IMPERFECT MARKET OR IMPERFECT THEORY? A UNIFIED ANALYTICAL THEORY OF THE PRODUCTION AND CAPITAL STRUCTURE OF FIRMS

The author presents a unified analytical theory of the production and capital structure of firms. This theory reinforces the impression from other recent studies that puzzles in corporate finance often result not from an "imperfect market" but rather from imperfect theory.

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Empirical tests find that the capital structure of firms often deviates systematically from optimal levels. This is often attributed to market imperfection. However, further investigation generally reveals that it is the designs of these tests that are flawed.[1] This means that the discrepancy between theory and market reality is often due to the imperfection of theory rather than the imperfection of the market. Nonetheless, many theories on capital structure are still built on the assumption of imperfection in the capital or product market.[2]

It has been about fifty years since Modigliani and Miller proposed that the capital structure of a firm was irrelevant in a perfect market.[3] Since then, researchers have searched for various imperfections in the capital market. If an imperfection were identified, it would be gradually reduced over time from competition or regulation. So we might expect that the capital structures of firms would be less and less relevant and that the financial decision making would become simpler and simpler over time. When Modigliani and Miller first published their paper, theories and practices in finance were relatively simple. Since then, problems in corporate finance have become more and more complicated. In the process, many complex financial instruments have been created in the financial markets. The number of finance professionals has also increased tremendously in the last fifty

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THEREFORE, HIGH-FIXED-COST SYSTEMS ARE MORE COMPETITIVE IN LARGE AND STABLE MARKETS WHILE LOW-FIXED-COST SYSTEMS ARE MORE FLEXIBLE IN SMALL AND DYNAMIC MARKETS.

years. Does all of this indicate that financial markets get less perfect over time?

Some have begun to question whether "imperfections," such as agency costs, can account for the observed patterns of capital structure:

> The possibility that managers might let their own interests override that of the shareholders was something that Franco Modigliani and I were certainly aware of back in 1958 and through all our subsequent revisions and extensions; and we knew that anecdotal evidence of non-value maximising behaviour by under-diversified managers would always be easy to come by. But we doubted that such nonoptimizing behaviour would lead to *systematic* departures from the model. We believed that the stockholders would learn to solve, or at least greatly to mitigate any excessive risk aversion of their managers by appropriate compensation and incentive mechanisms. The stockholders, after all, could always persuade the managers to act more like stockholders by giving the managers stock or stock appreciation rights or stock options of any of a number of kinds. Given the defenses available to stockholders to recapture value they believe belongs to them—including defenses such as large-shareholder influence and hostile takeovers by outsiders—it is hard to believe that a sum as large as $150 billion a year would be left lying on the table.[4]

If a so-called imperfection on a large scale persists for a long time, it often indicates a deep relation that is not well understood. For example, tax is often treated as a type of imperfection in the capital structure literature. However, tax is essential for the smooth running of a large-scale economy.[5] Labeling tax as an "imperfection" leaves an impression that a region with a higher tax rate is less perfect than a region with a lower tax rate. As Montesquieu observed long ago, "In moderate states, there is a compensation for heavy taxes: it is liberty. In despotic states, there is an equivalent for liberty: it is the modest taxes."[6] From this observation, we might conclude that despotic states are more perfect than moderate states. It would be desirable to integrate taxation and other factors into a theoretical framework of capital structure instead of treating them as an imperfection.

A brief review of the concept of "imperfection" in old astronomy will shed some light on our discussion. Ancient people had long observed that stars moved in perfect harmony in the sky. Several planets, however, moved in irregular trajectories. It was thought that this was caused by the imperfection of the planets. There were many elaborate theories that attempted to explain why the planets were "imperfect." However, after Copernicus proposed the theory of the sun-centered universe, the movements of planets appeared much less imperfect. Since then, the discrepancy between theory and the observation of planetary movements has been attributed to the former imperfection of scientific theory. The process of improving the theory, through the efforts of Kepler, Newton, and many others, turned out to be the driving force in the establishment of modern science.

