

Fixed Asset Management – Revisited

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The financial management textbooks introduce issues related to the financial management of fixed assets in a disjointed fashion rather than a comprehensive discussion in a single chapter like the working capital management. Students, analysts, and managers may not readily comprehend the linkages among these issues. In this study, we discuss a range of fixed asset related issues and explain their relationships with each other and how their impact on the accounting, financial, and economic performance measures. Finally, we assess the interrelationships between the fixed assets and financial mix. We encourage researchers to investigate and develop financial models of fixed asset management, which will link these variety of issues, and then support it with examples.

Keywords: fixed assets, NPV, capital budgeting, cash flow, EVA, deferred taxes, depreciation, operating expenses

INTRODUCTION

Porter (1992) argues that firms must continuously innovate to maintain and improve their competitive advantages via sustained investment in physical assets. He contends that management must ensure the flow of capital to those corporate investments that offer the greatest payoffs in the long run instead of short-run, and allocate capital to those businesses that can deploy it most productively and within businesses to the most productive investment projects. He further maintains that a firm's failure to understand and change the management of the capital investment process will simply lead to decline of its businesses. A firm's strategic plan (Gale, 1980), Gale and Branch (1987)), identifies among other things, (1) what businesses it should be in, their sustainable competitive advantage, and initiate a firm's exit from low market share and low-growth businesses, (2) its core competencies, investment intensities of its various businesses expressed as percentage of output and revenue and their impact on profitability, (3) the balance between capital and labor productivity and unit cost within and across industries at various stages of business cycle, (4) barriers to entry and exit owing to high or low levels of fixed asset investments, and its capacity utilization, and (5) its plan to monitor investment intensities among its business units. The finance literature largely agrees that a firm's goal should be to maximize shareholder wealth. Rappaport (1986) identifies the drivers of value creation as sales growth rate, operating margin, working capital and fixed capital investment, and risk which is influenced by management's investment and financing policy choices. He further argues that a firm may achieve and maintain its competitive position via cost advantage and or differentiation. To that end, a firm may utilize a menu of tactics such as increasing asset utilization to achieve cost leadership and/or deployment of specialized assets to create differentiation. Most finance text books (see Keown, Martin and Petty (2020), Brealey, Myers and Marcus (2019), Brigham and Daves, (2015), Brigham and Houston

(2018), Ross and Westerfield, and Jordan, (2016), Gitman, and Zutter (2019), Brigham and Ehrhardt, (2019)) include a chapter on working capital investment and discuss in detail management of cash, accounts receivable, and inventory. In addition, these textbooks generally contain a chapter on short-term financing planning. The topics include management of cash budgets, marketable securities, and disbursements, credit management policies, management of account receivables and inventory, trade credit, bank and commercial paper financing, accounts receivable and inventory financing. Many sophisticated financial models for cash, receivables and inventory management has evolved. The very demanding daily operations of these assets can be repetitive and may lead to a myopic approach to the management of such assets.

However, unlike the working capital, the level of investment in fixed assets does not change from day to day during regular operation. A firm needs to acquire fixed assets for efficient utilization and to improve productivity, which will boost the value driver of fixed capital investment to achieve cost leadership and improve its shareholder value. Although for most firms the fixed assets make up the significant portion of total assets, the finance textbooks do not devote a chapter on fixed asset management. Most issues related to these assets are discussed in textbooks in a disjointed fashion through several chapters. These topics include (1) the role of fixed assets in financial statements; (2) the acquisition of fixed assets in a capital budgeting chapter with a passing discussion on operating expenses and administration aspects of fixed-assets; (3) the role of deferred taxes and invested capital in calculation of economic value added (EVA) measure; (4) the financing of fixed assets in financing mix or capital structure chapter, which includes discussion on operating leverage, break-even analysis, business and financial risk, financing mix and the capital structure; (5) the planning and forecasting of fixed assets in the financial planning chapter with a short discussion on the hedging principle of matching of current assets with short-term financing and fixed assets with long-term financing, and forecasting of fixed using the percentage of assets method; and finally (6) the impact of fixed assets on financial ratios in the analysis of financial statements chapter. By and large, researchers have focused their investigations on one of the above six topics of financial management of fixed assets. Students, analysts, and management may not understand the linkages among these six issues since the research studies and the literature do not reconcile or provide linkages among these topics. Finally, insights on problems encountered in the business world are generally missing in these discussions. The purpose of this study, therefore, is 1) to first develop a comprehensive approach to fixed asset management, which ties together the various facets of fixed asset management, 2) to subject fixed assets to the same scrutiny that is accorded to costs, expenses and cash, receivables, and inventory, 3) to develop a framework, which will incent academicians to conduct further research in this area, 4) encourage textbook authors to give greater attention to the linkages among the accounting, economic and financial issues that bind them together in acquisition, maintenance and replacement of these fixed assets, and finally 5) to help the CFO to ask the right questions, and to set up coordinated fixed asset management practices within their organizations for a prudent financial management of fixed assets.

