On The Separability Of The Real And The Financial Decisions Of A Firm: A Review

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Abstract

This paper demonstrates the necessity for the simultaneous determination of a firm's investment, production and capital structure decisions in imperfect capital markets. The non-separability of the three corporate decisions arises from the fact that the savings and/or costs due to the market imperfections for different financial packages can be imputed to the effective cost of the firm's real variables. Thus, shifts in the firm's capital structure lead to adjustments of the firm's investment and production decisions, which in turn cause a change in the firm's value. Given the necessity for an integrated approach, the paper examines the extent to which the literature has taken into account the interactions between the three corporate decisions when addressing the optimal capital structure question.

Introduction

There is a great deal of controversy in the field of finance with regard to a firm's optimal capital structure. The interest lies in finding the capital structure (if any) which will maximize the value of the company (equivalently the value per share of common stock) because this will maximize the wealth of the firm's initial shareholders. Thus, value maximization is the driving force behind the research for the optimal capital structure of the firm. If it can be found that alternative capital structures have no effect on the value of the firm, then it can be concluded that financing decisions are irrelevant. If, on the other hand, it can be found that there is an optimal capital structure for the company, then the natural question becomes: what causes the value of the firm to change with the capital structure? In addition to its optimal capital structure, a firm has to determine its optimal level of investment and its optimal input-output mix.

The objective this paper is to first demonstrate the need for the simultaneous determination of the financial (i.e., capital structure) and real (i.e., investment and production) decisions of the firm when imperfections exist in the capital markets. A simple Fisherian-like one-period analysis is used for this purpose. The interactions between the real and financial decisions imply that the neoclassical microeconomic theory can be extended to account for the effects of the financial decisions on the input-output mix. It also implies that the optimal capital structure question cannot be pursued in isolation from the firm's real variables. The end result is an integrated approach to the determination of the firm's real and financial decisions. Secondly, given the necessity for this integrated approach, the paper examines the extent to which the literature has indeed incorporated the interactions between the two groups of decisions when addressing the optimal capital structure question. This is accomplished through the review of a selective group of papers that highlight the different levels of analysis (in terms of

the interactions between the real and financial variables) at which the optimal capital structure has been examined.

For concreteness, the three different kinds of corporate decisions are now defined. The production decision determines the combination and amounts of inputs to be used as well as the level of output to be produced given the technology the firm uses. The investment decision is concerned with the optimal amount of money which is to be spent for the acquisition of fixed assets and other inputs which are required by the firm in order to sustain production at the desired level. Finally, as far as the financial decision is concerned, the firm has to decide on the optimal combination of sources from which it will raise the money required to finance investment. To meet its financial needs, each firm issues a mixture of securities, each one promising a stream of future returns to the security holder in exchange for the present consumption he gives up when he buys the security. These securities are traded in the capital markets, which might meet different specifications[1], and their prices are determined in these markets. The sum of the values of all the securities issued by a firm gives the firm's market value.

Introducing the Problem

One general conclusion reached by the theoretical work in this area is the following: Under perfect capital markets the financial structure of the firm is irrelevant while under imperfect capital markets there is an optimal capital structure which maximizes the value of the firm, other factors kept constant. A graphic explanation of the meaning of the above conclusion and the limitations implied by such an analysis will be pointed out by means of a simplified example.

Consider the perfect capital markets[2] case where a one period horizon is assumed. All the Modigliani and Miller (MM) (1958) assumptions are made[3]. It is further assumed, for simplicity, that investors are risk neutral and the required rate of return is denoted by r. Currently the firm has no money available for investment. Assume though, that the firm has an optimal invest-ment policy which results in a capital budget of 0K1* dollars. Therefore, for this given investment decision, the firm has to raise 0K1* dollars. For simplicity, it is also assumed that the firm uses no labor. This assumption is dropped later on. The company faces the transformation function[4] given by the curve 0A in Figure 1. The end of period coordinates of the curve 0A are certain (expected) dollars given that certainty (uncertainty) is incorporated in the model. Since the rate prevailing in the market is r then the line BD in Figure 1 is the opportunity set[5] for each investor and the optimal investment decision of the firm occurs at the point of tangency between 0A and BD.

