Test of a Stock Valuation Model: Discussion

Edwin J. Elton

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DISCUSSION

EDWIN J. ELTON:* As Professor Bower states, his paper represents a report on a major ongoing research project. Because of this, my comments will be comments on his model and tests, and refinements of these tests rather than a discussion of his results. Because of this preliminarity, I will also be discussing a number of issues that may well be resolved long before the final results are reported. Happily, Professor Bower has been very careful to describe his project in a good bit of detail. This makes the discussant's task easier and, hopefully, more meaningful.

I would like to discuss three aspects of this project;

1. Model development
2. Problems of multicollinearity.
3. Alternative research directions.

Professor Bower's model has familiar origins. He is assuming a finite horizon model. In other words, he assumes that the value of the firm is the present value of dividends up to a horizon year plus the price at the horizon year. Each firm is assumed to have a unique growth rate to the common horizon and all firms have the same characteristics after the horizon. Professor Bower then uses Lintner's (2) work to derive an expression for expected dividend in year t and the Lintner (3)- Sharpe (4) market equilibrium studies to derive an expression for the expected return. After these substitutions he has a complex non-linear relationship involving 10 variables. Five of these variables are assumed to be constant in a cross section (the horizon year and post horizon values) and are discarded. An additional variable growth is discarded because of regression results and three variables are added because he believes they affect the price-earnings ratio. A linear or log-linear approximation is then used to represent the complex relationship.

Because he used such an approximation, Professor Bower performs some preliminary testing that I found very interesting. Professor Bower performs a series of simulations in which he assumes that prices are determined by a finite horizon model and that the variables he assumed constant are in fact constant. He uses this simulation to determine the results he would get with his linear approximation. Although this simulation is useful in analyzing the reasonableness of the linear approximation for the variables derived from the finite horizon model, it provides no guidance as to the appropriate form for the variables that were not derived from this model but were added later. For example, consider the marketability variable. The argument for its inclusion is that firms with larger market values trade in a more perfect market and hence sell at a premium. Since there is no provision in the simulation for such effects, including this variable and finding it significant would simply indicate possible problems of multicollinearity or bias.

The main thrust of Professor Bower's study concerns which risk variables are important and, in particular, the relative importance of systematic and diversifiable risk. He has three variants of risk variables, overall variability of price, systematic and diversifiable risk and the intercept, slope and standard error of a regression relating the return of a security to the return of a market index. These variables he tests in three separate sets of regressions. When he introduces the intercept slope and

* Associate Professor of Finance, Graduate School of Business Administration, New York University.

standard error of the regression just described as variables in the equation explaining the difference in price-earnings ratios between securities he encounters problems. To see why, let's examine the theory he is using. Professor Bower is utilizing the work of Sharpe and Lintner on the pricing of risky securities. As they have shown, in equilibrium the return of a security above the risk free rate is directly proportional to the return of the market above the risk free rate, or in symbols

$$(\overline{RR} - I) = (RR_m - I) \frac{Cov(RR, RR_m)}{\sigma^2_{RM}}$$

Where

1. I is the return on the risk free asset.
2. σ^2_{RM} is the variance of the market return.
3. RR is the return on the ith security.
4. RR_m is the return on the market.

He then assumes that the only source of interaction between firms is a common response to a market index. Recall what this means. Professor Bower is running the following regression. The return of a security is equal to an intercept term α+ the slope term β times the return of the market plus an error term. Utilizing the Sharpe-Lintner equilibrium relationship derived earlier, we can estimate the intercept α. α has two terms. The first term is the risk free rate (I) times (1—slope term β). The second term is the return on the market over and above the risk free rate ($RR_m - I$) times the fraction of the total represented by the security under consideration (x) times the ratio of the variance of the securities return (σ_ϵ^2) divided by the variance of the market return (σ^2_{RM}). The crucial term in this expression is x, the fraction of the market represented by the security. Since any security represents a small fraction of the total market, this last term is very small relative to the first. Recall the first term is the product of the risk free rate and one minus the slope β. Since in any particular cross section the risk free rate is a constant, the intercept is almost directly proportional to one minus the slope.

The addition of the intercept term α into the cross section equations which already include the slope β has the expected results. The standard error of the regression coefficient of β increases in every cross section and increases by a large amount. Further, the coefficients of the α and β are not in the relationship one would expect. The coefficient of α is from 10 to 200 times as large as the coefficient of β. This is much larger than the risk free rate and much larger than could be accounted for by the second term. Such a distortion of the relationship is what one expects when estimates of the coefficients are obtained for variables as highly correlated as α and β.

Why then was the intercept term β ever used as a variable? Professor Bower is testing the relative importance of systematic and diversifiable risk. However, in the model he chose to use the only term that diversifiable risk enters is the intercept term α (it was part of the second term). However, here its influence is totally obscured by β. Professor Bower seems to be in a dilemma. He wants to examine the relative influence of systematic and diversifiable risk, but he can't because of multicollinearity between α and β and because diversifiable risk is overwhelmed by the influence of systematic risk in α. Let me suggest a solution to this dilemma. There are a number of equivalent forms for stating the Sharpe-Lintner equilibrium relationship. Other forms do not have this difficulty. For example, if he uses return above the risk free rate, the value of α will only depend on systematic risk which is the form he desires.

An enormous amount of time and money has been spent on testing valuation models. We have had small return on this investment. While it is useful to continue this research, the past record should indicate that we ought to redirect much of our effort. One of the problems that has plagued most researchers has been the instability of the parameters either across samples at a point in time, or between consecutive cross sections. In fact, the only study I know of where the parameters approach stability is Professor Bower's (1) in the *Journal of Political Economy*. One likely explanation for this instability is that the functional relationship between price and its determinants is different for different groups of firms and that traditional industry groupings are inappropriate. Professor Bower found indications of this in his study. He states that the residuals of certain groups seemed to follow the same pattern in consecutive cross sections. The traditional resolution of this problem is to assume firms with the same industrial code are part of a group for which the same equation will predict price or the price-earnings ratio. Since the SIC industrial code is based on final product, the assumption being made is that the final product is a suitable way for grouping firms. The logic for this grouping procedure has never been made explicit and is getting less sensible with the increase in the number of firms with diverse product lines. Alternative ways of grouping are possible. Professor Bower indicates one when he discusses grouping on the basis of the pattern of residuals. Since most such alternatives involve not a single variable such as final products but a number of variables or patterns of variables, rather complicated procedures are required.

For the last several years Professor Martin Gruber and myself have been working on such procedures. Hopefully, the results of our work and that of others working on the same problem will assist in removing some of the instability we observe in valuation models like Professor Bower's.

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