitory in nature. Furthermore, ignoring the possible cointegration among variables and, therefore, failing to correct the model for this multivariate property, may lead

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to the model being mis-specified. This paper specifically takes into account both the univariate and multivariate time series properties of the variables studied. The methodology employed provides insight into both the long-run and short-run relationship between the index of consumer sentiment and the personal savings rate.

## Data and Methodology

Granger (1986), Engle and Granger (1987), Engle and Yoo (1987), Johansen (1991), and Johansen and Juselius (1990) examined the causal relationship between variables when a common trend exists between them, and have emphasized the need to examine the time-series properties of variables used in financial research. Therefore, we begin by examining the time-series properties of the individual variables by conducting unit root tests. This study employs the augmented Dickey-Fuller (ADF) test to check for the presence of unit roots. Appendix A provides the details of this test.

Two or more nonstationary time series are said to be cointegrated if some linear combination of them is stationary. Tests for cointegration seek to discern whether or not a stable long-run relationship exists among such a set of variables. The existence of a common trend among the savings rate and consumer sentiment means that in the long run the behavior of the common trend will drive the behavior of the variables. Shocks that are unique to one time series will die out as the variables adjust back to their common trend. In the context of this study, a finding of cointegration would simply mean that the transmission mechanism between the personal savings rate and its determinants is stable, and thus more predictable over long periods. The Johansen-Jusleius (1990) cointegration test is used in this study. Appendix B provides details.

If cointegration is present among the series under consideration, then we will be interested in examining the following equation known as an error-correction model.

$$(1)\quad \Delta S_t = a + \Sigma_{i=1}^{m} b_i \Delta S_{t-i} + \Sigma_{j=1}^{n} c_j \Delta C_{t-j} + \Sigma_{k=1}^{p} c_k \Delta I_{t-k} + \Sigma_{s=1}^{q} c_s \Delta r_{t-s} + \eta u_{t-1} + e_t$$

where $S_t$ denotes the personal savings rate, $C_t$ denotes the index of consumer sentiment, $I_t$ denotes real disposable income, and $r_t$ denotes the interest rate.[a] P, C, and I are entered in natural logarithms. $u_{t-1}$ is the error correction term, which is the lagged residual series of the cointegrating vector. The error correction term measures deviations of the series from the long-run equilibrium relation, and $0 < \eta < 1$ in order for the series to converge to the long-run equilibrium relation. Cointegration implies that the error correction term coefficient should not be zero in the error-correction model. From equation (1) the null hypothesis that C (or one of the other independent variables) does not Granger-cause S is rejected not only if the coefficients on the lagged values of C are jointly significant, but also if the coefficient on the error correction term is significant. (Consumer sentiment is said to Granger-cause the personal savings rate if including in the regression past values of consumer sentiment in addition to past values of the personal savings rate improves the predictive power of the model.) Changes in an independent variable may be interpreted as representing the short run causal impact while the error correction term provides the adjustment of changes in C and S toward their respective long run equilibrium. Thus, the error correction model allows us to differentiate between short run dynamics and long run relationships.

Monthly data for the study are obtained from the Federal Reserve Bank of St. Louis Economic Database (FRED) for the 1959:01-1997:07 period.[b] The following data are used in this study: the University of Michigan's index of consumer sentiment, the personal savings rate,[c] the interest rate on one year Treasury bills with constant maturity, disposable personal income (in billions of dollars), and the consumer price index (CPI-U, all items). In the analyses that follow, the index of consumer sentiment is entered in natural logarithms. Real disposable income is computed by deflating disposable income using the consumer price index and is converted into natural logarithms for use in the study. Figure 1 displays a plot of the personal savings rate and consumer sentiment. A casual review of the graph suggests that the two variables may be related. In particular, for most instances when the index of consumer sentiment exhibits a pronounced downward spike, the personal savings rate appears to exhibit a corresponding spike in the opposite direction. Very generally speaking, it appears that for periods when consumer sentiment is rising the savings rate is falling (e.g., from 1992 on). Also, during periods of declining, or flat, consumer sentiment the personal savings rate is rising or also flat. It is interesting to speculate that if one were to "eyeball" a straight line through each series representing their respective trends or averages, it might very well be the case that each line was horizontal and therefore parallel to one another. This would be consistent with the notion that the two series do not drift arbitrarily far apart from each other and that they share a common trend.