Assume that the company had no debt outstanding to start with, and that the management finances 0K1* through new equity. Then the value of the company at the end of the period is OV2. Now assume that the company issues bonds of an alpha 0K1* amount (0<alpha<1) and uses the proceeds to buy back an amount alpha 0K1* of the previously issued stock. By doing so the management intro-duces debt in the capital structure of the company. According to their Proposition I, MM (1958) indicate that again the value of the company at the end of the period will be OV2. The above analysis is true for any investment
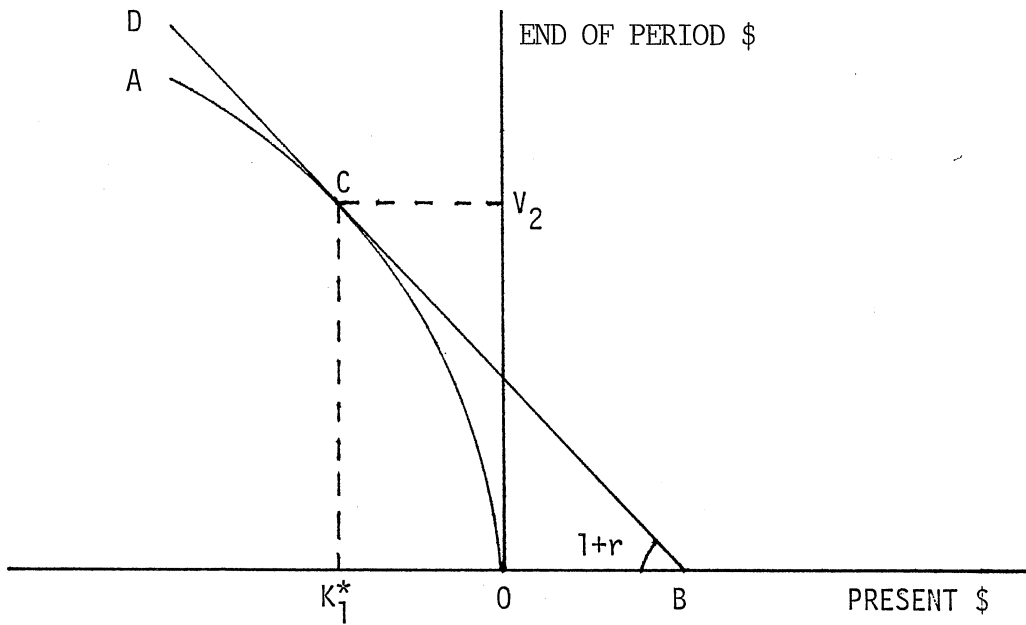
Figure 1.   Interactions Between the Real and Financial Decisions
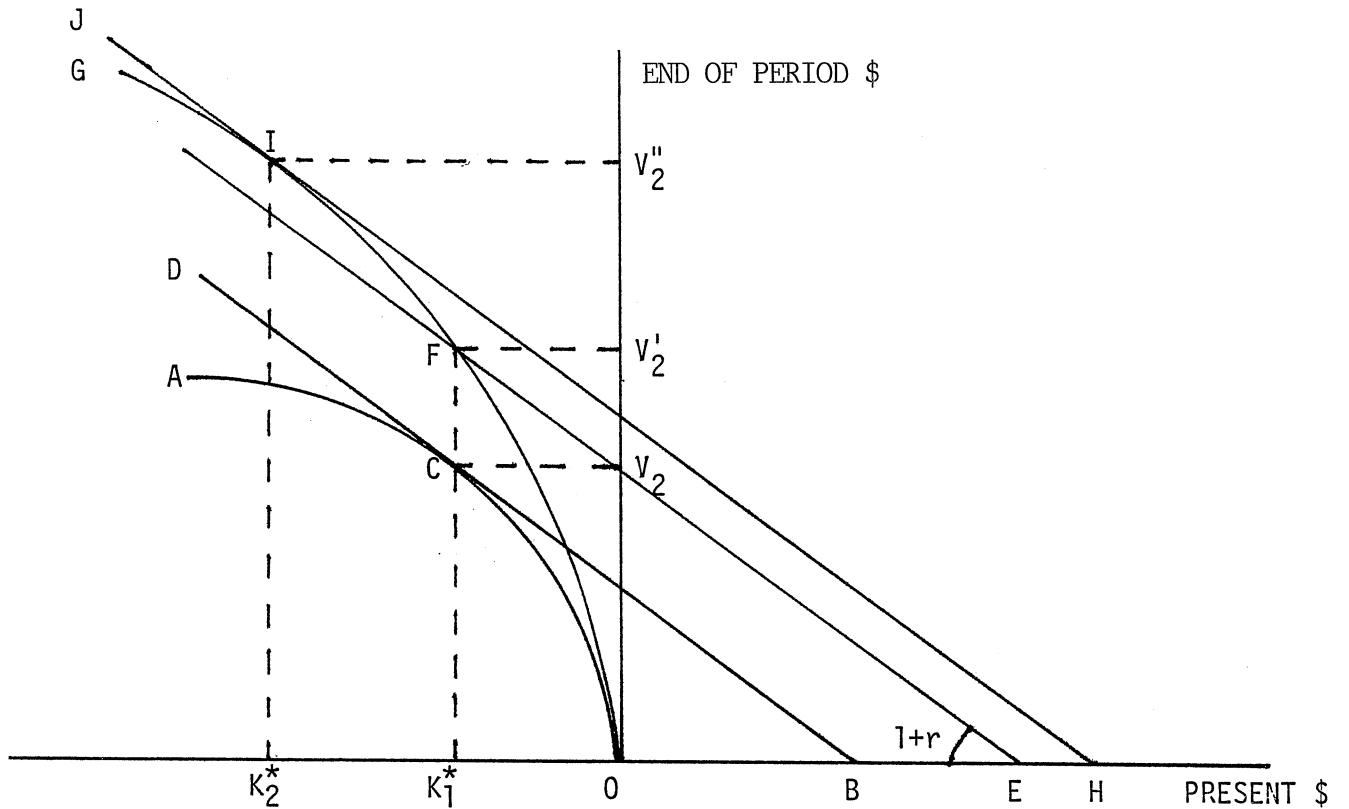in Perfect Capital Markets

Figure 2.   Interactions Between the Real and Financial Decisions
in Imperfect Capital Markets

decision and therefore one can reach the conclusion that under perfect capital markets financing and investment decisions will be independent. Hirshleifer (1958) and Fama and Miller (1972) provide similar analyses for the certainty case.

The imperfections of corporate taxes will be now introduced in the analysis in order to move in a world comparable with the MM (1963) one. The new case is analyzed in Figure 2.

The firm faces the same problem as in Figure 1. If the whole investment OK_1^* is financed with equity then the value of the firm at the end of the period is $V_2 = EBIT(1 - t)$. Note that the transformation curve OA in Figure 2 is different (at a lower level) than the curve OA in Figure 1 due to the inclusion of corporate taxes. If debt is now introduced into the financing of OK_1^*, then according to MM (1963), the end of period value of the firm becomes $V'_2 = EBIT(1 - t) + tDr$; where D refers to the market value of the debt utilized[6]. So, when the company uses alpha.(OK_1^*) dollars of debt to finance its OK_1^* investment outlay then the end of period value of the company is $V'_2 = EBIT(1 - t) + t$ alpha.OK_1r and not V_2 any more. Given that the company's policy is to use alpha. percent of debt financing for any level OK^* of investment, the transformation curve will become OFG and it will replace the OCA transformation curve which holds for the case where all the required investment is financed with equity. Thus, OFG is OCA plus the tax subsidy. (Obviously the location of OFG depends on the magnitude of alpha.. As alpha. gets values between 0 and 1, one gets a spectrum of OFG curves. In the MM (1963) framework, OFG corresponds to alpha.=1.) It is true that the company can realize a higher end of period (and therefore beginning of period) value V'_2, but this is not the best it can do for the initial shareholders. As the company moves from C to F, the initial shareholders become better off because they move to the higher present value opportunity set EF. But for the new transformation curve OFG, the best investment choice is OK_2^* and not OK_1^*, because at the OK_2^* level of investment, the marginal rate of return on investment, which includes the normal marginal revenue product and the marginal tax subsidy, is equal to the market rate r. Therefore, the company has to move to point I (and have an end of period value V''_2) and this will obtain the highest possible opportunity set HIJ for the initial investors.