LITERATURE REVIEW

The finance literature generally focuses on specific attributes of fixed assets. For instance, several survey articles identify business practices and academic research in capital budgeting (see L. J. Gitman and J. R. Forrester, Jr., 1987, Kim and Farragher (1981), Klammer (1972), Ryan (2002), Giovanni and Maccarrone (2001), Haka (2007)), Mukherjee and Henderson (1987), Baker and Mukherjee (2007), Graham and Harvey (2001)). The other areas of research include: acquisition and abandonment (Robichek (1967), Schwab and Lusztig (1969), Danielson and Scott (2006), replacement and modernization of fixed assets (Scapens and Sale (1981)), capital budgeting criteria (Bierman and Smidt (1984), Scapens and Sale (1981), Weingartner (1969), Osborne (2010), Phalippou (2008)), capital rationing (Pick (1991)), Lorie and Savage (1955), and capital budgeting under uncertainty (Lorie and Savage (1955), Schwab and Lusztig (1969). In addition, researchers have studied post-completion audits (Huikku (2008)), and real option in capital budgeting (McDonald (2006)). Several books are devoted to comprehensive discussions on capital budgeting (Pike and Neale (2003), Shapiro (2005), Baker and English (2011)). Ehrhardt and Brigham (2016) suggest a methodology to estimate the required level of fixed assets. Deo (1992) recommends that

a firm should monitor economic value of its fixed assets to maintain optimal levels of fixed assets. To stay competitive, he suggests a firm should conduct periodic assessment of its capital programs and offers a methodology to evaluate its capital spending rates and depreciation rates.

Reimers (2003), Harrison and Horngren (2014), Kiesco, Weygandt, and Warfield (2019), Spiceland, Wayne, Hermann (2019) have provided accounting perspective on fixed assets including the definition of fixed costs, acquisition costs, useful life, depreciation methods, operating expenses and taxes, impact on financial statements, and the concept of break-even analysis.

FIXED ASSETS

The fixed or long-term assets include three components, the gross property, plant, and equipment denotes the original purchase price of the fixed assets. Each year's estimated depreciation expense of each asset is added to the prior depreciation to derive the accumulated depreciation, which is then subtracted from the gross, plant, and equipment to obtain the net property, plant, and equipment. The yearly depreciation expense appears in the income statement. When the asset is sold, its original book value is removed from gross property, plant, and equipment. The associated accumulated depreciation is subtracted from the total accumulated depreciation account. If the sale price of the asset above its net book value, then a firm records capital gain in the income statement.

What Are Fixed Assets?

Property, plant, and equipment are considered long-term assets because they are expected to be useful longer than one year. A firm purchases long-term assets because those assets are needed to produce revenue in the normal course of business, and unlike inventory does not purchase them for resale. Because of their long-term nature and not being subject to the rapid turnover associated with current assets, property, plant, and equipment are commonly known as fixed assets. It is a common practice for a firm to purchase long-term assets as one of the first steps in founding its business. Fixed assets are classified either as tangible or intangible assets. The tangible assets include natural resources, property, plant, building, equipment, and land. Intangible assets include goodwill, franchise rights, trademarks, copyrights, and patents.

A firm's purchase of long-term of assets, which are not used in the business such as artwork or ownership interests in other companies, are treated as investments. The procurement of long-term assets requires an in-depth analysis because the investment in fixed assets is generally much greater than the investment in short-term assets. Upon purchase of a long-term asset, the cost is entered into the balance sheet as an asset – known as capitalizing the cost. Expenditures that extend an asset's useful life or extend its capacity are called capital expenditures. Businesses often purchase several assets for a single-lump sum amount. The company must identify the cost of each asset. The total cost is divided among the assets according to their relative unit sales or market value.

The GAAP historical cost principle requires a company to record an asset at its cost. The cost for PP&E includes all expenditures to setup an asset in place and ready for use. These costs include, purchase or construction cost, installation, insurance, delivery, employee training, cost of removal (if any) and any professional fees incurred in utilizing services of experts. When land and a building are purchased together, the firm should value each asset separately as some assets are amortized (buildings) and others are not depreciated at all (land). The lives of these assets may also vary. Establishing the historical cost of fixed assets can be a complicated procedure.

