Change and Firm Valuation in U.S. Food Retailing and Manufacturing

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The competitive environment in the agri-food sector is evolving as the food manufacturing and retailing industries become more concentrated. Evolving industry structure and new firm investment portend changes in future firm competitiveness and performance. This research describes how large food-manufacturing and retail firm performance has shifted and how firm valuation signals expected future change in performance. While there have been expectations that return on investment of large food retailers would increase relative to large packaged-food manufacturers, we find that this has not yet happened and that market valuations imply that retailers are not likely to gain on manufacturers in the future.

Consolidation and structural change garner considerable media attention and raise policy concerns about market structure and its implications for consumers and producers (Kaufman 2000b, 2000a). In response, firms stress potential efficiencies and heightened competitive forces as a motivation for consolidation (Kaufman 2000b). For example, continued expansion of Wal-Mart in the retail grocery business has increased expected competitive pressure on established grocery retailers (Hamstra 2002). The Wal-Mart model of large-scale procurement and use of supply-chain-management practices has likely increased buying efficiencies and bargaining power vis-à-vis agricultural and grocery suppliers.

Major organizational changes taking place within the industry may not have had their full impact on firm performance, however. These developments could lead to improvements in future firm competitiveness and performance over performance to date. We estimate the impact of these changes on future investment opportunities and expected performance according to how competing firms are valued. Estimating expected performance from market valuations is based on the efficient-markets hypothesis whereby capital markets effectively incorporate information about expected future performance into firm valuations. Value is the central financial incentive both for investors that allocate capital among firms, and for firm managers that employ capital. Firm managers compete to attract investors' capital by strategically or opportunistically investing to improve competitiveness and financial performance. As firms improve performance and grow, they enhance their capacity to pay dividends to investors, increase market value, and therefore increase investor returns and the attraction of new investment capital. Firms' expected future profitability as reflected in market values can inform us of expected changes in profitability relative to historic norms and of what may result from a changing business environment.

This study measures how the expected future performance of large food retailers and manufacturers, as reflected in market values, is expected to change relative to measured performance over recent years. In the early 1990s there was a belief that large packaged-food manufacturing firms' pricing power with high-margin brand products was weakening and that retailers would start to gain bargaining power with their packaged-food manufacturer-suppliers (Weston and Chiu 1996). Retailers were also expected to gain power in market channels from consumer information gleaned from scanner data on retail purchases and by becoming larger through consolidation (Kinsey 2000). Although the financial performance of major public U.S. food retailers has not yet improved relative to major packaged-food manufacturers, it is possible that the acceleration in retail consolidation or advances in information technology and productivity have not yet had their full effect. We hypothesize that future retail profitability will improve relative to those of manufacturers. Our approach is to examine *expected* firm performance by analyzing capital-market valuations of publicly traded major food manufacturers and retailers. In this manner we can test hypotheses concerning the impact of recent developments on future performance. The tests will

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not reveal whether changes in retail firms *cause* changes in manufacturer profitability, however. It is possible that retailer profitability could improve other than at the expense of manufacturers, and that both retailer and manufacturer profitability could change in the same direction. We instead test whether hypothesized changes are occurring, thereby informing the overall debate.

Firm Performance and Value

Firm value reveals the collective market evaluation of a firm's competitiveness and future profitability. Profitability is derived from a firm's distinct capabilities such as marketing expertise and effective use of brand names, efficient production means, technology, research and development capability, and managerial skill. Distinct capabilities derived from organizational, knowledge-based assets are intangible, but valuable for their power to generate profits and growth. Such organizational assets constitute intangible capital: organizational value in excess of the value of short-term and fixed assets.

While tangible capital can generally be duplicated across firms, intangible capital distinguishes a firm's competitive nature. Shifts in societal demands can draw on different intangible assets and shift valuations of a firm's intangible capital, such as the value of a brand name. A firm's competitive position may also change in relation to shifts in the business environment, typically sooner than firms change their internal operations, strategy, or actual performance. This results in the market revaluing a firm sooner than the firm can institute internal change that adjusts to the changed environment. Furthermore, many factors that underlie firm competitiveness, such as management quality, are tacit and cannot be measured (Jacobson 1992; Nelson 1995; Waring 1996; Jacobson and Hansen 1997). Even though competitive factors important to success are often tacit, capital markets generally are aware of them and value them accordingly.

Firm Performance

We assess firm profitability performance by measuring return on investment (ROI). Return on investment is a comprehensive measure of real firm performance that accounts for all costs including strategic and managerial resources, marketing, and overhead not allocated to firm business segment markets. In contrast, an economic rate of return relates an investment to all of its discounted cash flows over the life of the investment. It is not possible to measure a firm's economic rate of return over regular historical intervals because at any given time a firm is a composite of multiple investments at varying stages (Fisher and McGowan 1983). Thus economic rate of return can only be measured at the completion of an investment project (or termination of a firm). We must instead measure historical return on investment over sequential intervals as periodic signals of economic rate of return and the most useful measure of business performance (Jacobson 1987; Fama and French 2000a). Return on investment is therefore a tractable, periodic measure rather than a pure economic rate of return. We estimate average expected future return on investment and evaluate how it is expected to change from past performance.