This indicates that the imperfection of taxes will increase the value of the company by more than is suggested by MM (1963). It also indicates that under imperfect capital markets financing and investment decisions are no longer independent. This is due to the fact that the imperfection of the corporate taxes introduced here causes a shift in the transformation curve of the company and this forces the management to choose its new optimal investment. If one considers the simplest case of a company which uses as inputs real capital and labor, then one can proceed a step further. Assume that OK_1^* is the investment in real capital. If this real capital is coupled with labor, which is paid at the end of the period, one can get the end of period coordinate of the transformation curve (given, of course, the production function and the cost per unit of both capital and labor). As seen in Figure 2, when the

company introduces debt in the financing of its real capital expenditure, this will cause the firm to move from C to F and eventually to I. Therefore, one of the inputs of the production function changes, and since the firm moves to a different level of earnings and it keeps the same production function, the other input (labor) and/or the output could (as will be later indicated) also be affected. It can be concluded then, that the imperfection of corporate taxes introduced here will induce an interaction between the financial and the real decisions.

It becomes evident from the example above that the maximizing behavior of a company in an imperfect capital markets framework can be analyzed best in a model which allows for interactions between the three different kinds of corporate decisions. In such a model, one allows the investment and production variables to adjust fully to the changes of the financing decisions and as a result of this, the value of the company will also fully adjust to the new capital structure. The value adjustment is composed of the following two parts: a) the partial adjustment of the company's value due to the direct effect of the market imperfection on the end of period cash flows, i.e., the difference $V'2 - V2$ in Figure 2; and b) the partial adjustment of the firm's value due to the change of the end of period cash flows caused by the adjustment of the real variables to a change of the firm's capital structure, i.e., the difference $V''2 - V'2$ in Figure 2.

By assuming constant investment and production decisions when examining the effects of capital structure on the value of the firm, one actually considers only the partial adjustment (a) above and thus constrains the maximum value the company can obtain. In other words, one examines the constrained maximization problem in the sense that interactions between the three kinds of corporate decisions are not allowed. On the other hand, as demonstrated above the importance of the unconstrained value maximization lies in that: a) it indicates that the imperfections of the capital markets cause (for reasons that will be explained) an interaction between the financing, investment, and production decisions. As a result of this, for every capital structure the firm will have a different level of investment and also the production variables will be; b) it allows for a simultaneous determination of the optimal levels of the financing, investment, and input/output decisions; and c) it determines the value of the firm by taking into account both the direct effect of the market imperfections as well as the indirect effects of the adjusted real variables on the value of the firm.

Separability Between Real and Financial Decisions Under Certainty in Perfect Capital Markets

The first case that will be reviewed is the one of perfect certainty and perfect capital markets. It is well known that in this framework Fisher's Separation principle holds. This means that investment and consumption decisions can be made separately. The management has only to maximize the present value of the firm's cash flows and need not concern themselves with how this value is converted into the consumption pattern preferred by the firm's shareholders.

In this model, financial decisions refer to dividend policy because any income the firm does not retain is paid to the owners and also because, due to the lack of frictions in the capital markets, arbitrage equates the returns on equity and bonds with the risk-free rate. Given the firm's real decisions, the only way in which the firm can finance additional dividends is by raising money from sources outside the firm, i.e., by selling off rights to part of the

future dividends that the firm will distribute. In short, for each shareholder the positive effect of the higher dividends is totally offset by the lower capital gains he realizes. Therefore, the firm's market value is independent of its financial decision for given real decisions. Therefore, it can be concluded that real and financial decisions can be made independently of each other and of shareholders' tastes. The present model is easily explained in terms of Figure 1 (see, for example, Fama and Miller (1972)). It indicates that the management can choose the level of investment and production variables independently of the preferences of the shareholders in such a way as to maximize the value of the firm. Point C of Figure 1 summarizes these choices. Then, regardless of financial decisions, the value of the firm is not affected and therefore no interactions exist between the three kinds of corporate decisions.

When uncertainty is introduced, the separation between the real and financial decisions of the firm might or might not hold depending on one's assumptions about the capital markets. One starts with some models in which the certainty results are reproduced. Here the main distinction is between complete and in-complete capital markets. The models considered are general equilibrium models and their study is heavily based on Milne (1974).

Separability Between Real and Financial Decisions Under Uncertainty in Complete and Incomplete Capital Markets

In his Theory of Value, Debreu (1959) works under certainty and specifies goods and/or services physically, temporally, and spatially. He works in a multiperiod setting and he introduces a price system which indicates that the price of a good is the amount paid now for a future transaction. Consumers choose their consumption and they want to maximize their utility, while producers want to maximize their profits. In this model, Fisher's Separation Principle (as defined earlier in this paper) holds true, and also real and financial decisions are separable.

The contingent commodity model introduces a time-state sequence which records the progress of the economy as time unrolls. In this model, commodities are viewed as contracts which specify the delivery or acceptance of a specific number of units of a physical commodity if and only if a particular state occurs. The prices of the contingent commodities are determined in the market at the beginning of the period. Producers bear no risk in this setup. They simply have to choose the profit maximizing production plan out of all the permissible production plans in the state. (Delivery of the commodities takes place after the state has prevailed.) Consumers bear all the risk. Given consumers' probability beliefs over the states as well as their attitudes toward risk, they maximize their expected utility. Assuming risk aversion, the present model becomes identical with the certainty case model. This is so because here a complete set of markets which insure against all natural uncer- tanties exists and separation between the real and financial decisions holds once more.