When a firm acquires a fixed asset, the firm increases its asset account and corresponding entry on the liabilities and equity account. Note that any timing differences between acquisition and payment for these long-term assets are important business decisions and the cost of timing difference is an interest expense. When a firm spends on plant asset, it must decide whether to record an asset or an expense. Costs that do not extend the asset's capacity or its useful life, but merely maintain the asset or restore it to working order are recorded as expense. The tax issue plays a key role costs when deciding for expensing or for capitalizing any given item. Most companies expense all small costs, say, below \$10,000. It helps to avoid overstating assets and profits. Businesses defer recognizing the expense of long-term asset until the asset is used in the

business. When the asset is used and the expense is recognized, it is called depreciation expense and appears in the income statement.

What Are Capital Expenditures?

Any outlay which provides benefits for periods more than the current accounting period is treated as capital expenditure. An asset purchased with this capital becomes part of gross assets in the balance sheet and is depreciated over the accounting periods in which it is deployed and used. On the other hand, an outlay that benefits only the current accounting period is called a revenue expenditure and is treated as an expense in the current accounting period. Companies establish policies, that classify purchased goods as capital expense using the accounting principle of “Materiality”. Capital expenditures either increase the useful life of the asset or increase the efficiency of the asset. Some expenditures are routine and do not increase the useful life of an asset or its productivity and is treated as current expense. Managers over time do revise estimates of useful life and residual value of assets in place. R&D costs are expensed and not capitalized because a firm cannot confirm these costs represent something of value. Likewise, Software development costs are considered research costs until the software is considered technologically feasible, the ensuring costs are capitalized as part of the cost of the software. The business decisions to acquire or dispose of assets are part of long-term budgeting known as capital budgeting.

Capital Budgeting

Capital budgeting is the system of planning, evaluating, selecting, implementing, and tracking capital projects. It involves deployment of funds secured via long-term financing to invest in capital projects that will generate cash flows for several years to help attain strategic goals. Strategic planning primarily provides a top-down view while the capital budget is developed from a bottom-up process of appropriation request through a standardized data collection process. Since strategic planning and capital budgeting are both involve long-term planning, the integration of the two processes is important so that they complement each other. A strategic plan identifies investments in fixed assets and the required financing, and the acquisition of these assets is executed using the capital budgeting process in a timely manner.

Overview of a Capital Budgeting Process

Many capital projects require significant investment, and (1) the investment in long-term assets is generally much greater than the investment in short-term assets, (2) are difficult to unwind as these assets are not easy to liquidate, (3) finally, excessive investment fixed assets can lead to idle capacity and excessive expenses. On the other hand, inadequate capacity may not be sufficient to meet the demand for product and services. Therefore, capital projects are critical and may determine long-term financial well-being of the firm.

The GAAP provide the basic business process to account for the acquisition of long-term asset. The capital budgeting process involve several steps and the process is scrutinized by both the operational and finance management at various levels including approval at the highest level of the organization if the capital outlay exceeds specified threshold identified in a firm’s approval and authorization schedule. Finally, the capital budget requires approval by the Board of Directors, generally at the end of the year. The approved projects then undergo another approval process of spending authorization, which may include a bidding process, vendors’ presentations and selections, placing the order, submission and approval of purchase orders, and finally, receiving and inspecting the assets or services, and paying for the assets and services. as financial controls over capital expenditures are of utmost importance for operational controls. In summary, the steps in capital budgeting process include: 1. Search and Identify projects, 2. Perform economic analysis and estimate project cash flows, 3. Evaluate projects, 4. Select projects, 5. Authorize the project spending, 6. Implement the project, and finally 7. Conduct post-completion audit. In post audits, it is difficult to identify cash flows generated by a specific project as it is difficult to isolate the project cash flows from cash flows generated by projects in the rest of the business.

Types of Projects in Capital Budgeting

The first step of exploring of new and profitable investment opportunities is an on-going process and includes a firm's R&D department, information provided by suppliers, customers and employees, competitors' products and services, trade magazines and industry reports. The next three steps of economic analysis, evaluation, and selection process are extensively discussed in most finance text books. The project team needs to include engineering, marketing, and other operational subject matter experts. The fixed asset managers and purchasing agents need to maintain up-to-date knowledge of the industry and best practices including technological advances, technical issues such as availability of spare parts, reliability operation, efficiency and accuracy of the equipment, servicing facilities for maintenance and necessary training to operate the fixed assets. Some firms require classification of capital projects into several categories such as replacements for cost reduction, expansion, and projects needed for revenue growth. Replacement projects are required in response to increase in operating costs, which may be due to deterioration and increase in opportunity cost owing to obsolescence. These projects generally provide operating savings, improvement in quality of products, which may lead to higher demand for products, increased output and to less downtime from plant being out of commission for repair and overhaul. Thus, a firm enjoys greater productivity and reduced unit costs. Sometimes, a firm may incur capital expenditures to satisfy regulatory requirements. Increase in demand for current and planned new products, and expansion into new markets domestic and international lead to expansion and growth projects.

