

**The Modigliani-Miller Theorem**  
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The Modigliani-Miller Theorem is a cornerstone of modern corporate finance. At its heart, the theorem is an irrelevance proposition: The Modigliani-Miller Theorem provides conditions under which a firm's financial decisions do not affect its value. Modigliani (1980, p. xiii) explains the Theorem as follows:

... with well-functioning markets (and neutral taxes) and rational investors, who can 'undo' the corporate financial structure by holding positive or negative amounts of debt, the market value of the firm – debt plus equity – depends *only* on the income stream generated by its assets. It follows, in particular, that the value of the firm should not be affected by the share of debt in its financial structure or by what will be done with the returns – paid out as dividends or reinvested (profitably).

In fact what is currently understood as the Modigliani-Miller Theorem comprises four distinct results from a series of papers (1958, 1961, 1963). The first proposition establishes that under certain conditions, a firm's debt-equity ratio does not affect its market value. The second proposition establishes that a firm's leverage has no effect on its weighted average cost of capital (i.e., the cost of equity capital is a linear function of the debt-equity ratio). The third proposition establishes that firm market value is independent of its dividend policy. The fourth proposition establishes that equity-holders are indifferent about the firm's financial policy.

Miller (1991) explains the intuition for the Theorem with a simple analogy. "Think of the firm as a gigantic tub of whole milk. The farmer can sell the whole milk as it is. Or he can separate out the cream, and sell it at a considerably higher price than the whole milk would bring." He continues, "The Modigliani-Miller proposition says that if there were no costs of separation, (and, of course, no government dairy support program), the cream plus the skim milk would bring the same price as the whole milk." The essence of the argument is that increasing the amount of debt (cream) lowers the value of outstanding equity (skim milk) – selling off safe cash flows to debt-holders leaves the firm with more lower valued equity, keeping the total value of the firm unchanged. Put differently, any gain from using more of what might seem to be cheaper debt is offset by the higher cost of now riskier equity. Hence, given a fixed amount of total capital, the allocation of capital between debt and equity is irrelevant because the weighted average of the two costs of capital to the firm is the same for all possible combinations of the two.

The Theorem makes two fundamental contributions. In the context of the modern theory of finance, it represents one of the first formal uses of a no arbitrage argument (though the "law of one price" is longstanding). More fundamentally, it structured the debate on why irrelevance fails around the Theorem's assumptions: (i) neutral taxes; (ii) no capital market frictions (i.e., no transaction costs, asset trade restrictions or bankruptcy costs); (iii) symmetric access to credit markets (i.e., firms and investors can borrow or lend at the same rate); and (iv) firm financial policy reveals no information. Modigliani

and Miller (1958) also assumed that each firm belonged to a “risk class,” a set of firms with common earnings across states of the world, but Stiglitz (1969) showed that this assumption is not essential. The relevant assumptions are important because they set conditions for effective arbitrage: When a financial market is not distorted by taxes, transaction or bankruptcy costs, imperfect information or any other friction which limits access to credit, then investors can costlessly replicate a firm’s financial actions. This gives investors the ability to ‘undo’ firm decisions, if they so desire. Attempts to overturn the Theorem’s controversial irrelevance result were a fortiori arguments about which of the assumptions to reject or amend. The systematic analysis of these assumptions led to an expansion of the frontiers of economics and finance.

The importance of taxes for the irrelevance of debt versus equity in the firm’s capital structure was considered in Modigliani and Miller’s original paper (1958). Miller and Modigliani (1963) and Miller (1977) addressed the issue more specifically, showing that under some conditions, the optimal capital structure can be complete debt finance due to the preferential treatment of debt relative to equity in a tax code. For example, in the U.S. interest payments on debt are excluded from corporate taxes. As a consequence, substituting debt for equity generates a surplus by reducing firm tax payments to the government. Firms can then pass this surplus on to investors in the form of higher returns. This raised the further provocative question – were firms that issued equity leaving stockholder money on the table in the form of unnecessary corporate income tax payments? Miller (1977) resolved this problem by showing that a firm could generate higher after-tax income by increasing the debt-equity ratio, and this additional income would result in a higher payout to stockholders and bondholders, but the value of the firm need not increase. The crux of the argument is that as debt is substituted for equity, the proportion of firm payouts in the form of interest on debt rises relative to payouts in the form of dividends and capital gains on equity. Higher taxes on interest payments than on equity returns reduce or eliminate the advantage of debt finance to the firm.

