Why Are the Parts Worth More than the Sum? "Chop Shop," A Corporate Valuation Model

*Dean LeBaron and Lawrence S. Speidell**

Although the stock market is a reasonably efficient pricing mechanism, there are times when some of the laws of mathematics seem not to apply. Two plus two should equal four, but in the stock market the result is sometimes five, and sometimes three. Dramatic price changes can result, and many changes recently have been related to takeovers, mergers, and restructurings. While critics decry raiders, debt-hungry managements, or short-term-oriented investors, the wave of restructurings is symptomatic of a much broader, deeper, more enduring change in the financial markets.

Three Phases of Financial Markets

We have entered an era of corporate valuation, which is the third phase that the stock market has experienced in the postwar period. The key players in financial markets over the past 40 years have been individuals, institutions, and corporations. Success has depended upon identifying the particular set of players with the greatest influence on prices at each point in time. Table 1 describes three principal periods since World War II: The Age of the Individual Investor, The Age of the Institutional Investor and The Age of Corporate Valuation.

The Age of the Individual Investor

From 1940 until the late 1960s, individual investors were the dominant force in setting stock prices. This was the era of the stock picker, the

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Table 1
Three Ages of Equity Valuation

I. Age of the Individual Investor		
	Behavior	Tools
1950 to 1970	Good News = Good Company = Good Stock Positive Relative Strength Confidence in Forecasting	Company Reports Wall St. Reports Relative Price
II. Age of the Institutional Investor		
1965 to 1985	Value Investing Low P/E, High Yield Dispassionate Compression of Values	Computers Dividend Discount Models Databases Screens
III. Age of Corporate Valuation		
1980 to Present	Contests for Control Leveraged Buyouts Stock Buybacks Leverage	Breakup Value Replacement Cost Off-Balance-Sheet Items Tax Analysis Control Premium

research analyst, and the "star" portfolio manager. Passions ran high, and investors tended to "fall in love" with stocks. They were impatient with bad news and often obsessed with getting "the latest story." Ultimately, stocks were offered with nothing but projections, because the fundamentals were practically nonexistent. However, at the height of this "go-go" mania in 1968, individuals began a 15-year liquidation of their holdings of common stocks.

The Age of the Institutional Investor

From the late 1960s to the early 1980s, a new force emerged to set stock prices. As institutional portfolios swelled with cash flow from pension funds, institutional investors became the primary factor in the stock market. With them came the computer revolution on Wall Street. Applying quantitative techniques to financial databases, they used dividend discount models and price screens based on academic research to set the prices of stocks to within a few basis points, based on key value measures. These institutions are dispassionate: they do not care about control, they just want cheap stocks that go up. Their activity has made the market more efficient relative to their popular measures of value: price/earnings, price/book, yield, and so forth. Their activity also set the stage for a fresh perspective on value.

The Age of Corporate Valuation

Over the past 20 years, a gap has opened between stock market values and the replacement cost of underlying corporate assets. At first this gap was noticed by only a few individual entrepreneurial business-men such as T. Boone Pickens, Carl Ichan, and Irv Jacobs. These men earned a reputation as "raiders," yet they were simply setting a business value on companies that was above the stock market price. They gave free-riding shareholders much of the gain. The initial response of corpo-rations to raiders was a surge in antitakeover provisions, but sharehold-er outcry led to awareness that management entrenchment is not the solution.

Today, corporations themselves, encouraged by their investment bankers, are noticing the discrepancy in values. Their analysis of liquida-tion value, replacement value, and undedicated cash flow includes off-balance-sheet items (pension assets and liabilities, LIFO reserves, tax losses); tax considerations (the write-up of acquired assets, spinoff of tax shelters, capture of the tax shield from debt leverage); and "soft" assets (the control premium, market share, goodwill, and potential synergy). As a result, corporate behavior is increasingly dominated by financial considerations, where in the past it was often dictated by sales, market-ing, production, or tradition. Many successful companies are now led by chief executives with a finance background.

"Chop Shop:" The Analysis of Companies by Business Segment

As a money manager in search of undervalued opportunities, Bat-terymarch Financial Management has recently been exploring corporate behavior with respect to the business segment data disclosed in foot-notes to corporate annual reports. Since 1976, companies have been required by Statement 14 of the Financial Accounting Standards Board to disclose details of the operations of their business segments. This infor-mation has been collected by Compustat and is made available on com-puter tapes.

Over 6,000 companies disclose business segment results, covering over 10,000 divisions. Although most companies have only one or two segments, a few list as many as 10. The distribution is as follows:

Number of Segments:	1	2	3	4	5	6	7	8	9	10
Number of Companies:	4819	818	532	272	106	40	18	9	4	1

Our goal is to value companies by their parts, in the hope of identifying those firms where the whole is selling for less than the sum of values of

the parts, and others where the reverse is true. We began this project with several a priori notions to be tested:

(1) *The market as a whole may be undervalued.* Federal Reserve System statistics through 1985 show that stocks have been selling for 90 percent of replacement cost (figure 1). The postwar range has been from lows of around 50 percent in the late 1940s and again in the 1970s to a high of 105 percent in the mid-1960s. Batterymarch estimates show that the market value of corporate equity is now 71 percent of replacement cost.

(2) *Undervaluation may be proportional to the number of segments in a company.* In the 1960s, conglomerates sold at a premium in the market, but lately synergy among divisions has been discredited and the complexity of such companies has made them of less interest to investors. They may sell at a discount for three reasons:

   (a) There is a high cost to obtaining information about them.
   (b) Managers may be hoarding cash for internal expansion and acquisitions rather than maximizing shareholder returns.
   (c) Just as closed-end mutual funds sell at a discount, diverse companies may be valued at a discount because shareholders lack control over disposition of their assets.