When Modigliani and Miller first developed an analytical theory of capital structure, they assumed that the production of a firm was independent from financing decisions. Although later works recognized the cost of financial distress to firms, the absence of a structure model of various factors of a firm's operation made it difficult to handle endogeneity problems in empirical testing.[7] Empirical evidence also indicates that a firm's financial decisions are closely related to the operational side of the firm and market environment.[8] Therefore, it will be very helpful to develop a unified theory of production and financing of firms in which market environment is an integral part.

In this article we present a unified analytical theory of production and capital structure of firms. It is a natural extension from an analytical theory of production, whose main result is an analytical formula of variable cost of production as a function of fixed cost and uncertainty. From the theory, it can be derived that high-fixed-cost systems are much more sensitive to uncertainty than low-fixed-cost systems. When uncertainty increases, the variable cost of high-fixed-cost systems increases much faster than that of low-fixed-cost systems. In general, higher-fixed-cost systems need higher output volume to break even. At the same time, they have lower variable costs in production and earn higher rates of return in large markets. Therefore, high-fixed-cost systems are more competitive in large and stable markets while low-fixed-cost systems are more flexible in small and dynamic markets.

Problems in capital structure can be naturally incorporated into the theory of pro-

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duction from a simple observation. Debt is fixed income for investors and hence fixed cost for issuing firms. The increase of debt increases the fixed cost of firms. The decision on capital structure is part of the decision process that determines the level of the fixed cost and variable cost of firms to achieve a high rate of return based on the understanding of current and future market conditions. The new theory, by integrating financial decisions into the general decision processes, offers a simple and parsimonious understanding to a broad range of empirical patterns documented in the literature. This shows that market imperfection is not a concept that is needed in understanding empirical patterns. It reinforces the impression from other recent studies that puzzles in corporate finance often result not from an "imperfect market" but rather from imperfect theory. [9]

The capital structure of firms is one of the most active research areas in finance. Many recent works have offered an excellent literature review of the subject, which we will not repeat here. The theory presented here is from an earlier version of this article.[10] This article is structured as follows. First, we present an analytical theory of production and capital structure. Next, we show that this theory provides a simple and unified understanding of a broad stream of empirical results on the interaction between capital structure and other factors in production. Finally, we present our concluding thoughts.

A BASIC PROPERTY IN ECONOMIC ACTIVITIES IS UNCERTAINTY.

An analytical theory of production and capital structure

A basic property in economic activities is uncertainty. While a business may face many different kinds of uncertainty, most of the uncertainties are reflected in the price uncertainty of the product. Suppose S represents economic value of a commodity, r the expected rate of change of value, and σ the rate of uncertainty. Then the process of S can be represented by the lognormal process

$$\frac{dS}{S} = r\,dt + \sigma\,dz \qquad (1)$$

where

$dz = \varepsilon\sqrt{dt}$, $\varepsilon \in N(0,1)$ is a random variable with standard Gaussian distribution.

The production of the commodity involves fixed cost and variable cost. In general, production factors that last for a long term, such as equipments, are considered fixed costs while production factors that last for a short term, such as raw materials, are considered variable costs. If employees are on long-term contracts, they may be better classified as fixed costs, although in many cases they are classified as variable costs. Firms can adjust their level of fixed and variable costs to achieve a high level of return on their investment. Intuitively, in a large and stable market, firms will invest heavily on fixed cost to reduce variable cost, thus achieving a higher level of economy of scale. In a small or volatile market, firms will invest less on fixed cost to maintain a high level of flexibility. In the following, we will derive a formal analytical theory.

In natural science, there is a long tradition of studying stochastic processes with deterministic partial-differential equations. For example, heat is a random movement of molecules. But the heat process is often studied by way of a heat equation, a type of partial-differential equation. In studying quantum electrodynamics, Richard Feynman developed a general method of studying probability wave functions with partial-differential equations.[11] Kac provided a more systematic exposition of this method, which was later known as the Feynman-Kac formula.[12] Although this method is little known in social studies, its use is very common in natural sciences.[13] The Feynman-Kac formula has been widely used in finance. It has even been suggested that Feynman was the father of financial economics.[14]