Return on investment (ROI) is the most stable and comprehensive firm-profitability gauge, and single most important driver of firm value (Fama and French 2000a; Copeland, Koller, and Murrin 2000, p. 157; Cottle, Murray, and Block 1988, p. 160). ROI measures the ratio of operating profits to invested capital (e.g., Brealey and Meyers 2000, p. 834):

$$\text{ROI} = \frac{\text{Net operating profit}}{\text{Beginning invested capital}}$$

A firm's invested capital represents its accumulated depreciated investments in tangible assets, including working capital, fixed assets, and other tangible assets employed in the firm's operations to generate sales and operating profits. Because it cannot be measured directly, a firm's greater intangible capital (excluded from the denominator) that generates operating profits will thus be reflected in higher ROI. Return on investment depends on accounting assumptions of fixed-asset depreciation and inflation. Returns also depend on the lumpiness of fixed-asset investments and on the "time shape" of cash inflows generated by the investments (Fisher and McGowan 1983). For example, an enterprise may have higher undepreciated invested capital balances or yield lower benefits in the early, less-profitable stage of an investment, and yield higher returns in the later stage. Accounting rates of return to the firm represent weighted-average returns for all its individual investments across its business segments and across

segment investments at varying stages of maturity. For the purpose of this study, firm-level aggregation of accounting information across multiple investments tends to mitigate lumpiness of investment and the time shape of the corresponding benefits. This research focuses on expected *change* in ROI, so the impact of measurement errors will be limited to changes in accounting deviations from the true economic representation from year to year.

Valuation Model: Expected Future Performance

We use a firm-valuation analysis to estimate expected future return on investment and growth. Our analysis is founded on the widely accepted hypothesis that U.S. capital markets are efficient at incorporating relevant information and knowledge into performance expectations and valuations. In this analysis, efficiency implies that equity markets are "minimally rational" in that prices are unbiased, and forward-looking stock market investors cannot rationally expect extra-normal returns (Rubinstein 2001). The study does not rely on the hypothesis that markets are maximally rational in accurately incorporating all information into asset valuations, but instead that markets are efficient enough that there are no expected extra-normal returns to investors. Stock market efficiency is the prevailing theory primarily because there is no comprehensive alternative that better accounts for the wide range of observed market-price behavior (Fama 1997).

Because efficient markets result in unbiased valuations, our approach is to rely on the valuations as crucial information about expected future firm performance. In order to develop the link between expected future performance and value, we apply a general discounted-cash-flow model from investment theory. In the optimization problem for firm *i*, management makes strategic investment and operating decisions to maximize the present value of expected future cash flows:

$$\text{(1a)} \qquad \text{Value}_{it} = \max E_t \left(\lim_{T\to\infty} \sum_{s=t}^{T} \frac{CF_{is+1}\,(K_{is}\, I_{is+1})}{(1+r_i)^{s+1-t}} \right)$$

$$\text{subject to: } K_{is} - K_{is-1} = I_{is} - \text{Depr}_{is}(K_{is-1}),$$

where CF_{is+1} = net free cash flows from operations, or net operating profit less investment cash flows, i.e., [Net operating $\text{profit}_{is+1} - I_{is+1}$]; investment capital $I_{i\,s+1}$ is a function of beginning invested capital K_{is} and concurrent investment; E_t is the operator for expectations at the end of period *t*; Net operating profit_{is+1} is net of taxes and before after-tax interest expense that the firm generates from its beginning invested capital; r_i is the weighted-average cost of capital (discount rate); and $\text{Depr}_{is}(K_{is-1})$ is depreciation expense on fixed assets.

An equivalent operational representation is the residual income model (Lee 1999) that specifies firm value as the accounting value of beginning invested capital plus the present value of expected future residual income:

$$\text{(1b)} \qquad \text{Value}_{it} = K_{it} + E_t \left(\lim_{T\to\infty} \sum_{s=t}^{T} \frac{[ROI_{is+1} - r_i] \times K_{is}}{(1+r_i)^{s+1-t}} \right)$$

where ROI_{is+1} = (Net operating profit_{is+1})/K_{is}. Thus, $[ROI_{is+1} - r_i]\times K_{is}$ represents residual income which is analogous to economic profits in excess of normal competitive profits. Residual-income models are consistent with operational models such as the McKinsey Economic Profit Model (Copeland, Koller, and Murrin 2000) or the Economic Value Added (EVA™) model prominently deployed by Stern Stewart and Company (Stewart 1990). Residual-income models incorporate ROI, so their economic interpretation is consistent with historical ROI performance analysis. Reflecting market expectations, these are the most theoretically rigorous valuation models (Lee 1999). Average expected ROI is estimated using the procedures outlined below and in the Appendix and how it is expected to differ from past ROI is evaluated. Such valuations may be sensitive to model assumptions, however. To address this concern, we compare each industry's average difference of expected performance from its historic average so that only *differences* in valuation sensitivities across the two industries would have an impact. We also address model sensitivity by applying standard valuation procedures based on data generated through generally accepted accounting procedures (GAAP) and widely observed consensus growth estimates.