(3) *Stocks with low institutional holdings may be inefficiently priced.* Their prices may be significantly different (either higher or lower) from the prices of the stocks of similar, more popular companies.

(4) *Industries may fall into distinct patterns of valuation.* Different weights may be attached to sales, assets, and income, depending upon the economic sector or industry group.

Compustat has made business segment information available for some time, but we believe that our exploration of these data is innovative. Most users have focused only on company-by-company analysis, while others have used the data for risk measurement (exposures to each industry) rather than for valuation. Although we enjoy the opportunity to be pioneers, we would not achieve our goal of successful investing unless others follow our path, arbitraging some of these price disparities out of the market. We believe that this process is beginning, although today, investment bankers, bankers, and corporations are far ahead of institutional investors in using business segment valuation techniques. While institutions continue to focus on net earnings (after profitable and unprofitable divisions are combined), corporations themselves are increasingly aware of the values of their segments and are restructuring to make those values more evident in stock prices. In this era of corporate valuation in the stock market, institutions will have to adopt corporate techniques if they are to identify the best values.

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Figure 1

Net Worth of Nonfinancial Corporations

Net Worth $Million (log scale)
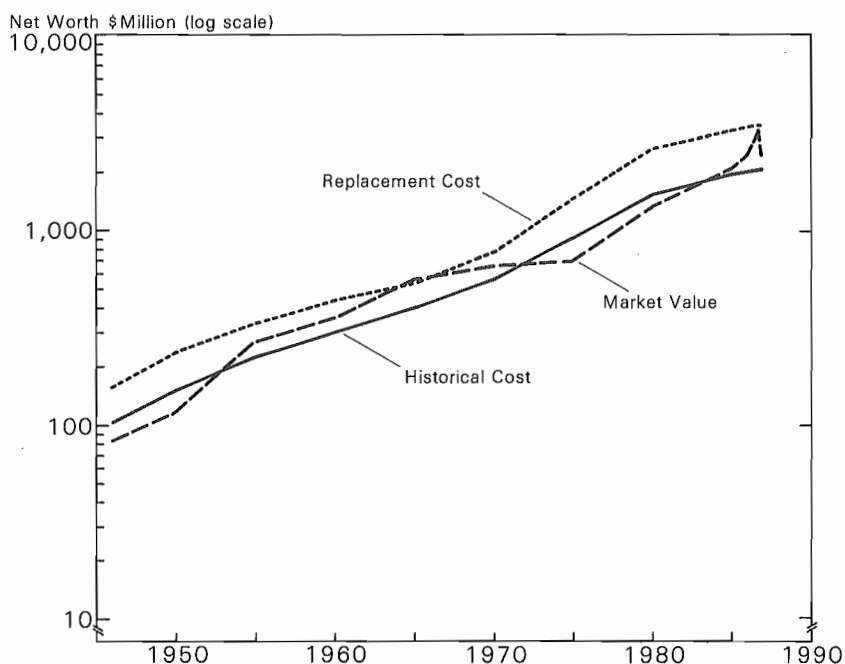
Source: Board of Governors of the Federal Reserve System, 1946-85; Batterymarch Financial
Management estimates, 1986 and 1987.

Methodology

Business segment disclosures include sales, assets, operating in-
come, depreciation, and capital spending for each division as well as
similar details for each geographic region. Our work has focused on the
first three items of data: sales, assets, and operating income by division.
The divisions are grouped by Standard Industrial Classification (SIC),
allowing analysis of very narrow industry slices such as the 4-digit SIC
2893–Carbon Black, or broader groupings such as the 2-digit SIC 28–
Chemicals and Allied Products (which includes SIC 2893).

Borrowing the terminology of automobile theft rings, our "Chop
Shop" analytical technique divides the 6,000 companies into their more
than 10,000 divisions, sorts them by SIC code, and calculates a set of
ratios for each code. Each of the 600 SIC codes may contain from one to

over 30 companies or divisions of companies. For "pure" companies (with 90 percent of sales within one SIC code) we calculate the total value of capitalization, including debt, compared with total sales, assets, and income. The ratio of capitalization to sales, for example, represents the theoretical value of a dollar of sales in the industry, based on the aggregate of all pure companies in it.

"Chop Shop" requires at least three pure companies within a SIC code in order to value it. For codes with fewer pure companies, valuation ratios are computed on the basis of the next larger SIC category (going from 4-digit 2893, for example, to 3-digit 289 or even to 2-digit 28 if necessary).

Table 2 shows a sample company, Dow Chemical, valued on the basis of its four business segments: Basic Chemicals, Industrial Specialties, Consumer Specialties, and Basic Plastics. The valuation ratio based on sales for Industrial Specialties is 0.61; in other words, a dollar of sales in SIC 2821 is "worth" $0.61, derived by dividing the capitalization of pure companies in the industry by their total sales. Similarly, a dollar of assets in the industry is "worth" $1.07. Given Dow's Industrial Specialties assets of $2,206 million, the division has a theoretical value based on assets of $2,360.4 million.

The theoretical values for the industry and for all Dow divisions are totaled for the sales analysis, the assets analysis, and the operating income analysis. Then, these three company totals are averaged. From this final theoretical value for the company, debt is deducted to produce the theoretical equity value. The ratio of theoretical to actual equity value indicates overvaluation or undervaluation by the market. In the case of Dow, the ratio of theoretical to actual market value is 1.2: thus, the company may be worth 20 percent more than the current stock price. By comparison, a model not relying on business segments, the financial tension valuation model, theoretically values Dow at 1.8, or 80 percent above the current market value.

