

Breakeven, Leverage, and Elasticity

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Breakeven Analysis

Breakeven analysis is what management is all about. The idea is to compare where you are now to where you might be if you take a specific action. If you would be worse off, you do not take the action. If you would be better off, you take the action. The outcome is more important than the process. Breakeven analysis is sometimes called cost/benefit analysis, but whatever it is called it is an important managerial tool and a relative modeling technique. Leverage and elasticity are merely artifacts of breakeven analysis.

Leverage and Elasticity

Of the many concepts presented in various accounting, economics, and finance texts, one that often causes a great deal of confusion is leverage. While a few people will bother to learn the formulas for the degrees of leverage, they may still find it difficult to grasp the underlying concept. The formulaic approach, while correct, is insufficient to show the relationship between leverage concepts and the operations of the firm.

Part of the difficulty with leverage is that it is nonintuitive. The various degrees of leverage are actually elasticity measures; a percent change in one value is divided by a percent change in another. Dividing a percentage by a percentage is an extremely strange mathematical process. Both the numerator and denominator of the elasticity calculation are themselves fractions, and the absolute size of the numerators and denominators in these fractions that make up the numerator and denominator of the elasticity calculation have a profound effect on the value calculated (see how strange this is?). What is even more confusing is that there are people who try to use this value as if it has special meaning. As it turns out, all the elasticity calculations are just another way to look at breakeven points, and breakeven analysis is a simple relative modeling technique that does have meaning in business operations.

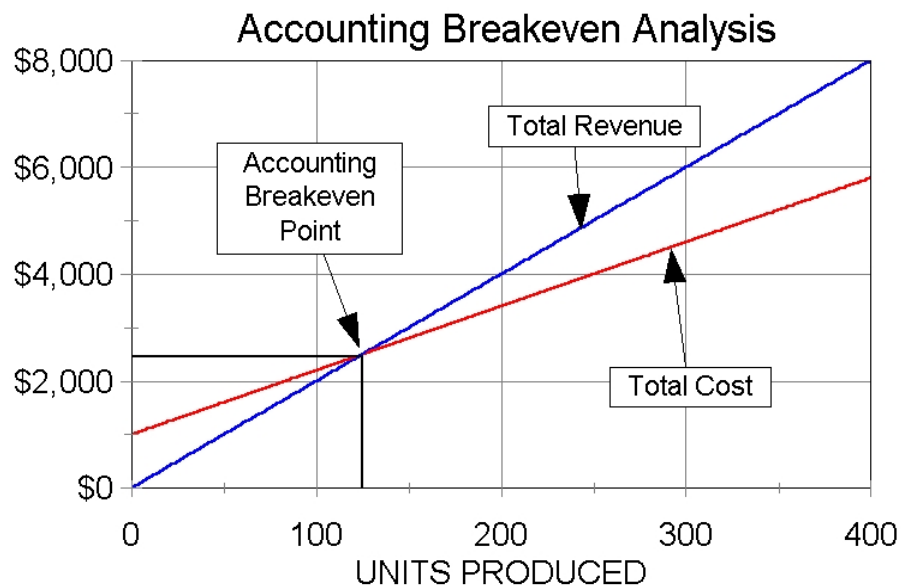
Accounting Breakeven Analysis

The first step to understanding leverage calculations is to understand breakeven analysis. The concept of accounting breakeven uses linear assumptions. The whole idea of any breakeven analysis is to compare costs and benefits. In order to demonstrate the interrelationship between breakeven and leverage, a simple numerical example will be used. The firm being analyzed has the following operational characteristics:

Selling Price per Item = \$20
Gross Profit Margin = 40%
Fixed Costs = \$1,000
Annual Interest Payment = \$400
Composite Tax Rate = 30%

The firm is in a market that can support various levels of production at the given selling price. The challenge facing the managers is to understand just how the various aspects of the business interact.

Standard accounting breakeven analysis relates to the top portion of the income statement, that portion of the income statement that reflects the operations of the firm. The standard graphical presentation of the accounting breakeven point is shown below:



The degree of operating leverage (DOL) shows a relationship within the top portion of the income statement and measures the sensitivity of changes in EBIT to changes in sales.

$$\begin{array}{l} \text{Sales} \\ - \text{ Cost of Goods Sold } \\ \text{Gross Profit} \\ - \text{ Fixed Costs } \\ \text{EBIT} \end{array}$$

