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The Federal Reserve's imputed cost of equity capital: A survey

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The U.S. Federal Reserve System provides services to depository financial institutions through the twelve Federal Reserve Banks. U.S. federal legislation, contained in the Monetary Control Act of 1980, requires the Federal Reserve Banks to price their services at a level that fully recovers their costs. The act specifically requires imputation of various costs that the Federal Reserve Banks do not actually pay, but that they would pay if they were commercial enterprises. Prominent among these imputed costs is a cost of capital, that is, a proxy for the cost of the debt and equity liabilities that a commercial enterprise would have to issue in order to finance its assets. The Federal Reserve has complied with the act by adopting an imputation formula for the overall cost of capital that combines separate imputations of costs of debt and equity. This *Chicago Fed Letter* provides a survey of the economic and statistical issues in imputing a cost of equity capital to the Reserve Banks and suggests a revised approach for doing so.[1]

Shortly after the Monetary Control Act was passed, the Federal Reserve formulated a Private Sector Adjustment Factor (PSAF) to quantify the costs that must be imputed to comply with the act. Currently, the Federal Reserve is considering possible revision of the PSAF. The goal is to adopt an imputation formula that will:

1. Provide a conceptually sound basis for economically efficient pricing;

2. Be consistent with actual Reserve Bank financial information;

3. Be consistent with economy-wide practice, and particularly with private-sector practice, in accounting and applied financial economics; and

4. Be intelligible and justifiable to the public, and replicable from information that can be obtained by the public.

The cost of equity capital used in the current implementation of the PSAF is estimated from a comparable accounting earnings (CAE) method. For each holding company (HC) in the specified peer group (currently, the largest 50 HCs by asset size), the estimate is calculated as the return on equity (ROE), defined as *ROE* = (*Net income*) / (*Book value of equity*). The individual ROE estimates are averaged to determine the average HC peer group ROE for a given year. For example, if the values of ROE for firms in the peer group were currently distributed uniformly between 15% and 25%, then the average ROE adopted for purposes of the PSAF would be 20%. A further complication is that, in order to smooth year-to-year fluctuations, the CAE estimate actually used in the PSAF for a given year is the average over the previous five years of these firm-average ROE measures.

The CAE method has been criticized for being "backward looking" since past earnings may not be a good forecast of expected earnings due to cyclical changes in the economic environment. As a firm makes its way through the business cycle, its earnings may rise above or fall below the trend line that might more accurately reflect sustainable economic earnings. A high ROE in the past does not necessarily imply that a firm's future ROE will remain high. A declining ROE might be evidence that the firm's new investments have offered a lower ROE than its past investments. The best forecast of future ROE in this case may be lower than the most recent ROE.

Therefore, one focus of efforts to meet the criteria for a revised PSAF is to take account of the scientific view that financial asset prices reflect market participants' assessments of future stochastic revenue streams has received strengthened statistical corroboration and general public acceptance. Quantitative models that reflect this view, rather than the backward-looking assessment implicit in the CAE method, have come into widespread use in investment banking and also for regulatory rate-setting in utility industries. We suggest an imputation formula that would average the estimated costs of equity capital from two such models, discounted cash flow (DCF) model and a capital asset pricing model (CAPM), together with the estimates from the CAE method. We show that the proposed approach would have provided stable and sensible estimates of the cost of equity capital for the PSAF over the past 18 years.

The theoretical foundation of corporate valuation is the DCF model, in which the stock price equals the discounted value of all expected future dividends. It is difficult to project expected dividends for all future periods. To simplify the problem, financial economists often assume that dividends grow at a constant rate, which they estimate from accounting statements. They assume that reinvestment of retained earnings generates the same return as the current ROE.

The assumption of a constant dividend growth may lead financial analysts to unreasonable estimates of the cost

of capital. However, the DCF model with multi-stage growth gives an economically meaningful and statistically robust estimate. We therefore recommend the implementation of the DCF model with multi-stage dividend growth rates for the cost of equity capital used in the PSAF.