Sample

We use a sample of large publicly traded firms in food retailing and manufacturing. To achieve this, we draw primarily on the S&P 500™ index portfolio, a widely followed benchmark for money managers, pension sponsors, and others. To be included in the S&P 500, firms must represent leading companies whose common stock shares have a

public float equal to at least 40% of the firm's total outstanding shares (public float refers to shares freely traded that help ensure active trading and more-efficient market valuations than would exist with shares closely held by insiders and thinly traded), and must be headquartered be in the U.S. (Standard and Poor's 2001).[1]

The S&P 500 portfolio classifies firms by the Global Industry Classification Standard (Standard and Poor's 2001). We use the 14 U.S. S&P 500 firms in the packaged-food- and beverage-manufacturer industries from the beginning of 2001: Heinz, ConAgra, General Mills, Sara Lee Corp., Campbell Soup, Hershey Foods, Kellogg Company, and William Wrigley Jr. (packaged-food-industry firms); Anheuser-Busch Companies and Adolph Coors (brewers); Brown-Forman (distillers and vintners); and Coca-Cola Company, Coca-Cola Enterprises, and PepsiCo (soft drinks).

There are six major retail food firms in our sample, consisting of the six largest U.S. public grocery retailers (Kaufman 2000c). Among top retailers, we excluded Wal-Mart Stores—which is not primarily a grocery retailer—and two foreign firms, Royal Ahold N.V. (Dutch) and Delhaize Group (Belgian). The six retailers in our sample include all four firms in the Standard and Poor's (S&P) 500 retail food industry: Albertson's Inc., Kroger Company, Safeway Inc., and Winn Dixie (Standard and Poor's 2001). The sample also includes Supervalu Inc.—which is classified in the S&P 500 food-distribution industry but has both retail stores and food distribution—and Great Atlantic and Pacific Tea Company from the retail food industry of the S&P Small-Cap 600 portfolio.[2]

Data and Performance Measures

Financial accounting measures yield the best period-by-period measure of current return on real investment, and are the underpinning of firm financial analyses. These measures are derived from firm accounting-information systems, the source of financial and firm-level managerial-performance information. We use source accounting-performance data from Securities and Exchange Commission (SEC) Forms 10-K and related reports filed by the respective firms for our return-on-investment analyses. SEC filings are rich in information, as they also have significant qualitative information on performance that we incorporate into our interpretation of the analyses.

Fundamental accounting data and published analysts' expectations efficiently summarize accumulated market information and are principal sources of capital-market efficiency. We use market valuations, historic ROI analyses, and published consensus of securities analysts' expectations for revenue growth in order to estimate expected future ROI performance and growth. First, we estimate expected return on investment for the first five years through fundamental accounting-forecast models (Abarbanell and Bushee 1997; Lev and Thiagarajan 1993). We estimate the first two years' revenue growth from professional securities analysts' consensus expectations about growth that are forecast up to five years. Analysts' revenue forecasts tend to be more accurate than earnings forecasts (Damodaran 2002; Chan, Karceski, and Lakonishok 2003). However, revenue forecasts also tend to be somewhat optimistic (Chan, Karceski, and Lakonishok 2003). We reduce this revenue growth rate for years 3-5 if the firm's historic three-year growth rate is less than the forecast rate. Real growth continues over the next five years and beyond at a rate that calibrates the model value to the actual market value (see Appendix for full valuation-model procedure). This approach is analogous to pro forma procedures used in Claus and Thomas (2001) in which return on equity is modeled in order to estimate the cost of equity capital.

Calibrated pro forma models yield weighted-average estimates of expected ROI [E(ROI)] and growth for the future life of the firm. Calculation

[1] U.S. headquarters serves our purpose of consistent performance measurement and comparability by studying firms under generally accepted accounting principles required of U.S.-traded firms. U.S. headquarters are required for firms to be added to S&P U.S. indexes. This was not always a requirement; to minimize index turnover, pre-existing foreign firms are not removed on that basis (Standard and Poor's 2001). In our sample, we exclude from our sample the only foreign (Dutch) company that was in the S&P packaged food industry, Unilever N.V.