Let K represent fixed cost and C represent variable cost, which is a function of S, the value of the commodity. If the discount rate of a firm is r, from the Feymann-Kac formula,[15] the variable cost, C, as a function of S, satisfies the following equation:

$$\frac{\partial C}{\partial t} = rS\frac{\partial C}{\partial S} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 C}{\partial^2 S} - rC \qquad (2)$$

with the initial condition

$$C(S,0) = f(S) \quad (3)$$

To determine $f(S)$, we perform a thought experiment about a project with a duration that is infinitesimally small. When the duration of a psroject is sufficiently small, it has only enough time to produce one unit of product. In this situation, if the fixed cost is lower than the value of the product, the variable cost should be the difference between the value of the product and the fixed cost to avoid arbitrage opportunity. If the fixed cost is higher than the value of the product, there should be no extra variable cost needed for this product. Mathematically, the initial condition for the variable cost is the following:

$$C(S,0) = \max(S - K,0) \quad (4)$$

where S is the value of the commodity and K is the fixed cost of a project. When the duration of a project is T, solving equation (2) with the initial condition (4) yields the following solution:

$$C = SN(d_1) - Ke^{-rT} N(d_2) \quad (5)$$

where

$$d_1 = \frac{\ln(S/K) + (r + \sigma^2/2)T}{\sigma\sqrt{T}}$$

$$d_2 = \frac{\ln(S/K) + (r - \sigma^2/2)T}{\sigma\sqrt{T}} = d_1 - \sigma\sqrt{T}$$

The function $N(x)$ is the cumulative probability distribution function for a standardized normal random variable. Formula (5) takes the same form as the well-known Black-Scholes formula for European call options.[16]

Suppose the volume of output during the project life is Q, which is bound by production capacity or market size. We assume the present value of the product to be S and variable cost to be C during the project life. Then the total present value of the product and the total cost of production are

$$SQ \text{ and } CQ + K \quad (6)$$

respectively. The return of this project can be represented by

$$\ln\left(\frac{SQ}{CQ + K}\right) \quad (7)$$

and the net present value of the project is

$$QS - (QC + K) = Q(S - C) - K \quad (8)$$

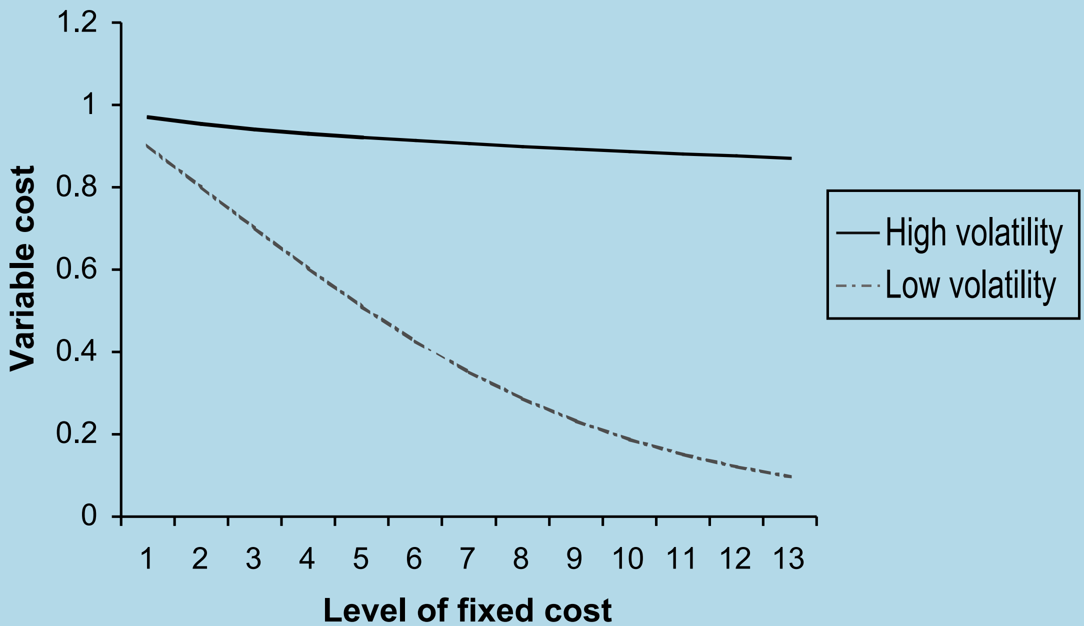
WHEN THE OUTLOOK IS STABLE AND MARKET SIZE LARGE, PROJECTS WITH A HIGH FIXED INVESTMENT EARN HIGHER RATES OF RETURN.