Arrow (1964) introduced the notion of primitive securities (which pay a unit of account if and only if an agreed upon state of the nature obtains) and so he obtained a model where there are as many securities as states of the nature (i.e., complete markets). In this model, the economic agents have to decide first on the number of the primitive securities they will hold, and secondly, given the realization of one state they have to decide about their consumption or production. Since the present model is a transformation of the contingent commodity model, one has to realize that the primitive securities

can provide the agents with full insurance against all natural uncertainties. So one is back again in the certainty case, and real and financial decisions are separable. From the three models above, Debreu's model addresses certainty and, since there are no imperfections introduced, one can logically expect the certainty/perfect capital markets results obtained earlier in this paper to hold. The contingent commodity model and Arrow's model deal with perfect capital markets and uncertainty. But the fact that the capital markets are complete nullifies the impact of uncertainty and the two models provide for perfect insurance against all natural uncertainties (i.e., the models become equivalent to the certainty case). Then the certainty/perfect capital markets results prevail once more. So the real and financial decisions do not interact with each other but they are reached independently in each one of the three models. Figure 1 will be decriptive of any one of the three models given that time is restricted to one period.

Since the completeness of the capital markets is a crucial factor in the treatment of uncertainty, it is desirable to examine what happens when the capital markets are incomplete, i.e., when the number of securities is less than the number of states.

Diamond (1967) introduced incomplete markets as well as technological uncertainty in his analysis. In his model, firms produce patterns of returns across the states and consumers are constrained to trade in linear combinations of these assets. He studies the special case where firms cannot change the patterns of their returns but only their scale. He assumes that competitive markets exist for the predetermined set of patterns of returns. In other words, the set of fixed patterns of returns is regarded as a set of commodities for which competitive markets exist. Thus, the present model becomes equivalent to the Arrow-Debreu model, and so real and financial decisions are separable.

In the general case of incomplete markets, implicit prices[7] are not necessarily equal for all the investors and as a result of it, the firm's objective is not independent of the shareholders' preferences. Therefore, Fisher's Separation Principle does not hold. Then the firm is without a well-defined rule of action, and the role of the financial decisions is difficult to evaluate.

Separability Between Real and Financial Decisions Under
Uncertainty in Perfect and Imperfect Capital Markets

As indicated earlier in connection with the general equilibrium models under uncertainty, in perfect markets, separation between real and financial decisions will hold but in imperfect markets, it will not. A market equilibrium proof of the separability between real and financial decisions as well as of the irrelevancy of capital structure under perfect markets is now presented.[8] In the case of uncertainty and perfect capital markets, real and financial decisions are separable because, regardless of their financial decisions, the firms cannot change the ultimate equilibrium holdings of the individual investors since investors can freely and with no costs transact in the perfect capital markets and transform the offered distributions of the future cash flows of the firms to the ones they desire.[9] Nor can any financial policy change the equilibrium prices of the investors' holdings because the investors who will ultimately obtain the ownership of the firm's cash flows will be those who offer the highest price for them. The prices of the different ultimate holdings of the firm's future cash flows are determined by the transactions between investors in the market, and it follows that in perfect capital markets

these prices are independent of the firms' financial decisions. Furthermore, since the total value of each firm is the sum of the values of the equilibrium holdings of the investors, it means that the value of each firm is independent of its financial decisions. The above holds true for any set of real decisions. Then it follows that real and financial decisions are separable. Figure 1 graphically illustrates the present model as well as its special case as developed by MM (1958).

MM (1958) prove, through arbitrage, the irrelevance of the financial decisions in perfect capital markets. Their theory implies the lack of any interactions between the real and financial decisions. As they indicate in their Proposition III, the firm's cut-off point for investment is unaffected by the capital structure and therefore different financing schemes will not change the optimal amount of investment that the firm will undertake. Then the input/output variables will remain also unaffected by the financing process because, given the level of investment, there is only one set of input/output variables which will maximize the value of the firm (which is not affected by the financial structure) and will bring the company to point C in Figure 1.

Attention will now be given to imperfect capital markets under uncertainty. What follows is a review of some partial equilibrium models which introduce different kinds of imperfections and an examination of the interactions between the real and the financial decisions caused by these imperfections.

MM (1963) introduced the imperfection of corporate taxes and proved that for a given level of investment, the value of the firm will be increasing with leverage due to the tax deductibility of debt payments. Therefore, they implied that the firm will go for a 100% debt financing. In this event, one can reinterpret some parts of Figure 2 in the following way: (a) $V'2 = K1F^*$ is the value of the company given 100% debt financing of the investment $OK1^*$; (b) OFG is the highest transformation curve obtainable by the company and contains all the points like F for all the possible levels of investment; (c) $V''2$ is the highest value the firm can obtain for its shareholders. In their study, MM (1963) indicate that the value of the firm can move up to a maximum $V'2^*$ given that the same level of investment $OK1^*$ is retained. In the analysis following Figure 2, it was indicated that the firm can do more than that for its owners.

Actually, it can move to a higher level of investment $OK2$ because, as MM (1963) proved, the cost of capital is reduced with the usage of leverage. By doing so, the value of the firm increases to $V''2$ and, as indicated in the analysis of Figure 2, the input/output variables of the firm will be affected. In conclusion, MM (1963) were concerned with the constrained maximization of the firm's value and therefore they did not bring out the interactions between the real and financing decisions of the firm, while it is argued here that such interactions exist and they work to the benefit of the shareholders.