Within our data base, a ratio of 1.2 is close to the median. Exceptionally undervalued companies may have segment values 50 percent or more above their market prices. The high median value suggests that there is some undervaluation in the market as a whole, which can probably be attributed to underpricing of both multi-industry companies and small companies.

In refining our "Chop Shop" calculations, we have added several constraints to cope with special conditions. If an SIC group has a ratio of market capitalization to operating income greater than 20, we test for depressed return on assets (ROA under 10 percent). Where returns are low we set the industry income ratio to the average for all industries (13.7) to prevent companies with large earnings in a depressed industry from being overvalued. This is also done with industries operating at a

Table 2
Corporate Valuation Model: Dow Chemical Company
Millions of Dollars

Segment Valuation Model

A) Sales Analysis

SIC	Code	Dow Segment Sales	Industry Ratio of Market Capital to Sales	Dow's Theoretical Market Value
2800	Basic Chemicals	5,237.0	2.29	11,992.7
2821	Industrial Specialties	2,765.0	0.61	1,686.6
2834	Consumer Specialties	2,029.0	3.58	7,263.8
3079	Basic Plastics	1,506.0	1.71	2,575.3
	Total	11,537.0		23,518.5

B) Assets Analysis

SIC	Code	Dow Segment Assets	Industry Ratio of Market Capital to Assets	Dow's Theoretical Market Value
2800	Basic Chemicals	4,762.0	2.43	11,571.7
2821	Industrial Specialties	2,206.0	1.07	2,360.4
2834	Consumer Specialties	1,645.0	2.92	4,803.4
3079	Basic Plastics	1,079.0	2.18	2,352.2
	Total	9,629.0		21,087.7

loss. Loss divisions in loss industries are valued with the income compo-
nent set to zero, while profitable divisions in those industries use the
income ratio of 13.7.

Another adjustment is made for unallocated expenses. Companies
vary in their definition of operating earnings, and often large expenses
are simply not allocated to the divisions. We have defined operating
income uniformly as "pretax plus interest expense." Rather than directly
allocating other expenses, we assign them a negative value in the in-
come calculation, which is multiplied by a weighted average of all divi-
sions' income ratios. Interest expense is not allocated because this stage
of valuation is independent of capital structure.

Additional modifications are undergoing research. Most significant
would be to vary the weighting of sales, assets, and income in the final
theoretical value for each division. This could be done inversely to the
scatter of data, or we could replace ratios with regression equations for
each industry. We are experimenting with several regression techniques.
If we had unlimited computer power, we could simply regress market
values for the 6,000 companies against their component sales, assets,
and income (42,000 data points). Our approach, however, has been

Table 2 continued
Corporate Valuation Model: Dow Chemical Company
Millions of Dollars

C)   Operating Income Analysis

SIC	Code	Dow Segment Income	Industry Ratio of Market Capital to Income	Dow's Theoretical Market Value
2800	Basic Chemicals	165.0	17.45	2,879.3
2821	Industrial Specialties	186.0	21.49	3,997.1
2834	Consumer Specialties	226.0	19.26	4,352.8
3079	Basic Plastics	60.0	15.06	903.6
	Total	637.0		12,132.8

D)   Average Theoretical Value (A+B+C)/3:   18,913.0

Less: Debt	3,661.0
Theoretical Equity Value	15,252.0
Recent Market Value	12,226.4
Ratio of Theoretical Equity Value to Market Value	1.2

Financial Tension Valuation Model

Pretax earnings	1,149.1
Depreciation	977.0
	2,126.1
Capitalized at 10 percent	21,260.6
Plus:	
Cash	114.0
Tax Loss	30.6
Net Pension Asset	208.0
Other	0.0
Theoretical Value	21,613.2
Recent Market Value	12,226.4
Ratio	1.8

simpler: we have divided the universe into 150 industry groups and done regressions on the pure companies in each of these groups, each designed to have at least eight companies. Unfortunately, several interesting groups were too small to be valued separately. While it would have been nice to run separate solutions for aluminum or homebuilding companies, for example, they were too small and had to be combined with the metals and general building groups, respectively.

Our regressions were done to produce the following general formulas:

Capitalization: a*(sales) + b*(assets) + c*(operating income) + constant.

In the current research mode eight regressions are run for each industry. Separate regressions are run for raw and log data, both with stepwise or block entering of variables and with a sales growth factor or without. Log data are used in an effort to counteract the heteroskedasticity in the data—the increase in variability of market capitalization for larger companies.

To determine the "best" regression for each industry's SIC code, we look for the model that has the narrowest confidence interval for its prediction of market capitalization. For the raw data regressions, this means taking the standard error from the regression and multiplying it by a value from a t-table based on the number of observations and the number of independent variables in the equation. It is also adjusted for the prediction of a point at the mean. For the log regressions, a similar procedure is used, except that once the confidence interval is determined at the log level, the antilogs must be calculated to bring it back to the same units as the raw data. The regression that produces the narrowest confidence interval is the one to be used in the segment analysis. The chosen regression coefficients go into two files. Because some companies do not have a number for growth, they must use the best of the regressions that do not include growth.

Interestingly, growth in sales does not appear to be particularly meaningful in most regressions. We are considering alternatives such as growth in earnings. Also, the stepwise procedure, which enters the independent variables one by one into the regression and tries to find the best combination of some or all, has not proved to add much value.

Results

This segment analysis, called the Corporate Valuation Model, or CVM, takes approximately two and one-half hours to run and produces scores for 2,773 companies in the Batterymarch stock universe of 3,000 stocks. Scores for the remaining companies cannot be produced because of missing data or industry problems. Financial stocks are generally not scored because sales and assets are not good indicators of their value. Banks and brokerage firms, for example, can leverage themselves up and down on spread arbitrage business without affecting corporate value significantly.