The remaining Modigliani-Miller assumptions deal with various types of capital market frictions (e.g., transaction costs or imperfect information) that are at the heart of arbitrage. The driving force in a perfect market for a homogeneous good is the “law of one price.” If debt and equity are merely different packages of an underlying homogeneous good – capital, and there are no market imperfections, then it follows immediately that the law of one price holds due to arbitrage. Investors simply engage in arbitrage until any deviation in the price of the two forms of capital is eliminated. Thus, the remaining discussion is organized around the three implications of the Theorem for firm capital structure, dividend policy, and the method of capital finance (lease versus buy).

With regard to firm capital structure, the Theorem opened a literature on the fundamental nature of debt versus equity. Are debt and equity distinct forms of capital? Why and in what specific ways? In order to answer these questions about the nature of capital, the optimal contract literature examines debt and equity as financial contracts that arise optimally in response to particular market frictions, when contracting possibilities

are complete or incomplete. Complete contracts can be written on all states if this is optimal; incomplete contracts cannot depend on some states of nature.

In one of the earliest contributions, Townsend (1979) combines elements of imperfect information and bankruptcy costs to examine the nature of debt in a complete contracting environment. In his costly state verification model, debt is an optimal response to costly monitoring and differential information: All agents know ex-ante the distribution of firm returns, but only the firm privately and costlessly observes the return ex-post. The lender can acquire this information, but must irrevocably commit to pay a deadweight verification cost. Townsend shows that debt is optimal because it minimizes this cost. When the firm makes the required fixed debt repayment, no cost is incurred. Only when the firm is insolvent, and hence cannot repay its debt fully, does verification occur. Townsend interprets this as costly bankruptcy (liquidation): the firm is shut down; firm assets are seized by a “court,” which verifies their magnitude and transfers the residual to the lender, net of the verification cost. Lacker and Weinberg (1989) extend the approach by specifying conditions under which equity is optimal in an analogue of the model, costly state falsification. Neither debt nor equity is ex-post efficient in this class of models because no agent wishes to request costly intervention, and incur the deadweight cost, ex-post. Agents know that bankruptcy occurs only when the firm is truly unable to repay due to a low realization, but they are implicitly assumed to be committed to the decisions they made ex-ante. Otherwise, debt is no longer optimal.

Krasa and Villamil (2000) show that a firm-lender investment problem with multiple stages, costly enforcement, limited commitment and an explicit enforcement decision, can illuminate debt’s distinct properties. The analysis also solves the ex-post inefficiency problem in the costly state verification model. Agents write a contract in the initial period, knowing only the distribution of project returns. The contract specifies payments and when enforcement will occur, and can be altered if agents receive new information. In the next period, the borrower privately observes the return and can make the unenforceable payment specified in the original contract or propose an alternative payment (i.e., renegotiate). In the final stage the investor can seek costly enforcement of the contractually specified payment or renegotiate enforcement. The opportunity to renegotiate is important because it introduces a new source of information: Any positive renegotiation payment by the firm would reveal information to the investor about the firm’s state. Debt is optimal because it minimizes information revelation. Renegotiation, which imposes a constraint on the contract problem, is only relevant when an agent acquires new information and can use the information to alter the initial contract. Debt weakens agents’ incentive to renegotiate by minimizing information revelation (a fixed face value reveals no information about the firm). The contract is ex-post efficient because all decisions are chosen optimally as part of a Perfect Bayesian Nash Equilibrium. This minimal information revelation of debt stands in sharp contrast to the active information revelation in signaling models of equity. For example, in Leland and Pyle (1977) retained equity by a firm signals a profit increase sufficient to offset the owner’s foregone diversification. In Myers and Majluf (1984), issuing equity signals bad news – owners with inside information sell shares when markets overvalue them. These

signaling models leave open why a firm would use financial decisions to reveal information, a problem that does not arise in Krasa and Villamil.

