IMPLEMENTING EBO/EVA® ANALYSIS IN STOCK SELECTION

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The concept of measuring a firm's anticipated wealth creation abilities has become the focus of much attention by both researchers and practitioners alike. Stern and Stewart (see Stewart [1991]), Edwards and Bell [1961], Ohlson [1995], and Frankel and Lee [1995] are among those who have addressed this issue. Many firms are adopting strategies made popular by the concept of economic value-added to align the interests of their employees with those of shareholders (see Tully [1993]).

Instead of using a dividend discount approach, these models measure value from the point of view of the firm's capacity for ongoing wealth creation rather than simply wealth distribution. While economic value-added pertains to both equity investors and debt holders, Edwards and Bell and Ohlson approach valuation from the perspective of the stockholder by focusing on *residual income* to equity investors only.

A primary objective of these models is to measure a firm's ability to generate *abnormal earnings*, that is, earnings in *excess* of its cost of capital for each period going forward. A firm's abnormal earnings for a given period t and cost of capital r can be stated as:

$$\text{Abnormal Earnings} = \text{Earnings} - (r \times \text{Capital}_{t-1}) = (\text{Return on Capital} - r)\,\text{Capital}_{t-1}$$

For example, a firm with a capital base of \$100 million and an associated cost of capital of 10% that generates 12% in profits on capital is said to have \$2 million in abnormal earnings. This is simply \$12 million in net income minus the \$10 million capital charge. The terms *abnormal earnings* and *residual income* are often used interchangeably, a practice followed in this article.

Residual income models compute an intrinsic value for each firm by combining its capital base, or book value, with the firm's cumulative present value of its anticipated future abnormal earnings. The firm's book value for each period is determined according to the *clean surplus accounting relationship*, which assumes that all changes in book value are determined by earnings and dividends (net of additional investments by owners in the firm). Thus, the derived book value in each period becomes the hurdle rate that the firm needs to overcome to generate positive abnormal earnings for the given period. By taking the ratio of each firm's intrinsic value to its market price within a given universe, we are able to generate percentile rankings for their securities.

Firms create wealth for their shareholders in numerous ways. They:

- Generate increased profits with existing capital.
- Maintain the same level of profitability while reducing required capital.

- Invest capital in high-return projects.
- Reduce cost of capital.

It is easy to see that the basic underlying theme is to do more with less.

We first discuss the Edwards-Bell-Ohlson [1961, 1995] (EBO) model and then the methodology used in the residual income valuation model (RIVM) introduced in this study. RIVM distinguishes itself from other residual income models in three ways:

1. It uses balance sheet and other financial data to modify each firm's book value, or capital base, to be more reflective of economic reality.
2. The data determine each firm's competitive advantage period, that is, the time until which it is anticipated that the firm will cease generating positive abnormal earnings.
3. It refines the traditional capital asset pricing model (CAPM) approach to computing a firm's cost of capital.

The EBO Valuation Model

The standard EBO model requires five inputs:

- Book value.
- FY1 and FY2 consensus earnings forecasts.
- Long-term consensus earnings growth rate.
- Cost of capital.
- Dividend payout ratio.

These inputs are used to compute the firm's expected *abnormal earnings*, which are its earnings in excess of cost of capital, in future years. The expected abnormal earnings are then discounted at the firm's cost of capital, which, when combined with the firm's book value, determines its intrinsic value.

Thus, in implementation of the standard EBO model, a firm's current intrinsic value (EBO_0) is defined as:

$$EBO_0 = B_0 + \sum_{t=1}^{\infty}[(EPS_t - rB_{t-1})(1+r)^{-t}] \quad (1)$$

subject to the clean surplus accounting relationship

$$B_t = B_{t-1} + EPS_t - DIV_t \quad (2)$$

where for each firm

B_0 = the book value at the beginning of year 1;
EPS_t = the expected earnings in year t;
r = the cost of equity capital;
B_{t-1} = the firm's book value at the beginning of year t; and
DIV_t = dividends paid out in year t.

