Operating Leverage Excerpt

We have discussed how to calculate and interpret various measures of break-even for a proposed project. What we have not explicitly discussed is what determines these points and how they might be changed. We now turn to this subject.

The Basic Idea

operating leverage
The degree to which a firm or project relies on fixed costs.

Operating leverage is the degree to which a project or firm is committed to fixed production costs. A firm with low operating leverage has low fixed costs (as a proportion of total costs) compared to a firm with high operating leverage. Generally, projects with a relatively heavy investment in plant and equipment have a relatively high degree of operating leverage. Such projects are said to be capital intensive.

Any time we are thinking about a new venture, there are normally alternative ways of producing and delivering the product. For example, Victoria Sailboats can purchase the necessary equipment and build all the components for its sailboats in-house. Alternatively,

TABLE 11.1

Summary of break-even measures

The general expression. Ignoring taxes, the relation between operating cash flow (OCF) and quantity of output or sales volume (Q) is

$$Q = \frac{FC + OCF}{P - v}$$

where

FC = Total fixed costs
P = Price per unit
v = Variable cost per unit

As shown next, this relation can be used to determine the accounting, cash, and financial break-even points.

The accounting break-even point. Accounting break-even occurs when net income is zero. Operating cash flow (OCF) is equal to depreciation when net income is zero, so the accounting break-even point is:

$$Q = \frac{FC + D}{P - v}$$

A project that always just breaks even on an accounting basis has a payback exactly equal to its life, a negative NPV, and an IRR of zero.

The cash break-even point. Cash break-even occurs when operating cash flow (OCF) is zero; the cash break-even point is thus:

$$Q = \frac{FC}{P - v}$$

A project that always just breaks even on a cash basis never pays back, its NPV is negative and equal to the initial outlay, and the IRR is −100%.

The financial break-even point. Financial break-even occurs when the NPV of the project is zero. The financial break-even point is thus:

$$Q = \frac{FC + OCF^*}{P - v}$$

where OCF* is the level of OCF that results in a zero NPV. A project that breaks even on a financial basis has a discounted payback equal to its life, a zero NPV, and an IRR just equal to the required return.

some of the work could be farmed out to other firms. The first option involves a greater investment in plant and equipment, greater fixed costs and depreciation, and, as a result, a higher degree of operating leverage.

Implications of Operating Leverage

Regardless of how it is measured, operating leverage has important implications for project evaluation. Fixed costs act like a lever in the sense that a small percentage change in operating revenue can be magnified into a large percentage change in operating cash flow and NPV. This explains why we call it operating leverage.

The higher the degree of operating leverage, the greater is the potential danger from forecasting risk. The reason is that relatively small errors in forecasting sales volume can get magnified or "levered up" into large errors in cash flow projections.

From a managerial perspective, one way of coping with highly uncertain projects is to keep the degree of operating leverage as low as possible. This generally has the effect of keeping the break-even point (however measured) at its minimum level. We illustrate this point after discussing how to measure operating leverage.

degree of operating leverage
The percentage change in operating cash flow relative to the percentage change in quantity sold.

Measuring Operating Leverage

One way of measuring operating leverage is to ask: If the quantity sold rises by 5 percent, what will be the percentage change in operating cash flow? In other words, the **degree of operating leverage** (DOL) is defined such that

$$\text{Percentage change in OCF} = \text{DOL} \times \text{Percentage change in } Q$$

Based on the relationship between OCF and Q, DOL can be written as:[6]

$$\text{DOL} = 1 + FC/\text{OCF}$$

The ratio FC/OCF simply measures fixed costs as a percentage of total operating cash flow. Notice that zero fixed costs would result in a DOL of 1, implying that changes in quantity sold would show up one for one in operating cash flow. In other words, no magnification or leverage effect would exist.

To illustrate this measure of operating leverage, we go back to the Victoria Sailboats project. Fixed costs were \$500 and $(P - v)$ was \$20, so OCF was:

$$\text{OCF} = -\$500 + 20 \times Q$$

Suppose Q is currently 50 boats. At this level of output, OCF is $-\$500 + 1{,}000 = \$500$.

If Q rises by 1 unit to 51, then the percentage change in Q is $(51 - 50)/50 = .02$, or 2%. OCF rises to \$520, a change of $(P - v) = \$20$. The percentage change in OCF is $(\$520 - 500)/500 = .04$, or 4%. So a 2 percent increase in the number of boats sold leads to a 4 percent increase in operating cash flow. The degree of operating leverage must be exactly 2.00. We can check this by noting that:

$$\begin{aligned}\text{DOL} &= 1 + FC/\text{OCF} \\ &= 1 + \$500/\$500 \\ &= 2\end{aligned}$$

This verifies our previous calculations.