[2] Inclusion of Supervalu is consistent with increasing internalization of distribution among the largest retailers, Albertson's, Kroger, and Safeway; the only other S&P 500 food-distribution-industry firm, Sysco Corp., is in food service, not groceries. S&P Small-Cap 600 firms have the same float-liquidity and U.S.-headquarters requirements as the S&P 500. Remaining S&P retail-food-industry firms are either not primarily in the grocery business or are specialized in natural foods or convenience stores.

of E(ROI) allows for comparison tests of expected future performance of retailers relative to manufacturers. Annual weights are the product of each period's beginning invested-capital amount and discount factor (i.e., period *s* weight = $K_{is-1} / (1+r_i)^s$). Weighted-average expected extra-normal return or expected average residual return on investment would be the weighted-average pro forma return on investment in excess of the cost of capital. Each firm's pro forma model valuation yields corresponding weighted-average measures of required ROI and revenue growth. We test differences between the two industries' weighted-average expected return on investment and weighted-average expected growth rates.

Recent Performance

In order to understand their expected future performance, we first examine the relative performance of food retailers and manufacturers since the early 1990s, a period of organizational and technological change. It also captures the period marked by the April 1993 bellwether, "Marlboro Friday," when Philip Morris announced 25% price cuts on their premium-brand cigarettes, signaling that the pricing power of high-margin branded consumer products was softening (*Advertising Age* 1994).

The firm-level measures include 1993 through fiscal year 2002, which includes firm fiscal-year ends ranging from July 2002 to June 2003. The ROI variable shows no trend for either industry; Table 1 shows the mean annual changes in ROI were -0.16% for retailers and 0.00% for manufacturers, both insignificant (*p*-values shown to indicate statistical-significance levels). In comparison, a t-test of the difference in the means indicates that the mean annual change in ROI is not significantly different for retailers and manufacturers.

Large-retailer gross margins (sales revenues less product costs) have improved as a percentage of sales revenues. Retailers most frequently attribute improving gross margins to their sales mix shifting toward more high-value products with higher margins, which improves overall reported gross margins (SEC; Murray 2000; Fagnani 2000). Some of the large retailers—Albertson's, Kroger, Safeway—attribute gross-margin improvements to increased private-label sales (SEC). Private-label goods have increased their share of the grocery-store market from 14.9% in 1993 to 16.3% in 2002 (PLMA 2003) as a proportion of total food-store industry sales (USDA 2002). The increase in retailer private-label sales is considered economically significant as a long-term force that could shift rents downstream from branded food-products manufacturers towards retailers.

However, while retailer profit margins as a percentage of sales improved, overall ROI did not improve, in part due to increases in operating expenses and increases in proportionate use of invested capital. The retailers' improved higher-margin sales mix has required commensurate remodeling and improvements to stores to support higher proportions of value-added products and services such as prepared foods, take-out foods, pharmacies, and florists (SEC). Retailers have upgraded the shopping experience and product mixes that usually require greater operating expenses for marketing, and greater tangible investments. Invested capital per dollar of sales increased, increasing the denominator of ROI and putting downward pressure on ROI.

Over the 1993–2002 period, food manufacturer gross margins have also increased. Although improved buying practices by large retailers may have been expected to pressure manufacturer-suppliers, many manufacturers also report improved sales mixes toward higher-margin products (SEC). Manufacturers have also benefited from improved workforce design and efficiently employed fewer people (Morris 2000). Productivity in food manufacturing has also made steady gains (USDA 2002). These

Table 1. Historical Performance: Mean Annual Changes, 1993–2002.

Measures	Retail	Mfg	Difference
ROI	-0.16%	0.00%	-0.16%
t Statistic	-0.34	-0.01	-0.27
p-value (two-tail)	0.74	0.99	0.79

Note: p-value is the minimum two-tail significance level at which hypothesized zero-value can be rejected.

operating improvements have contributed efficiency gains and allowed manufacturers to maintain ROI levels despite demands for capital investment.

We find little evidence to conclude that the financial performance of large food retailers has improved with respect to the financial performance of manufacturer-suppliers over the study period. It is possible that recent consolidation among large retailers has not yet produced the potential procurement power expected. As large retailers consolidate and integrate their disparate and geographically separated operations they may develop more effective organizational synergies and efficiencies. Valuation levels of the firms offer evidence of whether large-retailer efficiency and performance are expected to improve in the future relative to large manufacturers.

Expected Change

Given that the full impact of many industry changes are not yet reflected in performance, we now evaluate expected future changes in performance of food retailers and manufacturers. While retailers have not realized improved performance through the consolidation trend of the 1990s, yet the long-term concern is whether retailers' investments and changed industry structure will lead to greater future performance, relative to historical performance and to the performance of food manufacturers. Table 2 shows the mean expected future ROI and growth rates based on the pro forma models at two recent valuation dates: 15 August 2003 (Panel A), and 31 December 2002 (panel B). These two valuation dates are examined to assess the stability of results P(calendar year

Table 2. Valuation: Expected Weighted Average ROI [E(ROI)] in Excess of Historical ROI [His(ROI)], and Expected Growth Gates at Two Valuation Dates.