Each firm's *earnings* are based on consensus analyst projections for fiscal years 1 and 2, together with the consensus expected long-term rate of growth (LTGR) over the next five years. These inputs are used to calculate the firm's future earnings per share. For years 1 and 2, the firm's earnings are presumed to equal the consensus projections, with an adjustment made to account for the time remaining in fiscal year 1 from the valuation date.

In years 3 to 7, earnings are assumed to grow at the consensus projected long-term growth rate (LTGR) such that $EPS_{t+1} = EPS_t\,(1 + LTGR)$. In the EBO model, the dividend *payout ratio* (P) of a firm's earnings is presumed to equal the payout ratio in effect on the evaluation date.

It is easily seen that the clean surplus accounting relationship can also be stated as

$$B_t = B_{t-1} + (1 - P)\,EPS_t \quad (3)$$

It then follows that subsequent book values can be expressed by the equation

$$B_{t+1} = B_t\,[1 + (1 - P)\,ROE_{t+1}] \quad (4)$$

where ROE is the firm's return on equity.

Since the EBO model is an infinite-horizon model, its implementation requires the term ($EPS_t - rB_{t-1}$) in Equation (1) to become fixed from some period t going forward (see Frankel and Lee [1995] and Lee [1996]). This creates a perpetuity from which a terminal value for years t to infinity can be computed. The firm's intrinsic value is then equal to the sum of the present values for years 1 to t – 1 plus the terminal value computed for years t to infinity. The year in which the literature invokes the perpetuity assumption is generally the same for all stocks in the universe under evaluation.

Invoking a perpetuity assumption is mathematically convenient, but in our view not reflective of economic reality. First, not all firms are in the same stage of maturity. Smaller-capitalization growth firms, for example, may be able to maintain their competitive advantage and generate higher abnormal returns for longer periods of time than mature firms.

More specifically, a firm that happens to still be generating abnormally high earnings relative to a small capital base during the period in which the perpetuity is initiated will, by this assumption, be able to maintain abnormally high earnings in perpetuity. This, of course, is unrealistic since firms that do have an advantage will eventually see that advantage disappear as entry by competitors will drive abnormal profits to zero.

The flip side of this scenario also presents problems. Consider a firm that is earning unusually small returns relative to a large capital base, and that is thus not able to achieve earnings in excess of its cost of capital. In this case, the firm's abnormal earnings are negative and, therefore, subtracted from the capital base in each period. In reality, again, this cannot continue indefinitely. If the firm is not able to manage its own affairs effectively, outsiders will step in and restructure the firm in a manner designed to prevent good capital from being wasted.

THE RESIDUAL INCOME VALUATION MODEL (RIVM)

The RIVM addresses the concerns related to the infinite version of the model. It requires use of additional balance sheet data, but, given the easy availability of financial data bases and computers, this does not present a problem. We will then be in a position to evaluate large universes of stocks at a given time with essentially no sacrifice in terms of coverage of firms.

Instead of arbitrarily assigning a period in which the perpetuity is to be initiated, the data determine each firm's unique competitive advantage period (that is, the time until the firm is anticipated to no longer be able to generate positive abnormal earnings). The RIVM relies on the earlier period, the years in which we can have more confidence in terms of the data and assumptions being made.

An important component of the model is beginning capital, or book value. In January 1998, at the time of this writing, the price-to-book ratio for the S&P 500 is about five-to-one. Moreover, historically the price-to-book ratio for the market, except for several years in the mid-seventies, has always exceeded one (see Stober [1996]). This indicates that book value accounting is conservative and *not* unbiased.

There could be many reasons that might explain this phenomenon. As an example, firms often write off goodwill immediately upon the completion of an acquisition as "purchased research and development" (see MacDonald [1996]). This has the effect of reducing book value and making subsequent earnings relative to a smaller book value appear better in terms of return on equity. This could manipulate the way the firm's future earnings are perceived. One needs to examine the treatment of trademarks, patents, and other intangibles, and consider certain assets, such as valuable airline routes, for example, whose value may not always be fully reflected according to book value accounting.

