

## **Modigliani, the Modigliani-Miller Theorem, and Macroeconomics<sup>1</sup>**

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It is a great pleasure for me to be here on this occasion to honor the memory of Franco Modigliani. My fond remembrances of Franco Modigliani stretch from my days as a graduate student at MIT from 1963 to 1965, to my more recent encounters in Rome and Washington, D.C. Throughout that span of 40 years, Franco was an inspiration: he maintained an intellectual liveliness and depth, personal warmth and charm, and a political commitment that was unparalleled. Franco got excited by his ideas—and deservedly so—and he conveyed that excitement to everyone that he encountered. In an academic world where too often the official stance is ponderous—every idea has to be appropriately qualified, footnoted, its intellectual origins meticulously traced, its implications guardedly and cautiously put forward—Franco was unabashedly enthusiastic, an enthusiasm which was contagious. Franco never lost his youth.

In the spring of 2003, Franco traveled from Boston to Washington to be on a panel to discuss Bush's proposed tax cuts. His devotion to the well being of America, which he rightly felt would be hurt by these tax cuts motivated him to undertake the arduous journey, in spite of his health. He was outraged by Bush's proposals. But it was with humor and the force of argument that he made his attack: he pointed out, for instance, the intergenerational distributional effects, and though those of his generation might benefit, the tax cuts were still a bad thing.

Not long before that, I was on a panel with Franco in Rome, discussing the reforms in Social Security in Italy, a subject which had been one of his passions. It gave me such pleasure to see the reverence and esteem with which Franco was held in Italy. More than

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any other person, his thinking had helped shape the debates over social security reform there and elsewhere throughout the world.

My topic this afternoon, however, is concerned with Franco's impact on the development of macro-economics. His most noted contribution, of course, was the life-cycle model of savings<sup>2</sup>, which a half century after he formulated it, remains a mainstay of macro-economic analysis. But I want to focus on the *indirect* contribution that he exerted on macro-economics through his pioneering work with Merton Miller on corporate finance.<sup>3</sup>

### *The Modigliani-Miller Theorem*

One of the strictures of modern macro-economics is that it must be based on solid micro-foundations. The cost of capital is, of course, the central determinant of the level of investment. With most investment occurring within corporations, it is necessary to assess the cost of capital for corporations, and this has been—and to a large extent remains—a subject of enormous confusion. Certainly, the return to equity appears different from the return to bonds. Which is the relevant cost? Does it depend on how the firm actually finances its investment?

The startling conclusion of Modigliani and Miller was that corporate financial policy *made no difference*; the value of the firm was independent of how it was financed. An immediate corollary was that the cost of capital did not depend on how the firm was financed.

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<sup>2</sup> Modigliani, F. & Brumberg, R. (1954): Utility analysis and the consumption function: An interpretation of cross-section data. In: Kurihara, K.K (ed.): Post-Keynesian Economics. New Brunswick, NJ: Rutgers University Press.

<sup>3</sup> See Miller, M. H. and Modigliani, F. "The Cost of Capital, Corporation Finance and the Theory of Investment." The American Economic Review, Vol. 48, No. 3. June 1958. pp. 261-297.

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Like most classic papers, not only was their result a breakthrough, but so too was the analysis. By introducing the concept of risk classes, they provided a method by which one could analyze the competitive equilibrium of a market economy where the returns to firms were risky, but in which there was not a complete set of Arrow Debreu securities.

And yet, the underlying intuition behind the paper was remarkably simple. After reading it, one could not help but ask: why hadn't we all seen that before.

The paper was a great paper for another reason: it made one think. It ran counter to widespread beliefs, including much of what was taught at business schools throughout the world in courses in corporate finance. Thousands of people were working in Wall Street on corporate finance. They thought they were doing something. Modigliani had seemingly shown that they didn't know what they were doing. To be sure, Modigliani and Miller had pointed out that differential tax treatment of debt and equity meant that corporate financial policy did matter; but these Wall Street corporate financial experts were not just looking at how they could minimize taxes.