Financial Analysis in Capital Budgeting

Since capital budgeting involves long-term decisions, it is necessary to incorporate the time value of money in financial evaluation of capital projects. Capital investment is the allocation of scarce funds to future production and not future consumption, therefore, allocation of current funds is justified if the present value of future production exceeds the capital, which a firm plans to invest and not consume today. Most finance textbooks discuss the financial criteria of net present value, internal rate of return, profitability index and discounted payback period for selection and ranking of capital projects. Some of the issues in deploying the financial evaluation criteria include selection of an appropriate discount rate, estimation of incremental investments in fixed and working capital, identifying the true initial cost of the asset and on-going operating expenses, forecasting of cash flows during and at the end of planning period as sale proceeds of unused assets may lead to capital gains or losses depending on the tax-adjusted basis or tax-book value of these assets. In financial analysis of a project, it is common practice to assume that the purchase price and salvage value of current and future generations of fixed assets are constant. The underlying assumption is that the productivity of new equipment will offset any increases in purchase prices. The analysis generally also assumes that the obsolescence and deterioration increase arithmetically. Such analysis, however, ignores economic obsolescence. A significant economic obsolescence may lead to write-down of assets rather than replacement of assets as the later includes opportunity cost due to obsolescence but ignores economic obsolescence. The writing off the assets from a firm's accounting book comes from instant depreciation of the remaining base and reporting it in the income statement as a non-operating one-time charge. Many forecasts of operating savings and or revenue growth are overly optimistic and therefore funding all projects can lead to a financial ruin. Hence, firms generally require sensitivity and scenarios analysis to assess the risks involved in revenue, cost, expense, and cash flow projections.

Administration Issues in Capital Budgeting

Most firm have a well-defined authorization schedule as part of investment and spending controls to preserve cash and prevent management and employee frauds. The schedule includes the necessary level of approvals in the finance and operational departments based on the amount of funding, and usually involves several stages of such approvals prior to the final approval by the operational leader identified in the schedule of authorization. The project manager and his/her team are then responsible for execution of the project. Finally, after the completion of the project, a post-audit may be conducted to assess the successes and failure and to develop a change control process for future projects. It must be noted that in post audits,

it is difficult to identify cash flows generated by a specific project as it is difficult to isolate the project cash flows from cash flows generated by projects in the rest of the business.

Depreciation of Fixed Assets

Upon its deployment, an asset provides benefits such as revenue or cost savings to a firm over several periods. Depreciation is the disciplined, rational allocation of the cost of the asset over these periods, and therefore is also referred to as book depreciation. In other words, depreciation is a method of matching the acquisition cost of an asset to the benefits derived from it during its deployment over the accounting periods. Therefore, depreciation is not a process of valuation. The long-term assets are deployed by firms to generate revenues over time and it is a basic premise of accounting that capital invested in a firm should be maintained via a rationale provisions for depreciation. Depreciation does not refer to a decline in its market value or its physical deterioration, but rather the earnings capacity of the asset absorbed during its utilization by the firm. Any physical deterioration or inadequacy render a decline in usefulness of a deployed asset. Some assets may become obsolete as another asset can perform more efficiently. An asset in use may be inadequate to meet more than forecasted demand for a product and may require its replacement.

Depreciation accounts for loss, not restored by on-going maintenance until the retirement of the asset. In other words, depreciation is intended to preserve the productive capacity of the asset and prevents any violation of bond covenants and shareholder wealth in the long run. Depreciation is a non-cash expense, that is, a cash amount equal to the depreciation expense is not set aside, but it an accounting entry in the books of the firm- a paper transaction, indeed. The rate of depreciation may be linear or changing function of time. Therefore, there are several methods of allocating depreciation and reporting it to shareholders via the income statement and balance sheet from its accounting books. Therefore, it is also known as book depreciation. The most used depreciation methods by the firms include the straight-line, accelerated depreciation, and units of production.

Straight Line Depreciation

First, estimate the useful lie of an asset at the time of making the purchase decision. Second, estimate the residual value, based on experience and judgement about utilization of the asset and market value. This residual value represents the unused portion of the acquisition cost of the asset. Both the useful life and the residual life are subject to revision over the life of the asset. Finally, the difference between the purchase cost less the residual value also known as depreciable base is divided by the useful life to derive the equal amount of depreciation for each year over the life the asset. The main factors in estimating useful life include obsolescence, physical wear, and tear and in adequacy. In addition, safety and ethical issues may play a role as well. It is difficult to forecast the factors of inadequacy and obsolescence.