For companies scored, the equal-weighted average ratio of theoretical to actual market capitalization is 1.46, the median is 1.13, and the capitalization-weighted average is 1.19. We score 438 of the Standard & Poor's 500 stocks, and here the average scores are: equal-weighted average, 1.19; median, 1.10; capitalization-weighted average, 1.20.

Comparison with Market Characteristics

The ratio of theoretical to actual market capitalization (CVM) is com-pared with 12 investment characteristics in figure 2. In each panel, CVM data have been divided into deciles, and the equal-weighted average of each is plotted against a characteristic. In one panel, for example, CVM is plotted against the price-earnings ratio. The highest decile of CVM includes 277 stocks with an average CVM ratio of 5 and a price-earnings ratio of around 15. At the other extreme, the lowest decile of CVM has a negative value, indicating that the average theoretical value of the 277 stocks in this decile is negative. Their average price-earnings ratio is over 22. Although the relationship is irregular, the curve shows that stocks with lower price-earnings ratios tend to have higher CVM ratios. A somewhat similar pattern is shown in the panel showing CVM versus Estimated Growth Rate (from Ford Investor Services). Here, higher-growth companies tend to have below-average CVM ratios.

Several panels in figure 2 show patterns of wide variations. These include Yield, Market Capitalization, Institutional Holdings, Deviation (Variability of Earnings) and Quality (Value-Line financial strength rat-ing). In the case of Institutional Holdings, for example, stocks with low percentages held by institutions tend to have either very high or very low CVM ratios. To the extent that extreme ratios of CVM are an indica-tion of lower market efficiency, it appears that stocks with low institu-tional holdings are inefficiently priced, thus confirming our third initial hypothesis. Inefficient pricing also appears to occur among stocks with low yields, small size, low quality and high earnings deviation. Interest-ingly, these are all characteristics that produce discomfort among inves-tors, and contrarians would argue that stocks possessing these characteristics may produce above-average total returns. CVM may be particularly useful to contrarians because it distinguishes especially well among stocks that possess contrary characteristics.

Valuation versus Number of Divisions

Figure 3 confirms another of our initial hypotheses. It shows what appears to be a positive relationship between the number of segments in a company and the CVM ratio. The more divisions a company has, the more it is likely to be undervalued.

Industry Characteristics

Business-segment CVM ratios have been developed for roughly 400 of the 600 SIC groups. (Those with few companies are "rolled up" to a broader definition.) In order to generalize about industry characteristics,