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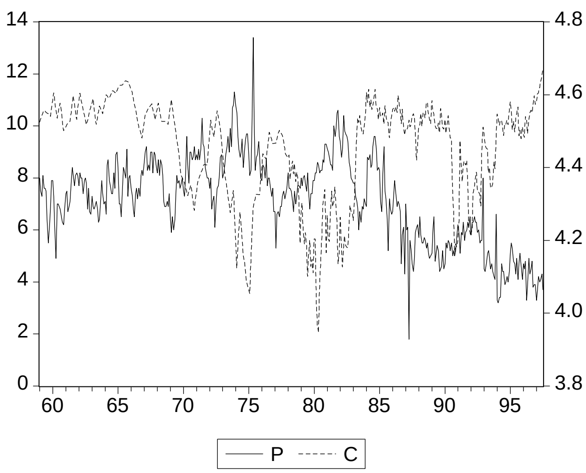
When two variables share a common trend or long run equilibrium relationship they are said to be cointegrated. However, it is also clear that the covariance between the two series is not perfect. The possibility of a predictable relationship leads us to examine the co-movements of the two variables further. The contemporaneous correlation between the index of consumer sentiment and the personal savings rate is -0.38. This is consistent with Carroll, et. al. (1994) who found that the index of consumer sentiment was positively correlated with spending which "does not refute traditional life-cycle or permanent-income models of consumption." Like Carrol, et. al. (1994), we are interested in the forecasting ability of consumer sentiment; however, our study differs from theirs, and others, in at least two distinct ways. First, we focus on the possibility of a predictable relationship between the savings rate and consumer sentiment. Second, we examine the long run co-movements of the variables using cointegration analysis.

**Figure 1**
Personal Savings Rate and Index of Consumer Sentiment




### Empirical Results

The Johansen-Juselius cointegration procedure discussed above is used to test for the presence of cointegration between $S_t$ and $C_t$, (and later we include real disposable income, $I_t$, and the interest rate, $r_t$, in the cointegration analysis). If the individual time series are integrated of the same order then one can proceed with the estimation of the cointegrating regression. Prior to conducting the cointegration analysis we tested for stationarity of the individual time series using the augmented Dickey-Fuller (ADF) test discussed previously. The results of the unit root tests for each of the variables used in this study (including real disposable income and the interest rate) are presented in Table 1. Each variable is found to contain a unit root. In terms of empirical work, the unit root findings suggest that studies using these variables should not be conducted in levels, but instead in changes of the variables (i.e., first-differences). Using the levels of these variables in a standard regression would violate the best linear unbiased estimator properties of ordinary least squares.

Given that all the respective time series are stationary in first-differences, (i.e., integrated of order one, I(l)) we proceed to the Johansen-Juselius cointegration tests, displayed in Panel A of Table 2. The results indicate that there is one cointegrating equation and suggest that consumer sentiment and the personal savings rate share a long run equilibrium relation.

**Table 1**
ADF Unit Root Tests

| | Definition | Levels | 1st-Differences |
|---|---|---|---|
| P | Personal savings rate | -2.8908 | -13.4149* |
| C | Index of consumer sentiment | -2.6591 | -11.3208* |
| I | Real disposable personal income | -1.5211 | -9.5636* |
| r | Rate on 1-year Treasury bond with constant maturity | -2.0464 | -8.9667* |

Notes: The ADF statistic tests to see if the variable contains a unit root and is described in Appendix A. The test statistic is the estimated coefficient $(\rho_1-1)$ in the following regression: $\Delta x_t = \rho_0 + (\rho_1-1)x_{t-1} + \rho_2 t + \Sigma_{i=1}^{m}\varphi_i \Delta x_{t-i} + \varepsilon_t$ . A variable containing a unit root requires first-differencing to become stationary and may be cointegrated with other variables that also contain a unit root. A description of cointegration is given in Appendix B. * denotes statistical significance at the 1% level based on critical values in MacKinnon (1991). C and I are in natural logarithms.

