Curriculum Integration: Does the Degree of Operating Leverage Defy Optimal Input Combinations?

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Fixed and variable inputs are analyzed in economic theories as well as management accounting. In economic courses, optimal input combinations require that the ratios of marginal product to input price be equal for all inputs. The degree of operating leverage (DOL) is a measure of the extent to which a business firm substitutes fixed inputs for variable inputs to boost the contribution margin. It is shown that the practice where a firm invests more in fixed inputs with no regards to relative input prices is a violation of optimal input combinations. This is obvious if input substitution topics in economics and business are integrated.

INTRODUCTION

Accounting as a subject is comprised of two parts: financial and management accounting. Financial accounting collects information from management or cost accounting to prepare financial reports. The data used by accountants to prepare financial reports is economic information. Yet, there is a general consensus that economics as a subject is a distinct and independent area from accounting.

Accounting information is used by management for planning and efficient investment decisions. While economics pursue efficiency in cost analysis, accounting is concerned with accuracy in reporting. Efficiency is a function of accuracy, thus the former and the latter should be integrated in a business course. As a potential manager the MBA student, for example, must conceptually connect the efficient production level as taught in economics to fixed input investment decisions as discussed in an accounting or a finance course.

One area of alienation of the business student from economics is whether the use of operating leverage in accounting and finance courses undermines the efficient inputs combinations as discussed in economics. Perhaps, business graduates would make better investment decisions if they are able to connect and integrate economic theories with relevant topics in business.

The American Assembly of Collegiate Schools of Business (AACSB, 2002) urged business schools to embark on a more integrative curriculum that places emphasis on interdisciplinary learning among students. Many colleges have responded by experimenting with different forms of curriculum integration. Davis, (1995) defines integration as "the degree to which the disciplines are woven together from two (or more) separate disciplines, or sub-disciplines, into a single larger discipline," (Ducoffe, Tromeley and Tucker, 2006).

Production costs in economics and accounting stem from the same theoretical source, yet it is incomprehensible for many students to make the connections. Thus, economics courses are very unpopular among business students (Gregorowicz and Hegji 1998). The disconnection in conceptualiz-

ation has resulted in many business students learning economics only in passing, and economic concepts become impracticable when faced with real business problems that need deeper understanding of economics.

Part 2 of this paper illustrates the usual optimal input combinations as discussed in economics courses, and part 3 presents the degree of operating leverage (DOL) as explained in business courses including managerial economics (Hirschey, 2008; McGuigan, Moyer & Harris, 2008). Part 4 integrates and shows how the practice of DOL violates optimal input combinations. Part 5 concludes with some implications.

ECONOMIC ANALYSIS

The basic production model in economics assumes the manager chooses technologically efficient combinations of fixed and variable input K and L. This level is where the marginal rate of technical substitution (MRTS) equals the ratio of the input prices, w/r, where r and w are prices of fixed input, capital (K) and variable input, labor (L), respectively. Total costs (TC) equals $rK + wL$ and output (Q) is a function of K and $L,$ [Q(K, L)].

$$MRTS = -dK/dL = w/r = MP_L/MP_K . \tag{1}$$

With cross multiplication, the two right terms in equation (1) becomes

$$MP_L/w = MP_K/r . \tag{2}$$

Equation (2) states that input combinations between fixed and variable inputs by the business firm are optimal when an additional dollar spent in any input generates equal increase in output. This efficient level is graphically illustrated as where the slope of the isoquant is tangent to the slope of the isocost. This is shown in figure 1 below.

FIGURE 1
ISOQUANT AND ISOCOST
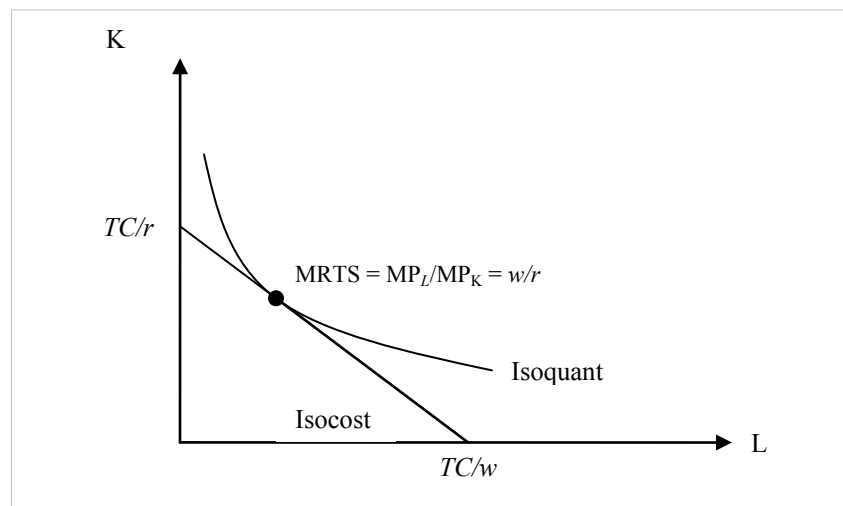
THE DEGREE OF OPERATING LEVERAGE (DOL)