RIVM examines each firm and uses balance sheet data to adjust its beginning book value. We first recognize the fact that the assets making up a firm's book value are not all the same. Some assets decline in value over time, while others maintain their value or even appreciate over time. Land, for instance, is an asset that typically would not be expected to decline in value. Each firm's *perpetual value assets* (PVA), or those assets that in combination are typically not expected to diminish in value over time, are separated out from book value.

We use the term *operating capital* to refer to the remaining portion of book value once PVA is removed. Thus, these two subsets are mutually exclusive and collectively exhaustive.

By recognizing that operating capital and PVA accounting conventions can vary from firm to firm, by sector, and over time, we see that we also need to examine the firm's operating capital in addition to its PVA. This is accomplished using historical returns on equity where we derive normalized adjustment factors with which to multiply the operating capital component of a firm's book value (see Fridson [1995]).

Each firm's future stream of anticipated abnormal earnings is discounted back to the present according to a rate presumed to be the return that the equity shareholder would require for the particular firm commensurate with its risk. This rate, referred to as the firm's *cost of capital*, is generally computed using a CAPM, or capital asset pricing model, approach (see Copeland, Koller, and Murrin [1994]).

The RIVM cost of capital is determined using a methodology that is a refinement of the standard CAPM approach, and is defined by the equation:

$$r = r_f + \beta(r_p + s) \tag{5}$$

where

r = firm's cost of equity capital;
r_f = risk-free rate using a ten-year U.S. Treasury note;
β = firm's weighted average of sixty- and six-month betas;

r_p = expected equity risk premium based on market geometric mean returns; and
s = market capitalization adjustment factor.

The rationale for using the ten-year Treasury note for the risk-free rate rather than the more commonly used thirty-year long bond is that the duration of the ten-year note is more reflective of the cash flows we are measuring. The reason for using a weighted average of six-month and sixty-month betas is to capture both short-term and long-term movements in the market. For example, if gold prices have been fairly dormant for a long period of time and then all of a sudden become very active, this will be reflected in the weighted average beta while overlooked with just the sixty-month beta.

We also modify the equity risk premium by making firm-specific logarithmic adjustments based on market capitalization (see Ibbotson [1996]). Thus large market capitalization firms get lower costs of capital, while small firms get higher ones. This is consistent with the intuition of what shareholders would expect as a rate of return according to the risk being undertaken.

We define a firm's intrinsic value according to the primary equation of the RIVM:

$$RIV_0 = PVA + b_0 + \sum_{t=1}^{T}(EPS_t - rb_{t-1})(1+r)^{-t} \quad (6)$$

subject to the clean surplus accounting relationship

$$b_t = b_{t-1} + EPS_t - DIV_t \quad (7)$$

where for each firm

PVA = perpetual value assets;
T = the last year the firm is anticipated to have positive abnormal earnings;
EPS_t = expected earnings in year t;
r = cost of equity capital;
b_{t-1} = adjusted book value at the beginning of year t; and;
DIV_t = dividends paid out in year t.

This equation differs from Equation (1) for the EBO model in several ways. It

- Uses each firm's specific perpetual value assets instead of implicitly assuming that PVA equals zero.
- Applies normalized adjustment factors to the operating capital component of book value.
- Goes out only a finite number of periods, to each firm's own specific competitive advantage period as determined by the data.
- Applies adjustments to each firm's cost of capital on the basis of the firm's market capitalization.

In essence, the RIVM uses firm capitalization and balance sheet and income statement data inputs in addition to the same five inputs of the EBO model. The model also assumes that subsequent to the long-term growth period, earnings growth decays to a typical perpetual growth rate, and that during this same period the firm's payout ratio decays to a long-term perpetual rate linked to the payout ratio of the Dow Jones Industrials.