One of my first papers, largely written while I was still at M.I.T., involved a re-examination of the Modigliani-Miller theorem.<sup>4</sup> I have to admit that I began with the suspicion that something was wrong with the theorem—could all of these people making their living designing corporate financial policies be that confused? Or had Modigliani and Miller left out something important?

### *The Modigliani Miller Theorem in Retrospect*

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<sup>4</sup> Stiglitz, J. E. "A Re-Examination of the Modigliani-Miller Theorem." *American Economic Review*, 59(5), December 1969, pp. 784-793 and J. E. Stiglitz, "On the Irrelevance of Corporate Financial Policy," *American Economic Review*, 64(6), December 1974, pp. 851-866.

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As I worked on the problem, the first result was to show that the Modigliani-Miller theorem was far stronger than they had realized. I showed one could dispense with the assumption of risk classes. The result was a very general, general equilibrium result. If there was a general equilibrium with a particular firm having a particular debt equity ratio, there was another general equilibrium with that firm having a different debt equity ratio—but with the value of the firm being the same.

This line of reasoning inspired by Modigliani and Miller led me to a generalization for the economy as a whole.<sup>5</sup> If there was a general equilibrium with the government having a particular financial policy (defined by taxes and borrowing of different maturity), then there was another general equilibrium with the government having any other financial policy, with all *real* variables completely unaffected. The same reasoning that said that corporate financial policy did not matter also said that public financial policy did not matter.

But of course, most economists—including Franco—believed that the size of the public debt does matter, as discussions concerning the current growing debt of the United States illustrate.

The fact that this line of reasoning had led to further results that seemed implausible reinforced my conviction that something important was being left out of the model. Subsequent work focused on three factors.

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<sup>5</sup> Stiglitz, J.E (1983), “On the Relevance or Irrelevance of Public Financial Policy: Indexation, Price Rigidities and Optimal Monetary Policy,” in *Inflation, Debt and Indexation*, R. Dornbusch and M. Simonsen (eds.), MIT Press, pp. 183-222 and “On the Relevance or Irrelevance of Public Financial Policy,” in *The Economics of Public Debt*, Proceedings of the 1986 International Economics Association Meeting, London: Macmillan Press, 1988, pp. 4-76.

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The first was one that Modigliani and Miller had raised—taxes<sup>6</sup>—but the analysis of the implications of taxation for corporate financial policy turned out to be far more complicated than they had originally envisioned. One needed to look simultaneously at corporate and individual taxes; and one needed to recognize that there were tax implications of *adjusting* the debt equity ratio; that is, if a firm had a low debt equity ratio, say because it had received some windfall profits, even if debt received favorable tax treatment, distributing the earnings to shareholders had tax implications—which might more than offset the advantages that would come from a higher debt equity ratio. History mattered. Firms that had had large windfall profits might wind up with a low debt equity ratio, while other firms (which from the current perspective looked quite similar) which had not had these windfall profits might have a high debt equity ratio. Both firms were rational, profit-maximizing enterprises.<sup>7</sup>

The second was bankruptcy. Bankruptcy was a subject discussed in law school, or among old fashioned institutional economists. But at the time, it was not part of standard economic theory. But increasing the debt equity ratio, or at least increasing it enough, would increase the probability of bankruptcy. And if there were costs to bankruptcy, then this put an important qualification on the Modigliani-Miller theorem—corporate financial policy made no difference only so long as the debt equity ratio remained sufficiently low that there was a zero probability of bankruptcy.<sup>8</sup>

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<sup>6</sup> Modigliani, F. and M.H. Miller (1963), "Corporate Income Taxes and the Cost of Capital: A Correction," *American Economic Review*, 53(3), June, pp. 433-443.

<sup>7</sup> See J. E. Stiglitz. "Taxation, Corporate Financial Policy and the Cost of Capital," *Journal of Public Economics*, 2, February 1973, pp. 1-34 and J. E. Stiglitz, "The Corporation Tax," *Journal of Public Economics*, 5, April-May 1976, pp. 303-311.