A widely accepted financial model for estimating the cost of equity capital is the CAPM. In this model, the cost of equity capital (or the expected return) is determined by the systematic risk affecting the firm.

How much faith can we place in the CAPM model? First, few people quarrel with the idea that equity investors require some extra return for taking on risk. Second, equity investors do appear to be concerned principally with those risks that they cannot eliminate through portfolio diversification. The CAPM captures these risks in a simple way, which is why finance professionals find it to be the most convenient tool with which to grip the slippery notion of equity risk. Given that the CAPM is readily accepted in the private sector, we recommend that it be incorporated into the estimation of the cost of equity capital for the PSAF.

Although clearly related, the three methods for calculating the HC equity cost of capital are based on different assumptions, models, information sets, and data sources. The question of which method is "correct" or "most correct" is difficult to answer directly. We know that all models are simplifications of reality and hence misspecified, i.e., their results cannot be a perfect measure of reality. In certain cases, the accuracy of competing models can be compared with observable outcomes, such as reported HC earnings or macroeconomic announcements. However, since equity cost of capital cannot be directly observed, we cannot make clear quality judgements among our three proposed methods.

Recommendation

In light of this, we propose to calculate a simple measure of HC equity cost of capital that incorporates the three measures. Since one measure may contain some information not included in the others, it might be disadvantageous to ignore any one of them. The practice of combining different economic forecasts is quite common in the academic and practitioner literature; it is generally seen as a relatively costless way of combining overlapping information sets on an ex-post basis. We propose to combine our three measures within a given PSAF year using a simple average; that is, $ROE = [ROE(cae) + ROE(dcf) = ROE(capm)]/3$. We choose equal weights because we do not have a strong prior opinion about which model provides more accurate estimates.

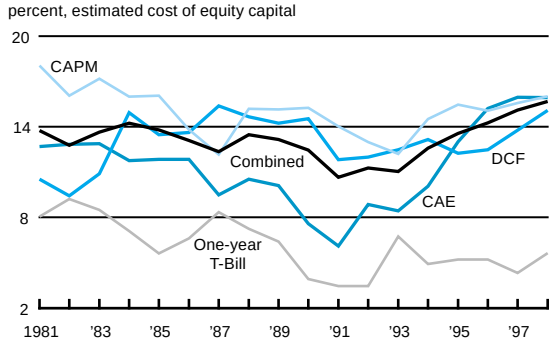
The combined measure has a mean value of 13.3% and a standard deviation of 1.34%. As expected, the averaging of the three ROE measures smooths this measure over time and creates a series with less variation than the three individual series (see figure 1). Individual differences between the combined and the individual measures range between +5% and –5% over this historical period; however, the average differences are less than 2% and cannot be said to be statistically different from zero. Note also that the deviations between the DCF and CAPM measures from the one-year risk-free rate (measured by the interest rate on a Treasury bill) are not as large as for the CAE measure due to their greater sensitivity to general market and economic conditions. This property is obviously passed on to the combined ROE measure through the averaging.

Our analysis assumes that calculation of the Reserve Banks' cost of capital would continue to be based on the largest 50 HCs. This choice was made, and will likely continue to be made, despite the knowledge that the services provided by Federal Reserve Banks are only a segment of the lines of business in which these HCs engage. Some of these lines of business (such as lending to firms in particularly volatile segments of the economy) intuitively seem riskier than the financial services that the Federal Reserve Banks provide. Moreover, there are differences among the HCs in the mix of activities in which they engage. These observations raise three related conceptual issues that we discuss below.

Three conceptual issues

The first conceptual issue regarding the HC sample is that the cost of a firm's equity capital should depend on the firm's lines of business and on its debt–equity ratio. A firm engaged in more risky activities (or, more precisely, in activities having risks with higher correlation to the overall risk in the economy) should have a higher cost of capital. There is some indirect, but perhaps suggestive, evidence that the Federal Reserve Banks' business activities may be less risky, on the whole, than some business lines of the largest HCs. Notably, the Federal Deposit Insurance Corporation has a formula for a risk-weighted capital/asset ratio. According to this formula, the collective risk-weighted capital/asset ratio of the Federal Reserve Banks would currently be 30.8%. This ratio is substantially above the average ratio in the HC sample.

