Southern Business Review

Volume 14 | Issue 1 | Article 7

April 1988

APT and Bank Holding Company Stock Returns

Adi S. Karna
Indiana University-Purdue University

Ghassem Homaifar
Middle Tennessee State University

Duane B. Graddy
Middle Tennessee State University

APT AND BANK HOLDING COMPANY STOCK RETURNS

Adi S. Karna, Ghassem Homaifar
and Duane B. Graddy

Introduction

Questions about the acceptability of CAPM as a basis for estimating the required rate of return in public utility rate cases have been raised in a recent paper by Bower, Bower, and Logue [3]. Their main point is that it may be premature to accept the CAPM paradigm when the findings for Arbitrage Pricing Theory (APT) seem so favorable. To buttress their argument, Bower, Bower, and Logue present new statistical evidence more approbative to APT. Accurate estimates of asset risk and expected returns are also important to the regulators of financial firms. The concern here is primarily with the appropriateness of the rate of return as an incentive for providing the capital necessary to support organizational risk. Extending the arguments of Bower, Bower, and Logue to bank holding company operations leads us to believe that APT may provide better conceptual and predictive results than the CAPM.

For instance, past studies have isolated several individual financial variables which impact on bank holding company (BHC) stock. Empirical investigations by Melicher [27], Yagill [39], Sachlis and Haslem [35], Jahankhani and Lynge [24], Graddy, Homaifar, and Karna [20], and Karna and Graddy [25] have examined the effects of various financial variables on the systematic risk of large banks and BHCs. The primary results of these studies can be summarized briefly. Sachlis and Haslem [35] found a negative correlation between business and financial risk measure for large commercial banks. Graddy, Homaifar, and Karna [20] detected a significant relationship between double leverage and BHC returns. In a related paper, Karna and Graddy [25] found a significant correlation between consolidated leverage and the cost of BHC capital. This result was also discerned in a somewhat different context by Jahankhani and Lynge [24]. Although the above studies provide insights into the determinants of risk and returns for BHCs, the finding of important factors which are independent of beta is at odds with the single factor capital asset pricing model (CAPM). Hence, tests constructed on the APT may more adequately consider these multifactor elements acting on BHC risks and returns.

This paper has three primary purposes. First, using factor analysis, we identify the number of significant risk premia for 44 large BHCs during the period of 1970-1984. Second, we evaluate the predictions of both the CAPM and APT using Theil's inequality. Finally, the required rates of return established using both models are examined to determine the comparability.

Review Of The Literature

The capital asset pricing model (CAPM), although still extensively used, has been severely criticized on several counts in recent years. The model implies that the only efficient combination of risky securities is the market portfolio. Beta is the focus in analyzing risk. Several major empirical tests of the CAPM were published in the 1970s and 1980s. Blume and Friend [2] and Friend, Westerfield, and Granito [17] have found that the predictions of the capital asset pricing model are not borne out in practice. Roll [31] has made some other criticisms of the model. He asserts that the only implication of the model is that the market portfolio is efficient and that this is untestable because such a broad aggregate of assets is unmeasurable, and that the most popularly tested implication of the linear relationship between return and beta will hold exactly for any efficient portfolio. The Roll critique, however, does not imply that the CAPM is an invalid theory. Roll posits that construction of a suitable method for testing ex-ante efficiency is very difficult, if not impossible. This inability to adequately test the CAPM leads Ross [34] to believe that the arbitrage pricing theory (APT) offers a testable alternative to the capital asset pricing model. The CAPM predicts that security rates of return will be linearly related to a single common factor--the rate of return on the market portfolio. The APT is based on the supposition that there are many close substitutes in financial markets and that such substitutes will be priced together. The point is that the arbitrage pricing model (APT), formulated by Ross, offers an alternative to CAPM. As an alternative to the CAPM, the APT allows more than just one return generating factor. Furthermore, returns are assumed to be linear functions of these factors. An important feature of the APT approach is that empirical tests do not depend on knowledge of the market portfolio. However, one of the frustrating aspects is that the return generating factors are not pre-specified; i.e., they are to be determined empirically before a performance measure can be obtained. Research into the identity of these factors is at a relatively early stage.