Unlike a conceptual framework, this analytical theory enables us to make a quantitative calculation of returns of different projects under different kinds of environments. First, we examine the relation between fixed cost and variable cost at different levels of uncertainty. For example, a product can be manufactured with two different technologies. One needs $10 million of fixed cost and the other needs $100 million of fixed cost. Assume that the unit value of the product is one million, the discount rate is 10%, and the duration of the project is twenty-five years. When the uncertainty of the environment is 30% per year, variable cost for the low-fixed-cost project is $0.59 million and variable cost for the high-fixed-cost project is $0.14 million, calculated from formula (5). When the uncertainty of the environment is 90% per year, variable cost for the low-fixed-cost project is $0.98 million, and variable cost for the high-fixed-cost project is $0.94 million. In general, as fixed costs are increased, variable costs decrease rapidly in a low-uncertainty environment and decrease slowly in a high-uncertainty environment. This is illustrated in Exhibit 1.

Next we discuss the returns of investment on different projects with respect to the volume of output. Continuing the example on two technologies with different fixed costs, we now discuss how the expected market sizes affect rates of return. Suppose the level of uncertainty is 30% per year and other parameters are the same. If the market size is 100, the return of the low-fixed-cost project, calculated from formula (7), is 37% and the return of the high-fixed-cost project is -12%. When the market size is 400, the return of the low-fixed-cost project is 48% and the return of the high-fixed-cost project is 97%. Exhibit 2 is the graphic representation of formula (7) for different levels of fixed costs. In general,

EXHIBIT 1 Level of Uncertainty and Variable Cost

In a low-uncertainty environment, variable cost drops sharply as fixed costs are increased. In a high-uncertainty environment, variable costs change little with the level of fixed cost.



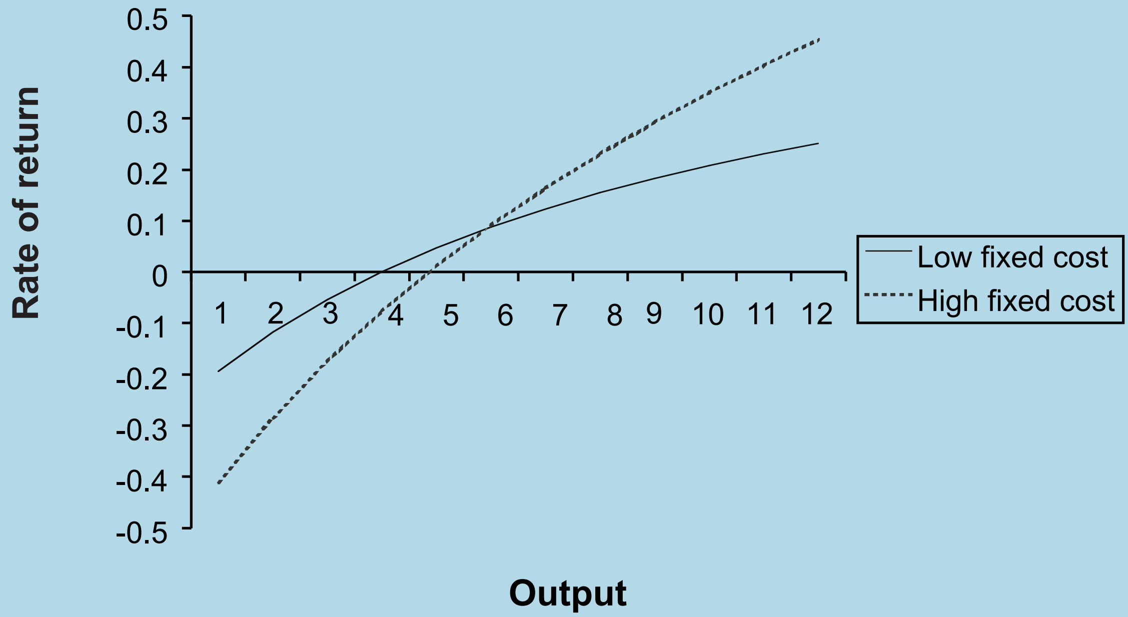
higher-fixed-cost projects need higher output volumes to breakeven. At the same time, higher-fixed-cost projects, which have lower variable costs in production, earn higher rates of return in large markets.

