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THE TREBUCHET AND MAGNIFIED LEVERAGE EFFECTS IN THE BUSINESS FIRM

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Abstract

The medieval catapult weapon known as the trebuchet provides a useful physical analog for the impact of the many leverage effects that exist in a business firm and its performance. The trebuchet is explained, as are an extensive number of leverage effects for the business firm. The algebraic framework for determining the leverage effects in a business is presented and explained. The implications for management, as well as examples, are provided.

INTRODUCTION

Trebuchets were missile launching, pivoted levers that were used from China to Western Europe from about 500 to 1500 A.D. Compared to conventional catapults, trebuchets could launch projectiles that were multiples in weight because advanced trebuchets incorporated magnifying forces. Although there were numerous types of trebuchets employed over the vast time/space of their usage, Figure 1 shows a typical counterweighted trebuchet. While the trebuchet looks much like a catapult to the uninitiated, note that there is a sling on the "business" or launching end and a counterweight on the shorter arm of the pivoted lever. Figure 2 shows graphically how the sling—known at least from Biblical times—magnifies the force at launch; similarly, Figure 3 demonstrates the more sophisticated types of counterweights that added force to the missile launch.

Why would an ancient machine of war have relevance today to business? First, several recent articles in widely-read periodicals have renewed interest in trebuchets [4][10]. Further, efforts in both England and the U.S. to bring trebuchets back to reality have generated much publicity and even an "International Hurling Society" (1-800-HURL-R-US). More particularly, trebuchets represent a physical analog to leverage effects for many firms. That is, there are many forms of leverage that businesses encounter besides the conventional financial leverage. The existence of these non-financial leverages can magnify business performance just like the slings and counterweights magnify the performance of trebuchets. So, the purpose of this paper is to use the physical analog of the trebuchet to help managers and others understand the numerous leveraging impacts that affect business performance particularly as represented by the income statement.

LEVERAGE

Levers allow a magnification of input-to-output relationships. Most remember being bounced and jostled on playground teeter-totters as children. These playground toys are representative of pivoted levers (see Figure 4, upper panel). As kids quickly learn, playmates of different weights can still have an equitable time playing by adjusting the lengths of the two ends of the lever so that the heavier person has the shorter end. This moving of the lever arms around the pivot is equivalent to moving the fulcrum (pivot) as shown on the lower panel of Figure 4.

The reader may again be wondering the relevance of this to a business firm. Although the term leverage is commonplace in business, *understanding* the impact of leverage in the performance and planning of businesses is less widespread. Leverage exists in a firm because of *fixed* costs that magnify the input/output relations that *aren't* fixed. So a business that has costs that are nonvarying finds that after meeting these expenses, the performance (e.g.,

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revenues less costs) will be affected in a more than one-to-one basis after some part of the revenues have been committed to meet these fixed costs (for a more complete explanation, see [1]). Remembering that all costs are variable in the longer run, the upper panel of Figure 4 shows the long-run input-output relationship of essentially one-to-one. In the shorter term (like for some planning or performance period), the existence of any fixed cost makes the input-output relationship greater than one such as is shown in the lower panel of Figure 4. In fact, the lower panel of Figure 4 shows about a one-to-five input-to-output relationship which was achieved by advanced trebuchets as shown in Figure 1 ([7], pp. 102 or 105). In business firms, these magnified input-output relationships are called degrees of leverage.

