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ARE NET DISCOUNT RATIOS STATIONARY?: THE IMPLICATIONS FOR PRESENT VALUE CALCULATIONS

by

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Federal Reserve Bank of Dallas

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Abstract

This paper analyzes the relationship between real interest rates and real growth rates in wages. The stationarity of these time series has been discussed in the literature. However, since the net discount ratio, $(1 + g_t)/(1 + r_t)$, is a nonlinear transformation, it is not necessarily stationary even if the interest rate and growth rate in wages series are each stationary. On the other hand, the net discount ratio, $(1 + g_t)/(1 + r_t)$, may be stationary even if the interest rate and growth rate series are both stationary. The significant finding of this paper is that this net discount ratio, $(1 + g_t)/(1 + r_t)$, is stationary. This conclusion appears robust since it holds for at least four different Treasury securities analyzed: 3 month, 6 month, 1 year, and 3 year. Therefore a real net discount ratio, $(1 + g_t)/(1 + r_t)$, can be used with confidence in constructing present value forecasts of expected earnings.

1. Introduction

Present value calculations are required for a multitude of reasons. One of the most common (and practical) reasons is to determine the value of future lost earnings. Estimating the present value of future lost earnings, however, is a process complicated by many factors. Some of the issues that have been topics of recent research include the appropriate methods of analyzing expected earnings (Becker and Alter, 1987), the age-earnings life cycle (Lane and Glennon, 1985; Lambrinos and Harmon, 1989), fringe benefits (Nieswiadomy and Slottje, 1988), lost household services, disability effects (Nieswiadomy and Silberberg, 1988), medical care (Anderson and Roberts, 1989) and the impact of state and federal taxes (Vernon, 1985). One topic, though, appears to have received more attention than any other; namely, the problem of determining the correct growth rate for forecasting future earnings and determining the correct interest rate for discounting these earnings to the present.

The purpose of this paper is to explore the relationship between interest rates and growth rates using standard statistical test for stationarity.[1] Specifically, this paper will test for stationarity of the net discount ratio. Section two discusses some of the past approaches in the literature to determining the appropriate discount rate and growth rate. In section three, unit root tests on the real growth rate in wages, several real interest rates and several real net discount ratios are discussed. The nonlinear transformation of the growth rate in real wages and real interest rate that yields the net discount ratio is discussed. Even if the growth rate of real wages and real interest rates are stationary, this finding would not imply that the net discount rate is stationary. Section four presents the empirical results obtained from the unit root tests.

2. Past Approaches

The number of different approaches to determining the proper growth rate and discount rate is considerably large. Yet, even in their disagreement, most researchers apparently agree on the use of historical data in formulating their arguments. Perhaps it is due to the belief that "History repeats itself". Whether or not this old adage applies to growth rates in earnings and discount rates is the subject of this paper. More specifically, this paper will analyze the stability of the relationship between real wages and real interest rates using historical data.

Several researchers have suggested bypassing the entire issue by using the "total offset method" (also referred to as the "Alaska Method"), whereby the growth rate in wages effectively offsets the discount rate (Franz, 1978; Schilling, 1985). As a justification for this method, it is often argued that the expected rate of inflation is the primary force that influences both the nominal wage growth rate and interest rates. This method, however, makes the implicit assumption that there is a stable relationship between the two series are equal. Furthermore, the growth rate of wages and the discount rate are assumed to be equal. Not everyone agrees with this assumption, as we discuss below.

Many researchers agree that growth and discount rates must be explicitly analyzed. Nonetheless, there is disagreement over many points. First, there is the question of analyzing growth and discount rates independently or dependently (Laber, 1977). Second, there is often disagreement concerning the appropriate term to maturity of the security used for the discount rate, although it is generally agreed that riskless (as close as possible) U.S. government securities should be used. Harris (1983) argues that the rate on current short-term securities is appropriate for discounting. Carpenter et al. (1986) argue for the use of the average rate of return on immediate annuity contracts, while Jones (1985, p. 147) argues that when "interest is high by historic standards, those high long-term rates are appropriate for discounting". Still other experts have recommended a mix of high grade corporate bonds and government securities be used in determining the discount rate (Hickman, 1977); others have suggested using long-term Treasury issues (Bell and Taub, 1977, p. 126); or let the recipients level of investing sophistication determine the appropriate rate (Edwards, 1975). Third, there is the question of which industrial sector's wage should be used (Lane and Glennon, 1985; Anderson and Roberts, 1989).