The discussion above illustrates that the level of fixed investment in a project depends on the expectation of the level of uncertainty of production technology and the size of the market. When the outlook is stable and market size large, projects with a high fixed investment earn higher rates of return. When the outlook is uncertain or market size small, projects with low fixed cost break even easier.

Projects are undertaken by firms, which often utilize existing assets to help reduce costs in producing or marketing new products. For example, Microsoft often bundles its application software together with its Windows operating system. This effectively reduces the cost of marketing. In general, new products from large firms often enjoy the benefit of brand recognition, which reduces variable cost in marketing. At the same time, costs of projects are often affected by the characteristics of firms. In general, ownership and management are less integrated in large firms than in small firms. Therefore, large firms adopt more rigorous check-and-balance systems for corporate control than small firms. This added cost of monitoring often increases the cost of projects. Therefore, higher-fixed-cost large firms generally concentrate on large and stable markets while lower-fixed-cost small firms thrive in uncertain niche markets. Firms of different sizes will choose different types of markets. For example, large banks, as high-fixed-cost systems with large networks of branches, concentrate on standard financial products with high volumes, such as the credit card business, or lending based on hard information that can be easily obtained from standard accounting measures. Small

EXHIBIT 2 Output and Return with Different Levels of Fixed Costs

For a large fixed-cost investment, the breakeven market size is higher and the return curve is steeper. The opposite is true for a small fixed-cost investment.



community banks, as low-fixed-cost systems, concentrate on small business loans based on soft information, which is specialized information with small market size. DeYoung et al. and Berger et al. provide organizational theories to explain the differences in lending practices of large and small banks.[17] But it can also be understood clearly from return patterns of firms of different sizes as shown in Exhibit 2.

The capital structure of a firm is a natural extension of its production structure. Since ancient times, financing has been used to reduce the fixed cost of projects.[18] The two main methods of financing are equity and debt. Since dividend payments from equity are not mandatory, equity issuance greatly reduces the fixed cost of a firm. At the same time, it dilutes ownership. Debt financing doesn't dilute ownership. But since interest payment is mandatory, it is less effective in reducing the fixed cost of firms. Since debts are fixed income instruments for investors, they are fixed costs for issuing firms. Therefore, the cost of debt forms part of the fixed cost in a firm's operation. The decision on capital structure is part of the decision process that determines the level of the fixed cost of firms. Although debt can be swapped into equity, rebalancing capital structure is costly, especially during financial distresses when the need to rebalance is at its greatest. For example, when a firm is doing well, its stock price is high and debt ratio low. There is little need to rebalance. When a firm is in trouble, the burden of debt service is heavy. But its stock price is low and issuing new shares at a low price may be a very costly way to rebalance capital structure.

Fixed cost in operations, or operating leverage, matters to the performance of a company. For the same reason, capital structure, or financial leverage, matters to the performance of a company. From Exhibits 1 and 2, firms will choose a proper combination of fixed cost and variable cost to achieve a high rate of profit based on their estimation of the current market condition and probable future market condition. High-fixed-cost systems perform well in

ACCORDING TO OUR THEORY, THE TRADE-OFF BETWEEN FINANCIAL FLEXIBILITY AND POTENTIAL DILUTION IS A MAJOR THEME IN FINANCIAL DECISION.

an environment of low uncertainty and large market size. They perform badly in an environment of high uncertainty or small market size. The performance of low-fixed-cost systems is the opposite. Besides the tax advantage of debt, firms adopt financial policy to reach a desired level of fixed cost and variable cost. In the trade-off theory, the cost of debt is essentially the cost of bankruptcy. In this theory, the variable cost of operation is a function of fixed cost and uncertainty, which are affected by the debt level. So the level of debt, by affecting the fixed cost and variable cost of operation, has a much broader impact on firms than the cost of bankruptcy. For example, employees in high debt firms, even with a low probability of bankruptcy, may be less willing to invest in firm-specific skills, for there is higher chance of layoff to reduce cost in the future.