1. Equity cost of capital estimates



Note: The Treasury bill rate is aligned with the PSAF year as defined in the text.

Source: Data provided by I/B/E/S International Inc.

A firm with a higher debt–equity ratio should have a higher cost of equity capital, other things being equal, because there is risk to equity holders in the requirement to make a larger, fixed payment to bondholders regardless of the random profit level of the firm. The imputed debt–equity ratio of the Federal Reserve Banks might not equal the average ratio for the HCs, if the imputed ratio were to be based on regulatory requirements rather than directly on the HC sample average. Such a difference would also lead to different conclusions on the imputed equity cost of capital of the Federal Reserve Banks.

The second conceptual issue is how to weight the 50 HCs in the peer group sample in defining their average cost of equity capital. Currently, the PSAF is calculated using an equally weighted average of the HCs' costs of equity capital according to the CAE method. An obvious alternative would be to take a value-weighted average, i.e., multiply each HC's cost of equity capital by its stock market valuation, and then divide the sum of these weighted costs by the total market valuation of the entire sample. Other alternatives, such as weighting the HCs according to the ratio between their balances due to other banks and their total assets could conceivably be adopted.

Equal weighting was originally adopted to mitigate defects of measurement in the CAE method. Those grounds do not apply with much force to the DCF and CAPM methods. In fact, value-weighted averaging is the standard procedure in studies using these methods. If an average of several estimates of equity cost of capital were to be adopted for the PSAF, there would not be any serious problem with using equal weighting to compute a CAE estimate, where that weighting scheme does some good, while using value weighting to compute DCF and CAPM estimates if value weighting would be preferable on other grounds. We recommend such a mixed procedure.

A final issue worthy of attention is that the equity cost of capital estimated via the CAPM method for some of the very largest HCs increased substantially in the mid-1990s due to increases in their sensitivity to market risk. Those increases might be suspected to be results of measurement error, and of course equal weighting would help to minimize them. However, an estimate of equity capital costs will be more credible if it is based on a weighting scheme that has been chosen ex ante on grounds of conceptual appropriateness, rather than on one that has been chosen with a view toward minimizing the influence of data that has already been observed. The recommendation to average several measurements of equity costs of capital is based on the idea that each method will be subject to some error, and that averaging across methods will diminish its influence. That is exactly what will happen if a value-weighted CAPM measure is averaged with two other measures that do not exhibit such marked differences between the very largest HCs and the other HCs in the peer group (i.e., all of the fifty largest ones) on which the PSAF is based.

To summarize, we propose a calculation of the PSAF cost of capital that would average the result of the current method (CAE) with those of two methods (DCF and CAPM) that are recommended by current theory and practice in financial economics. This proposal would help to achieve four goals that the Federal Reserve has articulated. Notably it would help to provide a conceptually sound basis for economically efficient pricing, and this basis would be consistent with academic and private-sector practice. Nevertheless some issues remain. These issues have to do with the inevitable situation that the Reserve Banks' lines of business do not correspond exactly to those of financial holding companies or other commercial firms.

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[1]This article is condensed from the authors' paper, "The Federal Reserve Banks' imputed cost of equity capital," issued as Federal Reserve Bank of San Francisco, working paper, No. 2001-01, to which readers are referred for a detailed treatment of the issues surveyed here. The paper is also available on the Web at www.frbsf.org/publications/economics/papers/2001/wp01-01.pdf. Zhenyu Wang worked on this project as a staff member at the Federal Reserve Bank of New York and a consultant to the Federal Reserve Bank of Boston. The authors are grateful to the members of the 2000 PSAF Fundamental Review Group, Paul Bennett, Eli Brewer, Simon Kwan, and Hamid Mehran for valuable comments and helpful discussions. The authors thank Adam Kolasinski and Ryan Stever for carrying out the many calculations needed for this study and for contributing to the technical appendix. The authors also gratefully acknowledge I/B/E/S International Inc. for providing earnings per share forecast data, available through the Institutional Brokers Estimate System, to Martin Haugen for providing the historical PSAF numbers, and to Eli Brewer for providing data on mergers of bank holding companies during the sample period.