In incomplete contracting models, control rights are an alternative justification for debt and equity contracts. Aghion and Bolton (1992) view debt as a particular assignment of control rights with important incentive properties. They show that when contracting possibilities are exogenously incomplete and control rights are assigned entirely to the investor or the firm, the first best contract cannot be implemented. If the investor has sole control, the investor may force the firm to expand to a sub-optimal level. Alternatively, if the firm has sole control it may not liquidate optimally. Aghion and Bolton show that, under some conditions, debt is the optimal contract because it assigns control to the firm in good states but to the investor in bad states. This ensures that optimal decisions are made in solvency and default states. Zender (1991) extends the model to include both debt and equity contracts. Grossman and Hart (1988) and Harris and Raviv (1988) examine control in the context of voting rights. They focus on the “one vote per share” property of equity and majority voting, showing circumstances under which equity is optimal and when other “extreme securities” are optimal.

Instead of focusing on the properties of debt and equity per se, Allen and Gale (1988, 1992) examine the properties of optimal securities more broadly – financial innovation. They study the problem of a firm that can issue securities in a market where the transactions cost of issuing securities makes the market incomplete. Market structure is endogenous, in the sense that because firms choose the securities they issue, this determines the transaction costs they incur. Allen and Gale (1988) prohibit short sales and show that neither debt nor equity is optimal. In contrast Allen and Gale (1992) permit unlimited short sales, and show by example that debt and equity can be optimal. They note that the example is a special case; in general their model predicts that optimal securities are much more complex than those typically observed. The debt-equity puzzle unleashed by Modigliani and Miller continues to be an active area of research. The common theme of both the complete and incomplete contracting literatures is that debt, equity, and hybrid securities arise endogenously to overcome frictions in capital markets. Debt and equity have unique properties that resolve these frictions.

The Modigliani and Miller (1961) and Miller (1977) result that firm value is independent of dividend policy has also been examined extensively. Bhattacharya (1979) and others show that firm dividend policy can be a costly device to signal a firm’s state, and hence relevant, in a class of models with: (i) asymmetric information about stochastic firm earnings; (ii) shareholder liquidity (a need to sell makes firm valuation relevant); and (iii) deadweight costs (to pay dividends, refinance cash flow shocks or cover under-investment). In a separating equilibrium, only firms with high anticipated earnings pay high dividends, thus signaling their prospects to the stock market. As in other costly signaling models, why a firm would use financial decisions to reveal information, rather than direct disclosure, must be addressed. As previously, taxes are another important friction which effect dividend policy (e.g., see Allen, Bernardo and Welch (2000)).

Finally, Miller and Upton (1976) show that firms are indifferent between leasing and buying capital, except when they face different tax rates. Meyers, Dill and Bautista (1976) develop a formula to evaluate the lease versus buy decision, where different tax rates across firms create different discount rates. They show it is optimal for low tax rate, and hence high discount rate firms, to lease. Alchian and Demsetz (1972) show that leasing involves agency costs due to the separation of ownership and control of capital; a lessee may not have the same incentive as an owner to properly use or maintain the capital. Coase (1972) and Bulow (1986) argue that a durable goods monopolist may lease in order to avoid time inconsistency, and Hendel and Lizzari (1999, 2002) show that it may lease to reduce competition or adverse selection in secondary (used goods) markets. Eisfeldt and Rampini (2005) show that leasing has a repossession advantage relative to buying via secured lending. They trade off the benefit of this enforcement advantage against the cost of the standard ownership versus control agency problem.

In addition to these specific advances in financial structure, an essential part of Modigliani and Miller's innovation was to put agents on equal footing. They, and others, then asked – what types of frictions would cause agents to have different market opportunities, information sets or commitment frictions? This perspective, which was novel at the time, has been used productively to analyze problems in monetary economics, public finance, international economics, and a number of other applications. In summary, the most profound and lasting impacts of the Modigliani-Miller Theorem have been this notion of “even footedness” and the systematic investigation of the Theorem's assumptions. The approach has motivated decades of research in economics and finance in a search for what *is* relevant in a host of economic problems (between borrowers and lenders, governments and citizens, and countries). As Miller (1988) said, “Showing what doesn't matter can also show, by implication, what does.”

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