We will use an example to illustrate how the use of debt changes the cost structure and profit of firms. Suppose two projects are developed by two different firms to produce two products. Both projects need $5 million of initial cost in production. The developers have $2 million of capital and need to raise $3 million in the market. Suppose the unit price of both products is $1 million. Both production facilities will last for ten years. The diffusion rate for the first project is 40% per annum and the diffusion rate for the second project is 60% per annum. The discount rate is 8% per annum. Suppose the market size for the two products is fifteen. If two firms raise $3 million of capital with equity, the fixed cost of the projects is $2 million. Calculated from formula (8), the net present value (NPV) for the first project is $5.48 million and NPV for the second project is $2.87 million. If the two firms raise $3 million of capital with debt, we assume it is equivalent to $2 million of fixed cost. Hence the total fixed cost of a project becomes $4 million. Recalculate NPV for each project, assuming all other parameters—diffusion rate, duration of project, market size, and discount rate—are the same. NPV for the first project is $6.18 million and NPV for the second project is $2.73 million. This shows that projects with low uncertainty benefit from a high debt level while projects with high uncertainty benefit from a low debt level. This is consistent with empirical evidence.

If the diffusion rate is 60% and the market size is thirty instead of fifteen, calculate NPV of the projects with debt financing and equity financing. With equity financing, NPV of the project is $7.74 million, and with debt financing, NPV of the project is $9.46 million. Therefore, projects with a large market size or production capacity benefit from more debt financing. The above calculation is a natural extension from cost structure of production to a unified cost structure of both production and financing.

The above assumes that other parameters remain the same while capital structure changes. However, empirical evidence shows that the change of capital structure leads to the change of many other factors. In the next section, we will show that the unified analytical theory of production and capital structure offers a simple and parsimonious understanding of empirical findings on the interaction of different factors.

The relevance of capital structure in the real world is often attributed to the tax preference for debt and the existence of default risk. However, "financial managers seem to weigh financial flexibility and potential dilution much more heavily than bankruptcy costs and taxes in their capital structure decisions."[19] According to our theory, the trade-off between financial flexibility and potential dilution is a major theme in financial decision. The increase of debt increases the fixed cost of firms. Since higher-fixed-cost systems are more sensitive to changes, higher debt reduces the financial flexibility of firms. At the same time, higher-fixed-cost systems have lower marginal costs, which means equity owners enjoy higher marginal profits on their investment and less dilution. The proper level of debt is determined by the relative importance between financial flexibility and dilution effect.

The interaction between capital structure and other factors in production

Istaitieh and Rodrigues-Fernandez classified studies on factor-product markets and a firm's capital structure into three strands of literature.[20] The first is the stakeholder theory of capital structure. The second is market structure literature. The third is the firm's competitive strategy literature. Each strand of literature contains diverse and complex methodologies and ideas. In the following, we will show that the new theory provides a unified understanding of the empirical evidence.

Research on stakeholder theory finds that firms that produce specialized products, purchase a high proportion of their inputs from dependent suppliers, depend on relatively few customers for a major proportion of their sales, engage in a high level of innovative activities, or have highly specialized employees generally maintain low debt levels.[21] This is because these firms face a high level of uncertainty in their business. Since a high level of uncertainty affects high-fixed-cost systems more, these firms will maintain a low level of debt to reduce the level of fixed cost. Skilled employees of highly leveraged firms can negotiate better contract terms than employees of similar but less-leveraged firms, because highly leveraged firms, as higher-fixed-cost systems, are more susceptible to uncertainty from employee movement.[22] On the other hand, firms with a high reputation, which are of lower uncertainty, can increase their debt capacity, for high-fixed-cost systems perform well in low-uncertainty environments.