Gehr [18] is credited with the first published empirical test of the APT. By factor analyzing the excess returns on 41 individual securities, Gehr concludes that there are apparently two, or at most three, common factors for the stock market that explain a large portion of the variance in stock returns. In a follow-up study, Roll and Ross [33] estimate the factor betas for securities and then estimate the cross-sectional relationship between securities betas and average rates of return. The input into factor analysis is the covariance matrix between the security returns. Factor analysis then determines the factor betas which best explain the covariances existing between the securities in the sample. After obtaining estimates of the factor betas, the estimated value of the factor prices associated with each factor can be determined. This is done by cross-sectionally relating the factor betas to average returns, using a procedure similar to that employed by Black, Jensen, and Scholes [1] in testing the CAPM. Roll and Ross [33] used this technique on 42 subsets of 30 stocks each over the period July 3, 1962, through December 31, 1972, in an effort to establish the number of "common risk" factors. They found that, at least, three or probably four identifiable common factors exist that have explanatory power and that their associated risk premiums are more or less positive, as one would expect from the arbitrage pricing theory (APT).

Following the Roll and Ross study, several research works raised important issues about the relationship between the theoretical concepts of the APT and its empirical tests. Brown and Weinstein [4] tests of the APT focused on estimating the intercept term $\lambda_0 = R_f$ and the values of the factor prices. Their results were ambiguous. Shanken [36] has raised an even more serious issue relating to the testability of the APT. He argues that the shares of stock traded in the

market place are actually portfolios of the individual units of production in the economy. Consequently, given a factor structure that relates to the returns on the individual units of production, we may not be able to recognize it on the basis of the portfolios. Dhrymes, Friend, and Gultekin (DFG) [11] raise several econometric issues relating to the Roll and Ross study. Their conclusions were that the study did not support the arbitrage pricing theory. A major criticism is that, as the number of securities analyzed increases, the number of "common risk" factors observed come to 10 percent of the number of securities analyzed. So if 1260 (42 × 30) are analyzed, the number of common risk factors would be 126. Such a large number of "common risk" factors would hardly add to understanding of the operation of financial markets. In reply, Roll and Ross [32] deny DFG criticisms on a point-by-point basis and provide further support for the usefulness of the APT approach. In another paper, Dhrymes [10] specifically looks at the following questions: (1) How close does the constant term of the APT equation come to the risk-free rate? (2) Do unique measures of risk, such as standard deviation of return, fail to add anything to the explanatory power of these models? (3) How robust are the results claimed by the Roll and Ross methodology relative to the size of the sample? On examining these questions, Dhrymes concludes that the empirical evidence does not support the arbitrage pricing theory and its use as a basis for security pricing is problematical and still an open question. Again, Ross rejects Dhrymes' criticism as based on misunderstandings of some basic issues.

Folger, John and Tipton [16], Oldfield and Rogalski [28], and Reinganum [30] use the factor loadings obtained from a common factor analysis to test the APT. These studies suggest the presence of between three and five significant common factors in a factor analytic sense. Evidence presented by these studies, except for Reinganum, support APT by noting the existence of several significant sources of systematic risk. Reinganum, with the size effect as the example, argues that APT may not explain everything about expected return. Chen [8] develops, perhaps, the most sophisticated empirical test for the APT. He concludes that in most cases the CAPM is misspecified and the missing price information is picked up by the APT. He also tests for Reinganum's size effect and finds no evidence of it. He observes that firm size does not have any explanatory powers after risk is adjusted by the factor loading. In conclusion, according to Chen, the APT does perform very well against the CAPM and therefore is a better model for understanding cross-sectional variation in asset returns.

In their comparison of the CAPM and APT models, Bower, Bower, and Logue [3] use monthly returns on 942 utility stocks for the period of 1971 to 1979. The returns were drawn from the CRSP data base. The 942 stocks were divided into 30 portfolios to reduce the noisiness of the data and to minimize the types of econometric issues raised by Dhrymes, Friend, Gultekin [11]. Portfolio returns were factor analyzed to produce monthly scores for four factors. In this paper, the authors set out to develop new evidence that arbitrage pricing theory was a better model for estimating the expected returns for public utilities than the capital asset pricing model. In short, the results of this study indicate that the APT equation explains more of the variance in portfolio returns as a function of asset risk than does the CAPM equation. This leads Bower, Bower, and Logue to claim that the APT is a better choice of policy decisions than the CAPM. Dybvig and

Ross [14] attempt to alleviate some of the confusion arising from previous empirical research by examining the issue of the testability of the APT. According to them, earlier studies on APT have taken two or even three different approaches. One set of studies believe that APT is a good approximation in a sequence economy, when there are "sufficiently many" assets.[1] The other group shows that the APT should be a good approximation in a finite economy.[2] Some even have assumptions sufficiently strong to ensure that the APT will hold exactly.[3] Dybvig and Ross examine some of the points raised by Shanken [36] and conclude his analysis of the APT has little relevance for actual empirical test. Dybvig and Ross further examine the relationship between the CAPM and the APT, with special emphasis on testability. They argue that testing the APT on subsets of assets is mostly valid and does not suffer from the shortcomings of the CAPM.