Returning to the question of dependence of growth rates and discount rates, there is considerable variance in opinions. Several studies have found that the relationship is erratic. Leuthold (1981) uses 188 years of average Consumer Price Index inflation from 1793 to 1979 and concludes that the relationship between inflation and interest rates is not stable. Hosek (1982) argues that "the use of historical averages and relationships provides a weak basis for estimating future growth rates in income and future rates of interest so that one must exercise extreme caution in the use of past data". He provided evidence which suggested that nominal wage rates and nominal interest rates are nonstationary time series. Since nonstationary series have moments that are functions of time, Hosek's findings imply that historical data will not provide useful advice for future forecasts. Indeed, in the case where the time series has one unit root, shocks in the data are permanent. Schilling (1985), using historical data (1900-1982) to make out-of-sample forecasts, finds that the Alaska Method is the best of several methods, although none of the methods performs very well.

Several studies have found that there is a stable relationship between growth rates and discount rates. Lambrinos (1985) found that real wages and real interest rates do exhibit stationarity, and thus are appropriate for forecasting the future. Anderson and Roberts (1989), using 1952-82 data, find that the relative difference between the average annual after-tax interest rate on short-term securities and the average annual growth rate in after-tax earnings is stable. Their study differs from Schilling's (1985) in two primary ways. First, they consider short-term reinvestment strategies, whereas Schilling (1985) used long-term bonds. Secondly, their time series (1952-1982) was substantially different than Schilling's (1985) (1900-1982). Bryan and Linke (1988) also find that the difference between interest rates and wage growth rates are reasonably constant when analyzing the covariance between the rates of growth of workers' earnings and interest rates. They find the average differential to be between zero and one percent for one year and twenty year Treasury securities over the 1953-1984 period.

3. Stationarity Issues for Wages and Interest Rates

Stationarity is an important and well known concept in time series analysis. Essentially, a time series is said to be stationary if the generating function for the series does not itself change through time (Granger, 1989, p. 66). This concept, however, has not received much attention in the estimation of the present value of expected earnings. This is unfortunate since serious problems can arise when non-stationary data are used to estimate the relationship between two variables. Indeed, drawing appropriate statistical inference is complicated by potential spurious correlation. Engle and Granger (1987) show that non-stationary time series may be represented as polynomial functions of time with a fixed starting point. If two series share a common relationship with time, then the chances that the coefficient is significant will be higher; that is, the estimated correlation is potentially spurious[2].

As the brief survey of the literature indicated, many researchers have examined the important issue of the relationship between the growth rate and the discount rate. Two studies (Hosek, 1982; Lambrinos, 1985) have explicitly examined the issue of stationarity. While it should be noted that these studies (as well as others) have made a significant contribution to this literature, the analysis should be extended further. Both Hosek and Lambrinos examined the stationarity of the wage growth rate and the interest rate as separate time series. But it should be recalled that the ultimate reason for analyzing the stationarity of these time series is to determine if the $(1 + g_t)/(1 + r_t)$[3] series is itself stationary, where "r" stands for the real interest rate and "g" stands for the growth rate in real wages.

Because the net discount ratio, $(1 + g_t)/(1 + r_t)$, is a non-linear transformation of the real interest rate and the growth rate of real wages, there remains an additional concern even if r_t and g_t are each stationary. As Hallman and Granger (1989) have shown, non-linear transformations applied to non-stationary time series can yield stationary series, and vice-versa. Consequently, using stationary series such as r_t and g_t, if they are found to be stationary, does not imply that the net discount ratio, $(1 + g_t)/(1 + r_t)$, is stationary.

