

# Merton Miller and modern finance

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## Abstract

In this keynote address to the 2000 Financial Management Association Meetings, I consider Merton Miller's contributions to the field of finance. I argue that his most important contribution is to have made arbitrage arguments the cornerstone of modern finance. The arbitrage proof of Proposition I introduced a new standard in finance, namely that any result the finance profession takes seriously must have the critical property that it cannot be undermined by clever arbitrageurs. I show how arbitrage is a constant theme in Merton Miller's career from his work in corporate finance to his analyses of financial innovation, financial crashes, and crises.

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Most of us learned first about how much finance owes to Merton Miller in our Ph.D. studies. I was lucky to be a Ph.D. student at MIT in the late 1970s. Throughout my studies, Merton Miller seemed omnipresent in the courses I took and in his influence on everybody connected with finance. He defined the field and shaped it by his actions. When we talked about the Black-Scholes formula, Merton Miller had played an important role in getting the paper published after it had been turned down by two journals. He had taken Fischer Black, who was then at MIT, from his work as a consultant to make him a full professor at the University of Chicago. In Robert Merton's asset pricing course, we learned that Merton Miller had defined the rules for empirical tests of the capital asset pricing model in his critique of the Douglas study with Myron Scholes. In Stewart Myers' corporate finance course, we obviously talked about the Modigliani-Miller papers, but at that time corporate finance's attention was turned to Merton Miller's address as president of the American Finance Association. Even in monetary economics courses, he was there in full force with one of his most beautiful papers, the Miller and Upton model of the demand for money.

For the twenty years after I received my Ph.D., finance was a field young enough that most of its founding fathers were active and still influencing its development. At the center of these founding fathers stood Merton Miller. For many people in finance, he played a key role in their career. Obviously, this was the case for the large number of Ph.D. students whose dissertation he supervised. Many of these students became stars in our profession - one received a Nobel prize. However, besides his students, he had a direct impact on many careers. Even though I never took a course from him, he was one of my most important finance teachers. I spent one year at the University of Chicago. I discovered early in that year that I could learn a lot of finance by joining Merton Miller's lunch group at the faculty club. In addition to

learning finance, I learned about all sorts of other things, because he was always fascinating. He was an important reason why I became editor of the **Journal of Finance** and he never stopped helping me during my years as editor. Even when his influence was not direct and personal, it was never possible to do much in finance without being reminded of his contributions and of his presence. He was always there, trying to push forward the field that he had played such a key role in creating. Nobody else deployed such energy and skills in advancing our profession. Even in his last stay at the hospital, he was still concerned about mistakes he thought were being made that he had to correct. At that point, he had finished the first draft of a paper and was waiting to go back home to finish it and submit it to a journal.

We can list many reasons why Merton Miller was so important to our field, but his contribution to our field transcends the list of his accomplishments. He was unique, and so we have to focus on why he was so unique. If we had to remember one thing about Merton Miller's contribution to finance, what would it be? Many financial economists are likely to answer that question by saying that we should remember the irrelevance propositions. I am going to start with a discussion of these propositions, but my purpose in doing so is to convince you that, even though any finance academic would be thrilled to have produced any one of these results, we should not think that Merton Miller's most important contribution to our field consists of the propositions themselves. To make my case, I will only talk about the first Modigliani and Miller paper. The most important result of the paper is the famed Proposition I which states that "the market value of any firm is independent of its capital structure and is given by capitalizing its expected return at the rate (...) appropriate to its class."

It is ironic that this leverage irrelevance result is what many may want to remember from Merton Miller. After all, Modigliani and Miller themselves write in the paper that "A number of writers have stated

close equivalents of our Proposition I...” They then cite works by Williams, Durand, and Morton in a footnote. Further, financial economists generally do not view Proposition I as a statement of the role of leverage in the real world - especially not for high levels of leverage. Proposition I is derived using the assumption that cash flows are unaffected by capital structure. Much of the literature in corporate finance since then has focused empirically and theoretically on whether investors’ expectations about cash flows and cash flows themselves are affected by capital structure. Work in the 1970s, including Merton Miller’s best book, the **Theory of Finance** with Eugene Fama, made clear the conditions that must be met for cash flows not to be affected by a firm’s capital structure. At the very least, however, the consensus among financial economists is that often capital structure does affect the present value of cash flows.