Methodology

This paper follows the methodology of Bower, Bower, and Logue in the sense of comparing the results of the CAPM to those of the APT model with an aim of developing a useful approach to policy choices. Like public utilities, BHCs are highly regulated firms and thus provide a further check on the Bower, Bower, and Logue conclusions. Foreshadowing the subsequent discussion somewhat, our factor analysis of 44 BHCs produced 10 factors common to the bank holding company stocks. However, only three factors were identified as being significant in the statistical sense.

The sample for this study included quarterly stock return data covering 44 large BHCs over the period 1970-1984. A two-step methodology was employed to test the hypothesis that the estimated required rate of return is different between the CAPM and APT. In the first step, factor sensitivity coefficients were estimated for each stock in the sample using least squares. The following model was specified:

$$rit = \lambda_o + b_{i1} F_{it} + b_{i2} F_{2t} \dots + b_{in} F_{nt} + E_{it} \quad (1)$$

$$rit = \alpha_i + B_i R_{mt} + e_{it} \quad (2)$$

where r_{it} = holding period return for i_{th} stock on t-th quarter

F_{it} = mean zero factor common to all stocks

b_{i1}, b_{i2}, b_{i3} = factor sensitivity of the stock with the Jth factor

$$= \frac{Cov\ (F_{jt}, r_{it})}{Var\ (F_{jt})}$$

λ_o = intercept

r_{mt} = holding period return on value weighted index of all stocks during 1970-84

B_i = beta coefficient for ith-stock

E_t = unique term with known property

---

[1]See Chamberlain (1983), Chamberlain and Rothschild (1983), Huberman (1982), and Ingersoll (1984).

[2]See Cragg and Malkiel (1982), Dybvig (1983), and Grinblatt and Tittman (1983).

[3]See Chen and Ingersoll (1983) and Dybvig (1983).

In the second step, BHC stock returns were regressed on the sensitivity coefficients from step one. This procedure is expressed as equation (3).

$$r_i = \lambda_o + \lambda_1 b_{i1} + \lambda_2 b_{i2} + \lambda_3 b_{i3} + e_i \quad (3)$$

λ_o =intercept term

λ_1 =price of risk for the ith factor

e_i =error term

If these specified factors are return generating factors and the APT is the correct specification of the process, the hypothesized factors should explain a significant portion of the variation in BHC common stock returns. In addition, the hypothesized factors should have a significant price in the pricing model. While APT does not require that all the prices be positive, it does require that the "net" price of risk be positive. We will examine this somewhat more closely when we compare our results to Bower, Bower, and Logue. The estimated λ_o in the equation (3) should be positive and close to the risk-free rate. The ability of the specified model to explain the variation in BHC stock returns is examined in terms of an F statistic. The hypothesis that the factor prices are significantly different from zero is determined by using t-test.

Results

The cross-sectional regression of individual stock average returns on the factor sensitivity coefficients produced the following results:

$$ri = .0679 + .0178b_{i1} + .0156b_{i2} + .013b_{i3} \quad (4)$$

$$(.09) \quad (1.90) \quad (2.33) \quad (2.55)$$

$R^2_{adj}=.173$ F=4.01

$$r_i = 0.0533 - 0.004 \text{ Beta} \quad (5)$$

$R^2=0.03$ LF=0.18

Forty-four characteristic lines were estimated using equations (1) and (2). A summary of the cross-sectional and time-series regression results are reported in Table 1. Following Bower, Bower, and Logue, we used Theil's inequality, μ^2, to assess the quality of the results. The interpretation of μ^2 is that the smaller the ratio, the better are a model's estimates relative to a naive forecast.

Analysis of the results in Table 1 indicates that the APT performs somewhat better than the CAPM when compared to our evaluation criteria. For example, the cross-sectional regressions produced positive and significant risk premiums for the three factors. Furthermore, the three factors explained 17 percent of the variation in BHC returns. In contrast, estimates for the CAPM reveal that the model explains very little of the cross-sectional variations in BHC returns; again emphasizing the importance of factors unrelated to beta in the determination of BHC returns.