Operating leverage is the relative combination of fixed and variable costs and the use of fixed assets (costs) to generate net income. In an operation where fixed costs (fixed assets) can be substituted for variable costs (labor and material), a firm can boost its contribution margin by investing more in fixed assets while reducing variable expenses. In this case, the firm uses fixed cost as a lever to increase its contribution margin. As the firm invests in fixed assets, it also acquires more risks. The degree of operating leverage (DOL) is a measure of this risk as shown in equation (4) below. Table 1 illustrates CVP income statement for different volumes.

TABLE 1
CVP INCOME STATEMENT

CVP INCOME STATEMENT FOR THE QUARTER ENDING MAR 31, 20XX					
	A-1000 sold	B-Per unit	C-1100 sold	D-1100 sold	E-900 sold
Sales	$600,000	$600	$660,000	$660,000	$540,000
VC	(400,000)	(400)	(440,000)	(385,000)*	(315,000)
CM	200,000	200	220,000	275,000	225,000
FC	(200,000)	(200)	(200,000)	(235,000)	(235,000)
Net Income	0	0	20,000	40,000	(10,000)
CM ratio	33.33%		33.33%	42%	
*FC are substituted for some VC; VC now $350 per unit				DOL = 6.875%	

The degree of operating leverage is the sensitivity of profits to changes in output. It is an elasticity concept, which is, dividing a percentage change in sales into a percentage change in profit (McGuigan, Moyer & Harris, 2008). Given that Q equals quantity sold, P equals price of the good, AVC equals unit variable cost, TFC is total fixed costs, and profit equals $\pi = Q(P - AVC) - TFC$,

$$DOL = (d\pi/\pi)/(dQ/Q) = \{dQ(P - AVC)/[Q(P - AVC) - TFC]\}/dQ/Q. \qquad (3)$$

Rearranging equation (3), DOL becomes:

$$\{Q(P - AVC)\}/\{Q(P - AVC) - TFC\}. \qquad (4)$$

The higher the TFC items in column A, Table 2, the greater the DOL for the firm. Thus, if TFC denotes only costs associated with properties, plants and equipment, excluding a host of other items that meet the definitions of fixed costs, the risks facing the firm are understated.

A higher level of operating leverage magnifies profits in times of high sales and magnifies losses during recession. For example, in Table 1, with 6.875 DOL, a drop in sales by 200 units reduces profit from a positive $40,000 to a loss of $10,000 (columns D and E, respectively). Higher levels of fixed inputs, therefore, could be linked to higher levels of risk.

DOL VERSUS OPTIMAL INPUT COMBINATIONS

Economic costs are defined by their behaviors with respect to changes in volume. Costs that remain fixed as output varies in the short run are called fixed costs, and costs that vary with output are called variable costs. In the long run, the firm can expand its fixed input through capital acquisitions. Thus, all costs are variable in the long run.

TABLE 2
ECONOMICS AND ACCOUNTING INPUTS

Economics Classification			
A - Fixed Inputs (K)		**B - Variable Inputs (L)**	
Accounting	**Assignment**	**Accounting**	**Assignment**
1.Machine (dep)*	Indirect	1.Material	Direct
2.Buildings (dep)	Indirect	2.Labor	Direct
3.Cost of capital	Indirect	3.Utilities	Indirect**
4.Plant Supervisor*	Direct/indirect^	4.Factory Supplies	Indirect**
5.Plant Maintenance*	Indirect	5.Sales Commission	Indirect
6.Insurance	Indirect	6.Delivery Charges	Indirect
7.Property Taxes	Indirect	7.Labor Fringe[1]	Indirect**
8.Advertising	Indirect		
9.Mngment Salaries	Indirect		
^Plant supervisor's pay could be indirect if (s)he supervises more than one plant.			
*Fixed manufacturing overhead. **Variable manufacturing overhead.			

Accounting courses and practice have the same cost arrangements as economic theories. However, management accounting further breaks fixed and variable inputs into direct and indirect inputs as shown in table 2.

In the application of operating leverage, a very popular practice in modern business models, the firm substitutes fixed inputs (some items in column A) for some variable inputs (items in column B) to enhance its contribution margin. Does the firm ignore optimal input combinations in the production process as described in equation (2)? The optimal input combinations as derived in economics take into consideration the input price ratio. However, from equation (4), DOL is a function of the quantity (Q), product price (P), TFC and AVC.

We can use data in table 1 to make an illustration. From column A, total variable cost is $400,000 comprising of $200,000 materials and $200,000 for labor. Assuming that this firm uses a quarterly labor hours of 5,000 and the hourly cost of labor including fringes is $40. This firm also applies 4,000 machine hours at a cost of $50.00 per hour.