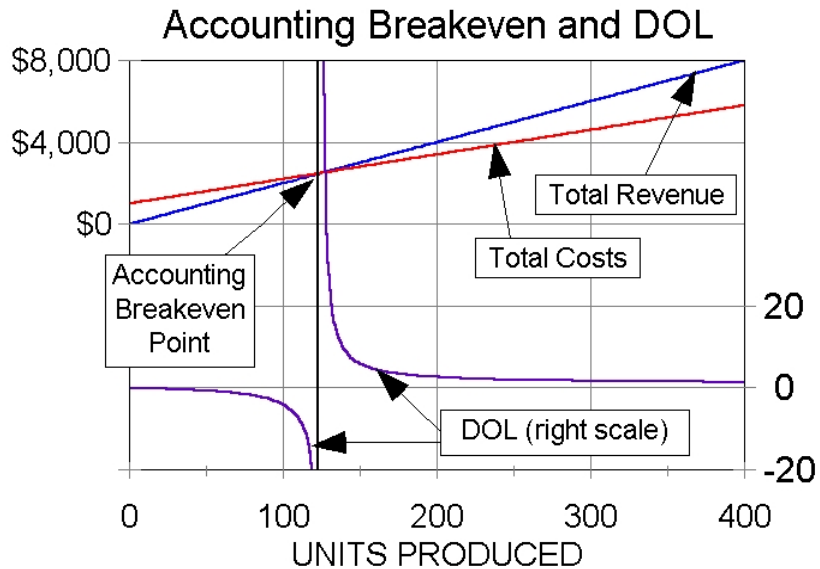
$$\text{DOL} = \frac{\Delta\% \text{ EBIT}}{\Delta\% \text{ Sales}}$$

The accounting breakeven volume is 125 items. Each item sells for \$20 and contributes \$8 towards fixed costs. The volume of 125 items provides the \$1,000 necessary to cover the fixed costs. The following table shows the EBIT and DOL at various levels of output.

Units of Output	EBIT (Operating Profit)	DOL
50	(\$600)	-0.67
100	(\$200)	-4.00
125	\$0	undefined
150	\$200	6.00
200	\$600	2.67

At 100 units of output, the firm's sales are \$2,000. Selling one more item would increase sales to \$2,020, a change of 1%. EBIT changes from (\$200) to (\$192) due to the additional \$8 the 101st unit contributes to the fixed costs. This \$8 causes the loss to decrease by 4%, and the $\text{DOL} = (-4\%/1\%) = -4$. Similar calculations can be made at all points along the breakeven curve except at the breakeven point. The existence of the vertical asymptote is easy to understand. At the breakeven point of 125 units, the EBIT is \$0. If even one penny is added to or subtracted from this amount, the percentage change of the EBIT is infinite since the calculation requires division by zero.

The relationship between accounting breakeven and the DOL can be shown by graphing the DOL on the same X-axis as the accounting breakeven graph as shown below.



The DOL graph has a vertical asymptote that passes through the accounting breakeven point. This makes sense since at the breakeven point every additional dollar of EBIT is a higher percentage of the total EBIT. Note that the DOL graph also has a horizontal asymptote on the right side of the accounting breakeven point of +1.0; this would be the case for a firm with no fixed costs so that each dollar of sales results in the same proportional change to EBIT. The DOL theoretically has a horizontal asymptote of +1 on the left side of the breakeven point, but since sales cannot be negative the DOL can only approach 0 on the left. The negative sign for the DOL to the left of the accounting breakeven point shows that the firm is losing money while the positive sign to the right of the accounting breakeven point indicates operating profits.

The vertical asymptote is an important mathematical characteristic of the DOL calculation. When operating near the breakeven point, any change in sales will have a dramatic effect on the DOL since the numbers in the denominator of the fraction are very small. A manager operating near the breakeven point will be able to say that his or her decisions have a large percentage effect on the profitability of the firm, but the absolute

level of profitability will be small. A manager operating far to the right of the breakeven point will not be able to effect great percentage changes in profitability due to the already high level of profits. This difference between absolute and relative profitability is the difference between breakeven analysis and leverage calculations, and both aspects of profitability can provide insight into a firm and its operations.

The nonlinear aspect of the DOL function can have practical implications. Consider whether you would rather make decisions that involve high degrees of operating leverage or low degrees of operating leverage. Since managers will be judged on whether or not they are able to make money for the firm, some people will choose to be in a high leverage situation where any decision they make that affects revenues will have a greater percentage impact on EBIT (a measure of pre-tax profits). What is not obvious is that high degrees of operating leverage imply that the firm is operating near its breakeven point. This is the point where each marginal dollar is a higher percentage of the EBIT for the firm. If you only have an EBIT of \$1, the next \$1 is a 100% change. If you are making \$1,000,000 the next \$1 is a .0001% change.