To test for stationarity, it is necessary to determine the order of integration of the time-series being considered. If the order of integration is equal to zero, then the series is said to be stationary. If, on the other hand, the series is integrated of order d (denoted I(d)), where d is some positive integer, then differencing the series d times yields a stationary series. Hence the series itself is non-stationary. Note that d also corresponds to the number of unit roots in the time series. Univariate analysis (unit root testing) is conducted to determine the order of integration. For this study we analyze the average hourly wage in the private nonagricultural sector (deflated by the CPI) and the real interest rate on different Treasury securities.

Several methods to test for the presence of unit roots are available. In this paper, the augmented Dickey-Fuller (1979) specification is adopted. Formally, this is represented as

$$(1) \quad \Delta x_t = \alpha + \beta x_{t-1} + \sum_{j=1}^{4} \delta_j \Delta x_{t-j} .$$

The presence or absence of a unit root depends on the value of the coefficient β. The null hypothesis is that the coefficient on the variable, x_{t-1} is zero. If so, then x_t has (at least) one unit root. If the test statistic indicates that the coefficient is significantly less than zero, the series, x_t , does not have a unit root. Hence, the variable is stationary.

The test statistic is of the form of the usual student's t for β, but the distribution of the test statistic is non-normal even asymptotically. The appropriate cumulative distribution is provided in Fuller (1976). From this cumulative distribution, the probability that the t-statistic is less than -2.88 (i.e., the probability of a Type-I error) is five percent.

4. Unit-Root Tests for Stationarity

The data are monthly and are available for the period 1964:1-1989:4.[4] To calculate the ex post real return, we used the nominal interest rate and subtracted the inflation rate (measured as the annualized rate of change in the CPI) that existed until that security matured. For example, the nominal return that was registered (on average) for 3 month bills in January, less the inflation rate over the period January to April, yields the real return. The presumption here is that the expected inflation level equals actual inflation. Thus, the model imposes the condition that expectations are rational. With $\pi^e = \pi$, the real return is, therefore, the nominal return less the inflation rate for the period during which the Treasury security was outstanding.[5]

Equation (1) is estimated using levels of the time series of interest rates and real wages. It should be noted that the level of real interest rates is "r". However, the real wage rate must be converted to percentage changes to yield "g", the growth variable (with which we are concerned). Four different Treasury securities are analyzed: 3-month, 6-month, 1-year, and 3-year. The results are presented in Table 1. As Table 1 indicates, the estimated coefficients on the lagged value of all of the Treasury securities variables are negative. Similarly, the coefficient on the lagged value of the (log of) real average hourly earnings is negative.[6] In all of the cases, however, the t-statistics, are smaller (in absolute value) than -2.14. Since the 5% critical value is -2.88, the evidence is consistent with the levels of average hourly earnings and real interest rates having a unit-root, and hence, all of the series are nonstationary when considered individually. Of course the stationarity of the real wage growth rate (g) still must be tested, but we have already found that real interest rates are not stationary. This finding does not agree with Lambrinos' (1985) conclusion that real interest rates are stationary. However, Lambrinos' (1985) conclusion was based on correlograms, not unit-root testing. Thus no unambiguous statistical inferential properties could be attached to his conclusion.

In the second test, a time trend variable is included in the regression as shown in Equation (2).

$$(2) \quad \Delta x_t = \alpha + \beta x_{t-1} + \sum_{j=1}^{4} \delta_j \Delta x_{t-j} + \gamma t$$

The null hypothesis is that the coefficients on the lagged level of the series under scrutiny and on the time variable are jointly equal to zero. The intuition behind this test is that the series may be made up of both deterministic and stochastic trend components.[7] The F-statistic for this null hypothesis will exceed its critical value if either (i) the deterministic trend, here captured by the coefficient on the time trend variable, explains a large portion of the time series (which is reflected in the coefficient on the time variable being different from zero); or (ii) the stochastic trend is small (which results in the coefficient on the lagged value being significantly less than zero). The results of this second test are consistent with those in the first test; that is, under the null hypothesis, the F-statistics are all less than 3.82 for the real interest rates. The F-statistic is 4.42 for average hourly earnings. In all cases, therefore, the values of the F-statistics are well below the critical value of 6.34, so that we fail to reject the null hypothesis. Thus, even with a trend adjustment, the various interest rate and growth rate series are not stationary.