Accelerated Depreciation Methods

The proponents of use of the accelerated depreciation methods argue that in the early years of its deployment, an asset is more productive generating more revenues or cost savings, but at the same time incurring higher depreciation of the asset. It helps to smooth the total expenses as over time in the later years though the depreciation is lower the maintenance expenses are likely increase. Finally, they argue, use of accelerated depreciation methods helps to mitigate the uncertainty as to the probable years of useful life, with respect to obsolescence of products and facilities. The book value is not net of the residual value. An asset may be depreciated below its residual value, hence a switch over from an accelerated depreciation method to the straight-line method. There are two common methods of accelerated depreciation, the double decking balance method, and the sum of the years' digits method. The steps in calculating these rates are explained with examples in most textbooks. We proceed to discuss a third depreciation method.

Units of Production Depreciation Method

The depreciation is calculated based on the estimated productivity of the asset. First, estimate the number of units produced or serviced during the asset's useful life. Then the purchase cost net of residual value is divided by the number of units. This rate is then multiplied by the number of units produced each

year. This method though appears to be fair, but it does not consider obsolescence into account. In addition, in most middle and large- size firms, the firm's assets are shared by the business units of the firm. The corporate headquarter manages these fixed assets and the depreciation of these shared assets are then assigned to the business units based their usage of these assets. While the corporate headquarters is responsible for the management of fixed assets, the individual business units are responsible for the management of their respective income statements. For a business unit operating in an industry with commodity products and services, any increase in volume, but with a decline in product prices, will lead to lower revenue. But, at the same time, it will also lead to a higher assignment of depreciation expense, and hence a lower operating income. Therefore, a medium or large size corporation needs to develop a methodology of allocating depreciation of shared assets, based on revenue or another better alternative and not just based on units of output consumed by the business units.

Accounting for Depreciation

Each year, the amount of gross fixed assets does not shrink by the depreciation charges, but the amount of net fixed assets does via creation of an accumulated depreciation, account which offsets the gross amount of fixed assets. This process maintains the separation of the actual historical cost from the accumulated depreciation, which is essentially an estimate.

Tax Depreciation

Firms follow GAAP in preparing financial statements and hence include book depreciation for reporting to the company's shareholders. However, tax filings are based on IRS code, and sometimes they lead to different reporting requirements. The U.S. congress has designed tax depreciation to incent firms to invest and raise tax revenue for the government. Most firms use the modified accelerated cost recovery system (MACRS) for calculating the depreciation expense for filing returns. This accelerated method provides incentives for firms to invest in new property, plant, and equipment. That is, the higher depreciation over a small number of years provides higher tax benefits and provides firms more cashflow in earlier years, which helps to partly mitigate any risk associated with new investments. In other words, the difference in depreciations (book versus tax) each year is due to allocation of the total depreciation over the life of the asset, but the total amount of depreciation expense is the same irrespective of the use of depreciation methods. In short, firms get to use the cash which otherwise would have been paid in taxes at an earlier period. This savings from taxes is the firm's tax rate times the difference in depreciation between the two methods of calculating the depreciation each year. Since firms invest in long-term assets on a continual basis, the tax savings in the early and interim years help the firms to fund any additional investments in long-term assets for replacement or expansion of the facilities. The 2017 Tax cuts and Jobs Act changed the corporate income tax rates which apply to taxable income from progressive tax rate structure to a flat 21 percent. Under the new law, a firm can depreciate 100 percent of the asset's value in the year the asset is placed in service. Beginning in 2023 it drops by 20 percent each year until it is eliminated in 2027. There are some limitations on what type of property qualifies for this bonus depreciation.

Deferred Income Taxes

As stated earlier, most firms use the MACRS to calculate depreciation for tax purposes but follow the GAAP to calculate depreciation on a straight-line basis to report on the income statement. The differences in these depreciation amounts lead to differences in cash income taxes to be paid to the IRS and accrued or allocated book income taxes in the income statement and are known as deferred taxes. The deferred taxes originate due to timing differences but the total depreciation under both methods remains the same. In the early years of deployment of a fixed asset, the deferred income taxes will increase but towards the end of the life of the asset, they will decrease. As firms continue to replace and or expand the asset base for growth there will be always be a balance in this account and is a source of funds with no interest cost. Since the deferred income taxes are recurring, the cumulative amount is shown as a deferred income tax reserve liability in the balance sheet.