FIGURE 1
Counterweighted Trebuchet

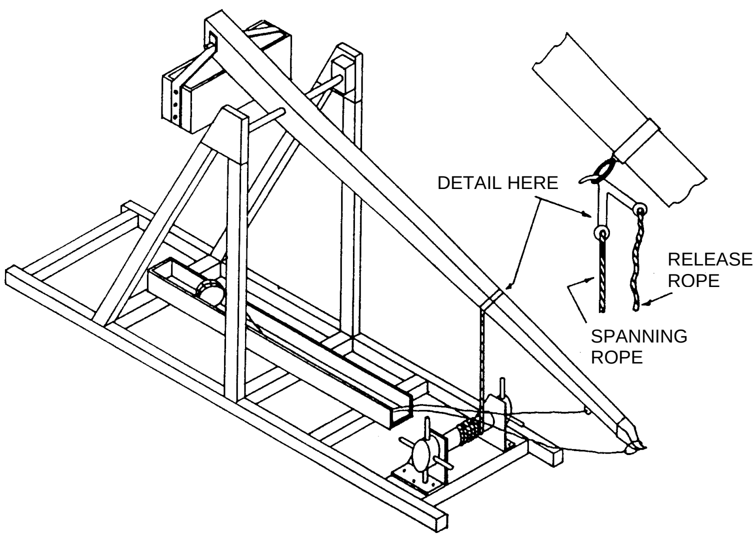


FIGURE 2
Sling-Release Device

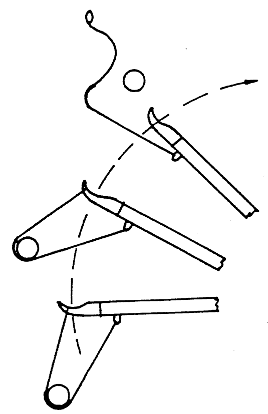
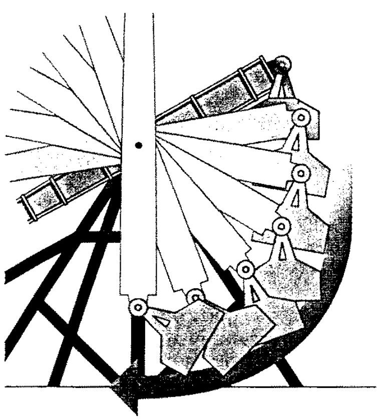


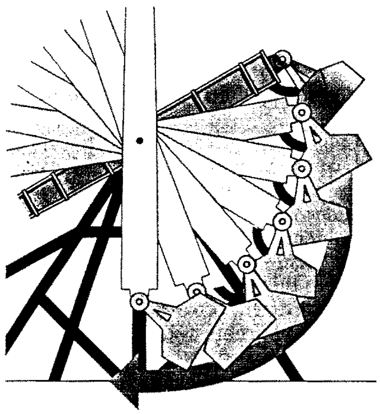
FIGURE 3a
Hinged Trebuchet Counterweight



Hinged counterweight machines added yet another increment to the range by improving the efficiency with which the trebuchet converted gravitational energy to projectile motion. The center of gravity of the weight fell straight down during the first phase of acceleration; as the hinge straightened, the rotation of the weight around its center of gravity added to the energy transferred. Continued rotation helped to slow the beam as the projectile was released, reducing strain on the mechanism. The smoothness of the trebuchet's action meant it did not have to be repositioned after each shot and so could discharge more missiles in a given time.

—Vernard Foley

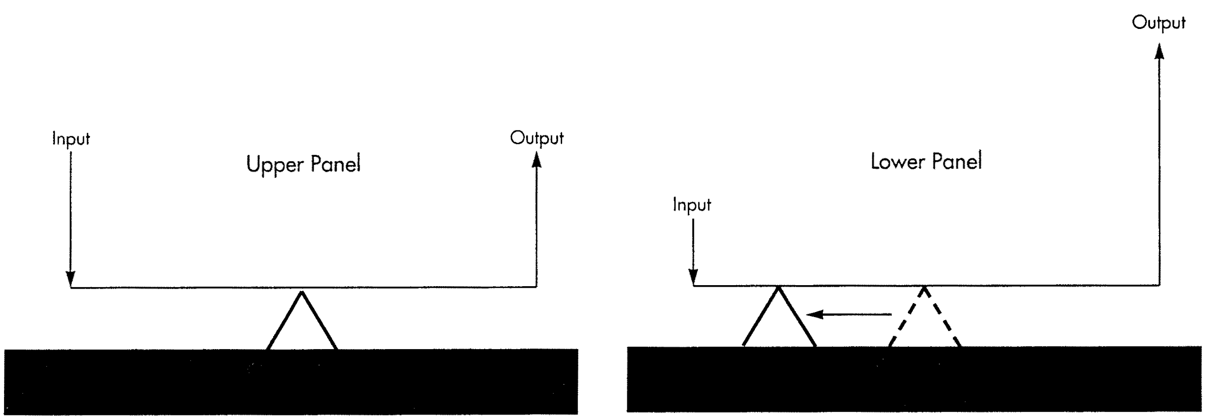
FIGURE 3b
Hinged and Propped Trebuchet Counterweight



Propped counterweights allowed engineers to squeeze even more energy out of the counterweight. By propping up the counterweight at an angle before firing, they gave it slightly farther to fall. This innovation also increased the distance between the center of gravity of the counterweight and the pivot around which the trebuchet beam rotated.