As far as explanatory power of the time-series models is concerned, APT has out performed CAPM in terms of R^2 (27 percent versus 12 percent, respectively). Even though Theil's inequality was greater than one for both models, the predictive error is twice as high for the CAPM, as for the APT. As was expected, the estimates of the required rate of return for BHC stocks was found to be different

Table 1

Regression Estimates For The CAPM and APT Models

	CAPM	APT
Average R^2 (time-series)	.12	.27
R^2 - (cross-section)	.03	.17
b_{i1}	--	.0088
b_{i2}	--	.0111
b_{i3}	--	.0102
Beta	.29	--
Required Rate of Return	.0521	.081
Theil's measure (u^2)	7.37	3.60

NOTE: $\mu^2 = \Sigma(\bar{r}_i - \hat{r}_i)^2 / \Sigma(\hat{r}_i - \hat{\bar{r}})^2$, where $\bar{r}_i$ and $\hat{r}_i$ are the realized and estimated average return on the ith BHC stock and $\hat{\bar{r}}$ is the grand mean of all of the estimated returns from equations (1) and (2).

between the CAPM and APT. This is consistent with the findings of Bower, Bower, and Logue [3] for gas and utility companies.

Conclusions

Proper estimates of the rates of return for BHCs are important to the regulatory decision process. These estimates are needed to assess the ability of BHCs to generate the amount of equity capital necessary to underwrite organizational risk and to assure the long-run viability of the firm. This paper focuses on forecasts from two models of the return generating process: CAPM and APT. In our tests, the CAPM had very little explanatory power. While the R^2s for our APT estimates are somewhat lower than those of Bower, Bower, and Logue, the results for this model (APT) were substantially better than the single factor estimations. (Our results are not strictly comparable to those of Bower, Bower, and Logue because they use portfolio returns and our estimates relate to individual securities.) This leads us to conclude that the APT does a somewhat better job in explaining and forecasting rates of return for bank holding companies than does the CAPM.

References

1. Black, F., Jensen, M.C., and M. Scholes. "The Capital Asset Pricing: Some Empirical Tests." **Journal of Finance** (March 1972), 19-34.

2. Blume, M.E. and I. Friend. "A New Look at the Capital Asset Pricing Model." **Journal of Finance** (March 1973), 19-34.

3. Bower, D., Bower, R., and D. Logue. **Journal of Finance** (September 1984), 1041-1054.

4. Brown, S.J. and M.I. Weinstein. "A New Approach to Testing Asset Pricing Theories." **Journal of Finance** (January 1983), 711-793.

5. Chamberlain, G. "Funds, Factors, and Diversification in Arbitrage Pricing Models." **Econometrica** (September 1983), 1305-1323.

6. Chamberlain, G. and M. Rothschild. "Arbitrage, Factor Structure, and Mean-Variance Analysis on Large Asset Markets." **Econometrica** (September 1983), 1281-1304.

7. Chang, E.C. and W.G. Lewellen. "An Arbitrage Pricing Approach to Evaluating Mutual Fund Performance." **The Journal of Financial Research** (Spring 1985), 15-30.

8. Chen, N. "Some Empirical Tests of the Theory of Arbitrage Pricing." **Journal of Finance** (December 1983), 1393-1414.

9. Chen, N. and J. Ingersoll, Jr. "Exact Pricing in Linear Factor Models With Finitely Many Assets: A Note." **Journal of Finance** (June), 985-988.

10. Dhrymes, P.J. "The Empirical Relevance of Arbitrage Pricing Models." **The Journal of Portfolio Management** (Summer 1984), 35-44.

11. Dhrymes, P.J., Friend, I., and N.B. Gultekin. "A Critical Re-examination of the Empirical Evidence on the APT." **Journal of Finance** (June 1984), 323-346.

12. Dhrymes, P.J., Friend, I., Gultekin, M.N., and N.B. Gultekin. "New Tests of the APT and Their Implications." **Journal of Finance** (July 1985), 659-674.

13. Dybvig, P.H. "An Explicit Bound on Individual Assets' Deviations from APT Pricing in a Finite Economy." **Journal of Financial Economics** (December 1983), 483-496.