The literature on market structure shows that during downturns more highly leveraged firms tend to lose market share and experience lower operating profits than less-leveraged competitors, and that highly leveraged firms that engage in research and development (R&D) suffer the most.[23] This is because both leverage and R&D add to fixed cost. As shown in Exhibit 2, higher-fixed-cost systems suffer more than lower-fixed-cost systems when the market size shrinks in economic downturns. When firms radically increase their leverage through a leveraged buyout, they greatly increase their fixed cost, which makes them vulnerable to rivals' aggressive competition.[24]

The firm's capital structure also affects its competitive strategy in the product market. First, leveraged firms have incentives to move aggressively to gain a strategic advantage.[25] "As firms take on more debt, they become motivated to pursue output strategies that raise returns in good states and lower returns in bad states. . . . firms will produce more than the . . . output level without debt."[26] A firm that increases its debt level increases its fixed cost. As Exhibit 2 shows, a firm with higher fixed cost earns a higher rate of return than lower-fixed-cost firms when revenue is high, that is, in good states, and earns lower rates of return when revenue is low, that is, in bad states. Firms with higher fixed cost also have greater incentive to produce more because the return curve is steeper. Financial instruments are often applied to reduce marginal cost by the increase of fixed cost, as described in the following passage:

> A firm that has access to resources at a lower marginal cost than its competitors has a strategic advantage that it can exploit to gain a larger market share and profits. Maksimovic (1990) shows that a firm that does not have such a strategic advantage can create it, for a fixed initial fee, by purchasing an option to acquire a factor of production, such as financing, at favorable terms. By initially negotiating a future bank-loan commitment, the firm can finance an expansion of output to meet a strategic contingency at more favorable terms than would be possible if the expansion had to be financed in the spot market. The ability to exercise the commitment enables the firm to threaten its rivals strategically . . . Firms can obtain low-interest rate loan commitments from banks and thereby create incentives for more aggressive product market competition (e.g., by increasing quantity).[27]

Second, unleveraged rival firms have strong incentive to react aggressively to exhaust a leveraged firm. From Exhibit 2, firms with high fixed costs need a high level of output to break even and, from Exhibit 1, are very sensitive to the increase of market uncertainty. If possible, rival firms will adopt aggressive production and marketing strategies to squeeze the highly leveraged firms and increase market uncertainty, which hurts leveraged firms more than unleveraged ones. Whether leveraged firms will increase output or decrease output depends on the competitive strength of different firms in those particular environments.

Khanna and Tice provide a detailed analysis on the role of debt and operating efficiency to the competitive strategies of firms.[28] They define operating efficiency as chain-wide sales per square foot. Higher operating efficiency may be achieved in several ways. Some chains put more money on advertising, which is fixed cost, to increase sales. Other chains may system-

THE FIRM'S CAPITAL STRUCTURE ALSO AFFECTS ITS COMPETITIVE STRATEGY IN THE PRODUCT MARKET.

SINCE MODIGLIANI AND MILLER FIRST PROPOSED THE CORPORATE FINANCE THEORY ABOUT FIFTY YEARS AGO, THE FIXED COSTS OF MOST ECONOMIC ACTIVITIES HAVE INCREASED TREMENDOUSLY.

atically select prime locations for their store sites, which generally have higher business volume but also higher purchasing or rental cost. Still others may provide better training to their employees with extra cost. Therefore, high-efficiency chains can be more precisely understood as low-marginal-cost chains that are often achieved through a higher level of fixed cost. High-debt firms, as we have discussed, are also high-fixed-cost firms. So the exit of a high debt, high efficiency store during a recession can be more intuitively understood as the exit of a high-fixed-cost, low-variable-cost store during recession, when market size shrinks.

To illustrate further the competitive dynamic of firms, we will apply the theory to compute the profit figures of two firms with identical production factors serving a common market under different competitive environments. We assume each firm has a fixed cost of 5, the discount rate is 12% per year and the duration of the fixed assets of both firms is fifteen years. If the uncertainty rate is 35% and the value of each unit of product is one, the marginal cost for each firm is 0.549, calculated from formula (5). Suppose the market size is sixty and each firm takes 50% of the market share. From formula (8), the profit for each firm is

$$\frac{1}{2}60(1 - 0.549) - 5 = 8.53$$

The level of fixed cost of a firm can be adjusted through a change of debt level. If other parameters are the same, we can calculate from formula (8) that the optimal level of fixed cost is 7.5, which can be achieved through higher debt level. At that level of fixed cost, the variable cost, according to formula (5), is 0.448 and the profit of the high-debt firm is