—*Vernard Foley*

FIGURE 4
Graphic Example of Leverage



Source: Brian Belt, "Leverage on the Cash Flow Statement," *Journal of Cash Management*, March 1993, p. 53. Reprinted by permission.

Typical financial management texts refer to these magnified input-output relationships as "degrees of operating or total leverage" ([15], 1993, pp. 639-43). For example, the degree of total leverage (*DTL*) is defined by Weston and Brigham([15], p. 642) as:

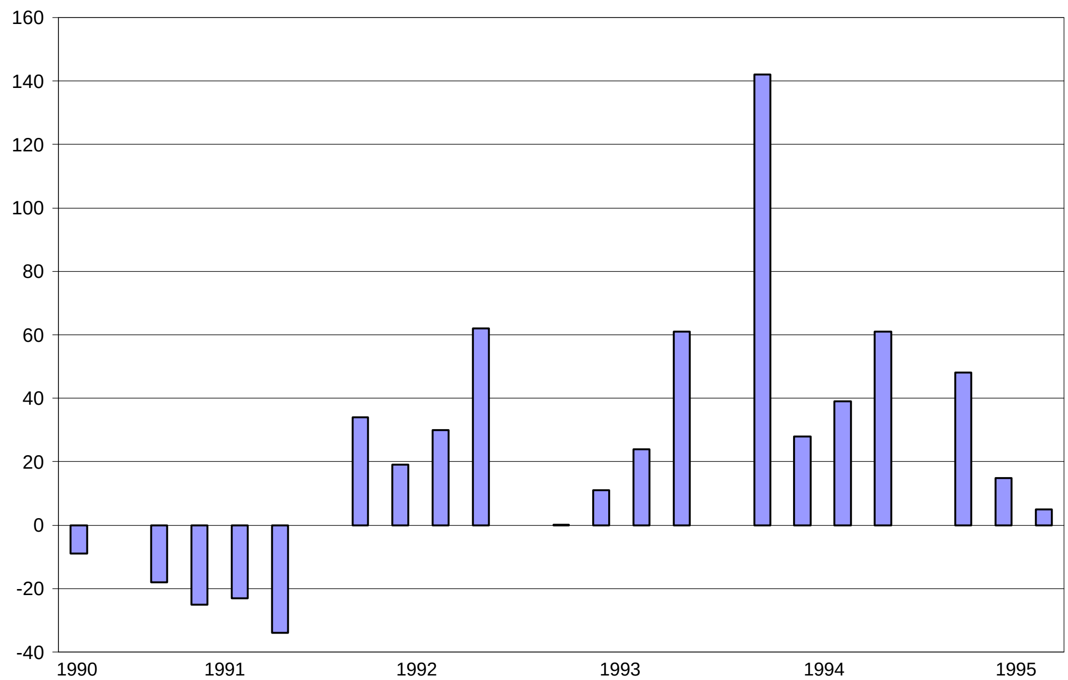
> *DTL* = (*% Change in Earnings After Taxes*) / (*% Change in Quantity Sold*). Rearranged, *DTL* is the multiplier (i.e., the lever) applied to the income statement input of (*% Change in Quantity Sold*) to determine an income statement output of (*% Change in Earnings After Tax*). Expressed as a conventional, algebraic formula with the input on the right side and the output on the left side of the equal sign:

Equation 1

(% *Change in Earnings After Tax*) = *DTL* × (% *Change in Quantity Sold*)

This magnified input-output performance is reported regularly in the financial press. Figure 5 provides recent earnings performance for selected companies as reported quarterly in the *The Wall Street Journal*. As the gross domestic product (GDP) (and presumably sales) changes several percentage points per quarter, earnings change many more percentage points. Interestingly, the same phenomena occurs both on the downswing (before 1992) and upswing (after 1991). Note that the percentage changes in profits during 1990-1991 were both negative as well as multiples of the several percentage points decline in GDP during that recessionary period.