Next, consider the case developed by Kim (1978). Under the imperfections of (a) corporate taxes and (b) stochastic bankruptcy costs, he proves in a CAPM framework that there is an interior capital structure which maximizes the value of the firm for a given level of investment. He argues that as the company increases the leverage used in financing its investment, its value increases due to the tax deductibility of debt payments. At the same time the expected after tax bankruptcy costs also increase and this has a detrimental effect on the firm's value. As long as the debt benefit exceeds the bankruptcy costs disadvantage, the value of the firm will be increasing and it will reach its

maximum when the two effects are equal to each other. Further usage of leverage will cause a decrease in the value of the firm because the debt benefit is less than the bankruptcy costs disadvantage. Thus, an optimal capital structure exists and the value of the firm is not independent of its financial decision.

The above development leaves once more intact the question of possible interactions between real and financial decisions, by assuming fixed investment. Going back to Figure 2, the following changes are introduced: (a) $V'2 =$ K1F is the maximum value of the company under corporate taxes and bankruptcy costs for the level of investment OK1 (i.e., if the firm uses more or less debt than the optimal in financing OK1, then the value of the firm will be less than $V'2$); (b) OFG is the highest transformation curve for the firm and it contains points like F; (c) $V''2$ is the highest possible value the firm can obtain for its owners. Given these notational changes, if one follows the line of argument presented in the analysis of Figure 2, one can conclude that the optimal financing decision will cause the value of the firm to increase more than suggested by Kim (i.e., it will go up to $V''2$ and not just $V'2$) because the optimal investment will become OK2 (not OK1), and also the production variables will be affected. In other words, one again concludes that interactions between real and financial decisions can be incorporated in the present model, and this will call for an adjustment of the firm's value beyond what Kim indicated.

As Miller (1977) and Baxter (1967) argue, bankruptcy costs are not high enough to guarantee the existence of an interior optimal capital structure. Therefore, research was directed towards other imperfections to support the relevance of the financial decisions.

The models presented up to now in this section, as well as Ross' model presented below, have one common feature. In their pursuit of an optimal capital structure they all assume that the investment and production decisions are exogenously fixed. All these models actually solve the constrained maximization problem where the real variables are not free to adjust to the changes of the firm's capital structure. This kind of analysis can be seen as the first step toward an optimal capital structure theory. It is mainly interested in studying the effects of the different market imperfections on the firm's optimal capital structure (and value).

Later studies allowed for interactions between the investment and capital structure variables in their search for the firm's optimal value. At this level of analysis, production decisions are still exogenously fixed. Examples of this approach to the optimal capital structure question, included in the present paper, are the models by Jensen and Meckling (1976) and Myers (1975) to which we turn next.

Jensen and Meckling (1976) introduced the imperfection of agency costs. These costs are due to the divergence of interests between the owner-manager of the firm and the outside shareholders and/or bondholders. More specifically, the agency costs result from: (a) The owner-manager's adverse incentives to consume large (as compared to the case where he is the sole owner of the firm) amounts of perquisites, N, when he sells to outsiders equity shares identical to the ones he owns; and (b) the owner's expropriation of bondholders' wealth through wealth transfers via investment decisions when outside financing is in the form of risky debt.[10] The owner-manager's behavior can be restricted by

either the shareholders or bondholders if they incur monitoring costs, or by the owner-manager himself, if he incurs bonding costs (and he will be willing to do so, since the result is an increase in the value of the firm). Since the model is characterized by rational expectations behavior, the above costs (as well as the bankruptcy costs in the case of risky debt) are reflected in a reduced value for the firm.

As far as interactions between the real and financial decisions are concerned, the model in hand indicates that the more the firm relies on any form of outside financing, the lower the level of investment which the firm will undertake. The reason for this is that as the firm relies more heavily on outside financing in order to undertake a given level of investment (I), the owner manager's share of the firm drops. Thus, agency costs appear and the value of the firm is reduced to V. If V-I turns out to be negative, the investment is not undertaken. In the absence of agency costs, the value of the firm is $V^* > V$ and $V^* - I > 0$ and so the project is acceptable. When monitoring and/or bonding costs are incurred and they are effective, the value of the firm is V^{**} such that $V < V^{**} < V^*$. For some I with $V^* - I > 0$, one can now have $V^{**} - I < 0$, while for some I with $V - I < 0$ one can now have $V^{**} - I > 0$. Thus, the level of investment is higher than the one for the agency costs no monitoring/bonding costs case but lower than the no agency costs case. The theme underlying the present model is that the existence of agency costs does not allow the probability distribution of future cash flows to be independent of the (ownership) structure of capital as opposed to the MM (1958) assumption.

The Jensen and Meckling model will be graphically illustrated for the simple case in which the owner-manager sells part of his ownership to outsiders. (Analogous analysis can be done for the case in which he raises funds by the issuance of bonds.) Figure 2 can be used for this purpose. Again, OIG is the transformation curve for the case in which the owner-manager owns 100%

of the equity. For the level of investment OK2, the end of period value is $V''2$ if the amount of non-pecuniary benefits, N, required by the owner is zero. However, if this is not the case and $N = N^* > 0$, then the firm's value is reduced by this amount. Say $V^* = V - N^*$ the new value. If the owner now sells shares of equity to outsiders (and thus reduces the proportion of his ownership), then he is induced to consume higher amounts of perquisites (since it is cheaper for him to do so now) and this will further reduce the end of period value of the firm due to the agency costs. Since this is true for any level of investment, then it can be realized that the transformation curve will shift to a lower position, OCA; and then it can be again concluded that there is an interaction between the real and financial decisions of the firm. This interaction is due to the fact that the end of period resources available are reduced, due to (1) the owner's preferences for non-pecuniary benefits and (2) the sale of equity to outsiders. Note that Jensen and Meckling consider only the interactions between financial decisions and investment while they do not comment on the input/output decisions.