Assuming also that the marginal product of labor and marginal product of capital are equal to their respective average products, we can use the information in column A, table 1 to generate marginal product per dollar spent (table 3 below). This assumption is not over-simplistic knowing that the business firm produces at the relevant range where the production function is linear.

TABLE 3
OPTIMAL INPUT COMBINATIONS AND DOL

Table 1 Column	Input	Output	Hours	MP_L MP_K	w or r	MP_L/w MP_K/r	Optimal
A	Variable	1,000	5,000	0.2	$40	0.005	Yes
	Fixed	1,000	4,000	0.25	$50	0.005	
D	Variable	1,100	4,625	0.238	$40	0.006	No
DOL	Fixed	1,100	4,700	0.234	$50	0.0047	
Note that in table 1 column D, $385,000 total variable cost equals (4,625 labor hours x $40) + $200,000 for material and $235,000 total fixed cost equals 4,700 hours x $50.							

Although, the firm builds the capability to boost profit to $40,000 (column D in table 1) by substituting fixed input for variable input, the optimal input combination is violated. This has dire consequences in times of volatile economic conditions. For instance, the firm loses $10,000 when 900 units are sold (column E, table 1). Operating leverage applied by the firm has created inflexibility in input substitution in times of economic fluctuations. While variable inputs can be reduced to match declining sales, fixed inputs do not have such flexibility.

Optimal input substitution violation by the operating leverage practices can be graphically illustrated by the divergence of potential operating leverage expansion path from optimal input combination expansion path as illustrated in figure 2.

FIGURE 2
OPTIMAL VERSUS DOL EXPANSION PATHS

Isocost GH in figure 2 is the initial budget for the firm producing 1,000 outputs using $600,000 total costs ($400,000 variable plus $200,000 fixed costs). At point 'a', the firm makes zero net income as shown in table 1, column A. If the firm applies optimal input combinations in capital expansion, the firm produces 2,000 outputs at point 'c' on isocost KL, where equation (2) holds. Isocosts GH and KL have the same slope and MP_L/w equals MP_K/r, which is 0.005 as shown in table 3.

With the application of operating leverage in the production of 100 additional outputs as indicated in column D, tables 1 and 3, the firm substitutes more hours of fixed inputs for variable inputs incurring $620,000 total costs ($385,000 variable plus $235,000 fixed costs). The firm boosts contribution margin and makes a net income of $40,000 at point 'b' on isocost IJ. At this point, MP_L/w equals 0.006 and MP_K/r equals 0.0047 (see table 3). As the firm continues with the same trend in the substitutions of fixed inputs for variable inputs, and input prices w and r remain the same, the DOL expansion path is diverging from the optimal input combinations expansion path (point d, figure 2).

One could argue that in practice there are too many inputs in the production process such that the calculation of marginal or average products would be too cumbersome to undertake for each input. This problem could be resolved, however, by taking the composite average products of inputs as classified in table 2. Besides, available modern software technology could also make this process practicable.

Another possible argument is that the firm is naturally a risk taker and need not observe efficient input combinations. In this case, the optimal fixed and variable input combinations for different industries could be studied and prepared by researchers as a benchmark to measure risky firms that deviate far from efficient input combinations. This is important because firms that engage in the practice of DOL are more prone to problems in fluctuating economic times.

The popularity of DOL and other business practices that violate optimality as derived using economic theory could be due to the absence of deeper contents of economics in business curriculum. The classroom presentations in silos (Berry, 2009) of the degree of operating leverage (DOL) and economic input combinations in business schools, for instance, leaves this and other concepts beyond imaginations in practice. The integrations of the economic input substitution theories with the practice of DOL as taught in business courses would reveal that the latter is a violation of the former.

CONCLUSION

Fixed and variable inputs describe the same information in economics as well as management accounting. Economic theory provides the optimal level of fixed and variable inputs combinations. In practice, firms invest in fixed inputs in the production process with little attention to the efficient input combinations benchmark. The degree of operating leverage (DOL) is the extent a firm applies fixed inputs as a substitute for variable input to boost contribution margin. It is shown that the practice of operating leverage is a violation of optimal inputs combinations as theorized in economics. Over investment in fixed inputs that defy optimal input combinations cumulates to social costs, owing to huge losses in times of economic downturn.

Economic production theory is concerned with efficiency. Since management accounting is a form of application of economic theories, perhaps, integrating business topics with economics in classroom pedagogy is necessary in order for business curricula to take advantage of optimality as illustrated in economics.

NOTES

1. Labor fringe includes social security, life insurance, health insurance, pension, training, vacation, sick leave, overtime and idle time. Some companies classify these as indirect costs and others as direct. Many of these items are expressed as a percentage of labor hours; therefore, they fit into variable costs.

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