FIGURE 5
Corporate Profits: Year-to-Year Percentage Change in Net Income for Companies in the Dow Jones Equity Market Index, 1990Q4 through 1995Q3



When one envisions a 4-quarter moving average run for the corporate profit data of Figure 5, the impact is much less dramatic. Why would that be true? Partly, smoothing implies a longer period of time and, as such, costs are less likely to be fixed. More importantly, though, is the fact that most conventional discussions of degrees of operating and/or total leverage imply that *everything else is constant* and the longer the period of time, the less likely everything else actually is unchanged. In fact, for longer periods of time, almost anything can change and create a magnified input-output relationship because of the existence of fixed costs on the income statement.

MULTIPLE LEVERAGE EFFECTS

So if anything else on an income statement may change, how would one determine the impact of such a change and what would the leverage effect be from such a change? First, let us assume a simple, but conventional income statement such as the one shown in Table 1, which does not include other (non-operating) income. Taking *each* variable one at a time allows the derivation of an input (for that specific variable)-to-output leverage effect to be determined (an example is given in the Appendix that follows the approach of Weston and Brigham ([15], p. 334)).

TABLE 1
Income Statement Model (Excludes "Other Income")

+ *Total Sales*	(= *Quantity* (or *Q*) × *unit Selling Price* (or *SP*))
– *Total Variable Costs*	(= *Q* × *unit Variable Cost* (*VC*))
= *Total Contribution Margin*	(= *Q* × (*SP* – *VC*))
– *Fixed Operating Costs*	(= *Fixed Cash Operating Costs* (*FCOC*) + *Depreciation* (*D*))
= *Earnings Before Interest and Taxes*	(*EBIT*) (= *Q* (*SP* – *VC*) – *FOC*)
– *Interest* (*I*)	(= *interest rate* (*i*) × *debt* (*B*))
= *Earnings Before Tax*	(*EBT*) (= *Q* (*SP* – *VC*) – *FOC* – *I*)
– *Taxes* (*T*)	(= *average tax rate* (*t*) × *EBT*)
= *Earnings After Tax*	(*EAT*) (= (*l* – *t*) × *EBT*)

Earnings Per Share (*EPS*) = *EAT divided by number of common shares* (*NS*)

Therefore,

$$EBIT = Q \times (SP - VC) - FOC$$

and

$$EAT = [(Q \times (SP - VC) - FOC) - i \times B] \times (l - t)$$

and

$$EPS = \frac{[(Q \times (SP - VC) - FOC) - i \times B] \times (1 - t)}{NS}$$

Each of the leverage effects for each variable are shown in Table 2. Please note that each is dependent on the income statement definition used and, at the least, the income statement given in Table 1 could have been expanded to include "other income". Also, note that the values of each leverage effect involving a fixed cost must be at least +1.0 if the firm is operating above its breakeven point or less than –1.0 if the firm is below its breakeven point. In addition, Table 2 provides the specific algebraic formula using the model income statement given in Table 1 as well as the accounting terminology which is necessary when dealing with aggregated accounting information when there is no unit data. Also provided in Table 2 are the input-output formulas patterned after equation #1 as shown above. These formulas as presented can be incorporated directly into spreadsheets that readers may wish to construct for firm-specific forecasting.

SELECTED EXAMPLES OF SPECIFIC MAGNIFIED LEVERAGE EFFECTS

Most business firms employ conventional financial leverage, that is, using fixed-cost forms of financing, which magnify input-output relationships. For example, *Forbes* recently reported that the average of the debt ratios for 20 different industries was 33%, so debt leverage is common ([5], Jan. 1, 1996, p. 237). But, how about the other types of leverage that add to and, therefore, further magnify input-output relationships just as the sling and counterweight further magnify trebuchet results? A few recent examples should prove illustrative.