BACKTEST PERFORMANCE RESULTS

According to the literature, residual income models provide the best results for three- to four-year holding periods (see Frankel and Lee [1995]). We performance test the RIVM on the DAIS top 1,000 universe from March 1985 through March 1997 for an entire spectrum of holding periods ranging from one month to four years.

The RIVM is used to generate historical intrinsic values for the firms in the universe. Then, by taking the ratio of each firm's intrinsic value to its market price and computing z-scores, percentile ranks are determined and the stocks assigned to quintiles accordingly. Equally weighted portfolios are constructed on the last day of each period. The results we present are based on mean returns for all the portfolios constructed for the given holding period.

Performance is measured each month for the one-month holding period, and each quarter for the longer holding periods. We assume that trading occurs at closing prices and ignore transaction costs. For the longer holding periods, the transaction costs would not be very significant. Transition matrices are provided to serve as an indication of turnover and potential transaction costs.

Cumulative returns are calculated for consecutive one-month holding periods over the sampling period, March 1985 through March 1997. The monthly holding-period cumulative returns for quintiles 1 to 5 are illustrated in Exhibit 1. It is evident that the quintile returns are purely monotonic.

Exhibit 2 shows the one-month holding-period cumulative returns for the first and last deciles, together with the top 1,000 universe. It is

EXHIBIT 1
RIVM QUINTILES 1 TO 5 FOR TOP 1,000 UNIVERSE — ONE-MONTH HOLDING PERIOD FROM 8503 TO 9703

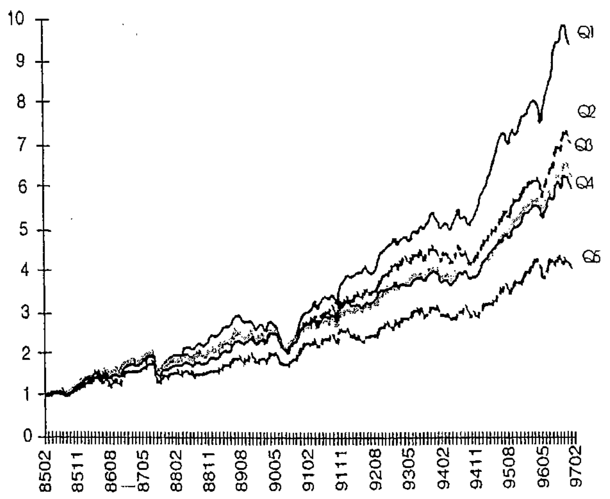
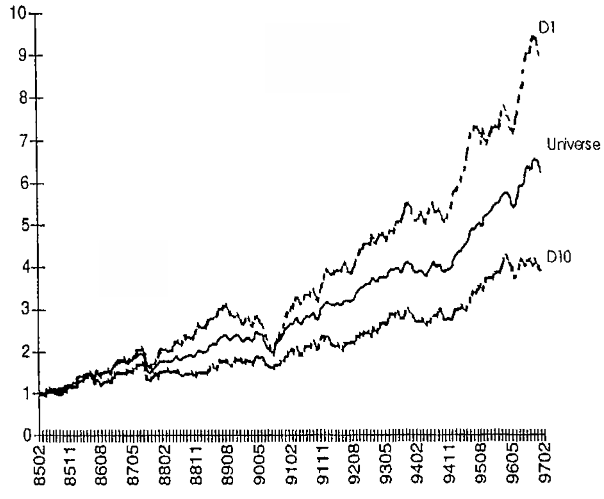


EXHIBIT 2
RIVM D1, UNIVERSE, AND D10 FOR TOP 1,000 UNIVERSE — ONE-MONTH HOLDING PERIOD FROM 8503 TO 9703



evident that the average D1 returns far exceed those of the universe, while the universe returns far exceed the D10 returns.

RIVM essentially favors the firms whose stock prices appear inexpensive relative to analysts' positive outlook for earnings and growth. It turns out that the RIVM has been adept in this stock selection process over the past twelve years. A key measure of the robustness of a stock selection model is the degree of monotonicity associated with the returns of quintiles 1 to 5.