While a big percentage change might seem impressive, it is only a relative measurement which is subject to what is being measured against what. High positive DOLs imply that any new dollar is a high percentage of EBIT, thus EBIT must be low. The stockholders are more likely to be concerned with the absolute dollar level of returns rather than relative changes in the EBIT. Low positive DOLs are indicative of a firm that is making a lot of money, just what the shareholders want.

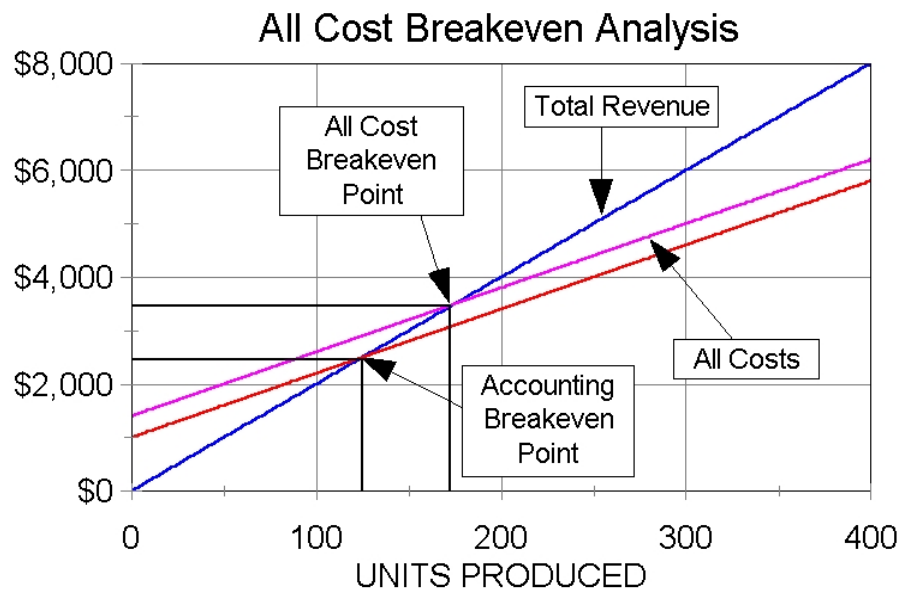
For the firm's managers, knowledge of the breakeven point and DOL give immediate information concerning the firm's profitability. A negative DOL means that the firm is not covering its fixed costs, and the absolute magnitude of the DOL indicates how close the firm is to the breakeven point. An increase in costs will shift the Total Cost curve upward and the breakeven point to right. For any given volume, the DOL will become less favorable (either a smaller negative value or a larger positive value). In this situation, the firm could try to increase the selling price of each item in order to increase the slope of the

Total Revenue curve and shift the breakeven point back to the left. This would cause the DOL to become more favorable (either a larger negative value or a smaller positive value).

All Cost Breakeven and the Degree of Financial Leverage

The DOL is an operating concept and only affects the top half of the income statement and the left side of the balance sheet. In order for a firm to be profitable, it is also necessary to generate enough money to pay interest and taxes. These latter two items relate to the bottom half of the income statement and the right side of the balance sheet.

The degree of financial leverage (DFL) can be illustrated in a manner similar to the DOL by extending the concept of breakeven to include all variable and fixed costs, including interest. For the sake of this discussion, the breakeven point that includes the interest charge will be called the “All Cost Breakeven Point”, and graphically it would appear as shown below.



For this firm, the all cost breakeven volume is 175 items. Since interest charges are \$400 per year and each item has a contribution margin of \$8, it takes 50 additional items beyond the accounting breakeven point before the firm pays all its costs.

The DFL is a relationship between certain values on the bottom half of the income statement.

$$\begin{array}{r} \text{EBIT} \\ - \text{Interest} \\ \hline \text{EBT} \\ - \text{Taxes} \\ \hline \text{Net Income} \end{array}$$

$$\text{DFL} = \frac{\Delta\% \text{ Net Income}}{\Delta\% \text{ EBIT}}$$

One potentially confounding factor is the existence of taxes and tax shields. If the firm is able to use a loss on a particular product to create a tax shield for other operations, then the tax shield should be credited to the calculation of net income for that product. Such a tax shield would result in an increase in Net Income relative to the EBIT and would therefore affect the DFL. The firm's tax rate is actually irrelevant, however, since it has a constant proportional effect on the Net Income relative to the Earnings Before Taxes (EBT), and thus the percentage change of any dollar of EBT and the Net Income is the same.