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Tracking Midwest manufacturing activity

Manufacturing output indexes (1992=100)

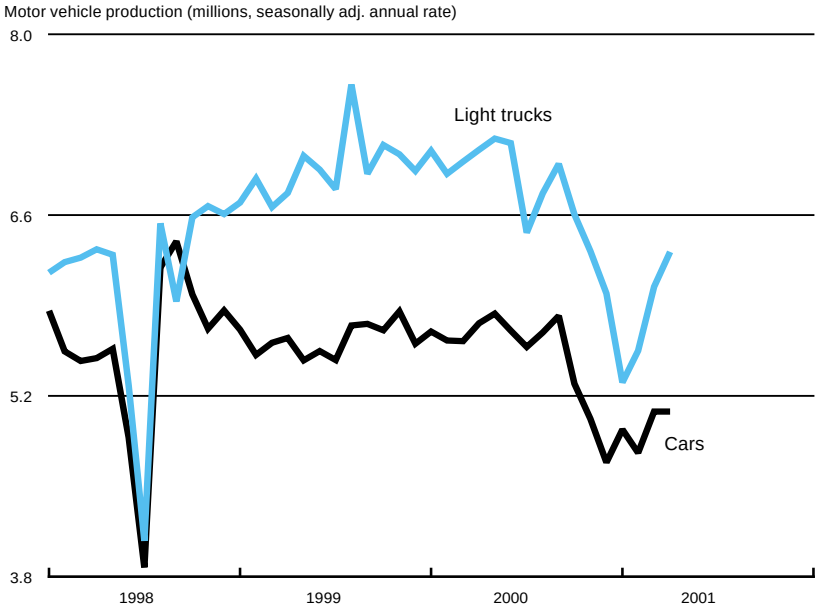
	Apr.	Month ago	Year ago
CFMMI	157.3	160.9	167.0
IP	149.8	150.3	152.2

Motor vehicle production (millions, seasonally adj. annual rate)

	Apr.	Month ago	Year ago
Cars	5.1	5.1	5.8
Light trucks	6.3	6.0	7.1

Purchasing managers' surveys: net % reporting production growth

	May	Month ago	Year ago
MW	43.8	40.5	55.1
U.S.	42.7	42.9	56.3



Auto production was at 5.1 million units in both March and April; while light truck production increased from 6.0 million units in March to 6.3 million units in April. The CFMMI fell 2.2% from March to April, reaching a seasonally adjusted level of 157.3 (1992=100). Revised data show the index was at 160.9 in March and had fallen 0.5% from February. The Federal Reserve Board's IP for manufacturing fell 0.3% in April after falling 0.2% in March.

The Midwest purchasing managers' composite index for production increased to 43.8% in May from 40.5% in April. The purchasing mangers' index increased in Chicago, Milwaukee, and Detroit, with the largest increase in Detroit. By comparison, the national purchasing managers' survey edged down from 42.9% to 42.7%.

Sources: The Chicago Fed Midwest Manufacturing Index (CFMMI) is a composite index of 16 industries, based on monthly hours worked and kilowatt hours. IP represents the Federal Reserve Board's Industrial Production Index for the U.S. manufacturing sector. Autos and light trucks are measured in annualized units, using seasonal adjustments developed by the Board. The purchasing managers' survey data for the Midwest are weighted averages of the seasonally adjusted production components from the Chicago, Detroit, and Milwaukee Purchasing Managers' Association surveys, with assistance from Kingsbury International, LTD., Comerica, and the University of Wisconsin–Milwaukee.

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