We compute average quintile returns relative to the top 1,000 universe for holding periods ranging from one month to four years over the sampling period, March 1985 through March 1997. The results are presented in Exhibit 3.

The downward-sloping surface illustrates the model's strong propensity toward monotonicity in terms of quintile returns. The rank information coefficients, which measure the correlation between ranking and subsequent stock returns, range from 0.027 to 0.136 and increase monotonically with the length of the holding period. The T-statistics measure the significance of the IC or correlation coefficients.

Exhibits 4 and 5 display annualized mean returns for Q1 minus Q5 and D1 minus D10 for holding periods ranging from one month to four years. The mean D1 minus D10 returns exceed the mean Q1 minus Q5 returns for all holding periods examined. It is also notable that both sets of return differences demonstrate similar patterns with best results for the very short (one-month) and very long (three- to four-year) holding periods. The annualized average Q1 minus Q5 returns range from a low of 3.58 (one-year holding period) to a high of 8.03 (one-month holding period), while the corresponding decile return differences range from a low of 4.74 to a high of 8.37 for these two holding periods.

The "weighted frequency positive" metric combines the frequency of generating positive returns with the weighting of each observation according to the magnitude of the given return. Thus, for example, if the only two returns are +4.0 and −1.0, then the frequency positive that assigns equal weights to outcomes regardless of magnitudes would be 50% and the weighted frequency positive 80% [4/(4 + 1)]. The range of weighted frequency positive for Q1 minus Q5 is 67.2 (six months) to 98.8 (three years), while the corresponding range for D1 minus D10 is 67.9 (six months) to 98.6 (three years).

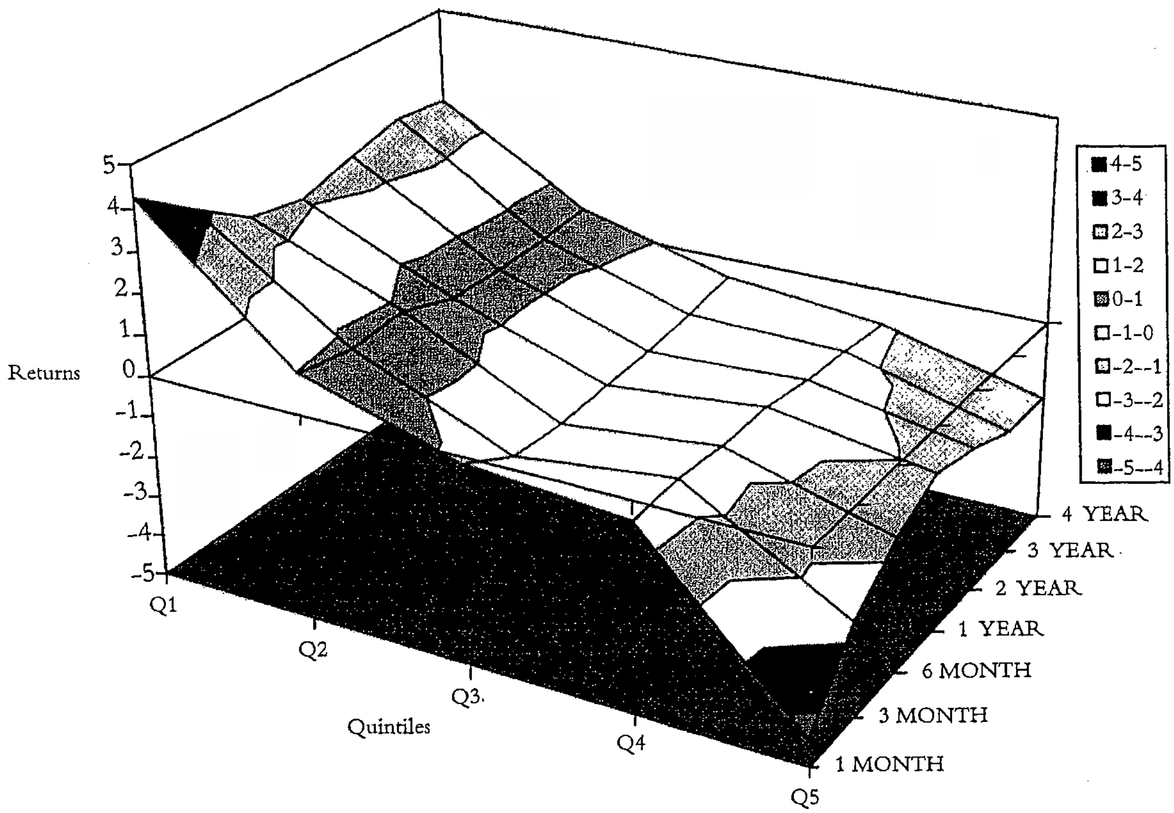
Exhibits 6 and 7 show that use of PVA provides better backtest performance than the model not using PVA for six of the seven holding periods. (The exception is the two-year holding period, where the no-PVA slightly outperforms, 4.46 to 4.33.) Also, not making the size adjustment to the equity risk premium within the cost of capital calculation yields slightly better returns for the one- and three-month holding periods, but does worse than the RIVM for the other five holding periods.