A common form of leverage is selling price leverage. For example, crude oil prices fell throughout 1993 to five-year lows causing oil producer earnings and credit ratings to fall [12]. But many oil companies are both producers and consumers of crude oil, so what is important are both the price direction and the firm's exposure to oil price changes. For example, British Petroleum (BP) was characterized in 1994 as having "more oil-price leverage ... BP's earnings per share would increase 17% for every $1 rise in the price of oil" ([9], p. 77).

TABLE 2
Comprehensive Income Statement Leverage Factors

NAME OF LEVERAGE FACTORS	ALGEBRAIC FORMULA	ACCOUNTING TERMINOLOGY	INTERPRETATIVE FORMULA
TRADITIONAL:			
Operating (*DOL*)	$\frac{Q_O(SP-VC)}{Q_O(SP-VC)-FOC}$	$\frac{Total\ Contribution\ Margin_O}{EBIT_O}$	$(\%\Delta\ in\ EBIT) = DOL\ (\%\Delta\ in\ Q)$
Financial (*DFL*)	$\frac{Q_O(SP-VC)-FOC}{Q_O(SP-VC)-FOC-I}$	$\frac{EBIT_O}{Taxable\ Income_O}$	$(\%\Delta\ in\ EPS) = DFL\ (\%\Delta\ in\ EBIT)$
Total or Combined (*DTL*)	$\frac{Q_O(SP-VC)}{Q_O(SP-VC)-FOC-I}$	$\frac{Total\ Contribution\ Margin_O}{Taxable\ Income_O}$	$(\%\Delta\ in\ EPS) = DTL\ (\%\Delta\ in\ Q)$
EXPANDED:			
Pricing (*SP*) Leverage			
@EBIT level	$\frac{Q(SP_O)}{Q(SP_O-VC)-FOC_O}$	$\frac{Sales_O}{EBIT_O}$	$(\%\Delta\ in\ EBIT) = \frac{DPL(\%\Delta\ in\ P)}{EBIT}$
@EBT/EAT/EPS levels	$\frac{Q(SP_O)}{Q(SP_O-VC)-FOC_O-I}$	$\frac{Sales_O}{Taxable\ Income_O}$	$(\%\Delta\ in\ EBT/EAT/EPS) = \frac{DPL(\%\Delta\ in\ P)}{EBT}$
Variable Cost (*VC*) Leverage			
@EBIT level	$\frac{-Q(VC_O)}{Q(SP-VC_O)-FOC_O}$	$\frac{-Variable\ Costs_O}{EBIT_O}$	$(\%\Delta\ in\ EBIT) = \frac{DVCL(\%\Delta\ in\ VC)}{EBIT}$
@EBT/EAT/EPS levels	$\frac{-Q(VC_O)}{Q(SP-VC_O)-FOC_O-I}$	$\frac{-Variable\ Costs_O}{Taxable\ Income_O}$	$(\%\Delta\ in\ EBT/EAT/EPS) = \frac{DVCL(\%\Delta\ in\ VC)}{EBT}$
Fixed Operating Cost (*FOC*) Leverage			
@EBIT level	$\frac{-FOC_O}{Q(SP-VC)-FOC_O-I}$	$\frac{-Fixed\ Operating\ Costs_O}{EBIT_O}$	$(\%\Delta\ in\ EBIT) = \frac{DFCL(\%\Delta\ in\ FOC)}{EBIT}$
@EBT/EAT/EPS levels	$\frac{-FOC_O}{Q(SP-VC)-FOC_O-I}$	$\frac{-Fixed\ Operating\ Costs_O}{Taxable\ Income_O}$	$(\%\Delta\ in\ EBT/EAT/EPS) = \frac{DFCL(\%\Delta\ in\ FOC)}{EBT}$
Interest (*I*) Leverage			
@EBIT level	n/a	n/a	n/a
@EBT/EAT/EPS levels	$\frac{-I_O}{Q(SP-VC)-FOC-I_O}$	$\frac{-Interest_O}{Taxable\ Income_O}$	$(\%\Delta\ in\ EBT/EAT/EPS) = DIL(\%\Delta\ in\ I)$
Interest Rate (*i*) Leverage			
@EBIT level	n/a	n/a	n/a
@EBT/EAT/EPS levels	$\frac{-i_O B}{Q(SP-VC)-POC+-i_O B}$	$\frac{-Interest_O}{Taxable\ Income_O}$	$(\%\Delta\ in\ EBT/EAT/EPS) = DiL(\%\Delta\ in\ I)$