<sup>8</sup> See J. E. Stiglitz, "Some Aspects of the Pure Theory of Corporate Finance: Bankruptcies and Takeovers," *Bell Journal of Economist*, 3(2), Autumn 1972, pp. 458-482; and J. E. Stiglitz, "A Re-Examination of the Modigliani-Miller Theorem." *Op. cit.*

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The third was information. Decisions about financing affect the value of the firm, because they convey information.<sup>9</sup> The willingness of existing managers/owners of a firm to sell their equity claims to others conveys information that (on average) the owners of the firm think the market has overvalued their shares. Such actions, accordingly, lead to a lowering of the price of shares. The financial structure of the firm can also affect incentives. In short, the financial structure of the firm *does* matter, after all.

Moreover, Stiglitz and Weiss<sup>10</sup> showed that with imperfect information, there can be credit rationing. Firms may not be able to borrow as much as they would like. The amount a firm can borrow—and hence the amount it may be able to invest—will depend on the size of the firm’s equity. A firm may not want to increase its indebtedness, even if doing so had tax advantages, because doing so exposed the firm to the risk that it could not undertake high return investments in some subsequent period. Thus, the possibility of credit rationing in the future has an affect on firm behavior today.

### *The impact of the Modigliani Miller Theorem on Macro-economics: investment behavior*

It was, however, to be a decade and a half before all of these limitations of the Modigliani-Miller theorem came to be understood. In the meantime, the power of the idea captured macro-economists attempting to provide more rigorous foundations for the analysis of investment behavior. In one of the earliest econometric studies of investment,

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<sup>9</sup> See Ross, S. (1977), “The Determination of Financial Structure: The Incentive Signaling Approach,” *Bell Journal of Economics*, 8(1), Spring, pp. 23-40; and Majluf, N. and S.C. Myers (1984), “Corporate Financing and Investment Decisions When Firms Have Information that Investors Do Not Have,” *Journal of Financial Economics* 13, pp. 187-221; J. E. Stiglitz, “Information and Capital Markets,” In *Financial Economics: Essays in Honor of Paul Cootner*, William F. Sharpe and Cathryn Cootner (eds.), Prentice Hall, New Jersey, 1982, pp. 118-158; and B. Greenwald, J. E. Stiglitz, and A. Weiss, “Informational Imperfections in the Capital Markets and Macroeconomic Fluctuations”, *American Economic Review*, 74(2), May 1984, pp. 194-199.

<sup>10</sup> See Stiglitz, J.E. and A. Weiss (1981), “Credit Rationing in Markets with Imperfect Information,” *American Economic Review* 71(3), June, pp. 393-410.

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Meyer and Kuh<sup>11</sup> had shown that profits and cash flow were important determinants of investment. But under neoclassical doctrines, this could not be so. Investment was (according to neoclassical doctrines) determined by *expected* returns; capital market imperfections did not exist, implying that variables like cash flow and firm net worth *had* to be irrelevant; and the Modigliani-Miller theorem meant that one did not have to pay attention to how investment was financed. The Hall-Jorgenson Neoclassical Investment Function<sup>12</sup> (and a number of variants) swept the profession. Since cash flow, by assumption, could not matter, it was viewed to be wrong even to test the possibility that it might matter. If it showed up, it clearly was a surrogate for something else, such as future returns that had been imperfectly and inadequately measured.

### *Post-Modern Investment Theory*

Ironically, in the enthusiasm for theoretically rigorous foundations for investment theory, econometric analyses typically mis-specified the cost of capital. While in the absence of taxation, financial structure did not matter, with taxation it did. The calculated after tax cost of equity capital appeared to be different from the after tax cost of debt. This, by itself, should have alerted economists to a problem: depending on which was lower, firms should be financed either by debt or by equity. But, putting aside such theoretical niceties (curious, given that the underlying justification of the approach was its theoretical grounding), the cost of capital was taken to be a weighted average. The “story” told was that debt was cheaper, but there were limits to the debt equity ratio. But this, of course, was totally inconsistent with the spirit of the Modigliani-Miller theorem.

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<sup>11</sup> See Meyer, J.R., and E. Kuh (1957), “The Investment Decision,” Cambridge, MA: Harvard University Press.

<sup>12</sup> See Jorgenson, D. (1963), “Capital Theory and Investment,” *American Economic Review*, Papers and Proceedings, 53(2), May, pp. 247-259; and Hall, R. and D. Jorgenson (1967), “Tax Policy and Investment Behavior,” *American Economic Review* 57, June, pp. 391–414.