Ross (1977), like Jensen and Meckling (1976), introduces managerial self interest in the determination of the firm's optimal capital structure. The market imperfection here is the asymmetric information between insiders and outsiders. Investors are informed about the firm's profitability and its business risk through financial signalling, which is geared to the manager's compensation schedule in order to produce valid signals[11] (the end of period component of the manager's compensation includes a penalty if the firm goes bankrupt). As Ross indicates: "What is valued in the marketplace, however, the perceived stream of returns for the firm."[12] So when the manager issues

more debt, this signal is interpreted by the marketplace as higher present value for the firm and at the same time it increases the beginning of period compensation of the manager. On the other hand, higher leverage will increase the present value of the penalty imposed on the manager in the event of bankruptcy at the end of period. Then the optimal leverage for the manager is the one at which the two marginal effects of increasing penalties and increasing current wage are equal in magnitude. If the optimal capital structure chosen by the manager gives correct signals, then the capital market will correctly identify the different types of firms. Then the present value of the company will be equal to the value of investment.[13] Financial structure is relevant to the extent that when it is optimal, it maximizes the manager's wealth and it also allows for discrimination between the different types of firms. As Ross indicates: ". . . in a perfect market with incentive-signalling phenomena some Fisherian separation results should hold..."[14] This, the coupled with the previous finding that the value of the firm will not change as its capital structure changes, indicates that there are not any interactions between the real and financial decisions in the present model. Thus, Figure 1 is a good description of it.

Myers (1975) argues about the agency costs induced by risky debt. In Myers' model, the agency cost induced by the existence of risky debt is the suboptimal investment of the firm. He observes that a firm is valued as a going concern and this implies that the firm's value reflects the expectation that it will continue investing in the future. This investment, however, is discretionary (i.e., the firm has an option to make further investment), and its amount depends on the Net Present Value, NPV, of the opportunities as they arise in the future.

Myers assumes that the firm acts in the shareholders' interest, that the existing risky debt matures after the firm's investment option expires, and that there are no taxes and bankruptcy costs. Let $V(S)$ be the value of the asset the firm obtains in state S when investment I is made, and let P be the payment promised to the existing bondholders. Then, given that a project is profitable (i.e., $V(S) > I$), it does not mean that the firm will undertake it. The project will be accepted only as long as $V(S) \geq I + P$, because if $V(S) < I + P$ then the investors' outlay (I) exceeds the market value of their shares $(V(S) - P)$, and by adopting such a project (with $V(S) < I + P$), the interests of the shareholder are not served in the best way as it has been assumed. Therefore as P increases, the value of an otherwise profitable option (i.e., one with $V(S) > I$) will become less than $I + P$. Thus the option is not undertaken, the firm will follow a suboptimal investment policy, and the firm's value will be reduced. This interaction between the financial and investment decisions leads to the conclusion that, under the given assumptions, the firm will employ no debt at all. If there is a corporate tax, and interest payments are tax-deductible, the optimal strategy involves a trade-off between the tax advantages of debt and the cost of suboptimal future investment strategy.[15]

To check for the possibility of interactions between the real and financial decisions in Myers' framework without taxes, consider Figure 2 once more and apply the following interpretation. In this exhibit, 0IG is the transformation curve for the company given all equity financing of any level of investment; $OK2^*$ is the optimal level of investment (under all equity financing); and $K2I = V''2^*$ is the corresponding value of the company. Assume now that the firm uses a proportion alpha. of debt financing in the $OK2^*$

investment. If the firm can use a proportion alpha. of debt financing regardless of the level of investment OK*, and if P is the promised payment to the bondholders, then the firm moves along OIG to point F. Thus, the firm follows a suboptimal investment policy (OK$_1^*$ < OK$_2^*$), its value is reduced to V'2, and its initial shareholders end up on the lower opportunity set EF. Therefore, as Myers noted, it is in the best interest of the firm not to issue risky bonds at all. It can be further indicated, as in the previous models, that the production decision will also be affected by the introduction of risky debt. Thus, Myers' framework can be extended to account for both the relevance of the financial decisions and for interactions between real and financial decisions.

Vickers (1968) introduces the imperfection of capital rationing. It means that the firm, in making its optimum production and factor use decisions, faces a shortage of money capital. This is opposite to the money capital saturation assumption of the neoclassical theory of the firm, where no such shortage exists. The capital rationing imperfection enables Vickers to demonstrate, to an extent, the need for simultaneous consideration of both the real and financial decisions in an integrated model of the firm.

Under the neoclassical assumption of capital saturation, the marginal cost of money capital is zero because money capital is not a scarce resource. But under capital rationing, money capital is regarded as a scarce resource and thus it carries with it a marginal cost which is different from zero. Vickers' concern then becomes to impute this cost to the different factors used in production. In doing so, he obtains an equilibrium condition for the value maximizing firm which requires that the ratio of marginal products of the factors is equal to the ratio of the effective marginal costs of the factors. The effective marginal cost of any factor is equal to its direct cost plus the imputed capital cost the factor is called upon to carry. Furthermore, the extent to which each factor is required to carry a capital cost imputation depends on the factor's Money Capital Requirement Coefficient[16] (MCRC). In the neoclassical theory of the firm, the corresponding equilibrium condition requires that the ratio of the marginal products be equal to the ratio of direct factor costs.

One can see the difference between the right hand sides of the two equilibrium conditions. In one, the right hand side is the ratio of the direct factor costs while in the other, it is the ratio of the effective marginal costs of the factors. It is known that the left hand sides of both these equilibrium conditions give the slope of the isoquant contour while the right hand sides of these two relations give the slope of the isocost contour, and also that these two contours will be tangent to each other in equilibrium. Therefore, the difference between these two equilibrium conditions enables Vickers to demonstrate that the capital rationing induces a change in the optimum factor combinations. So the optimum structure of the production process is not independent of the conditions of the availability of the investable money capital. Changes in the availability of money capital will cause the actual attainable level of output to change also.[17]

One can say, then, that Vickers studies the effects of capital rationing on the optimum structure of the firm. But he stops there. He does not investigate the effects of different financial decisions (the debt-equity ratio, for example) on the firm's structure. This point will be made clear through the following example. Suppose that the money capital available to the firm turns out to be $1 million. Then Vickers indicates that the optimal factor combination in this case will be different than the one under the money capital saturation case. But he does not consider what will happen to the

optimal combination of factors, as the firm's debt-equity ratio changes from zero to one, while at the same time the money capital available is always $1 million. Such a study could indicate the existence or not of an interaction between the financial and real decisions of the firm, with the causation running from the financial to the real decisions.