Figure 2

Comparison of the Ratio of Theoretical to Market Capitalization (CVM)
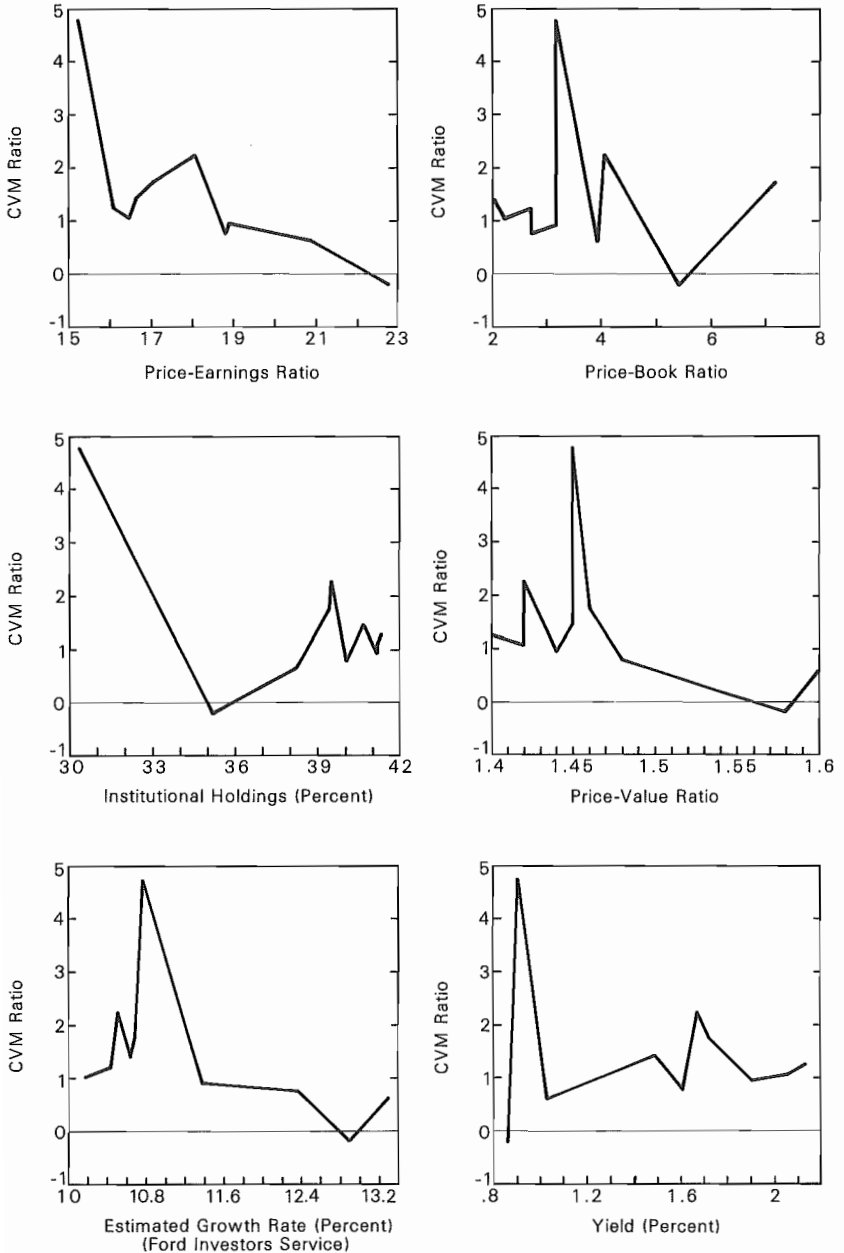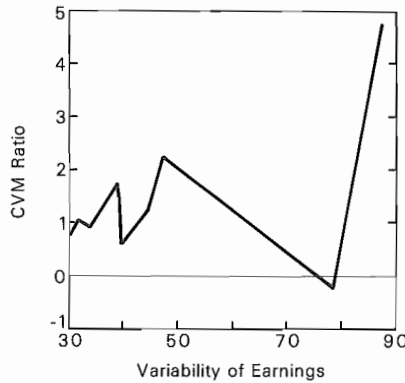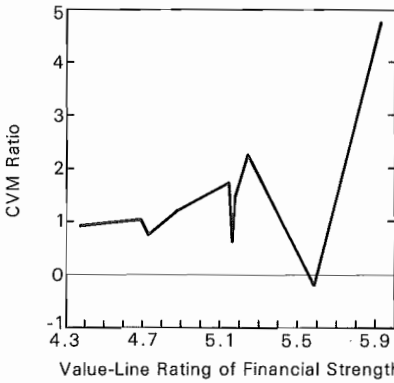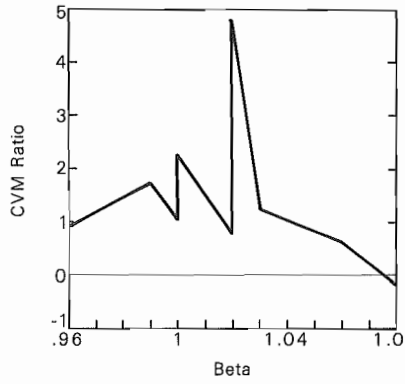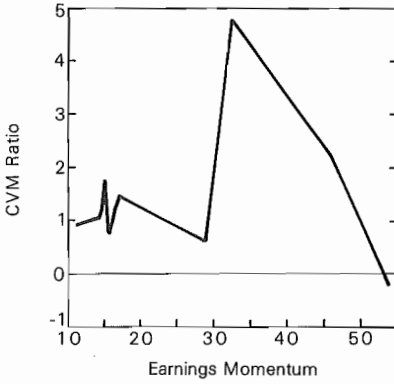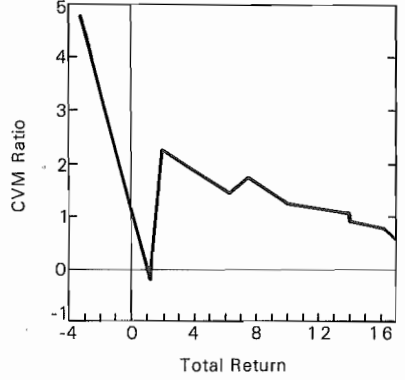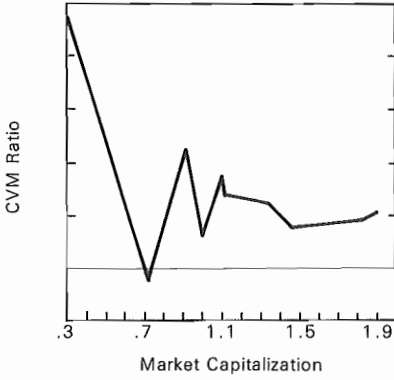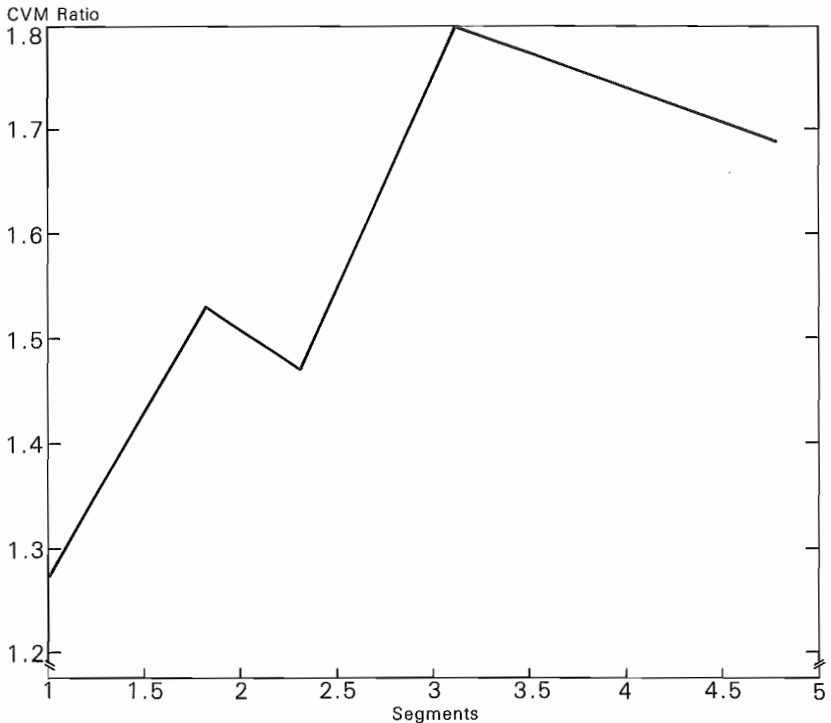and Selected Market Characteristics of 2,773 Companies, 1985

Fig. 2 continued

Source: Batterymarch Financial Management.

Figure 3

## Comparison of Number of Business Segments in an Industry and Its CVM Ratio[a]

[a] Ratio of a firm's theoretical value (using the corporate valuation model) to its market value.
Source: Batterymarch Financial Management.

however, it was found useful to group the data into 55 industry groups, which are shown in figures 4 and 5.