The next step is to determine whether a second unit root is present in the data. If so, then the first differences are non-stationary. Equation (1) is also estimated with first differences of the various real interest rates (r) and the growth rate (g) of real average hourly earnings. The results of these estimations are also presented in Table 1 (in the second column). Under the null hypothesis that the coefficient on the lagged first difference of the Treasury interest rate is less than zero, the t-statistics range from -5.11 to -9.60. In each case the evidence suggests that the first difference of these real interest rate series are stationary. This indicates that these Treasury interest rate series must be first differenced before any forecasting is done using these individual series. However, the growth rate of the real average hourly earning series is stationary since the model using the growth rate (g) in real average hourly earnings has a t-statistic of -5.33. Furthermore, when a time trend is included in the models, the conclusions based on the F-statistics in the last column of Table 1 are congruent with the unit-root tests in equation (1): the first differenced real interest rate series are stationary, and the growth rate in real wages is stationary. This second result is consistent with Lambrinos' (1985) conclusion that the growth rate in real wages is stationary, according to his correlogram.

In short, the evidence is consistent with the real interest rates not being stationary but the growth rate of real average hourly earnings being stationary. This result could present serious problems for forecasting the present value of expected future earnings since only one of the series are stationary. However, as noted above, it is possible that the $(1 + g_t)/(1 + r_t)$ series is stationary even though the real interest rate is not stationary since this series is a non-linear transformation of the r_t and g_t series.

Unit root tests on the net discount ratio, $(1 + g_t)/(1 + r_t)$, are presented in Table 2. These tests were conducted in a similar fashion to the ones described in Table 1. Four different net discount ratios are constructed, one for each of the different real interest rates under consideration, while the same growth rate in real wages is used each time. The results indicate that the net discount ratio is stationary in each case. This conclusion holds whether the time trend is included or not. These results appear to be quite robust with respect to the choice of different Treasury securities used in constructing the net discount ratio.

Some summary statistics are shown in Table 3. Of interest is the mean values of the net discount rate, $k = (r - g)/(1 + g)$. These mean values range from approximately zero to plus two percent. Thus, based on the time period under consideration, the Alaska rule does not appear to generally hold.

5. Conclusion

This paper has found that the growth rate in real wages is stationary, as Lambrinos (1985) concluded. Our results differ with Lambrinos' (1985) conclusion, however, because real interest rates are not stationary. However, the issue of individual stationarity of the interest rate and growth rate series is really moot. Ultimately, the concern is over the stationarity of the net discount series, $(1 + g_t)/(1 + r_t)$, because this is the variable of interest. It has been noted (Hallman and Granger,

1989) that stationarity of individual series does not guarantee stationarity of a non-linear transformation such as $(1 + g_t)/(1 + r_t)$. The significant finding of this paper is that this net discount ratio, $(1 + g_t)/(1 + r_t)$, is stationary. This conclusion appears robust since it holds for at least four different Treasury securities analyzed: 3 month, 6 month, 1 year, and 3 year. Therefore a real net discount ratio, $(1 + g_t)/(1 + r_t)$, can be used with confidence in constructing present value forecasts of expected earnings.