So, if the leverage irrelevance proposition is not the most important contribution that we should remember from the paper, what is? What makes Proposition I memorable and changed finance is not the Proposition itself but its proof. The other authors did not have the proof. Remember how the proof works. Modigliani and Miller assume that financial markets are perfect, so that there are no frictions whatsoever, and that the firm’s cash flow is independent of its capital structure. They then show that “if Proposition I did not hold, an investor could buy and sell stocks and bonds in such a way as to exchange one income stream for another stream, identical in all relevant respects but selling at a lower price. The exchange would therefore be advantageous to the investor quite independently of his attitudes toward risk. As investors exploit these arbitrage opportunities, the value of the overpriced shares will fall and that of the underpriced shares will rise, thereby tending to eliminate the discrepancy between the market values of the firms.” (Modigliani and Miller (1958), p. 269).

I would like to submit that it is the idea of arbitrage that is at the center of Merton Miller’s career

and of his contributions to our field. The arbitrage mechanism is how Merton Miller thought about finance phenomena. Results that would lead to arbitrage opportunities could not possibly be important because market forces would step in to make prices right. Fischer Black called Merton Miller a “warrior,”<sup>1</sup> and he certainly was, but he was a “warrior” who always fought to make sure that market forces would be allowed to play their role and that we in finance would not be misled by a poor understanding of these forces. In the remainder of this address, I first consider how the idea of arbitrage has affected the development of finance. I then turn to the role of arbitrage as the cornerstone of modern corporate finance. Merton Miller was always passionate in his defense of market efficiency and arbitrage played a key role in his thinking about market efficiency. I therefore consider the relation between market efficiency and arbitrage in the third part of my address. I finally turn to how liquidity and regulation affect arbitrage in the last section.

## **1. Arbitrage in the history of finance.**

When Modigliani and Miller wrote their paper, there already was a powerful arbitrage argument in the economics literature. In international finance, academics and practitioners knew how to price forward currency contracts by arbitrage. Modigliani and Miller did not, therefore, invent arbitrage. To prove the interest rate parity theorem, we take a position in a risk-free asset and a forward contract to create a foreign currency synthetic risk-free asset. That synthetic foreign currency risk-free asset must then sell for the same price as the foreign currency risk-free asset. The proof of the irrelevance proposition is on a different intellectual plane from the arbitrage argument used in international finance. With the interest rate

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<sup>1</sup> See Fischer Black’s “Foreword” to Miller (1991a).

parity theorem, one uses securities that exist and are risk-free in their respective numéraires. With the irrelevance proposition, the argument proceeds with the assumption that there are firms in a similar risk class. More precisely, there are firms whose assets have proportional - perfectly correlated - returns. Hence, one does not start from existing risk-free securities that are easily identifiable in markets, but instead derives a relation between the present values of two hypothetical risky cash flow streams.

The Modigliani-Miller paper did not spend time telling us why it would be reasonable to assume that there would always be firms in a given risk class that would enable investors to arbitrage away differences in valuations between levered and unlevered firms. Instead, the paper went straight to provide empirical evidence supporting the leverage irrelevance proposition. The Modigliani-Miller paper generated an avalanche of comments and the **American Economic Review** published a number of them. The theoretical comment that is probably best remembered is the one by Durand, who was a professor at MIT at the time. His comment discusses in detail obstacles to arbitrage and helped clarify the Propositions. Durand's position was that the Propositions were right, but he quickly added "in their own properly limited theoretical context." (Durand (1959), p. 640). His quarrel was with the relevance of the assumptions that made possible the arbitrage proof of Proposition I. In particular, his comment points out the various obstacles to homemade leverage. He pays a great deal of attention to the restrictions on margin buying.

Merton Miller never argued that there were no frictions. Rather, what justifies focusing on the leverage irrelevance result is that it describes "the central tendency around which observations scatter" (Modigliani and Miller (1958), p. 281). In other words, the Modigliani-Miller Propositions tell us what we should expect to see when we abstract from the frictions of the real world if these frictions just create noise. In contrast, Durand was skeptical about equilibrium results. In his comment, he talks about "those of us

who doubt the existence of equilibria.” (Durand (1959), p. 644). He wanted instead to argue that these results were not relevant because they were built on assumptions that were too far removed from the real world. The key assumptions of Modigliani and Miller have been used over and over in our field not because we think that they hold, but because we think that they allow us to make predictions and that our results ought to be judged not by the assumptions that lead to them but by the usefulness of the results in explaining empirical phenomena. This view of research, often associated with Milton Friedman in economics, was not the view of research in finance before the Modigliani-Miller papers. It became the approach to building their field financial economists adopted as a result of these papers and of the controversies associated with them.