Figure 4 compares capitalization-weighted (CVM) ratios for "impure" or multi-industry companies, grouped by their primary industry, with ratios for pure companies located in the same industries. Since the ratios are weighted by capitalization, it is natural that the industry averages for pure companies are close to 1. The Y-axis, however, shows that multi-industry companies vary widely in their valuation. Diversified companies in transportation, leisure and consumer durables appear overvalued by the market while those in the cosmetics, hotel, aerospace and computer industries appear to be undervalued. Although generalizations can be misleading, it appears that breakup opportunities are greater in more glamorous industries, because investors "pay up" for

Figure 4

Comparison of Pure and Multi-Industry Companies, by Primary Industry, Weighted by Capitalization
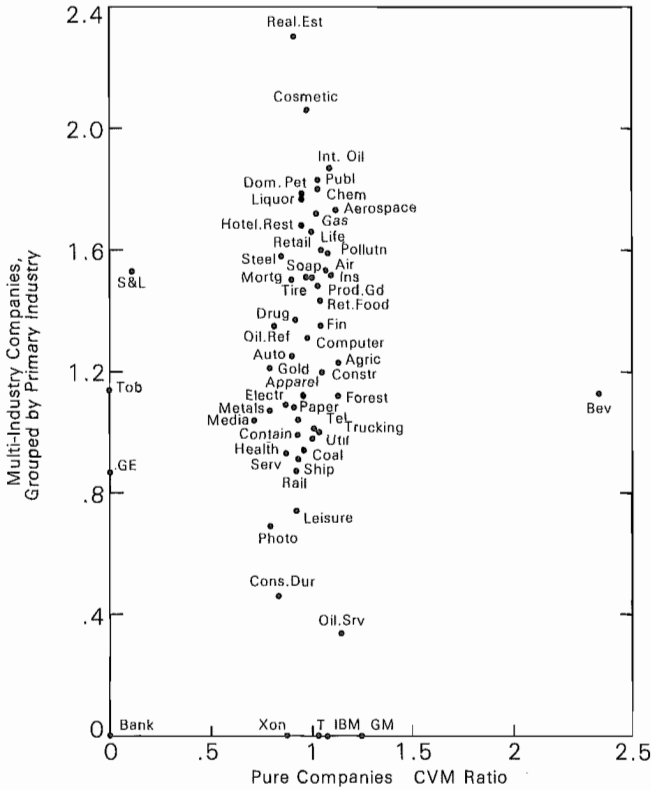
Source: Batterymarch Financial Management.

specialists that occupy a market niche. In less glamorous industries, diversified companies are given more generous valuations.

Figure 5 presents the same comparisons but uses equal weights for all companies to construct the industry average. The effect is to place more importance on smaller companies than in figure 4. The X-axis position of each industry shows a clear difference among pure companies from the vertical centering around 1 in figure 4. In retailing, hotels, drugs and pollution control, for example, small companies tend to have higher capitalization ratios than large ones, whereas the reverse is true in domestic petroleum, oil services, autos and shipping. Again, there may be a pattern related to the "glamor" of the industry, where small

Figure 5

Unweighted Comparison of Pure and Multi-Industry Companies, by Primary Industry

Source: Batterymarch Financial Management.

companies in industries that are unpopular sell at a premium while those in favored industries sell at a discount. In executing a small-stock strategy, it might make sense to avoid industries that are out of favor.

Although results of our regression analysis are still in the research stage, we have some interesting findings. As mentioned earlier, growth in sales does not appear to be a significant factor in most cases. Our regressions would not distinguish between two competing companies with identical sales, assets and income, one of which had experienced a decline in market share while the other had experienced an increase. While this confirms our suspicion that the market undervalues changes in market share, we still believe that our equations could be improved by

including some growth measure. We will be experimenting with income growth data, but their instability will require some smoothing. In addition, the universe will shrink because many companies have changed their reporting format, grouping divisions in different categories over the years.

There are several interesting surprises in the regression coefficients. In roughly half of the cases, the coefficient for sales is negative, suggesting that corporate value shrinks with size. In some of these cases, the explanation is that industry income is negative; but in others, large companies may be dinosaurs, producing commodity products and losing more profitable customers to smaller niche specialists. Industries with a negative coefficient on sales include chemicals, electrical equipment, telephones and cosmetics. In other industries, sales are unimportant, with a coefficient close to zero. These include oil refining, computers and autos. On the other hand, the reverse is true in radio and television broadcasting, where both assets and income have coefficients close to zero and value depends almost entirely on sales.

Of course, coefficients will change over time with industry and economic cycles. The regressions are a cross-sectional snapshot capturing companies that seem out of place at this instant. Expectations may explain much of this, and we have plans to include estimated income, from the Institutional Brokers Estimate System, to supplement current reported income.

Conclusions

Business-segment analysis suggests that there are opportunities to add value by separating multi-industry companies into their parts. In addition, even with our current, relatively crude techniques, there do appear to be significant patterns in the market. Different industries are valued in different ways and our "Chop Shop" analysis may lead us to industry-specific valuation models with implications beyond the analysis of business segments.

The question of why the parts are worth more than the whole for many companies is of particular interest since the reverse was true 20 years ago, when conglomerates were in vogue and synergy was mentioned in nearly every annual report. We suggested earlier some explanations for the current condition, such as the "closed-end fund effect" and the high cost of information. But there are other issues about which we can speculate.