Table 1

Unit-Root Test for Real Interest Rates and Real Wages, 1964:1 - 1989:4

Models: (1) $\Delta x_t = \alpha + \beta x_{t-1} + \sum_{j=1}^{4} \delta_j \Delta x_{t-j}$

(2)[a] $\Delta x_t = \alpha + \beta x_{t-1} + \sum_{j=1}^{4} \delta_j \Delta x_{t-j} + \gamma t$

	t-statistic on lag variable x_{t-1}		F-statistic on lag variable, x_{t-1} and time, t	
Variable	Level	Change	Level	Change
3-month rate	-1.99	-9.60*	3.48	46.08*
6-month rate	-2.14	-7.60*	3.82	28.96*
1-year rate	-1.90	-6.00*	2.75	17.98*
3-year rate	-1.48	-5.11*	1.46	15.14*
real wage	-0.81	-5.33*,b	4.42	15.59*,b

* denotes significance at the 5% level.
The 5% critical value for the t-ratio is -2.88.
The 5% critical value for the F-ratio is 6.34.
[a] Note in model (2) that "t" represents the time trend variable.
[b] The growth rate in real wages is used.

Table 2

Unit-Root Test for the Net Discount Ratio
1964:1 - 1989:4

$$x_t = (1 + g_t)/(1 + r_t) = 1/(1 + k_t)$$

Models: (1) $\Delta x_t = \alpha + \beta x_{t-1} + \sum_{j=1}^{4} \delta_j \Delta x_{t-j}$

(2)[a] $\Delta x_t = \alpha + \beta x_{t-1} + \sum_{j=1}^{4} \delta_j \Delta x_{t-j} + \gamma t$

Interest rate variable used	t-statistic on lag variable x_{t-1}	F-statistic on lag variable, x_{t-1} and time, t
3-month rate	-3.19*	11.63*
6-month rate	-3.75*	14.67*
1-year rate	-3.73*	12.29*
3-year rate	-2.90*	6.89*

* denotes significance at the 5% level.
The 5% critical value for the t-ratio is -2.88.
The 5% critical value for the F-ratio is 6.34.
[a] Note in model (2) that "t" represents the time trend variable.

Table 3

Summary Statistics for the Net Discount Ratios and Rates, 1964-1989

Net Discount Ratio: $(1 + g)/(1 + r)$

Using the following Treasury securities	Mean	Standard Deviation
3-month	1.01	0.05
6-month	0.98	0.05
1-year	0.98	0.05
3-year	0.98	0.06

Net Discount Rate: $k = (r - g)/(1 + g)$

Using the following Treasury securities	Mean	Standard Deviation
3-month	0.02	0.05
6-month	-0.003	0.05
1-year	0.01	0.05
3-year	0.02	0.06

References

Anderson, Gary A. and David L. Roberts, 1989, "Stability in the Present Value Assessment of Lost Earnings," Journal of Risk and Insurance, 56: 50-66.

Anderson, Gary A. and David L. Roberts, 1989, "An Historical Perspective on the Present Value Assessment of Medical Care," Journal of Risk and Insurance, 56: 218-32.

Becker, William E. and George C. Alter, 1987, "The Probability of Life and Workforce Status in the Calculation of Expected Earnings," Journal of Risk and Insurance, 54: 364-75.

Bell, Edward B. and Allan J. Taub, 1977, "Additional Comment," Journal of Risk and Insurance, 54: 122-29.

Bryan, William R. and Charles M. Linke, 1988, "Estimating Present Value of Future Earnings: Experience with Dedicated Portfolios," Journal of Risk and Insurance, 55: 273-86.

Carpenter, Michael D., David R. Lange, Donald S. Shannon and William Thomas Stevens, 1986, "Methodologies of Valuing Lost Earnings: A Review, A Criticism, and A Recommendation," Journal of Risk and Insurance, 53: 104-18.

Edwards, N. Fayne, 1975, "Selecting the Discount Rate in Personal Injury and Wrongful Death Cases," Journal of Risk and Insurance, 52: 342-45.

Engle, R.F. and C.W.J. Granger, 1977, "Co-Integration, and Error-Correction: Representation, Estimation and Testing," Econometrica, 55: 251-76.

Franz, Wolfgang W., 1978, "A Solution to Problems Arising from Inflation When Determining Damages," Journal of Risk and Insurance, 45: 323-33.

Fuller, Wayne A., 1976, Introduction to Statistical Time Series, New York: Wiley.