Exhibits 8 and 9 address the issue of potential turnover within a portfolio. The three-month quintile transition matrix displays the probabilities of moving from one quintile to another after three months. For example, a stock in Q2 has a 4.56% chance of being in Q4 three months later.

Since the quintile a stock finds itself in is a function of intrinsic value divided by market price, quickly moving from Q1 to a lower quintile is generally very desirable from a RIVM perspective. This is because the primary cause of such a move is price appreciation.

As can be seen from the matrix, 74% of the stocks from Q1 show up in Q1 three months later, while a comparable 73% of the stocks in Q5 are in Q5 three months later. It will frequently be the case that the superior returns will be achieved by the stocks in the group of 26% that move out of Q1 after three months. Typically, the longer the holding

EXHIBIT 3
RIVM Annualized Average Returns Across Quintiles Relative to the Top 1,000 Universe for Different Holding Periods



Holding Period	Q1	Q2	Q3	Q4	Q5	Rank IC	T-Stat
1 Month	4.21	0.97	−0.17	−0.47	−4.39	0.027	0.72
3 Month	3.27	0.77	−0.91	−0.39	−2.68	0.035	0.95
6 Month	2.37	0.87	−0.98	−0.53	−1.70	0.039	1.04
1 Year	2.11	0.41	−0.90	−0.47	−1.14	0.044	1.16
2 Year	2.49	0.39	−0.87	−0.65	−1.41	0.073	1.91
3 Year	2.80	0.42	−0.68	−0.76	−1.90	0.113	2.95
4 Year	2.64	0.51	−0.49	−0.89	−1.92	0.136	3.49

EXHIBIT 4
RIVM Quintile 1 versus Quintile 5 — Top 1,000 Universe from 8503 to 9703

Holding Period	Annualized Mean Return	Std. Dev.	Weighted Frequency Positive
1 Month	8.031	8.718	71.1%
3 Month	5.792	9.552	70.1%
6 Month	3.758	10.57	67.2%
1 Year	3.576	9.584	71.6%
2 Year	4.332	9.680	82.9%
3 Year	5.664	9.031	98.8%
4 Year	5.736	8.074	98.6%

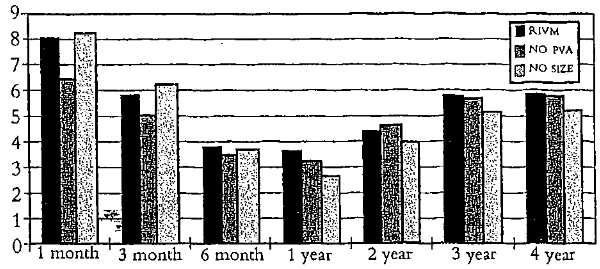
EXHIBIT 5
RIVM Decile 1 versus Decile 10 — Top 1,000 Universe from 8503 to 9703