On the other hand, Vickers' analysis is helpful in the following sense. If, in imperfect capital markets, some costs or savings arise due to the specific way of financing, then these costs or savings could be imputed to the different factors of production. Then a relationship analogous to Vickers' equilibrium condition could be developed, and this would imply that different financing decisions will cause changes in the input/output . This supports the comment made earlier in this paper (in connection to Figure 2) that changes in financial decisions will not only affect the investment decision but also the input/output decision. This line of thought is the starting point for a third type of approach to the optimal capital structure question. Examples of this approach included in the present paper are the models by Hite (1977), Prezas (1982), and Dotan and Ravid (1985). Their common feature is that they all account for the interactions between the real and the financial variables. In Hite (1977) though, the causality runs from the financial to the real decisions but not the other way around. On the other hand, in Prezas (1982) and Dotan and Ravid (1985) the causality runs both ways and thus, real and financial decisions are determined simultaneously. These models are reviewed next.

Hite (1977) considers a model in which the firm acts under uncertainty and the capital markets are perfect with the exception of corporate income taxes. This imperfection is shown to cause an interaction between the real and financial decisions of the firm. Hite considers a new firm which faces uncertain demand and which is a price-taker in all factor markets as well as in the second-hand markets. This firm has a given production function with the neo-classical properties and it finances a proportion, gamma, of its initial outlay with riskless debt, while the remaining 1 - gamma is financed with equity. The tax deductibility of the debt interest payments enables Hite to demonstrate that the user cost of capital is a decreasing function of gamma (while the user cost of labor is independent of gamma). In this model, wages are also tax deductible and this creates a situation in which it is favorable for the firm to become more labor and less capital intensive. On the other hand, as seen above, the user cost of capital decreases as gamma increases and this makes it favorable for the firm to become more capital intensive. These are two opposite tendencies and Hite demonstrates that an increase in gamma will result in: a) an increase (decrease) of the optimal output of the firm if capital is a normal (inferior) input; b) an increase of the optimal stock of capital employed by the firm;[18] and c) an undetermined change in the amount of labor employed by the firm.

Thus, one can conclude that there is an interaction between the real and the financial decisions of the firm and this is caused by the imperfection of corporate income taxes. In Hite's model the direction of causality runs from the financial to the real decisions but not the other way. Thus, Hite's model does not allow for a simultaneous determination of the real and financial decisions. Under riskless debt and corporate taxes, Hite demonstrates that the firm's capital structure is indeterminate[19] and he speculates that if an optimum exists it might well involve the issuance of risky debt. By allowing both the investment decision and the input/output decision to change as the proportion gamma of debt financing is increasing (i.e., moving from one risk class to another), contrary to the MM theory where the firm increases only

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gamma keeping everything else constant (i.e., substituting debt for equity and thus remaining in the same risk class), Hite is able to demonstrate that the increment of the value of the firm in his model is strictly higher than the one in the MM model.[20]

Prezas (1982) studies an equilibrium where the real and the financial decisions interact with each other but, unlike Hite's model, the causality runs from the financial to the real decisions and back again. This allows for a simultaneous determination of the real and the financial variables and it also completes Hite's generalization of the MM theorems. Under the assumptions of corporate taxes, risky debt (and associated with it bankruptcy costs),technological uncertainty, and risk neutrality, it is demonstrated that an interior optimal capital structure exists. The firm's value (as a function of gamma.) reaches its interior maximum for sufficiently high bankruptcy costs.[21] Furthermore, expressions describing the optimal adjustment of the investment and input-output variables to leverage changes which incorporate the effects of risky debt are derived, thus expanding Hite's results. Specifically, it is demonstrated that both the user cost of capital and the user cost of labor are functions of leverage, and that the effect of financial leverage on the firm's capital-labor ratio depends upon whether capital and labor are complements or substitutes in the production process. Finally, as in Hite's model, the NPV curve (as a function of financial leverage) of the firm when the real and the financial decisions interact with each other, is the envelope of a family of NPV curves of the firm when interactions are not allowed, each curve of the family corresponding to a fixed set of real variables.

As an application of the simultaneous determination of the real and financial decisions to management problems, consider a case of mergers. It has been recognized in the financial literature that the potential value of unused debt capacity of a firm B creates an opportunity for another firm A, to purchase B. Assume B is all equity financed and has a market value V. The potential value of B if it used some financial leverage, L, (and utilized the associated tax shelters) is $V(L) > V$. Thus, firm A can buy B for V, get back L by borrowing against its new acquisition, and provide its shareholders with a $V(L)-V$ gain. This strategy though, ignores the effects of leverage on B's real decisions. If the interactions between the real and financial decisions are taken into account, A's shareholders can benefit even more from the merger. All the manager of A has to do is buy B for V, borrow L against B, adjust the real variables of B to the new level of leverage L, and provide stockholders with a $V'(L)-V$ gain; where $V'(L) > V(L)$ is the value of the leveraged company B given that the interactions between the real and financial decisions were taken into account.

<div align="center">Conclusions</div>

This paper has demonstrated that the investment, production, and capital structure decisions of a firm should be made simultaneously if capital market are imperfect. It has been argued that a shift in the company's capital structure will cause a change in its value because of the adjustment of the end of period cash flows due to 1) the direct effect of market imperfections and 2) the adaptation of the real variables to the changing capital structure. The simultaneity of the real financial decisions results in an integrated theory of capital structure, investment and production decisions in rational, well functioning capital markets.