A. Valuation measure at 8/15/03	Retail	Mfg	Difference
mean E(ROI)	12.22%	28.70%	NA
mean Hist(ROI) (7 yrs.)	13.02%	31.21%	NA
E(ROI)-Hist(ROI) mean	-0.80%	-2.51%	1.71%
t Statistic	-0.70	-2.00	1.02
p-value (two-tail)	0.51	0.07	0.33
E(growth rate) mean	2.37%	4.24%	-1.88%
t Statistic	5.05	15.20	-3.44
p-value (two-tail)	0.00	0.00	0.01
B. Valuation measure at 12/31/02	Retail	Mfg	Difference
mean E(ROI)	12.22%	27.83%	NA
mean Hist(ROI) (7 yrs.)	14.55%	28.87%	NA
E(ROI)-Hist(ROI) mean	-2.33%	-1.04%	-1.29%
t Statistic	-1.37	-1.24	-0.68
p-value (two-tail)	0.23	0.24	0.52
E(growth rate) mean	2.26%	4.11%	-1.85%
t Statistic	5.97	16.80	-4.11
p-value (two-tail)	0.00	0.00	0.00

Note: p-value is the minimum two-tail significance level at which hypothesized zero-value can be rejected.

2002 year-end and subsequent date). The first line of each panel shows the large-firm mean expected future ROI for each industry, "mean E(ROI)." The second line of each panel shows the mean historical ROI, "mean Hist(ROI)," for each industry over the preceding seven-year interval from the respective valuation dates. Overall ROI levels are higher for food manufacturing. An oft-cited reason is the earning power of manufacturer brand names and product differentiation, intangible assets with real earning power,[3] but, the concern here is how relative performance is changing over time.

"E(ROI)-Hist(ROI) mean" in each panel shows for each industry the difference of the mean expected future ROI in excess of the mean historical ROI. Panel A shows at 15 August 2003 an insignificant expected decline of 0.80% for large retailers expected future ROI relative to their mean historical ROI (p-value indicates t-statistic of -0.70 would be significant at only the 51% level). For large manufacturers there is an expected decline of 2.51% in expected ROI relative to historical ROI, significant at the 7% level. The difference in the mean expected ROI change, -0.80% for retailers less -2.51% for manufacturers, is 1.71%. The difference is not significant (it is significant at only the 33% level). Thus market valuations do not offer evidence that expected future ROI for manufacturers will decline significantly more than for retailers (i.e., no evidence that retailers will improve relative to manufactures).

Expected future ROI is only part of the value picture, since expected growth also contributes to firm value. The second part of each panel of Table 2 shows tests of the differences in the mean expected annual growth rates implicit in the valuation analyses of the large firms from each industry. As of 15 August 2003 the mean expected growth for the large retail firms is 2.37%; for the large manufacturers it is 4.24%. The expected future annual growth rates for the retailers is 1.88% less than for manufacturers; this difference is significant at the 1% level.

Thus the 15 August 2003 evidence is that retailer ROI is expected to drop less than manufacturer ROI by a statistically insignificant difference of 1.71%. Furthermore, expected future growth rates for the retailers are a statistically significant 1.88% *less* than for manufacturers. In sum, there is no evidence as of August 2003 that retailers are expected to improve performance relative to manufacturers.

To assess the stability of these results, the same tests are performed at the 31 December 2002 valuation date; the results are shown in panel B of Table 2. Again, the expected change in ROI performance is not significantly different. Retailer ROI is actually estimated to decline 1.29% more than manufacturer ROI (52% significance level). Also, retailer expected growth is again lower than for manufacturers (1.85% lower; significance at less-than-1% level). Based on market-value evidence that neither retail ROI performance nor growth are expected to gain relative to manufacturers, we conclude that based on capital-market valuations, average large-retail firm performance is not expected to gain on the performance of large manufacturers.

Conclusion

This study examines whether large food-retailer performance has gained relative to large food-manufacturer performance. This question emanated from the early 1990s when increasing retailer concentration and perceived weakening of manufacturer brand names led many to hypothesize that retailers would gain on manufacturers. The evidence is that, first, the historical mean annual change in return on investment has been insignificant for both retailers and manufacturers since the early 1990s. Second, the hypothesis that relative performance improve for retailers in the future is rejected by tests indicating that expected changes in retail return on investment and expected future growth do not exceed those of manufacturers. We based these tests on market expectations derived from market valuations of the firms. Thus even if large retailers gain efficiencies and market power over manufacturer-suppliers, this value may well not be captured as higher or faster growing profits but instead passed on to consumers because of competition among retailers.