Granger, C.W.J., 1989, Forecasting in Business and Economics, Boston: Academic Press.

Hallman, Jeffrey J. and C.W.J. Granger, "The Algebra of I(1)," Journal of Time Series, forthcoming.

Harris, William G., 1983, "Inflation Risk as Determinant of the Discount Rate of Tort Settlements," Journal of Risk and Insurance, 50: 265-80.

Hickman, Edgar P., 1977, "Further Comment," Journal of Risk and Insurance, 54: 129-32.

Hosek, William R., 1982, "Problems in the Use of Historical Data in Estimating Economic Loss in Wrongful Death and Injury Cases," Journal of Risk and Insurance, 49: 300-308.

Jones, David D., 1985, "Inflation Rates Implicit in Discounting Personal Injury Economic Losses," Journal of Risk and Insurance, 52: 144-150.

Laber, Gene, 1977, "The Use of Inflation Factors in Determining Settlements in Personal Injury and Death Suits: Comment," Journal of Risk and Insurance, 44: 469-73.

Lambrinos, James, 1985, "On the Use of Historical Data in the Estimation of Economic Losses," Journal of Risk and Insurance, 52: 464-76.

Lambrinos, James and Oskar R. Harmon, 1989, "An Empirical Evaluation of Two Methods For Estimating Economic Damages," Journal of Risk and Insurance, 56: 733-39.

Lane, Julia and Dennis Glennon, 1985, "The Estimation of Age/Earnings Profiles in Wrongful Death and Injury Cases," Journal of Risk and Insurance, 52: 686-95.

Leuthold, Steven C., 1981, "Interest Rates, Inflation and Deflation," Financial Analysts Journal, Jan-Feb.: 28-40.

Nieswiadomy, Michael L. and Daniel J. Slottje, 1988, "Estimating Lost Future Earnings Using the New Worklife Tables: A Comment," Journal of Risk and Insurance, 55: 539-44.

Nieswiadomy, Michael L. and Eugene Silberberg, 1988, "Calculating Changes in Worklife Expectancies and Lost Earnings in Personal Injury Cases," Journal of Risk and Insurance, 55: 492-98.

Pagan, A. R. and M.R. Wickens, 1989, "A Survey of Recent Econometric Methods," The Economic Journal, 99:962-1025.

Schilling, Don, 1985, "Estimating Present Value of Future income losses: An Historical Simulation 1900-1982, "Journal of Risk and Insurance, 52: 100-116.

Smith, Franklin C., 1976, "The Use of Inflation Factors in Determining Settlements in Personal Injury and Death Suits," Journal of Risk and Insurance, 43: 369-76.

Stock, James H. and Mark W. Watson, 1988, "Variable Trends in Economic Time Series, "The Journal of Economic Perspectives," 2: 147-74.

Vernon, Jack, 1985, "Discounting After Tax Earnings with After Tax Yields in Torts Settlements," Journal of Risk and Insurance, 2: 696-703.

Endnotes

1. The other factors such as tax rates and age earnings profiles which influence specific present value calculations are not analyzed in this paper. They do not significantly affect our conclusions.

2. Spurious correlation, however, is not problematic when the two series are co-integrated. Because a linear combination of the two series is stationary, (i.e., not a polynomial function of time), the inferences about the correlation coefficient are valid. See Pagan and Wickens (1989) for a detailed, intuitive discussion of integrated time series and co-integration.

3. This ratio is also sometimes written as $1/(1 + k_t)$, where k_t is referred to as the net discount rate (e.g., Anderson and Roberts, 1989).

4. 1964 was the first year in which monthly changes in hourly wage rates were available.

5. Mishkin (1988) uses this approach to calculate the ex post return series.

6. The unit-root test was also conducted for the level of the real wage. As one might expect, with a unit root in the log-level of the series, the evidence indicated that a unit-root was present in the real wage level as well.

7. See Stock and Watson (1988) for a description of the breakdown of a series into its deterministic and stochastic trend components.

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