14. Dybvig, P.H. and S.A. Ross. "Yes, The APT is Testable." **Journal of Finance** (September 1985), 1173-1188.

15. Fama, E.F. and J. Macbeth. "Risk, Return, and Equilibrium: Empirical Test." **Journal of Political Economy** (May/June 1973), 607-636.

16. Folger, R.H., John, K., and J. Tipton. "Three Factors, Interest Rate Differentials and Stock Groups." **Journal of Finance** (May 1981), 323-335.

17. Friend, I., Westerfield, R., and M. Granito. "New Evidence on the CAPM." **Journal of Finance** (June 1978), 903-917.

18. Gehr, A., Jr. "Some Tests of the Arbitrage Pricing Theory." **Journal of the Midwest Finance Association** (1975), 91-105.

19. Gertler, M. and E.L. Grinels. "Unemployment, Inflation, and Common Stock Returns." **Journal of Money, Credit, and Banking** (May 1982), 206-233.

20. Graddy, D., Homaifar, G., and A. Karna. "Double Leverage as a Source of Systematic Risk in Bank Holding Company Stocks." **Journal of Bank Research** (Summer 1984), 115-122.

21. Gultekin, N.B. and R.J. Rogalski. "Interest Rate Risk and the APT." **Journal of Finance** (March 1985), 43-61.

22. Huberman, G. "A Simple Approach to Arbitrage Pricing Theory." **Journal of Economic Theory** (October 1982), 183-191.

23. Ingersoll, J., Jr. "Some Results in the Theory of Arbitrage Pricing." **Journal of Finance** (September 1984), 1021-1039.

24. Jahankhani, A. and M.J. Lynge. "Commercial Bank Financial Politics and Their Impact on Market-Determined Measures of Risk." **Journal of Bank Research** (Autumn 1980), 169-178.

25. Karna, A. and D.B. Graddy. "Bank Holding Company Leverage and the Return on Stockholders' Equity." **Journal of Bank Research** (Spring 1980), 42-48.

26. Kryzanowski, L. and M.C. To. "General Factor Models and the Structure of Security Returns." **Journal of Financial and Quantitative Analysis** (March 1983), 31-52.

27. Melicher, R.W. "Financial Factors Which Influence Beta Variations Within a Homogeneous Industry Environment." **Journal of Financial and Quantitative Analysis** (March 1974), 231-241.

28. Oldfield, S., Jr. and J. Rogalski. "Treasury Bill Factors and Common Stock Returns." **Journal of Finance** (May 1981), 337-350.

29. Pari, R.A. and S.N. Chen. "An Empirical Test of the Arbitrage Pricing Models." **Journal of Financial Research** (Summer 1984), 35-44.

30. Reinganum, M. "The Arbitrage Pricing Theory: Some Empirical Results." **Journal of Finance** (December 1981), 313-321.

31. Roll, R. "A Critique of the Asset Pricing Theory's Tests." **Journal of Financial Economics** (March 1977), 129-176.

32. Roll, R. and S.A. Ross. "A Critical Re-examination of the Empirical Evidence on the Arbitrage Pricing Theory: A Reply." **Journal of Finance** (June 1984), 347-352.

33. Roll, R. and S.A. Ross. "An Empirical Investigation of the Arbitrage Pricing Theory." **Journal of Finance** (May 1980), 1073-1103.

34. Ross, S. "The Arbitrage Theory of Capital Asset Pricing." **Journal of Economic Theory** (December 1976), 341-360.

35. Sachlis, J.M. and J. A. Haslem. "Commercial Bank Capital Debt, Business Risk, and Stock Price." **Quarterly Review of Economics and Business** (December 1976), 1073-1103.

36. Shanken, J. "APT: Is It Testable." **Journal of Finance** (December 1982), 1129-1140.

37. Sharpe, W. "Capital Asset Prices: A Theory of Market Equilibrium Under Condition of Risk." **Journal of Finance** (September 1964), 425-442.

38. Theil, H. **Applied Economic Forecasting** (Amsterdam: North-Holland Publishing Company, 1966).

39. Yagill, J. "On Valuation, Beta, and the Cost of Equity Capital: A Note." **Journal of Financial and Quantitative Analysis** (September 1982), 441-449.

Adi S. Karna is Professor of Finance in the Department of Economics and Finance at Indiana University-Purdue University at Fort Wayne. Ghassem Homaifar is an Assistant Professor of Finance in the Department of Economics and Finance at Middle Tennessee State University. Duane B. Graddy is Professor of Finance in the Department of Economics and Finance at Middle Tennessee State University.