Panel B of Table 2 presents the normalized cointegrating vector of the stable personal savings rate relation. Following the literature on cointegration we normalized the vector by setting the coefficient on the personal savings rate at -1 so that the vector may be interpreted as a personal savings rate determination function. Note that an increase in consumer sentiment (C ) is associated with a decrease in the personal savings rate (P) and enters significantly into the normalized cointegrating equation.

The next step in our analysis is to check the robustness of our finding by including other variables thought to impact the personal savings rate and seeing if the cointegrating relationship still exists. In particular, savings rates should depend on the interest rate. A higher interest rate increases the opportunity cost of not saving, thus we expect that the personal savings rate and

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the interest rate should be positively related. It is also believed that real disposable personal income may impact savings rates; however, it is not known, *a priori*, whether this effect will be positive or negative. As a nation becomes wealthier, the ability to save increases and developed countries tend to have higher savings rates than less developed (and poorer) countries. Researchers have also suggested that the savings rate in the United States has declined in recent years (Bovenberg & Evans, 1989), though Cullison (1990) argued that this decline has been overstated. The results of the cointegration test which includes all four variables (P, C, I, and r) are presented in Table 3, Panel A. The finding of a cointegrating relationship is confirmed. The normalized cointegrating vector (Panel B) reveals that the personal savings rate is negatively related to consumer sentiment, positively related to the interest rate,[d] and negatively associated with increases in real disposable personal income.

**Table 2**

Panel A: Johansen-Juselius Cointegration Test Results for P and C

| Hypothesized # of cointegrating equations | $\lambda_{trace}$ | 5% critical value | 1% critical value |
|---|---|---|---|
| None | 16.8968 | 15.41 | 20.04 |
| At most one | 3.6724 | 3.76 | 6.65 |

Notes: A discussion of the Johansen-Juselius test is provided in Appendix B. The statistic ($\lambda_{trace}$) tests to see if the variables in question are cointegrated and share a long run common trend. Cointegrated variables tend to move together over the long run. The test results above indicate one cointegrating equation.

Panel B: Normalized Cointegrating Equation

| P | C | constant |
|---|---|---|
| -1.0000 | -14.5079<br>(5.3850) | 71.6977 |

Note: Standard error in parentheses.

Finally, Panel C of Table 3 reports a summary of the error correction model estimation of equation (1). The negative and significant coefficient on the error correction term corroborates the previous finding of a cointegrating relation. The size of the error correction coefficient may be interpreted as a measure of the speed at which the series adjust to a change in equilibrium conditions and implies that the movement of the series towards eliminating disequilibrium within the first month is about 16 percent. In terms of the short-run dynamics, we found evidence that only lagged changes in the interest rate Granger-caused changes in the personal savings rate (F = 2.99 with probability value, p = 0.03).[e]

**Table 3**

Panel A: Johansen-Juselius Cointegration Test Results for P, C, I, and r

| Hypothesized # of cointegrating equations | $\lambda_{trace}$ | 5% critical value | 1% critical value |
|---|---|---|---|
| None | 97.0313 | 47.21 | 54.46 |
| At most one | 27.0888 | 29.68 | 35.65 |
| At most two | 10.4879 | 15.41 | 20.04 |
| At most three | 0.5424 | 3.76 | 6.65 |

Notes: A discussion of the Johansen-Juselius test is provided in Appendix B. The statistic ($\lambda_{trace}$) tests to see if the variables in question are cointegrated and share a long run common trend. The test results above indicate one cointegrating equation.

Panel B: Normalized Cointegrating Equation

| P | C | I | r | constant |
|---|---|---|---|---|
| -1.0000 | -12.6782<br>(1.9630) | -2.8645<br>(0.5282) | 0.1762<br>(0.0693) | 84.5017 |

Note: Standard error in parentheses.