Operating Expenses Associated With Fixed Assets

Accountants treat an expenditure that will benefit only the current accounting period as a revenue expenditure, and therefore is recognized as expense in the current accounting period. It is a common practice for firms to institute policies, typically based on dollar amounts to classify purchases as capital expenditures or revenue expenditures. The two types of costs associated with fixed assets are the capital costs to acquire the fixed assets and the operational costs to produce goods and provide service. The determination of the characteristics during the acquisition of assets will have significant impact on future operating costs. We have discussed the depreciation or capital repayment component of the operating expenses associated with the capital costs to acquire the fixed assets earlier in the paper. A firm incurs expenditures to maintain a fixed asset in a working condition and not to increase its useful life or efficiency, and therefore these outlays are treated as revenue expenditure. A firm continues to incur operational costs or revenue expenditures while the fixed assets are deployed in its operations. The major components of operational costs are labor and material, and specifically the employee related expenses such as wages and salaries. Other operating expense items include maintenance to keep the fixed assets at working conditions, costs of fuel oil, supplies, operating taxes, and general and administrative (G&A) expenses. These G&A expenses include insurance, rents, expenses for various functions within associated departments necessary to daily operations of these fixed assets, taxes by school districts, fire, local and other public agencies, property taxes imposed on value of the fixed assets based on assessment, and finally, social security and unemployment taxes, which are part of the maintenance and therefore are part of the operational cost. The fixed assets are replaced over time, but the operational costs associated with the fixed assets continue to exist as long as the fixed assets are in use, and therefore these operational costs including depreciation are treated as fixed costs. Some businesses report operating expenses separate from depreciation while others bundle these together in their income statements, which may help to minimize disclosures to its competitors.

Unit Costs of Products and Services

The operating expenses are the primary component of the unit cost of a product. Most academic literature focuses on firms' pricing of products and services for profit maximization. Economists advocate a pricing model, which states that a firm attempts to maximize profits by setting prices such that marginal revenue equals marginal costs, which generally are variable costs. Such a pricing model supports variable cost pricing, but does not support allocated costs, which include allocated fixed costs. The proponents of another product pricing model argue that a firm's financial goal is to earn a satisfactory return, and therefore the revenue must cover all costs and earn a profit. GAAP require the use of absorption costing for external reporting purposes, which includes allocated overhead or fixed costs. Other academicians argue that although such a requirement works in practice, it is at odds with economic principles.

In a competitive market, product prices are derived based on supply and demand in the marketplace. A firm's pricing and supply of its products associated with the various levels of demand requires understanding of unit costs of its products to generate profits. The unit cost is an average cost of producing one unit of the product and is derived by dividing the total cost of production including the associated operating expenses by the total number of units produced. Each firm utilizes a unique internal cost-allocation methodology and is incorporated in its accounting system, which is a part of the firm's management information system. The financial transaction data from this system are used to develop total cost for each product. Such an endeavor ensures management accountability and provides the necessary tools for the planning process.

ACCOUNTING, ECONOMIC, AND FINANCIAL TOOLS TO ANALYZE THE IMPACT OF FIXED ASSETS

As discussed earlier, the existence of fixed assets leads to incurrence of fixed costs, which include depreciation expense and operating expenses related to the facilities. These fixed costs necessitate the use of financial tools such as the break-even analysis. Since variable costs are incurred only if units are produced and vary with the level of production, that is, these costs are not fixed, firms face a daunting challenge of

covering the fixed costs and then achieving the desired target profitability levels. In short, the remainder of difference between the revenue per unit less the variable cost per unit contributes first towards the payment of total fixed cost, which is commonly known as contribution margin per unit, and may be viewed as contribution of each unit towards payment of total fixed cost. One can find out the breakeven quantity by answering the question: If one unit of production provides an “X” amount of contribution margin dollars, then how many units a firm needs to produce to cover the total dollar fixed cost? The calculations narrow down to simply dividing the total dollar fixed cost by contribution margin per unit. At this breakeven quantity level, a firm covers both the variable and fixed costs, and therefore its operating income is zero. The concept of breakeven analysis both in terms of units and dollar amount is commonly discussed in finance textbooks. While the intermediate milestone is to achieve the breakeven quantity to cover all costs, the goal is to achieve target profitability, a planned amount, which is more than the sum of the variable and fixed cost. Of course, to achieve a desired profit, it needs to produce even more quantity, and how much more depends on the total dollar amount of target profitability. For instance, if the firm desires “Y” dollars of profit then the effortless way to calculate the required unit production quantity is to add to the fixed costs the amount “Y,” and divide it by the contribution margin per unit. In other words, this methodology treats the dollar amount of target profit as if it were an additional fixed cost. A firm may derive its target profit by first deriving a target for return on assets and then multiply it by average fixed assets. Ehrhardt and Brigham (2016) suggests a methodology to estimate the required level of fixed assets, which may be summarized with the following equation:

Required level of fixed assets = (Actual fixed assets/Full capacity sales) times Projected sales, where the full capacity sales are calculated as:

Full capacity sales = (Actual sales/Percentage of capacity at which fixed assets were operated).