TABLE 2
Comprehensive Income Statement Leverage Factors
(CONT'D)

NAME OF LEVERAGE FACTORS	ALGEBRAIC FORMULA	ACCOUNTING TERMINOLOGY	INTERPRETATIVE FORMULA
EXPANDED:			
Debt Level (*B*) Leverage			
@EBIT level	n/a	n/a	n/a
@EBT/EAT/EPS levels	$\frac{-iB_O}{Q(SP-VC)-POC+-iB_O}$	$\frac{-Interest_O}{Taxable\ Income_O}$	(%Δ *in EBT/EAT/EPS*) = *DBL*(%Δ *in B*)
Tax Rate (t) Leverage			
@EBIT/EBT levels	n/a	n/a	n/a
@EAT/EPS levels	$\frac{-t_O}{1-t_O}$	$\frac{-tax\ rate_O}{1-tax\ rate_O}$	(%Δ *in EAT/EPS*) = *DtL*(% Δ *in tax rate*)
Number of Shares (*NS*) Leverage			
@EBIT/EBT/EAT levels	n/a	n/a	n/a
@ EPS level	$\frac{-NS_O}{NS_1}$	$\frac{-number\ of\ common\ shares_O}{number\ of\ common\ shares_1}$	(%Δ *in EPS*) = *DNSL*(% Δ *in # of shares*)

n/a: account doesn't occur on this income statement model until after (i.e., below) the relevant income statement level.

Cost leverage is important for firms consuming raw materials like cotton. Fieldcrest Cannon, a sheet and towel manufacturer, found its profits impaired substantially when spot cotton prices rose about $0.67 to $1.17 per pound in 1995 from 1994. Forecasted earnings were expected to drop by more than 34%; the decline was not as dramatic as anticipated by the cost increase because Fieldcrest initiated many cost reducing measures including "buying more cotton on long-term contract rather than on the spot market" ([3], p. 123). Thus, when firms are aware of these magnifying leverage effects, they can take actions to mitigate the expected results when the impacts are undesirable. This is an important element for any planning process.

Sometimes both selling prices and raw material cost vary simultaneously. IBP, Inc. produces boxed beef and pork products. Hog prices in 1994 were the lowest in 20 years while product prices stayed firm; this combination allowed IBP to have its highest ever operating margin in the fourth quarter of 1994 while earnings more than doubled ([8], p. 162+). This doubling of the firm's earnings took place even though pork is only one of IBP's major products.

One of the most illustrative industries for leverage effects is the automotive industry. For example, from 1992 to 1993 Chrysler increased unit sales from 2.18 million to 2.48 million, an increase of +14%, but automotive earnings went from $1.65 billion to $2.05 billion or +24%. This works out to an improvement of $628 per vehicle. In the words of the widely followed "Harbour Report 1994", ([6], p. 65):

> But the *explosion* [emphasis added] in Chrysler's profits were not just the result of a [n]...increase in vehicle sales. There were other important factors...Chrysler was able to improve its margins with higher-profit cars...We [Harbour] estimate that higher margins, and fewer sales incentives added $120 to Chrysler's per unit profit, while higher volume added another $243 per unit. ...We also estimate that improvements in productivity ... added $48 ... and the low cost components provided by these suppliers improved profitability $217 on a per unit basis.

So, less than 40% of Chrysler's per unit profit "explosion" in its 1993 automotive operations came from higher volume and more than 60% came from non-quantity forms of leverage. Thus, factors other than traditional financial leverage and quantity leverage greatly affect performance.