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What is relevant for investment (in the neoclassical models) is the *marginal* cost of capital. In a world with perfect capital markets, firms can surely finance their investment at the margin by debt, and since interest payments on debt are tax deductible, there is no distortion, at the margin, in the investment decision as a result of the corporate income tax.<sup>13</sup>

But, of course, capital markets are imperfect—for reasons explained above. The financial structure of the firm does make a difference. One cannot cavalierly simply take the average cost of capital to be the marginal cost of capital. Assume, for instance, that because of signaling problems, it is too expensive for the firm to raise funds by issuing new equity; the firm acts as if it is equity constrained.<sup>14</sup>

On the other hand, assume that the firm faces equity and credit rationing. Then changes in the *average* tax rate affect the availability of funds for investment—and hence the level of investment. It is not just the marginal tax rate that matters. Indeed, in the case described, it is *only* the average tax rate that matters.

By contrast, for a risk neutral firm unconcerned about the risk of bankruptcy, which is not credit constrained (either today or the future), neither the average nor the marginal tax rate matters, for reasons we have already explained. The corporate income tax is an *infra-marginal* tax, and is thus completely non-distorting.

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<sup>13</sup> That is, with a single tax rate, the after-tax marginal returns are  $(1-t)$  times the before tax returns, and the after tax marginal costs are  $(1-t)$  times the before tax costs, so marginal returns equal marginal costs *at exactly the same level of investment as before taxes were imposed*.

<sup>14</sup> See Greenwald, B., J.E. Stiglitz, and A. Weiss (1984), “Informational Imperfections in the Capital Markets and Macroeconomic Fluctuations,” *American Economic Review* 74(2), May, pp. 194-199..



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On the other hand, if the firm is risk averse (and the general theory of imperfect information explains why firms should act in a risk averse manner) then *both* the average and the marginal tax rates matter; for in deciding on how much to invest, the firm calculates the increased expected bankruptcy costs (the cost of bankruptcy times the increase in the probability of bankruptcy). The probability of bankruptcy is affected by the average tax rate, while the *marginal* bankruptcy probability is affected by both the average and marginal tax rates.<sup>15</sup>

### *Implications for the consequences of a dividend tax cut*

Though it is a slight digression from the major theme of this paper, I cannot help but comment on the implications of a dividend tax cut, which both Franco and I railed against in the meeting in Washington mentioned a little earlier. We had claimed that the argument that the dividend tax cut would stimulate investment was faulty. There were two parts of the argument of the proponents: first, it would increase share prices; and secondly, the increase in share prices would lead to increased investment. The notion that an increase in share prices would lead to an increase in investment, it seemed to me, was dubious, for the same reason that lowering of interest rates had had little effect on investment. There was excess capacity; with 97% of fiber optics having yet had to see any light, it did not seem plausible that a slight increase in the market price of shares of fiber optic companies, should it occur, would lead to any increase in investment in fiber optics. More generally, the evidence for Tobin's  $q$ —the notion that share prices have large effects on corporate investment—is weak at best.

But my real reservations were directed at the notion that a dividend tax cut would lead to a significant increase in share prices. I noted that (a) the increased government

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<sup>15</sup> See Greenwald, B. and J.E. Stiglitz (1990), "Asymmetric Information and the New Theory of the Firm: Financial Constraints and Risk Behavior," *American Economic Review* 80(2), May, pp. 160–65.

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indebtedness as a result of the tax cut could quite likely lead to higher long term interest rates, and this would lead to a fall in share prices (other things being equal); (b) most individuals in the United States held most of their stocks in pension funds, IRA accounts, and other forms in which the dividends were already exempt from taxation; hence, if there was a positive effect, it would likely be small; (c) the firms whose share prices would be affected by a temporary dividend tax cut were those that were paying dividends over the period of the tax cut, i.e. mature firms with sufficient cash on hand, for which higher share prices did not yield much benefit since they had no need to raise new capital.<sup>16</sup> On the other hand, young firms, which were presumably more in need of new capital, would not experience any significant increase in share prices from a temporary dividend tax cut, since the time when they would pay dividends was far in the future, largely after the expiration of the tax cut. In a nutshell, those firms whose share prices increased did not need new equity, and those for which new equity would come in handy would not see any effect of the dividend tax cut on their share prices.