[3] High manufacturer ROI can be partly attributed to accounting principles whereby advertising and research and development are accounted for as current-year expenses. Advertising and research expenditures are really long-term investments in product and brand-name development but are not capitalized as invested capital; not treating them as invested capital tends to understate invested capital and overstate ROI, more so for packaged-food manufacturers that have heavier advertising and research. (This accounting artifact is a reason that prior research has found a positive relations between advertising and ROI) (Fisher and McGowan 1983; Jacobson 1987). Annual changes in return on investment evaluated in this study are less affected by accounting differences than are absolute levels.

Although store innovations may add new value to products and services, our analysis shows that product substitutions and competitive pressures may preclude retailers from earning significantly higher returns. We may be encountering here a fundamental economic proposition that over time extra-normal returns induce firm entry that pressures returns toward competitive levels (Fama and French 2000a). This is consistent with the drop in retail food equity values near the end of 2001 when Kroger led other major retailers in announcing that it would aggressively maintain market share through competitive pricing (Waters 2001). Recent competitive pressures from Wal-Mart and other price-oriented retailers, coupled with slackened demand arising from less-than-buoyant conditions in the general economy, have contributed to depressed retailer valuations in 2002.

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Appendix: Valuation Model Calibration to Market Value

The pro forma model forecasts residual income over three future intervals: Initial interval over years 1–5, a transition period over years 6–10, and a continuing steady-state from year 11 through perpetuity. Value is the sum of the beginning invested capital and present value of expected residual income (defined in Equation 1b). The model parameters which determine overall expected average ROI, growth rates, and resulting operating and investing cash flows are estimated as follows:

1. Growth, g_{it} (t = 1–5). Securities analysts' consensus forecast growth estimates tend to be biased upward—more so for earnings than for sales and more so five years out than two years out (Chan, Karceski, and Lakonishok 2003). To attenuate this bias while using widely disseminated market information, we use consensus estimates of sales growth for only the first and second year (Thomson Financial Network 2001–02). We then estimate sales growth for Years 3-5 as $g_{i,3-5}$ = minimum of (i) $g_{i,2}$ (Year-2 growth rate) or (ii) average of g_{i2} and the greater of (a) the 5-year U.S. Treasury bond yield or (b) the historical 3-year average growth rate (adjusted to remove the effect of acquisitions and reflect only organic growth). The effect of this formula is to continue the sales growth rate

for years 3–5 ($g_{i,3-5}$) at the second-year consensus growth rate $g_{i,2}$ while keeping $g_{i,3-5}$ equal to or less than the average of $g_{i,2}$ and the greater of either the firm's demonstrated 3-year historical growth rate or the Treasury bond yield, which approximates expected overall nominal economic growth (expected inflation plus a real return that corresponds to expected real economic growth); this limitation serves to dampen excessively optimistic consensus growth forecasts.

Example: At the 15 August 2003 valuation date, securities analysts' consensus forecast growth estimates of sales for each of the next two years for the first of the six retailers, Albertson's, were $35,900 million and $36,700 million, respectively. This results in a first-year growth rate ($g_{i,1}$) of 0.77% and a second-year growth rate ($g_{i,2}$) of 2.23%. This second-year growth rate was also forecast for the next three years ($g_{i,3-5}$ = 2.23%) because it less than the maximum of the adjusted historic average growth rate (-1.5%, which reflects divestitures and adjusts out the effect of a large acquisition three years before that had doubled the firm's size) and the 5-year U.S. Treasury bond yield (3.42%—binding maximum).

2. ROI_{it} (t = 1–5): ROI in the first two pro forma years (t = 1–2) is set to equal ROI realized in the last historical year for a seamless transition from historical to pro forma performance. A residual-income model requires only a specification of ROI, but the inherent costs, expenses, and asset utilization would occur as follows in an detailed valuation model. Pro forma expenses and asset balances for calculating ROI are ultimately a function of sales (Copeland, Koller, and Murrin 2000, p. 240–241). Costs and operating expenses and beginning net property, plant, and equipment (PPE) and other asset balances are calculated as a percentage of sales; depreciation expense is a percentage of beginning gross PPE (average life); schedule of PPE is maintained with historical relationships of accumulated depreciation to depreciation expense (average age). Income-tax expense is calculated by multiplying the resulting earnings before interest and taxes (EBIT) by the historical seven-year average tax expense percentage of EBIT. After deducting taxes, the resulting net operating profit is divided by the resulting beginning asset balance to yield ROI.

In the first pro forma year, beginning asset balances are already fixed as the realized ending balances from the last historical year which may alter the asset balance from its prior-year percentage of sales; if so, the cost and operating-expense percentage (of sales) is adjusted slightly to calibrate first-year ROI to equal ROI realized in the last historical year. With changing growth rates over time, depreciation expense from the PPE schedule can cause slight variations in depreciation as a percentage of sales. For this reason, in the second year we adjust the cost-expense and asset-balance percentages of sales (in proportion to their respective seven-year historical standard errors, even though the allocation is irrelevant to the resulting ROI) to calibrate ROI to the same level as Year 1. ROI for Years 3–5 then depend on the constant percentages from Year 2.