Holding Period	Annualized Mean Return	Std. Dev.	Weighted Frequency Positive
1 Month	8.372	11.08	69.5%
3 Month	7.329	12.26	70.7%
6 Month	4.902	13.40	67.9%
1 Year	4.741	12.34	73.7%
2 Year	5.849	10.98	88.3%
3 Year	7.013	9.47	98.6%
4 Year	6.877	10.73	96.4%

EXHIBIT 6
Quintile 1 versus Quintile 5 Mean Returns — Top 1,000 Universe from 8503 to 9703

Holding Period	RIVM	No PVA	No Size Adjustment
1 Month	8.031	6.298	8.156
3 Month	5.792	4.919	6.176
6 Month	3.758	3.359	3.611
1 Year	3.576	3.063	2.518
2 Year	4.332	4.462	3.865
3 Year	5.664	5.580	4.988
4 Year	5.736	5.614	5.069

EXHIBIT 7
RIVM, No PVA, and No Size Adjustment Comparison — Quintile 1 versus Quintile 5 — Top 1,000 Universe



period, the greater the likelihood of stocks moving out of quintile 1.

The diagram in Exhibit 9 illustrating decile transition probabilities after three months shows similar results. That is, there is less likelihood of shifting when a stock is closer to one of the extremes.

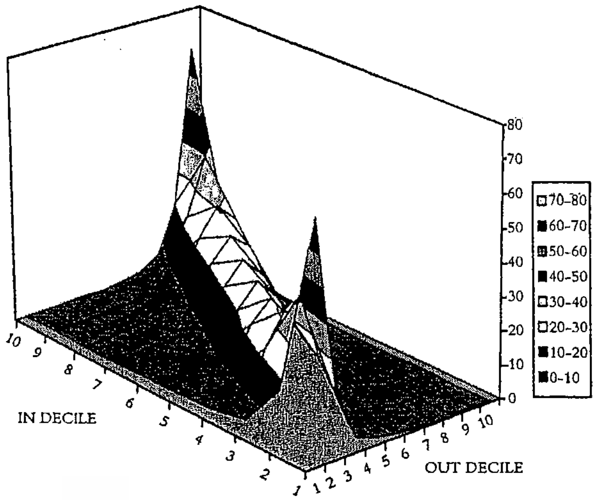
Exhibit 10 illustrates the three-month holding-period performance of the RIVM on an individual sector basis. As one would expect, the average of the Q1 minus Q5 returns for the more homogeneous sector subgroupings is greater than for the universe as a whole. We also find that the better-performing sectors in the model are the ones with the more reliable earnings. Sectors consisting of more speculative firms such as health and technology do not fare as well.

The correlation of RIVM to other models (book-to-price, earnings-to-price, yield, dividend discount model, and return-on-equity) is shown in Exhibit 11. Of the models examined, book-to-price correlates most closely with RIVM. Exhibit 12,

EXHIBIT 8
Three-Month Quintile Transition Matrix — Top 1,000 Universe from 8503 to 9703

	3 Months Later				
Begin	Q1	Q2	Q3	Q4	Q5
Q1	74.03	20.31	3.77	1.29	0.61
Q2	19.26	52.87	22.56	4.56	0.76
Q3	4.38	23.25	47.51	22.05	2.81
Q4	1.31	4.93	22.79	51.54	19.43
Q5	0.63	1.29	4.06	20.87	73.16

EXHIBIT 9
DECILE TRANSITION PROBABILITIES AFTER THREE MONTHS

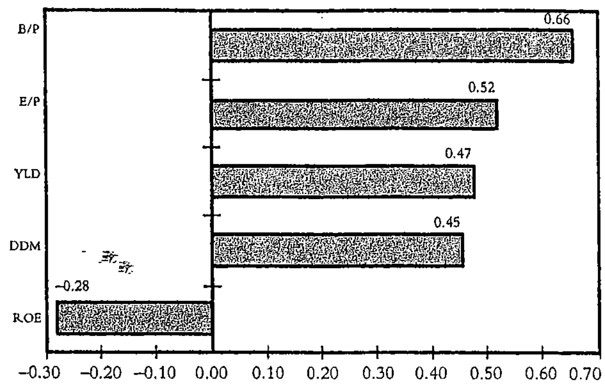


therefore, compares the performance of RIVM to a book-to-price strategy. Stocks are sorted according to their ratios of book-to-price, with the superior ranks assigned to the higher ratios. RIVM outperforms B/P for all the holding periods tested.