In perfect capital markets the real and the financial decisions do not interact and the financial decisions are not relevant. Thus, the solutions to the constrained and unconstrained value maximization problems produce identical

results. In contrast, when capital markets are imperfect, the savings and/or costs due to the market imperfections for the different financial packages can be imputed to the effective (or user) cost of the real variables and this leads to new optimal values for the real variables. Therefore, the real and the financial variables interact and (due to the market imperfections) the financial variables are relevant as well. The new values of the real variables will be reflected in a new optimal value for the firm.

As a result of the above interactions, the increment in the firm's value resulting from a change in the capital structure is higher in the unconstrained case. The implication for management is that the firm's value maximization objective cannot be reached by mere shifts in the capital structure. The feedback loops on factor costs, input mix, and output determine the size of adjustments in the real decisions that must accompany capital structure shifts for value maximization. In order to simultaneously optimize over the real and the financial decisions, management should adhere to the following steps: 1) Set financial leverage equal to zero and determine the values of the real variables that maximize the firm's value. Then, calculate this maximum value of the firm; 2) Marginally increase financial leverage and calculate the new (adjusted) values of the real variables that maximize the firm's value. Then, calculate the new maximum value of the firm; 3) Repeat step two as long as the maximum value of the firm corresponding to the new level of financial leverage exceeds the one obtained in the last step. Stop when the value increment, in response to the new level of financial leverage, is zero.

A factor determining whether or not management will actually allow the real variables to adjust to the changes of the firm's capital structure, is the cost of these adjustments. If the adjustment costs consume the benefits provided by the unconstrained value maximization over the constrained one for any chance in the firm's capital structure, management has no other choice but to practice constrained maximization. This will be an interesting question to explore.

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Footnotes

1. These specifications will indicate the extent to which the capital markets are perfect, complete, and competitive.
2. Perfect capital markets preclude personal or corporate taxes, brokerage fees, underwriting costs, bankruptcy costs, or other types of transaction costs as well as indivisibilities of securities.
3. MM (1958) assume perfect capital markets, riskless debt, and investors with homogeneous expectations about future earnings.
4. The transformation curve contains all the operating policy alternatives open to the firm.
5. The opportunity set contains all the income-consumption alternatives open to the individual.
6. To make the present one period model comparable with the perpetuity model developed by MM (1963), one has to assume that both interest payments and principal are tax deductible. See also Fama and Miller (1972).
7. For each investor his implict price is equal to his marginal rate of substitution between present and contingent income. In complete markets the implicit prices for different investors are equal.
8. For a detailed exposition, see Fama and Miller (1972), Chapter 4.
9. Notice that in perfect capital markets investors can issue the same kinds of claims as firms.
10. Chen and Kim (1979) argue that in the case of risky debt, the owner-manager is induced to appropriate higher levels of perquisites as compared to the absence of debt. This is so because in the case of bankruptcy, the bond-holders will have to bear most of these costs, since for $1 of perquisites, the owner's cost is alpha p < alpha; where alpha is the owner's percentage

of firm equity and p is the probability that the firm will remain solvent.

11. Leland and Pyle (1977) use the entrepreneur's fraction alpha of a project's equity as a signal when informational assymetry exists about the end of period value, V, of a project. The market perceives the expected V as a (strictly increasing) function of alpha.. At any level of investment the firm's end of period value increases with alpha. Thus, the firm's trans formation curve shifts upwards in Figure 2, indicating an interaction between the financing and real decisions.

12. Ross, S. Spr. 1977. The Determination of Financial Structure: The Incentive-Signalling Approach. The Bell Journal of Economics 8: 25.

13. Chen and Kim (1979) argue that this is correct only if one assumes that the penalty imposed on the manager goes to the bondholders in the event of bankruptcy.

14. Ross, S. op. cit., p. 38.

15. In another paper, Myers (1974) indicates that: (a) when a firm accepts a new project, it will normally increase the amount of debt it can obtain; and (b) the incremental cash flows of a project have to be balanced by the financing flows (since the sources of funds must be equal to the uses of funds). These two interactions between financing and investment shift the firm's transformation curve to a place different than the one of the base (all equity financing, irrelevance of dividends) case in Figure 2. Thus, the interaction between the real and financial decisions follows immediately.

16. The MCRC of a factor is defined as the dollar amount of money capital required to be invested in fixed assets when one unit of factor capacity is employed.

17. It is obvious that in this model the market rental rate on money capital jumps discontinuously from a finite rate to infinity (the firm cannot raise money at any rate). The firm has to operate with what capital it has on hand. In such a constrained environment, non-separability is a trivial result. It is an assumption, not an implication. Vickers' model can be seen as an unsuccessful attempt to provide an integrated model of the firm.

18. Treating debt as an independent variable (i.e., a dollar amount, not a percentage of capital investment as in Hite's model), endogenizing nondebt-related tax shields, and using risk neutral valuation, Dotan and Ravid (1985) demonstrate that a firm must optimize simultaneously over capital investment (which is also used as a capacity constraint on production) and debt capacity. Unlike Hite's model though, they demonstrate that optimal capital investment is a decreasing function of financial leverage. Labor is totally disregarded in their analysis.

19. This is so because as gamma increases, the value of the firm increases too, and this is in accordance with the firm's objective to maximize its value. Therefore, the firm will push gamma towards 100%.

20. Alberts and Hite (1983) examine the leverage optimizing behavior of firms operating in a competitive industry. They indicate that free entry drives the long-run profits, as a function of financial leverage, to zero regardless of the existence of leverage-related imperfections. In the presence of these imperfections, firms select lower leverage ratios as compared to the case of no imperfections. If, in addition, free enry takes place, firms select even lower (long-run) leverage ratios due to the effect of the imperfections on the cost of capital, and the effect of entry on output, output price, and operating profits.

21. If bankruptcy costs are not high enough to guarantee the existence of an interior optimum, the firm moves towards a corner (gamma=1) solution.