But as I reflected more on the issue, working with a Columbia graduate student, Anton Korinek, it became clear that a dividend tax cut might actually lead to a reduction in investment.<sup>17</sup> The reason is simple: if firms believe that the dividend tax cut may be temporary, they will want to distribute profits while the dividend tax is low. This means that they will be less liquid (hold less cash, have a higher debt equity ratio) than they would have been had the dividend tax not been cut. Hence, when a good investment opportunity comes along, equity and credit constrained firms will engage in less investment. Share prices, after the temporary dividend tax cut, may be higher than they

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<sup>16</sup> One of the insights of the earlier cited work on taxation and the corporate finance was that round trips were expensive: it made no sense for firms to simultaneously pay out dividends and raise new revenues on capital markets. In those earlier papers, I had argued that any tax analysis had to integrate the effects of both the individual and corporate income tax. Dividend pay-outs forced individuals to have to pay an individual income tax on the dividends. Though the foolishness of sending money back to the individual—after which he sends it back to the firm—is most patent in the case of the representative agent model, our analysis showed that similar results held even when the firms receiving the dividend were different from those financing the new investment.

<sup>17</sup> See Korinek, A. and J.E. Stiglitz (2005), “Dividend Taxation and Capital-Constrained Firms,” Columbia University, mimeo.

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otherwise would have been, and yet investment may go lower than it otherwise would have been. Our analysis makes clear that a fully dynamic analysis of investment has to incorporate assumptions not only about taxes today, but also beliefs about taxes in the future.

### *Throwing off the shackles of misguided theory*

Interestingly, *after* the new information economics pointed out that *theory* implied that both net worth and cash flow could affect investment, then it once again became permissible to add these variables in well-specified econometric investment functions; and when that was done, they often turned out to be significant.<sup>18</sup> At least for small and medium sized firms, financial constraints do matter; and since variability in investment by small and medium sized firms seems to play an important role in macro-economic fluctuations, these constraints in turn play an important role in economic variability.

Indeed, these financial constraints allowed us finally to make sense of Samuelson's famous multiplier-accelerator model.<sup>19</sup> The accelerator had long been discredited, not just because the model seemed to be based on a rigid capital output ratio. The underlying investment function was not forward looking, in the way that neoclassical economics taught us it should be. In the multiplier accelerator model, current investment depended on current increases in output.

But in these capital constrained models, there was a *financial accelerator*; higher levels of profits today *allowed* firms to increase their investment, and this stimulated the

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<sup>18</sup> See, as one example of the large literature, Fazzari, S.M., R.G. Hubbard, and B.C. Petersen (1988), "Financing Constraints and Corporate Investment," *Brookings Papers on Economic Activity* 1988(1), pp. 141-195.

<sup>19</sup> See Samuelson P.A. (1939), "Interaction between the multiplier analysis and the principle of acceleration," *Review of Economic Studies* 21, pp. 75-78.

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economy. As Greenwald and I showed, this meant that shocks to the economy could be amplified, and that their effects could persist.<sup>20</sup>

It was thus through this circuitous route that Modigliani's work in corporate finance had come to have a large and persistent effect on modern Macro-economics. Rigorous reasoning led to disquieting results, which forced a re-examination of the foundations of corporate finance. And the re-examination of the foundations of corporate finance finally let us to understand cyclical movements in investment.

Franco always believed that theory should be grounded in reality. Neoclassical theory—ungrounded in reality--led the economics profession astray. But it was economic theory *grounded in the realities of imperfect and asymmetric information and the possibilities of bankruptcy* that finally led to an understanding of the real determinants of investment behavior. I think Franco would be pleased to see how his theory helped reground modern macro-economics.

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<sup>20</sup> Greenwald, B. and J.E. Stiglitz (1993), "Financial Market Imperfections and Business Cycles," *Quarterly Journal of Economics* 108(1), February, pp. 77–114.