CONCLUSIONS

RIVM uses an intuitive approach to arrive at a firm's intrinsic value. This is accomplished by

EXHIBIT 11
CORRELATION BETWEEN RIVM AND OTHER MODELS — TOP 1,000 UNIVERSE FROM 8503 TO 9703



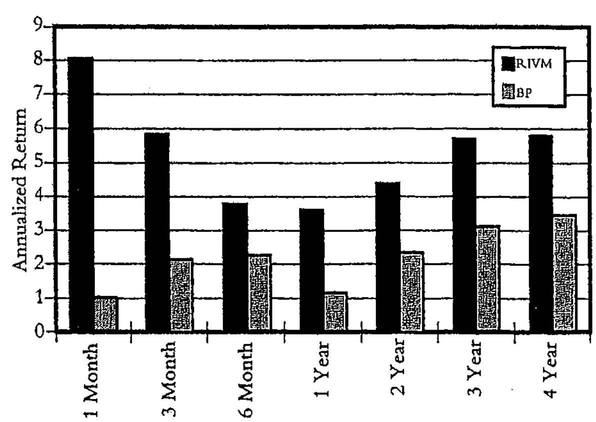
examining attributes that are instrumental in the firm's ability to create wealth on an ongoing basis. Inputs to the model include book value, earnings and growth estimates, dividends, cost of capital, and other balance sheet data. The use of perpetual value assets and the treatment of book value along with a refined CAPM methodology for computing cost of capital are important innovations of the model. Moreover, the RIVM allows the data to determine each firm's competitive advantage period.

Backtesting for the period March 1985 through March 1997 for holding periods ranging

EXHIBIT 10
RIVM SECTOR PERFORMANCE Q1 VERSUS Q5 FROM 8503 TO 9703 FOR THREE-MONTH HOLDING PERIODS

SECTOR	MEAN	STD. DEV.
Energy	9.99	15.80
Financial	9.27	11.70
Capital Goods	7.98	11.84
Transportation	7.98	15.34
Utilities	7.03	8.73
Basic Materials	6.87	16.21
Con. Cyclical	6.12	11.95
Con. Services	5.36	19.99
Technology	4.91	18.16
Con. Staples	2.44	11.74
Health	–1.71	16.21

EXHIBIT 12
COMPARISON OF RIVM AND BOOK-TO-PRICE STRATEGIES — ONE-MONTH TO FOUR-YEAR HOLDING PERIOD — Q1 VERSUS Q5 FOR TOP 1,000 UNIVERSE



from one month to four years confirms the literature that the optimal holding period for residual income models is three to four years, but superior performance is also found for short-term holding periods, even for three months or shorter.

Quintile returns are generally monotonic for all holding periods. Decile 1 minus decile 10 returns outperform quintile 1 minus quintile 5 returns for all the holding periods tested. The weighted frequency positive metric ranges from 67.2% (Q1 minus Q5 for the six-month holding period) to 98.8% (Q1 minus Q5 for the three-year holding period).

Thus, for the twelve-year period of the back-test, RIVM appears to have been very effective in uncovering firms whose stock is underpriced when considered in conjunction with expectations for strong earnings and growth.

ENDNOTE

The author wishes to express his appreciation to the members of The DAIS Group for their tireless effort during the development of the model. He is grateful to Larry Brown, James Guo, Ashish Malhotra, Vito Renna, and Aram Schlosberg for their assistance, and he thanks Hans Erickson for helpful comments.

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