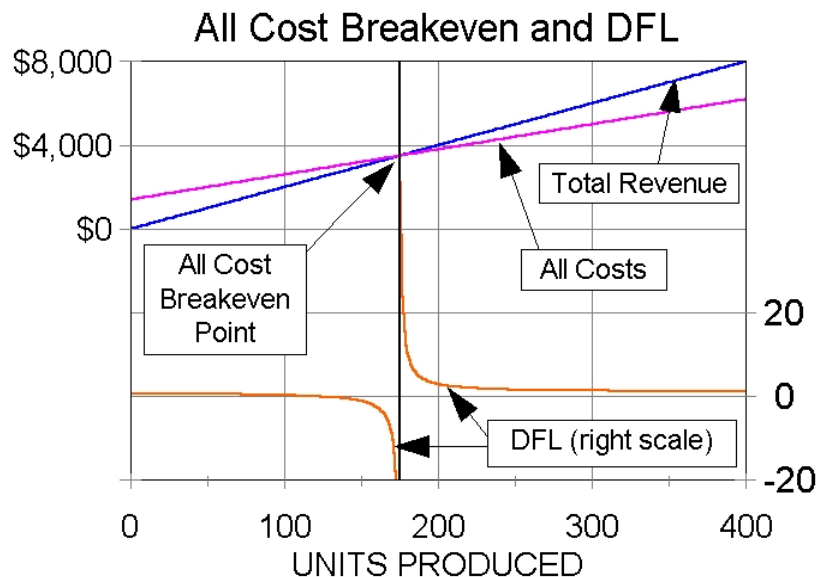
The DFL measures relative changes, and a tax rate does not change the relative relationship between EBT and Net Income. The following table shows the firm's Net Income (both with and without a tax shield) and DFL at various levels of output

Units of Output	Net Income (With Tax Shield)	Net Income (No Tax Shield)	DFL
100	(\$420)	(\$600)	-1.33
150	(\$140)	(\$200)	-6.00
175	\$0	\$0	undefined
200	\$140	\$140	8.00
250	\$420	\$420	3.33

At 200 units of output, the firm's sales are \$4,000. Selling one more item would increase sales to \$4,020, a change of .5%. Net Income changes from \$140 to \$145.60 due

to the additional \$8 the 201st unit contributes to the EBT which is reduced by 30% due to taxes for an increase in Net Income of \$5.60. This \$5.60 causes the Net Income to increase by 4%, and the DFL = $(4\%/1.5\%) = 8$. Similar calculations can be made at all points along the breakeven curve except at the all cost breakeven point. Note that in a manner similar to the DOL, the DFL has a vertical asymptote at the complete cost breakeven point and a horizontal asymptote of +1.0 (which would be for a firm with no interest payments).

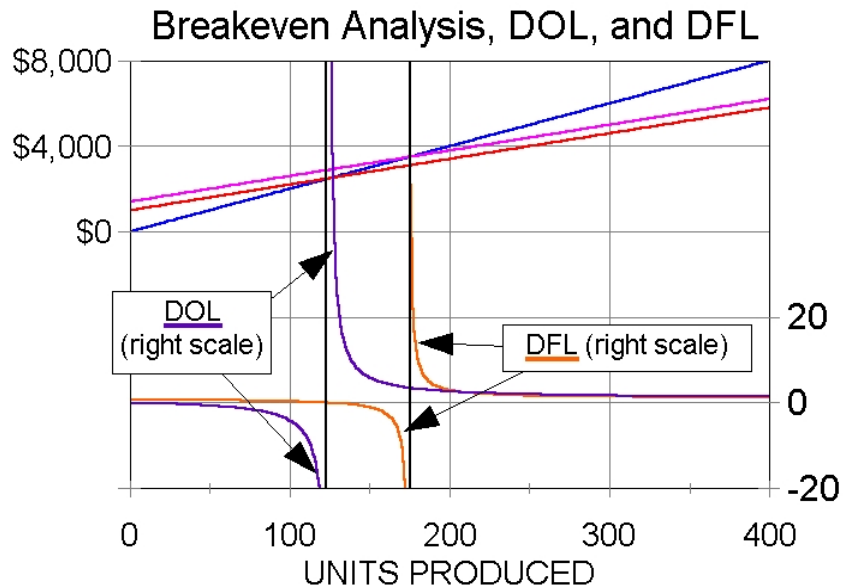
When the DFL is graphed on the same X-axis as the complete cost breakeven graph, a relationship similar to that of the DOL and the accounting breakeven graph.