Of course, during periods of slowdown, a firm’s production activities may contribute towards payment of only a part of its fixed cost, and hence not realize its breakeven point or a profit during a temporary slowdown.

The Characteristics of Fixed Costs

The fixed assets are lumpy in nature, which leads to faster increase in fixed costs with a higher level of production capacity and leads to temporary distortion in the benefits of economies of scale and the financial performance ratios, specifically the ratio of sales over fixed costs or the fixed-asset turnover and is discussed in other part of this paper. This lumpy nature of assets originates from arguments that in an ever-changing technology landscape to achieve necessary economies of scale and be competitive, a firm needs to add fixed assets in large discrete units. Some firms may operate in multiple shifts, operate several plants, or share excess capacity to mitigate such a behavior of fixed assets. Therefore, it is important that a firm defines a period over which the fixed assets remain fixed. As discussed earlier, in large, decentralized corporations fixed assets and the associated balance sheet accounts are managed by the corporate headquarters and the associated costs are allocated to the business units generally based on usage of its facilities. The business units are then responsible for management of their respective income statements. Since some of the costs remain fixed only up to a certain level of output, these allocated costs may be treated as semi-variable or semifixed costs. Note that from an economic point of view (See Peppers and Bails (1987)), the long run assumes that all factors of production are divisible into fractional units, that is, all costs are considered variable. However, in practice, such a division is difficult due to the lumpy nature of fixed assets. As a result, the long run cost curve exhibits increase cost with output, but it is an intermittent flat long-term curve. The cost data used are based on accounting periods and as a result, are subject to accounting practices and ignore prevailing economic conditions. Should a firm accumulate excessive fixed assets capacity, then it needs to increase its revenues to improve its profitability and the turnover ratio before it can add more fixed assets.

What actions should a firm undertake to resolve the issue of excess level of fixed assets? Some of the solutions discussed in the financial literature include capital rationing to curtail capital spending, sale and

leaseback of fixed assets, which helps to lower or eliminate depreciation expenses, property taxes and insurance, and associated working capital requirements while providing flexibility for the firm to purchase new equipment. Of course, the firm may incur leasing expenses, and lead to other issues including loss of flexibility and control, and sometimes with detrimental effects on inventory turnover. In summary, a comprehensive financial analysis is required to ensure the appropriate actions.

Impact of Fixed Assets on Accounting, Financial, and Economic Performance Measures

The deployment of fixed assets in a firm affects both the income statement and balance sheet accounts, and as a result, fixed asset related costs and expenses impact both the accounting ratios and financial performance measures. Most finance textbooks discuss financial statement analysis using financial ratios such as return on sales, asset turnover, return on assets and equity multiplier. These financial ratios sometimes with adjustments serve as the value drivers and are linked to the calculations of financial and economic performance measures of shareholder value maximization. These measures include free cash flow (FCF), net present value (NPV), return on invested capital (ROIC), the year-over-year change in EVA or MVA, latter being the sum of the present value of future EVAs.

Depreciation Expense and Cash Flow

The depreciation expense originates due to the presence of fixed assets in a firm. The various methods of calculating depreciation, and its role as a non-cash expense are routinely discussed in the financial textbooks, specifically in the financial statements and financial ratio analysis chapters.

Depreciation and EVA

The EVA measure helps to link shareholder expectations to both the income statement and balance sheet transactions. The EVA (Stewart (1999)) measure is calculated as follows:

$$\text{EVA} = \text{NOPAT} - (\text{Invested capital} \times \text{WACC}), \text{ where}$$

NOPAT is net operating profit after taxes; invested capital is the amount of funds deployed by a firm; and WACC is the weighted-average cost of capital. Multiplying invested capital by WACC provides a charge for using the invested capital. The calculation of economic value added (EVA) involves using book value data from the financial statements and making further adjustments. The depreciation expense associated with the fixed assets enters the EVA calculations in two ways. First, EVA subtracts depreciation expense to determine incremental income or NOPAT though it is a non-cash expense. The “net” in NOPAT represents “net of depreciation.” The invested capital is calculated as a sum of net fixed-assets and net working capital, and the net fixed-assets are gross fixed-assets net of cumulative depreciation expense. Shrieves and Wachowicz [2001] claims that to calculate economic profit it is necessary to deduct depreciation expense component because it represents a portion of the total cost of the firm’s fixed assets. Stewart (1999) contends that a firm must recover depreciation of assets through wear-and-tear and obsolescence from its cash flow over time to provide investors with a return of their capital before they receive a return on their capital.