Example continuation: Albertson's in its last fiscal year had ROI_i = 10.5%. This reflects costs and expenses of 92.30% of sales, depreciation of 2.71% of sales, and taxes of 36.9% of EBIT or 1.56% of sales. After deducting these expenses there is a net operating profit of 3.43% of sales. Assets were 32.6% of sales. Dividing the profit margin by the asset percentage (3.43% / 32.6%) yields an ROI of 10.5%. In the first pro forma year the beginning asset balance (from the prior-year ending balance) in conjunction with the first-year pro forma sales results in a pro forma asset percentage of 31.5%. The depreciation percentage remains at 2.71%. The cost-expense percentage is adjusted to 92.03%, which results in taxes of 1.94% of sales (36.9% of EBIT) and a net operating profit margin of 3.32% of sales; $ROI_{i,1}$ = (3.32% / 31.5%) = 10.5%. In the second year, increased consensus sales-growth forecasts and stable cost-expense and asset percentages and depreciation of 2.69% of sales would result in an ROI of 10.6%. The cost-expense percentage is adjusted to 92.07%, which results in taxes of 1.93% of sales (36.9% of EBIT) and a net operating profit margin of 3.31% of sales; the asset balance is adjusted to 31.4% of sales; $ROI_{i,2}$ = (3.31% / 31.4%) = 10.5%. By Year 5, depreciation expense falls slightly to 2.68% (before later rising back to 2.69%), and $ROI_{i,5}$ = 10.6%.

3. ROI_{it} ($t \geq 6$). Adjust ROI for the continuing period ($t \geq 11$) so that the pro forma model's present value of residual-income cash flows equals actual market value, solved with Excel's "Solver" program subject to constraints that the continuing growth rate equals the expected inflation rate, and the continuing ROI is less than or equal to the posterior estimate of ROI equal to the average of the ROI realized in the last historical year (from Step 2 above) and the

seven-year historical average ROI. Transition-period ROI levels (t = 6–10) adjust linearly from the end of initial period (t = 5) to the beginning of the continuing steady-state period from t = 11 (the tax rate transitions linearly from the historical rate to a statutory rate of 35% while cost-expense and asset percentages transition to bring ROI to the long-term posterior estimate). The transition growth rate (t = 6–10) is adjusted from the expected inflation rate (estimated from the U.S. Treasury bond yield curve) to calibrate to market value, but the corresponding real growth rate is limited to a maximum of the Year-5 level. If the continuing long-term ROI constraint (posterior ROI estimate) is binding so that pro forma value is still less than actual market value, continuing long-term growth rate, g_t ($t \geq 11$), is calibrated so that pro forma value equals market value (corresponding real growth rate limited to a maximum of the Year-10 level; if pro forma value is still below market value, g_t for $t \geq 6$ are increased by the same increment until pro forma value equals market value). The market value of a firm equals the market value of its equity (share price multiplied by number of shares outstanding) plus the accounting book value of its debt and preferred stock (with a market-value adjustment cited in the footnotes of the financial statements and rolled forward from the financial-statement date to the valuation date to account for income received and new investments made) which closely approximates market value. (The use of book value follows Fama and French [1999], Megna and Klock [1993], and others.)

Example continuation: Albertson's historic seven-year average ROI was 10.5%, the same as the ROI realized in the last historical year, so the posterior ROI is 10.5%. From Year 5 to Year 11, cost-expense percentage is adjusted linearly to 92.20%, which results in taxes of 1.79% of sales (35.0% of EBIT) and a net operating profit margin of 3.32% of sales; the asset balance transitions to 31.5% of sales; $ROI_{i,2}$ = (3.32% / 31.5%) = 10.5%. This results in a pro forma valuation that is below the market valuation of $13,657 million ($7,532 million of equity plus debt of $6,125 million), so the growth rate for t = 6–10 is increased to 2.69% (resulting in the maximum real growth of 0.31% from Year 5), resulting in a pro forma value still below market value. Finally, the long term growth rate for $t \geq 11$ was increased to 2.50%, at which the pro forma value is equal to the market value of $13,657 million. The pro forma models shows a weighted average ROI = 10.53% and a weighted-average annual growth rate of 2.45%.