Panel C: Summary of Results of Causality Tests from Error Correction Model

| Lags | EC(η) | ΣcC | ΣcI | Σcr | Adj. $R^2$ |
|---|---|---|---|---|---|
| 4, 1, 1, 3 | -0.1591<br>(0.00) | +<br>[0.80]<br>(0.37) | +<br>[0.05]<br>(0.82) | +<br>[2.99]<br>(0.03) | 0.20 |

Notes: Results are from the estimation of (1). Lags denotes the lag structure as determined by AIC method. EC(η) is the estimated coefficient on the error correction term. ΣcX indicates the sign of the sum of the coefficient(s) on the lagged change(s) in the independent variables C, I, and r, respectively. The corresponding Granger-causality F-statistic of their joint insignificance is presented in square brackets. The F-statistic has the following form: $F = [(SSE_R - SSE_U)/(SSE_U)q] \times (N-k)$, where $SSE_R$ and $SSE_U$ are the sum of squared errors for the restricted and unrestricted regressions, respectively, N denotes the number of observations, k is the number of estimated parameters in the unrestricted regression (k = p + q + 1), and q is the number of parameter restrictions. The statistic is distributed as F(q, N-k). If the null hypothesis is rejected, then the conclusion is that the lagged values of the explanatory variable cause the savings rate in a Granger-sense. Actual probability values in parentheses.

## Implications for Financial Counselors and Planners

The finding that the savings rate is nonstationary (i.e., contains a unit root) is particularly interesting for practitioners. For example, economic shocks such as the increase in access to financial markets through the Internet would permanently impact the savings rate. Similarly, a one-time unanticipated change in consumer sentiment would have permanent effects. This finding also indicates that the personal savings rate follows a random walk, a trait often attributed to the stock market.

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By itself, this finding suggests that unanticipated changes (i.e., shocks) to the personal savings rate contain a permanent component and provides preliminary support for savings plans based on the life-cycle hypothesis and the permanent income hypothesis. These permanent shocks imply that financial plans should be revisited every couple of years, or when a major event in one's life occurs such as career changes, marriage, birth of a child, or death of a spouse.

The finding of cointegration implies that the savings rate and consumer sentiment tend to move in proportion to each other over long horizons and do not drift "too far" apart. This is consistent with the notion that people do behave as if they are smoothing their consumption over their life time, and thus provides some support for the life-cycle approach to financial planning. While a long run equilibrium relation between the personal savings rate and consumer sentiment exists, there may be a short run lag before households adjust their savings rate to be in line once again with consumer sentiment. The financial planner should consider the behavioral tendency to reduce the percentage of income devoted to savings today when it is believed that the future is economically bright. On the other hand, households appear to increase their savings rate when they expect less fortuitous times in the future, perhaps quite wisely.

The results of the expanded cointegration test further revealed that the personal savings rate is negatively associated with increases in real disposable personal income. This suggests that, at least initially, households may increase their propensity to spend rather than save when they experience current increases in real disposable income. Of course, financial advisers will want to make clients aware of this tendency so that they may plan their savings accordingly. This finding can be used as an argument for establishing and maintaining emergency funds.

The results of the error-correction model suggest that households do respond to shocks and adjust their savings behavior over the long run, perhaps to smooth out the consumption over their life-cycle. By being aware of this adjustment process the financial planner may assist households by encouraging faster responses to major changes.

Events that affect consumer sentiment should be watched closely by financial planners. For example, sudden stock market corrections or rallies, as well as Federal Reserve announcements about the economy have the potential to change consumer sentiment and thus influence household savings rates. Based on the evidence provided in this study on the co-movement of savings and sentiment and the finding that households tend not to make long-run adjustments immediately, the financial planner can aid households by facilitating this adjustment process thereby helping to smooth consumption over the life-cycle.

## Concluding Remarks

This study examined the long run relationship between the personal savings rate and the index of consumer sentiment in the United States over the 1959:01-1997:07 period using cointegration analysis. Our results suggest that households reduce their savings rate when consumer sentiment is high; however, the two variables do not drift arbitrarily far apart. Consistent with both the life-cycle and permanent income hypotheses, consumer sentiment and the personal savings rate are cointegrated. This long run equilibrium relationship holds when we control for real disposable income and the interest rate. A higher interest rate is associated with higher personal savings rates while increases in real disposable income are associated with declines in the savings rate. The latter suggests that households may continue to save the same amount even when their real disposable income goes up.