    (1)   *Cynicism versus naivete.* After the poor performance of corporate profits in recent years, investors may have grown cynical about the talents of high-priced managers. In the 1960s, we believed

we could manage the economy, at both the government and the corporate levels. Now we may have gone too far, but we are all aware of the limited influence of management in the face of overwhelming and often unknown external influences such as the oil crisis and inflation. Even some of the companies cited for great management skill in books like *In Search of Excellence* have shown disappointing subsequent results. It is not that management is ineffective, simply that management is less influential than managers themselves would like. In today's environment, investors prefer situations where the management tasks are made simpler by fewer divisions.

(2) *Inflation and hidden assets.* Many of today's multi-industry companies were formed over 15 years ago. Divisions acquired then have disappeared from close investor scrutiny for a long period while inflation has distorted their asset values. As recent restructurings have shown, much of the merchandise that disappeared into "corporate attics" in the late 1960s is worth far more than book value on the open market today. Despite experiments with inflation accounting (Financial Accounting Standards Board Statement 33), most of our accounting and reporting framework has focused financial analysis on historical costs, leaving investors ill-equipped to anticipate the "hidden assets" of complex companies.

(3) *Agency problems and the control premium.* Some of the current discount of multi-industry companies may reflect the agency problems of managements and shareholders in recent years. Contests for control and increased antitakeover provisions have made investors conscious of the importance of control. The more complex a company is, the more valuable will be control over its restructuring decisions. If investors believe they have lost the ability to affect those decisions, either by influencing or by changing management, then the stock prices will drop.

We see several directions in which the current conditions may lead. We may be witnessing a change in the nature of common stocks that will signal the end of shareholder ownership as we have known it. It could be that corporations are indeed becoming closed-end funds. It could be that common stocks are becoming a form of nonvoting preferred stock, with a dividend tied to earnings. This would bring us closer to other world markets, where the discount for lack of control is 10 times as great as the 3 to 4 percent spread in our market today. The resulting increase in the cost of capital to our economy would be large.

More likely, however, is a continuation of active corporate restructurings with the goal of simplification. We believe the interests of share-

holders and management are coming together, as managers are increasingly aware that a high stock price is their best protection against takeover. This should lead to increased management incentives based on stock price, improved shareholder relations, and more active partici-pation by shareholders in corporate decisions. Spinoffs and sales of divi-sions will continue. A related development may be partial public ownership of divisions to establish their market value (similar to the program tried by LTV in the early 1970s). In this environment, we hope that the companies identified by our business segment analysis will be market leaders.

Discussion

Joseph A. Grundfest*

"Chop Shop" is a provocative model based on an insight that can be expressed in three different but closely related forms. "Chop Shop" is, at once: (1) a closed-end fund valuation model; (2) a statement about how a corporate raider might value a potential target; and (3) an implementation of arbitrage pricing theory. Each perspective complements the others. Indeed, by viewing the model from these three different vantage points, it may be possible to develop a richer understanding of the basic trading problem presented by the authors: How do you spot undervalued companies before the rest of the market, and how do you profit from that information?

The Conglomerate as Closed-End Fund

From one perspective, "Chop Shop" views a conglomerate firm as a closed-end investment company holding a portfolio of nontraded securities that represent equity interests in identifiable lines of business. By estimating the open-market value of each of those closely held securities, the model infers the value that the stock market would assign to the conglomerate if, by creating a publicly traded security for each line of business and then spinning that security off to its stockholders, the conglomerate converted itself into the equivalent of an open-end fund.

There is substantial evidence that closed-end funds trade at a discount to net asset value.[1] Further, some conglomerates have recently

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*Commissioner, U.S. Securities and Exchange Commission. The views expressed herein are the author's, and do not reflect those of the Commission, other Commissioners, or Commission staff.

begun to spin off subsidiaries in an effort to convert themselves into more open-ended structures in which separate lines of business are independently valued.[2] "Chop Shop," if it works, represents an appraisal technique designed to estimate the increase in value that the market would assign to an open-ended conglomerate as opposed to its closed-ended analogue.

The Conglomerate as Bust-Up Target

The more immediate inspiration for "Chop Shop" arises from takeover bidders who acquire conglomerates for the purpose of subdividing them into separate lines of business that are then sold off. Such transactions effectively transform closed-end conglomerates into more valuable economic structures. The rhetoric associated with these transactions (for example, "bust-up" deals) is most unfortunate because it conjures up the image of a scorched earth policy that leads to massive plant shutdowns and inefficient economic dislocations.

The evidence, however, is quite the opposite. For example, a recent study by Michael E. Porter suggests that a large percentage of conglomerate acquisitions are failures because the acquired operations do not rationally add value to the firm's overall performance (Porter 1987). Significantly, the transactions in Porter's sample are predominantly the result of friendly corporate acquisitions and Porter suggests that economic value can be created by breaking up conglomerate structures that result from these friendly transactions.

Such breakups will permit some subsidiaries to operate as free-standing entities subject to independent capital market discipline instead of the bureaucratic internal budgeting discipline employed in most conglomerate organizations. Alternatively, divisions that are sold off to other firms are typically combined with operations in similar lines of business. These combinations can take advantage of economies of scale and scope unavailable in the conglomerate form. Thus, Porter's research suggests that friendly takeovers may, on occasion, create inefficient conglomerate structures that can be beneficially unraveled through a restructuring that causes a realignment of corporate divisions. The analysis thereby strongly supports "bust-up" transactions that are frequently vilified in the press.

Viewed from this perspective, "Chop Shop" provides an estimate of the increased value that results from the subdivision of a conglomerate into entities that focus on defined lines of business. No doubt, bidders considering conglomerate acquisitions engage in similar analyses. "Chop

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[1] See, for example, Brickley and Schallheim (1985); Brauer (1984); and Brauer (1988).
[2] See, for example, Rose (1988).

Shop" can thus be thought of as an effort to estimate the reservation price that a bidder might assign to a conglomerate as a result of the gains that could be earned by restructuring the firm.