4. Expected ROI implicit in residual income and the measured historical ROI to which it is compared do not account for asset write-offs and some expenses that bypass the income statement (even though these investments and expenses consume cash) nor for the expected dilution cost of outstanding stock options. Accordingly, a valuation allowance is made for the effects of (i) outstanding employee stock options and dilutive securities, and (ii) average periodic "dirty surplus" income accounting whereby write-offs and expenses that reduce asset values but are not reflected in reported income (Penman 2001, pp. 238–248). The valuation allowance is a deduction from the pro forma value and thus results in a higher pro forma ROI and residual income required to calibrate to market value, consistent with the overstatement of historical ROI which also did not include these expenses and to which pro forma ROI is compared. Historical returns are analyzed to incorporate clean surplus accounting (Feltham and Ohlson 1995), whereby changes in a firm's accounting-capital balances must equal income less dividends and firm securities transactions. This accounts for all income-related items, including those that have by-passed income statements (inconspicuously), and asset write-offs that are sometimes erroneously ignored by analysts as "one-time" or "non-recurring" events. Clean surplus accounting allows valuation adjustments for inferences about expected future ROI in forward-looking valuation models (Penman 2001, pp. 654-656). These losses for the historic seven-year period are calculated as an average loss on assets and are assumed to continue in perpetuity but not grow. Stock-option-dilution percentage of equity is calculated from footnote information on dilution and on the number of employee stock options, average exercise price and maturity.

Example continuation: Albertson's clean surplus losses averaged 3.48% of assets over the past seven years (relatively large revaluations and write-offs resulted after large acquisitions). Annual losses were calculated at $480 million = 3.48% × $13,805-million ending historical total asset balance; in perpetuity this is negatively valued at $6,734 million. Stock-option dilution was calculated at 0.54% (2 million shares dilution divided by 372 million shares outstanding), resulting in a negative equity valuation allowance of $41million (0.54% × $7,532

million equity). The total valuation allowance of \$6,774 million is a negative amount subtracted from required residual income value to arrive at the total net pro forma valuation of \$13,657 million.

5. *Discount rate* is estimated as the weighted average cost of capital, $r_i = [(D/(D+E))_i \times r_{id} \times (1-\tau)] + (E/(D+E))_i \times [r_f + (r_m - r_f)\cdot\beta_i]$, where D is market value of firm debt estimated from the firm's published financial statement accounting book value (Fama and French 1999) plus any adjustment to fair market value as disclosed in financial statement footnotes, E is firm equity market value calculated from shares outstanding multiplied by share market price, r_{id} is the firm's cost of debt capital (estimated from financial statement disclosures and Moody's debt ratings [2002]), τ is the marginal corporate tax rate used to calculate the firm's after-tax cost of debt capital (we follow Copeland, Koller, and Murrin [2000, p. 253] and use $\tau = 35\%$), $(r_m - r_f)$ is the market risk premium where r_f is risk-free rate of return and r_m is expected return on market portfolio (we follow Claus and Thomas [2001] and Copeland, Koller, and Murrin [2000] and use ten-year U.S. Treasury bond yield as r_f), and β_i is firm's beta sensitivity to market risk premium under capital asset pricing model (Sharpe 1964). Empirical tests of asset-pricing models to estimate beta and the market risk premium have low power, and there is not a dominant approach to estimating cost of capital. Part of the reason for this is that expected market risk premium $(r_m - r_f)$ and firm beta (β_i) are ex-ante concepts that must be estimated from historical data with a measurement error; measurement error for betas of individual firms or industry-group portfolios of firms is particularly high (Fama and French 1997). Thus we assume the market risk premium $(r_m - r_f)$ is 4%, following Fama and French (2000a), who also use an ex-ante approach to estimation; and we assume a market-wide average beta of 1 for each firm on the basis that estimated betas have large measurement errors, even at the industry level (Fama and French 1997).

To estimate r_i for each firm we first develop an average cost-of-capital discount rate for average corporate business risk, r_a, assuming average corporate leverage D/(D+E) = 20%; and average cost of debt capital r_d = yield on average corporate bond with Moody's Baa rating (U.S. Federal Reserve Board 2001-2002): $r_a = [20\% \times r_d \times (1-.35)] + [80\% \times (r_f + 4\%)]$. We then estimate each firm's cost of equity capital, $r_{ie} = r_a + [(r_a - r_d) \times (D/E)_i]$; this adjusts the cost of equity capital for firm leverage $(D/E)_i$ consistent with theory and practice (Brealy and Myers 2000, p. 483). The firm's estimated cost of capital is then $r_i = [(D/(D+E))_i \times r_{id} \times (1-\tau)] + [(E/(D+E))_i \times r_{ie}]$.

Example completion: For the 15 August 2003 valuation date, the average cost of capital $r_a = [20\% \times r_d \times (1-.35)] + [80\% \times (r_f + 4\%)] = [20\% \times 7.14\% \times 0.65] + [80\% \times (4.55\% + 4\%)] = 8.27\%$. Albertson's debt was rated at Baa1; $r_{id} = 7.14\%$. Albertson's cost of equity capital was $r_{ie} = r_a + [(r_a - r_d) \times (D/E)_i] = 8.27\% + [(8.27\% - 7.14\%) \times 0.813] = 9.19\%$. Thus Albertson's estimated cost of capital is $r_i = [(D/(D+E))_i \times r_{id} \times (1-\tau)] + [(E/(D+E))_i \times r_{ie}] = [0.448 \times 7.14\% \times 0.65] + [0.552 \times 9.19\%] = 7.15\%$.