Deferred Income Taxes and the EVA Measure

In calculations of EVA using the operating approach, the NOPAT is net of cash taxes paid, which, in turn, is derived by subtracting increase in deferred taxes from the book income taxes. From an economic point of view the deferred income tax reserve liability in the balance sheet is viewed as an equivalent of permanent equity source of capital, and in the financing approach to EVA calculations it becomes part of the invested capital.

Impact of Fixed Assets on Financial Ratios

The timing of deployment of assets is crucial as firms may either not realize the forecasted demand leading to idle capacity or lag the demand due to conservative management policies. It is common to see a

lead/lag between the fixed assets and the sales of a firm as the latter is primarily the outcome of demand and supply for a firm's products and services in combination with productive capacity of the firm. Returns from assets are sensitive to the efficient management of both the cost structure and the asset structure, that is, return on assets equal return on sales also known as profit margin times asset turnover. The fixed-asset requirements may vary for each industry and each firm, which may be based on a firm's management policy. If a firm is vertically integrated, then it may pick up profit at each stage of production and will earn a higher return on sales, and therefore a higher return on assets. However, it will also add fixed assets at each stage, which will lead to a lower asset turnover and therefore, may lower the return on assets. The net effect on return on assets then depends on which ratio dominates to help increase or lower the return on assets. In addition, a lower return on assets in the short run due to higher fixed-assets may be inconsequential if it helps to achieve a higher return on assets in the long-run. A temporary higher level of fixed assets may be required if the firm's capacity utilization has reached its peak in response to a sudden demand for its products and services. A higher level of fixed assets may also be due to a firm's attempt to differentiate its products, which, in turn, may help to prevent squeezing its profit margin in a highly price sensitive environment. Finally, a firm should be aware that higher fixed asset investment may act as a barrier to exit during a downturn in the economy or in an industry with a declining growth rate.

Fixed Costs and Capital Structure

If fixed assets are deployed in a firm, then it is subject to the effects of operating leverage, that is, a firm's higher fixed cost structure leads to increase in variability in operating earnings in response to changes in revenues, and therefore, it is the source of operating risks. In other words, while the variable costs rise and fall with the revenues, fixed costs do not vary with the revenues over a certain output. By and large a firm's cost structure is influenced by the industry in which it operates. The operating risk affects a firm's choice of financial leverage. The hedging principle commonly deployed in financing assets, matches the cash flow generating characteristics of an asset with the maturity of the source of financing used to fund its acquisition. That is, permanent assets, which include long-term fixed assets and minimum level of current assets are financed with permanent source of financing such as long-term debt, preferred stock, and common equity. The choice of a firm's capital structure determines the variability of its after-tax cash flows to the common stockholders. These series of factors together affect a firm's cost of capital, which is used in calculation of net present value in the capital budgeting decisions to accept or reject projects and directly affect a firm's asset structure.

CONCLUSION

Introductory financial management textbooks introduce issues related to the financial management of fixed assets in a disjointed fashion throughout the textbook rather in a single chapter like the issues in working capital management. While some of the text books highlight selected financial and accounting issues, students, analysts, managers, and researchers may not readily comprehend the linkages among these issues and how they relate to each other as these textbooks and other finance literature fail to explore relationships among the array of fixed asset related topics. Some of the academic research focus heavily on specific areas of financial management of fixed assets, for instance, the capital budgeting process.

Starting with the definition of fixed assets, we introduce and discuss in a stepped manner, the range of accounting and financial issues including capital budgeting, book depreciation, tax depreciation, deferred income taxes, operating expenses, and unit cost. Then we proceed to explain how each of these factors related to the existence of fixed assets and influence the financial performance measures including the financial ratios, cash flow, and the EVA measure. Finally, we assess the interrelationships between the fixed assets and financial mix, which in turn, impact the cost of funds and the asset structure via the capital budgeting decision process.

In view of the importance of understanding the impact of fixed asset management on short-term financial health and the long-term financial well-being of a firm, we recommend that text books in corporate finance introduce these concepts in a single chapter devoted to fixed asset management, which captures and

provides a comprehensive picture and demonstrate relationships among the range of issues, and explain the linkages among these issues. Such efforts will provide students and practitioners with a broader understanding of financial management of fixed assets. We encourage researchers to investigate and develop financial models of fixed asset management, which will link these accounting, financial and economic issues, and support it with examples.

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