Our formulation of DOL depends on the current output level, Q. However, it can handle changes from the current level of any size, not just one unit. For example, suppose Q rises from 50 to 75, a 50 percent increase. With DOL equal to 2, operating cash flow should increase by 100 percent, or exactly double. Does it? The answer is yes, because, at a Q of 75, OCF is:

$$-\$500 + \$20 \times 75 = \$1{,}000$$

Notice that operating leverage declines as output (Q) rises. For example, at an output level of 75, we have:

$$\begin{aligned}\text{DOL} &= 1 + \$500/1{,}000 \\ &= 1.50\end{aligned}$$

The reason DOL declines is that fixed costs, considered as a percentage of operating cash flow, get smaller and smaller, so the leverage effect diminishes.[7]

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[6] To see this, note that, if Q goes up by 1 unit, OCF goes up by $(P - v)$. The percentage change in Q is $1/Q$, and the percentage change in OCF is $(P - v)/\text{OCF}$. Given this, we have:

$$\begin{aligned}\text{Percentage change in OCF} &= \text{DOL} \times \text{Percentage change in } Q \\ (P - v)/\text{OCF} &= \text{DOL} \times 1/Q \\ \text{DOL} &= (P - v) \times Q/\text{OCF}\end{aligned}$$

Also, based on our definition of OCF:

$$\text{OCF} + FC = (P - v) \times q$$

Thus, DOL can be written as:

$$\begin{aligned}\text{DOL} &= (\text{OCF} + FC)/\text{OCF} \\ &= 1 + FC/\text{OCF}\end{aligned}$$

[7] Students who have studied economics will recognize DOL as an elasticity. Recall that elasticities vary with quantity along demand and supply curves. For the same reason, DOL varies with unit sales, Q.

What do you think DOL works out to at the cash break-even point, an output level of 25 boats? At the cash break-even point, OCF is zero. Since you cannot divide by zero, DOL is undefined.

EXAMPLE 11.1 **Operating Leverage**

The Huskies Corporation currently sells gourmet dog food for $1.20 per can. The variable cost is 80 cents per can, and the packaging and marketing operation has fixed costs of $360,000 per year. Depreciation is $60,000 per year. What is the accounting break-even? Ignoring taxes, what will be the increase in operating cash flow if the quantity sold rises to 10 percent more than the break-even point?

The accounting break-even is $420,000/.40 = 1,050,000 cans. As we know, the operating cash flow is equal to the $60,000 depreciation at this level of production, so the degree of operating leverage is:

$$\begin{aligned} \text{DOL} &= 1 + FC/\text{OCF} \\ &= 1 + \$360{,}000/\$60{,}000 \\ &= 7 \end{aligned}$$

Given this, a 10 percent increase in the number of cans of dog food sold increases operating cash flow by a substantial 70 percent.

To check this answer, we note that if sales rise by 10 percent, the quantity sold rises to 1,050,000 × 1.1 = 1,555,000. Ignoring taxes, the operating cash flow is 1,155,000 × .40 − $360,000 = $102,000. Compared to the $60,000 cash flow we had, this is exactly 70 percent more: $102,000/60,000 = 1.70.

Operating Leverage and Break-Even

We illustrate why operating leverage is an important consideration by examining the Victoria Sailboats project under an alternative scenario. At a Q of 85 boats, the degree of operating leverage for the sailboat project under the original scenario is:

$$\begin{aligned} \text{DOL} &= 1 + FC/\text{OCF} \\ &= 1 + \$500/1{,}200 \\ &= 1.42 \end{aligned}$$

Also, recall that the NPV at a sales level of 85 boats was $88,720, and that the accounting break-even was 60 boats.

An option available to Victoria is to subcontract production of the boat hull assemblies. If it does, the necessary investment falls to $3.2 million, and the fixed operating costs fall to $180,000. However, variable costs rise to $25,000 per boat since subcontracting is more expensive than doing it in-house. Ignoring taxes, evaluate this option.

For practice, see if you don't agree with the following:

NPV at 20% (85 units) = $74,720
Accounting break-even = 55 boats
Degree of operating leverage = 1.16

What has happened? This option results in slightly lower estimated net present value, and the accounting break-even point falls to 55 boats from 60 boats.

Given that this alternative has the lower NPV, is there any reason to consider it further? Maybe there is. The degree of operating leverage is substantially lower in the second case. If we are worried about the possibility of an overly optimistic projection, we might prefer to subcontract.

There is another reason we might consider the second arrangement. If sales turned out better than expected, we always have the option of starting to produce in-house later. As a practical matter, it is much easier to increase operating leverage (by purchasing equipment) than to decrease it (by selling equipment).[8] As we discuss later, one of the drawbacks to discounted cash flow is that it is difficult to explicitly include options of this sort, even though they may be quite important.

CONCEPT QUESTIONS

1. What is operating leverage?
2. How is operating leverage measured?
3. What are the implications of operating leverage for the financial manager?