A major theme of Durand’s paper is that Modigliani and Miller “have underestimated the difficulty of setting up an equivalent return class, which is the cornerstone of their theory.” (p. 653). He then goes on arguing that “The concept of an equivalent return class, derived from notions of static equilibrium, is not adaptable to a highly dynamic economy...” (p. 654). Little did he or anybody else know that arbitrage arguments of the type introduced by the Modigliani and Miller paper and that the focus on explaining empirical phenomena rather than on the relevance of assumptions would lead to major developments in finance that removed the “difficulty of setting up an equivalent return class.” We learned in the 1960s that if investors care only about the distribution of the return of their wealth and if some other assumptions are made, then in equilibrium changes in the leverage of firms do not affect firm values. The arbitrage portfolio strategies in the Modigliani-Miller paper are static portfolio strategies. If a levered firm sells for more than an unlevered firm, one can make a risk-free profit by selling short the levered firm and buying the unlevered firm. With the discovery of the Black-Scholes formula and the introduction of continuous-time models,

finance added to its tool box dynamic arbitrage strategies. Through trading in perfect markets, we learned that we could form portfolios which would perfectly replicate the payoffs of existing securities. This extension in the arbitrage argument was developed first in the context of option pricing but quickly became used throughout finance to price securities.

The 1958 article explained superbly why arbitrage arguments have contributed so much to the success of finance in pricing securities. In their proof, Modigliani and Miller emphasized that arbitrage is profitable to the one who undertakes it “quite independently of his attitudes towards risk.” (Modigliani and Miller (1958), p. 269). Throughout the years, finance has found it difficult to understand exactly how to measure and price risk for securities. Arbitrage arguments bypass this problem altogether. They lead to a theory of pricing of securities that does not rely on attitudes towards risk. In a world without arbitrage opportunities, we can price securities by discounting their expected payoffs at the risk-free rate as if investors were indifferent towards risk. This approach to pricing securities is now not only one that is present throughout the academic literature but one applied in the business world.

## **2. Arbitrage and corporate finance.**

Though arbitrage arguments are now pervasive throughout finance, the more immediate and direct impact of the arbitrage proof of Proposition I was to provide the foundation for modern corporate finance because it specifies sufficient conditions for leverage not to matter. Because of the proof, we know that if financial markets are perfect, the value of a firm cannot be affected by leverage. As a result, practitioners and academics alike know that if leverage affects value, it must be that some of the assumptions required by the arbitrage proof do not hold. The arbitrage proof assumes a world where contracting is costless, all



parties have the same information, transaction costs do not exist, there are no taxes, there are no limitations to short-sales, and firms and investors take prices as given. Of these assumptions, the absence of taxes was quickly identified as posing substantial difficulties for the result that leverage is irrelevant for firm value in the real world.

In their papers, Modigliani and Miller eliminated once and for all the argument that leverage is costly because it increases the cost the corporation pays for its debt. Their work made clear that an increase in the coupon paid on debt as leverage increases is not a cost of leverage in a world of perfect markets. As leverage increases in a world of perfect markets, the coupon paid on debt increases, but that is because bondholders bear more risk and have to be compensated for this additional risk. This will happen even though the firm's cash flows are unaffected by the additional leverage and hence, as Merton Miller pointed out in his Nobel lecture, the increase in the risk of debt has no social costs because the firm's total risk is unaffected by the change in leverage.<sup>2</sup> However, when looking at the cost of debt, Modigliani and Miller immediately realized that with corporate income taxes, the cost of debt for the firm is the cost after taxes. Since coupon payments are tax deductible, Modigliani and Miller saw that corporate taxes could make leverage valuable. The tax shield of debt with corporate income taxes was large since "the deductibility of interest could amount to a subsidy of as much as fifty cents on each dollar of debt capital raised by the firm."<sup>3</sup>

If the only departure from the assumptions leading to Proposition I is a tax subsidy to corporate debt, one would expect to observe extremely high leverage since extreme leverage would maximize the

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<sup>2</sup> See Miller (1991b).

<sup>3</sup> Miller (1991a), p. 273.

value of the tax subsidy. Empirically, however, leverage is not extreme. In fact, some firms even have negative leverage - they pay more in taxes on securities held than they get to deduct because of paying interest on debt. To make sense of the limited levels of leverage in the presence of what appeared to be a large tax subsidy for debt, finance had to either relax other assumptions leading to Proposition I or conclude that the subsidy was illusory. Initially, the route chosen by finance was to take into account bankruptcy costs. Bankruptcy costs are effectively the outcome of contracting costs - as the firm defaults, the firm cannot be costlessly reorganized. In the presence of bankruptcy costs and tax benefits of debt, each firm has an optimal amount of debt such that the increase in the present value of expected bankruptcy costs resulting from an additional dollar of debt for that firm is exactly equal to the present value of the expected tax benefits from that additional dollar of debt.