The all cost breakeven point and the DFL show the effect of changing the financial structure of the firm by incurring additional interest charges. For this firm, a change in financial structure that caused interest charges to increase would cause the vertical distance between the Total Cost and All Cost lines to widen. This would have no effect on the accounting breakeven point but would shift the all cost breakeven point to the right. A change in the underlying cost structure or the selling price per unit would affect both cost curves and breakeven points and leverage values. This illustrates how changes in costs

and revenues can affect all aspects of the firm and its profitability while purely financial changes do not affect operations but do affect profitability.

The following graph combines the all cost breakeven graph and both the DOL and DFL graphs. In this format, the similarity of the concepts of DOL and DFL are evident.

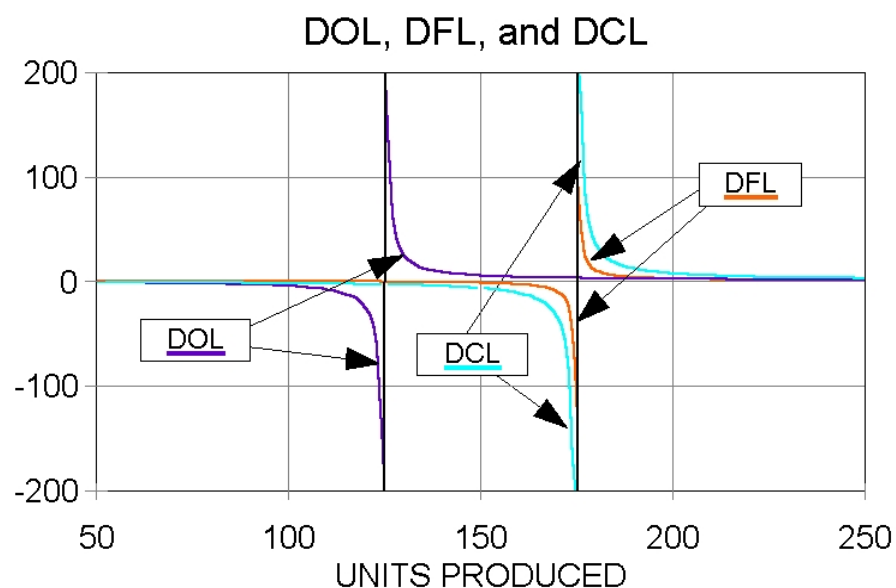


This graph illustrates the sensitivity of the DOL and DFL to changes in operating characteristics of the firm. For example, if a firm automates its production line and incurs higher fixed costs, both the DOL and DFL curves shift to the right. If a firm changes its capital structure to include more or higher priced debt, the increase in the amount of interest paid on the breakeven graph would shift the DFL curve to the right while the DOL curve would be unchanged. Changes in the variable cost structure would move both the DOL and DFL curves. The concepts of DOL and DFL are clearly interrelated.

The Degree of Combined Leverage

The degree of combined leverage (DCL) is supposed to show the relative relationship between the top and bottom of the income statement. While it would be easy enough to write out a formula for this relationship, it is simpler still to recognize that the

DCL is simply the product of the DOL and DFL. The following graph presents the three leverage graphs, DOL, DFL, and DCL, and shows their relationships.



Note that the DCL is similar to the DOL in that it has the same horizontal asymptote to the right of the breakeven point and approaches 0 to the left of the breakeven point. The rate at which the DCL value approaches the asymptotic values is different than the DOL due to the effects of the DFL. Changes in operating characteristics would change the DCL in a manner similar to the DFL, except that decreases in fixed and variable operating costs will cause the DCL to “approach” the DFL. The DCL also has the same vertical asymptote as the DFL, but again with a different pattern of approach due to the DOL. The fact that the DCL shares asymptotes with both the DOL and DFL indicate that it does capture effects of each concept.

Summary

There are times when a picture truly can be worth thousands of words. Pictures can be especially helpful in illustrating concepts that are nonintuitive or that involve nonlinear functions. Traditional breakeven analysis is intimately related to the measures of leverage associated with a firm’s income statement. Graphical analysis shows the relationship and

can identify how the various breakeven points and leverage factors interact. This interrelation shows that any manager or analyst who works with either breakeven points or leverage factors is in fact working with both, and knowledge of the interrelation can lead to better decision making. Appropriate application of breakeven analytical techniques and the related leverage concepts can provide managers and analysts alike with powerful tool for diagnosing and predicting the behavior of firms.