"Chop Shop" as an Arbitrage Pricing Theory Model

The arbitrage pricing theory is based on a relatively simple but powerful insight: identical items should sell at identical prices because any price differences can be arbitraged away. This "law of one price" suggests that the return on any one stock can be expressed as a linear combination of various indexes, that is:

$$V_i = a_i + b_{i1}I_1 + b_{i2}I_2 + \ldots + b_{ij}I_j + e_i.$$

In the case of "Chop Shop," the underlying hypothesis is that the law of one price and associated arbitrage should equalize the value of a conglomerate and the value of the conglomerate's component parts. By relating the conglomerate's value, V_i, to a set of indexes that describe the value of the conglomerate's constituent lines of business, I_j, "Chop Shop" seeks to estimate the value that the law of one price would impute to a conglomerate if the market were given an opportunity to engage in the necessary arbitrage.[3]

Synthesis

In "Chop Shop," all three of these views come together as one. The bust-up transaction is modelled as an exercise in open-ending a closed-end fund and is also revealed as an application of the law of one price. The model does not explain the source of the undervaluation, but that is not the model's purpose: the model is designed to be purely predictive and its purpose is to serve as a valuable trading rule for its developers.

The model's ability to predict may, however, be seriously constrained by currently employed estimation techniques and data. The model's current estimation approach, which relies on a linear regression on predetermined indexes with certain fixed weights as explanatory factors, may place unnecessary constraints on the underlying analytic approach. A factor analysis technique that relies on a richer data set and assumes fewer constraints on the variables that are most useful as explanatory factors may lead to better results (Elton and Gruber 1987, pp. 344–48). This approach could incorporate additional variables such as cash flow and other performance measures that are likely to be informa-

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[3] See generally, Elton and Gruber (1987) and especially pp. 336–54.

tive in predicting a conglomerate's potential breakup value.

To the extent the model relies solely on publicly available data that can be gleaned from annual reports and SEC filings, the model fails to incorporate some of the information most valuable to a "bust-up" analysis and subjects itself to some serious vagaries in accounting practice. In a bust-up transaction, in which each division is eventually sold to the highest bidder, the best estimate of a division's value may well be its replacement cost. That cost is most commonly estimated through market appraisals that do not rely at all on accounting data as reported in public filings. Indeed, to the extent that accounting data focus on historical cost measures that do not reflect current market values, those data are particularly unsuited to the market valuation task that is critical to the model's mission.

Further, the vagaries of FASB's Statement No. 14, which provides the basis for line of business reporting, have been frequently noted in the literature. In particular, "[q]uestions have been raised regarding the usefulness of the segment approach to forecasting because of potential data contamination. This contamination is perceived to arise because of difficulties in classifying firm activities into segments and the arbitrariness of transfer pricing and joint cost allocation. Because of the problems, it is possible that the use of segment data may lead to invalid forecasts" (Horwitz and Kolodny 1980, p. 27). In many respects, however, this criticism is simply a fact of life with which "Chop Shop" must live because, whatever the drawbacks of publicly reported line-of-business data prepared in accordance with FASB Statement No. 14, those are the only available data upon which the model can operate.

Can "Chop Shop" Become a Profitable Trading Rule?

Suppose that "Chop Shop" evolves into a highly accurate valuation model that estimates the discount the market applies to a conglomerate's shares. The authors suggest that they might, in the spirit of financial "glasnost," make their model available to other investors so that they would be willing to bid the conglomerate's shares to a higher value (LeBaron and Speidell 1987).

If the authors seek to profit from this research they will, however, have to proceed carefully. If they simply disclose the best version of their model, other investors will be able to acquire shares as rapidly as the inventors and few profitable opportunities will be available for them. Accordingly, they cannot place their work in the public domain if they are to profit.

Instead, the authors will have to develop a credible signalling strategy in which they first accumulate positions and then explain to the

market why they believe the companies in which they invest are under-valued. The explanation will have to be sufficiently persuasive that other investors will acquire shares, bid up the company's price, and still per-ceive an opportunity for profit because they expect yet another increase in share price after their acquisition.

Alternatively, the authors may want to adopt substantially more passive or aggressive strategies. At the passive end of the spectrum, the authors may want to abandon the idea of popularizing their model and simply rely on market forces to recognize the discounts identified by "Chop Shop." Several mutual fund managers attempt to identify future takeover targets by analyzing cash flow estimates and underlying asset values. Instead of popularizing these predictions, these managers invest in promising takeover candidates and then sit on the sidelines while nature takes its course. At the aggressive end of the spectrum, the au-thors can get into the acquisition business directly. After all, if their model is an accurate predictor of realizable values that are not fully incorporated into market prices, the authors may well be able to maxi-mize the value of their information by directly participating in takeover activity.

This last observation emphasizes a major implementation problem that is not addressed in "Chop Shop" or any other valuation model of its genre: identification of a potential discount is not a sufficient condition for profitable trading. Profits cannot be realized until there is a realistic plan for eliminating the conglomerate's discount and passing those gains through to the corporation's stockholders. Put another way, "Chop Shop" may be able to identify a conglomerate trading at a substantial discount, but if the conglomerate's management holds a majority of the corporation's shares and if management has committed itself to continue in its conglomerate strategy, the simple fact that the conglomerate's shares are trading at a substantial discount does not suggest that the discount is unwarranted or that purchasing the conglomerate's shares would be a profitable acquisition.

Thus, the analysis needs to go a step further and evaluate the prob-ability that an identified discount can be eliminated in the marketplace. Simply identifying the existence of a discount from some valuation that is reasonable, but perhaps difficult or impossible to attain, will not cause the price of a conglomerate's shares to rise to that value.

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