The results are particularly important for financial counselors and planners who must advise clients of this phenomenon since good times do not always last or materialize and to save accordingly. The results provide evidence in support of financial decisions that are based on the life-cycle and permanent income hypotheses. In particular, households should revisit their plans on a regular basis, and especially after major changes. We find that there is room for faster adjustment to the long run equilibrium relationship between the personal savings rate and consumer sentiment. Financial planners may assist households by encouraging establishment of emergency funds and faster responses, which should help to alleviate problems associated with this adjustment process.

## Appendix A: Unit Root Test

A time series containing a unit root follows a random walk and requires first-differencing to obtain stationarity, and is said to be first-order integrated, I(l). A variable that is stationary in level form is I(0). The augmented Dickey-Fuller (ADF) test is used in this study to check for the presence of unit roots, and is conducted from the ordinary least squares estimation of equation (A1).

(A1) $\Delta x_t = \rho_0 + (\rho_1 - 1)x_{t-1} + \rho_2 t + \Sigma_{i=1}^{m}\varphi_i \Delta x_{t-i} + \varepsilon_t$

where x is the individual time series under investigation; $\Delta$ is the first-difference operator; t is a linear time trend; $\varepsilon_t$ is a covariance stationary random error and m is determined by Akaike's information criterion to

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ensure serially uncorrelated residuals. The null hypothesis is that $x_t$ is a nonstationary time series and is rejected if $(r_1-1) < 0$ and statistically significant. The finite sample critical values for the ADF test developed by MacKinnon (1991) are used to determine statistical significance.

## Appendix B: Cointegration Test

The Johansen-Juselius (1990) approach to testing for cointegration considers a p-dimensional vector autoregression that may be written as a conventional "error correction" model as follows:

(B1) $\Delta X_t = \mu + \Sigma_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} - \Pi X_{t-k} + \varepsilon_t$

where the $\Pi$ matrix contains information about the long-run relationships between the variables. Let the rank of the $\Pi$ matrix be denoted by r. When $0 < r < p$, the $\Pi$ matrix may be factored into $\alpha\beta'$, where $\alpha$ may be interpreted as a p x r matrix of the "error correction" parameters and $\beta$ as a p x r matrix of cointegrating vectors. The vector of constants, $\mu$, allows for the possibility of deterministic drift in the data series. The number of lags used in the vector autoregression is chosen based on the evidence provided by Akaike's Information Criterion (AIC).[f] Maximum likelihood estimates for $\alpha$, $\beta$, and $\Gamma_i$ are derived in Johansen (1991). To test the hypothesis that there are at most r cointegrating vectors, one calculates the trace statistic ($\lambda_{trace}$), where Johansen-Juselius (1990) provide critical values for the statistic.

## Endnotes

a. *This study is a partial analysis of the determinants of savings rates.*

b. *This was the longest time period available from the Federal Reserve Economic Database. Hakkio and Rush (1991) in footnote 4, page 579, state "Some of the research using cointegration that we mention uses a multivariate setup. It might be the case that having additional independent variables yields additional observations on long-run fluctuations and so shorter sample periods might be 'acceptable.' However, we do not pursue this line of inquiry in this paper." Additionally, others have claimed that monthly data outperforms annual data in cointegration and error correction models. See, for instance, Engle, Granger and Hallman (1991). Thus, given our multivariate framework we use monthly observations rather than annual observations.*

c. *The personal savings rate is defined as personal saving as a percentage of disposable personal income. Personal savings is defined as disposable personal income less the following: personal consumption, interest paid by persons, and personal transfer payments to the rest of the world. See Table 2.1, "Personal Income and Outlays", of the National Income and Product Account data for details.*

d. *We replaced the nominal interest rate with the real interest rate, calculated as the difference between the interest rate and the inflation rate, and then conducted each of the tests. The results were nearly identical and the conclusions were unaltered. We report the findings using the nominal rate simply because most savings alternatives, such as bonds, pay a nominal interest rate.*

e. *The model using the real interest rate did not exhibit any significant short-run Granger-causality.*

f. *The optimal lag length chosen is the one that minimizes AIC, where AIC = ln det $S_k^n$ +$(2d^2k)/T$, and k = 1, 2,…, n, d is the number of variables in the system, n is the maximum lag length considered, det denotes determinant, and $S_k$ is the estimated residual variance-covariance matrix for lag k.*

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