$$\frac{1}{2}60(1 - 0.488) - 7.5 = 9.05$$

Since the high-debt firm has lower variable cost than the low-debt firm, it has strong incentive to expand its market share. At the same time, the low-debt firm, fearful about the possible expansion by the high-debt firm, may start an aggressive marketing war, which increases the uncertainty level to 55%. We can compute the new profit figures of high-debt and low-debt firms. Assume each firm takes 50% of the market share. For the low-debt firm, the profit figure, from formula (8), is

$$\frac{1}{2}60(1 - 0.740) - 5 = 2.806$$

While the profit for the high-debt firm becomes

$$\frac{1}{2}60(1 - 0.682) - 7.5 = 2.055$$

Therefore, under intensified competition, both firms earn less, and the high-debt firm's earning is even lower than the low-debt firm's. The computation shows that the change of capital structure changes the dynamics of competition. The level of competitive intensity is partly determined by rival firms' capital structures. It is consistent with Khanna and Tice's observation that competition is more intensive in cities with stores of different levels of debt level than cities with stores of homogenous debt levels.[29]

Now suppose a recession hits,and the market size shrinks to forty. Assume each firm takes 50% of the market share. For the low-debt firm, the profit figure, from formula (8), is

$$\frac{1}{2}40(1 - 0.740) - 5 = 0.204$$

While the profit for the high-debt firm becomes

$$\frac{1}{2}40(1 - 0.682) - 7.5 = -1.130$$

The profit for the high-debt firm becomes negative. This will make it easier for the low-debt firm to drive out the high-debt firm. The above computation shows that high-debt firms are more vulnerable to intensified competition, especially during economic downturn, when the market size shrinks. This is another reason why the actual debt levels taken by firms are lower than optimal debt levels calculated from many works.[30] It also explains that low-debt firms, the "fat" firms, will do well in an industry downturn, for fatness is an important factor of fitness in lean time.[31] In general, there does not exist a universally applicable measure of fitness.[32] The concept of fitness is conditioned on environmental constraints, which may change over time.[33]

This theory of capital structure of firms can be extended to understand the relation between the "capital structure" of countries and the characteristics of their industries. If a country's economic activities are heavily financed by bank loans, as in Germany, they are of high fixed cost. The country will be more closely associated with mature industries whose level of uncertainty is low. If a country's economic activities are heavily financed by equity markets, as in the US, they are of low fixed cost. The country will be more closely associated with new industries whose level of uncertainty is high. This is indeed what Carlin and Mayer observed in their study.[34]

Since Modigliani and Miller first proposed the corporate finance theory about fifty years ago, the fixed costs of most economic activities have increased tremendously. A large portion of the labor force goes through college education at great cost before starting to work. Many projects cost billions of dollars to build and maintain. As high-fixed-cost systems are very sensitive to uncertainty, financial decisions, by affecting both the levels of fixed cost and uncertainty, become more and more important over the years. This helps answer the question raised at the beginning of the paper: It is not the imperfection of the market but rather the increase of the fixed cost of economic activities that makes the financial decisions more relevant over time.

Concluding remarks

Current capital structure theories may be classified as the trade-off theory, the pecking order theory, and the market timing theory.[35] Pecking order and market timing are both due to information asymmetry. The cost of financial distress discussed in the trade-off theory is also largely due to information asymmetry. Therefore, these theories are not mutually exclusive. Factors discussed in these theories all play a part in determining financial structure. But the absence of a structural model in these theories makes it difficult to determine the relation between these factors and market conditions.

The theory presented here is derived from simple and universal assumptions, and the parameters in this theory have clear meaning. The analytical results derived from the theory about the relation among many factors in the production, financing, and market environments are consistent with a broad spectrum of empirical results. This shall mitigate the problem of endogeneity in modeling, which is central in understanding many puzzles in corporate finance.[36]

While the simplicity and universality of the theory make it less likely to overfit empirical patterns, great amount of details need to be worked out for each individual problem. For example, qualitatively, it is easy to identify debt with fixed cost. But for each firm, it can be challenging to quantify the relation between the level of debt and the level of fixed cost in each case, for different firms have different levels of financial flexibility under different kinds of market conditions. This difficult work will be left to the future. ■

NOTES

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