When a specific firm reports higher percentage changes in sales and profits, why is the latter not *always* some huge multiple of the former? Keep in mind that many factors are changing simultaneously as in the Chrysler example. Some of these changes multiply each other as the sling and counterweight do in the trebuchet while others mitigate the changes. In the trebuchet, if the sling releases too early or too late, the missile takes off at other than the desired angle mitigating the desired launch result. Some of the changes themselves are positive or negative (prices rise or costs fall) while the effects as shown in Table 2 are positive (like the impact of higher prices) or negative (like the impact of higher costs, generally). Further, higher prices should affect performance (i.e., earnings) positively, but real-world market factors like the price-elasticity of demand mitigate part of the expected benefit.

As Congress discusses the Federal budget at this writing, a last factor to note here are tax rates. Without any sophisticated analysis, any business person knows that lower tax rates are beneficial to business performance. Table 2 shows the algebraic formula for the tax rate leverage effect. For example, if the combined state and Federal rate declines from 40% to, say, 36%–a change of –10% or (36% - 40%) / 40%–then the tax rate leverage effect is: $DtL = -t_o / (1 - t_o) = -.4 / (1 - .4) = -0.67x$.[1]

So a decline of tax rates as suggested would have (from Table 2) the following impact, in line with Formula #1, on earnings (*EAT*) and earnings per share (*EPS*) for a typical firm:

(% *Change in EAT or EPS*) = *DtL*(% *Change in tax rate*) or
(% *Change in EAT or EPS*) = *–.67x* (*-10%*) = *+6.7%*.

So as proposals to cut tax rates unfold, the impact of any change on a firm's earnings performance can be determined directly from the above discussion and the formula in Table 2.

If we extend the concept of performance beyond the income statement to include the stock market, investors frequently are seen to use leverage. For example, all options imbed return leverage due to the fixed striking price. Also, so-called "value" investors often search for "low" price-to-earnings or "low" price-to-dividends stocks hoping that the pricing multiple will increase to at least "average" levels while firm performance does not deteriorate during the holding period. Some investors like Thomas Sweeney of Fidelity Capital Appreciation look at firms selling depressed commodities: "I like commodity-based industries, because the price of the underlying product shows when the industry is at a low point" ([16], p. 170). Sweeney researches the historical commodity cycle and, apparently using the pricing leverage noted above, selects stocks by estimating when and how much earnings will recover.

PROFIT CHANGES AS CASCADES

As noted above, profit changes can be substantial if several input factors work in conjunction or profit changes may be small or even negative if input factors mitigate one versus another. As a physical analogy, consider a pile of sand to which several grains at a time are added. Sometimes these grains get caught on existing grains and little appears to change; other times, however, the last grains added cause a cascade of both the existing and newly added sand grains. Profit changes can cascade, also.

There are two (2) possible causes of profit "cascades": 1) the firm may be operating very close to the breakeven point (e.g., see [1], p. 54); and 2) the effect of several of the input variables work in conjunction to magnify the result as does the counterweighted trebuchet with a sling (Figure 1). Let's look at the firms operating near the breakeven point first.

Table 3 displays profit changes for operating companies that had very low profit margins in 1985 (an expansionary year) and 1990 (during a recession). The profit margin (and presumably profits, too) changes for profitable firms still reported were several hundred percent higher both one and two years later. What this means is that these firms with operations very close to breakeven levels frequently have profit "cascades" as inputs such as sales increase, costs decline or some combination.

Firms not operating around the breakeven point also can experience profit cascades. Even when managers are trying to change but one factor, rarely can participants in complex environments actually do but "one thing." Changing prices affects quantity demand. Changing costs can alter either the perception and/or the reality of the goods and services offered.

In the complex and, possibly, chaotic conditions that exist in competitive markets, what appear to be deterministic actions may in fact become probabilistic events. So selling prices may change with little impact on quantity demanded and profits may "cascade" into the firm if no other input factors (such as shown in Tables 1 and 2) change. Or another round of price increases may lead to several counter-vailing effects and profits not only *don't*

TABLE 3
Changes in Net Profit Margins For Selected Manufacturing Firms, 1985-1987 and 1990-1992: Firms Had Base-Year (1985, 1990) Net Profit Margins of +0.0% to +1.0%

Number of Original Firms	Mean Net Profit Margin	# of Firms*	Mean Net Profit Margin	# of Firms*	Mean Net Profit Margin
	1985		**1986**		**1987**
26	+0.57%	18	+2.02%	16	+3.86%
Percentage Change Compared to Base Year, 1985	––		+254%		+577%
	1990		**1991**		**1992**
38	+0.48%	22	+2.16%	30	+3.05%
Percentage Change Compared to Base Year, 1990	––		+350%		+535%

* excludes firms with deficits or those no longer listed in *Forbes*, "Annual Report on American Industry"
Source: "Annual Report on American Industry," *Forbes*, various issues.

rise, but may actually decline. Here again the trebuchet is a useful analogy: when everything works as assumed, the missile may fly far on an optimal trajectory. When the inputs are misassessed and work against each other, the missile may fly straight up in the air and land on the trebuchet itself with shattering results such as happened to Cortez in Mexico City (Tenochtitlan) in the last recorded use of trebuchets in 1521 [4].

CONCLUSION

Using the physical analog of the medieval trebuchet, the concept of leverage has been explored and expanded. For any given planning and/or performance period, the existence of fixed costs—financial or operating—makes the impact of any change a multiple of the changed variable. Most firms employ financial leverage (fixed cost forms of financing) and have other costs that are for shorter time periods fixed, also. So input-output relationships are magnified and this is true for any change of income statement variables. The specific magnifying relationships are developed for a typical income statement model and are presented in Table 2. Managers can review Table 2 with several thoughts in mind: 1) what income statement variables can management actually change; 2) what is the magnitude of the impact that these changes cause; and 3) what magnifying and/or mitigating factors will be involved.

Various recent, real-world examples are discussed to help provide meaning to the conceptual framework presented. Anyone interested in measuring and assessing firm performance for a period of time—past, present or future—should understand these concepts clearly and, hopefully, the image of the trebuchet will help to implant the concept firmly. Medieval warriors used trebuchets to break down walls and modern business people can use the concept of multiple leverage in trebuchets to break down the walls that prevent understanding performance changes on the income statement.

ENDNOTE

1. The tax rate leverage effect, *DtL*, is an exception to the earlier statement that leverage effects are greater than or equal to 1.0. The reason that *DtL* can be less than one is that the tax (*T*) is computed "below" the income statement accounts that are fixed like fixed operating costs (*FOC*) or fixed interest expenses (*I*). As shown in Table 2, the other possible exception to the leverage effects being greater than or equal to one is the "number of shares" leverage (*DNSL*).

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APPENDIX
A Sample Income Statement Leverage Factor Derivation

The leverage factors given in Table 2 are all derived in the same approach shown by Weston and Brigham ([15] 1993, p. 334). One example of the derivation process may clarify their application for the reader. Take the first listed of the expanded income statement leverage factors: "pricing leverage" (or the degree of pricing leverage (*DPL*)) at the operating profit (*EBIT*) level from the income statement in Table 1 as an example:

$$DPL_{EBIT} = \frac{\%\,Change\,in\,EBIT}{\%\,Change\,in\,Price\,(SP)} = \frac{\dfrac{EBIT_1 - EBIT_0}{EBIT_0}}{\dfrac{SP_1 - SP_0}{SP_0}} = \frac{\dfrac{(Q(SP_1 - VC) - FOC) - (Q(SO_0 - VC) - FOC)}{(Q(SP_0 - VC) - FOC)}}{\dfrac{SP_1 - SP_0}{SP_0}}$$

and simplifying,

$$DPL_{EBIT} = \frac{Q(SP_1 - SP_0)}{Q(SP_0 - VC) - FOC} \times \frac{SP_0}{(SP_1 - SP_0)}$$

and simplifying again,

$$DPL_{EBIT} = \frac{Q(SP_0)}{Q(SP_0 - VC) - FOC}$$

Rearranging the first equation above yields the interpretative formula on the right hand side of Table 2 that corresponds to formula #1 in the text:

$$(\%\ Change\ in\ EBIT) = DPL_{EBIT} \times (\%\ Change\ in\ SP)$$

Note that all of the interpretative equations are set up so that the input variable—in this case selling price change per unit (*SP*)—is on the right-hand side and the output variable—*EBIT* change for this leverage factor—is on the left-hand side, thus paralleling conventional mathematical and scientific formulae.