Merton Miller was skeptical that expected bankruptcy costs could be large enough to explain why firms did not take advantage of the tax subsidy of debt more. His assessment of the evidence on bankruptcy and financial distress costs was that “neither empirical research nor simple common sense could convincingly sustain these presumed costs of bankruptcy as a sufficient, or even as a major, reason for the failure of so many large, well-managed US corporations to pick up what seemed to be billions upon billions of dollars of potential tax subsidies.” (Miller (1991a), p. 274). This assessment led him to one of his most memorable statements, namely that “the supposed trade-off between tax gains and bankruptcy costs looks suspiciously like the recipe for the fabled horse-and-rabbit stew - one horse and one rabbit.” (Miller (1977), p. 264).

Since direct bankruptcy costs could not explain why firms were not taking advantage of the apparent tax subsidy of debt, finance turned to other explanations for low leverage based on contracting

costs. Jensen and Meckling (1976) showed that, as leverage increases, shareholders become tempted to take advantage of bondholders by increasing the volatility of the firm even if doing so would hurt shareholders if the firm had less leverage. The bondholder-shareholder conflict identified by Jensen and Meckling makes debt more costly because it forces firms to behave inefficiently as a result of leverage or to spend real resources to insure that they will not take advantage of bondholders. Myers (1977) showed that when firms are highly levered, the existing shareholders may choose not to issue equity to finance projects because the new equity will increase the value of the firm's debt at the expense of the value of the equity of the existing shareholders. Myers called this problem the underinvestment problem and identified it as a cost of leverage because firms with high leverage invest less than firms with lower leverage. In a world of perfect markets, neither the underinvestment problem nor the bondholder-shareholder conflict would exist because in a world without contracting costs, the capital structure of the firm can always costlessly be changed to make sure that a firm can take advantage of all profitable investment opportunities and does not invest inefficiently as a result of leverage.

Merton Miller was always skeptical that the bondholder-shareholder conflict or the underinvestment problem could explain why firms did not take greater advantage of the tax shield of debt. Not surprisingly, his skepticism was the result of the role of arbitrage in how he thought about economic phenomena. If the tax shield of debt was so large, why was it that investment bankers would not devise solutions that would enable firms to take advantage of this tax shield and overcome the costs of debt through clever contracting? As always, he wanted a solution to the problem that would not provide clever arbitrageurs with profit opportunities. He pointed out that for bankruptcy costs, debt securities that would avoid these costs already exist and that if these costs were large, one would expect these debt securities to be used much more than

they are. With income bonds, interest has to be paid in any year only if earned, but it is fully tax deductible if paid. This made it hard for Merton Miller to believe that direct bankruptcy costs or the impact of high leverage on investment were the explanation for why firms did not have more debt in the presence of an apparently large tax advantage to debt.

In 1977, Merton Miller revisited the issue of the impact of corporate taxation on the irrelevance propositions in a classic paper titled “Debt and Taxes” that shows perhaps better than any of his other papers how he could use arbitrage arguments to change how finance academics and practitioners understood how the world works. In that paper, he pointed out that the tax advantage of corporate debt might be mostly if not completely illusory. Because interest on corporate debt is taxed as income for the holder of corporate debt, the interest paid on corporate debt must be high enough so that the after-tax income from holding corporate bonds is attractive relative to the income from equity which, when it accrues as capital gains, is taxed at a lower effective rate. As a result, corporations get to deduct from their taxes interest payments but, because personal taxes on interest income are higher than on capital gains, the before-tax cost of capital on debt must be higher than on equity if investors are to hold debt.

In his paper, Merton Miller showed that under specific conditions the leverage irrelevance proposition could hold even in the presence of taxes. In his argument, the tax rate on personal income from bonds is progressive, but there is no income tax on equity income. Bonds are risk-free. There is a demand for bonds which is satisfied by taxable and tax-exempt bonds. Merton Miller shows that in equilibrium the coupon on taxable bonds must be the coupon on tax-exempt bonds grossed-up for taxes at the corporate tax rate. Let  $r_0$  be the tax-exempt rate and  $J_C$  be the corporate income tax rate. With this notation, the interest rate on corporate bonds is  $r_0/(1-J_C)$ . If the interest rate on corporate bonds is say  $r_C > r_0/(1-J_C)$ ,

corporations prefer equity financing since the risk-adjusted cost of equity is  $r_0$  while the cost of debt after tax is  $(1-J_C)r_C > r_0$ . Alternatively, if the interest rate on corporate bonds is lower than  $r_0/(1-J_C)$ , corporations would rather obtain debt financing than equity financing since the after-tax cost of debt is lower than the risk-adjusted cost of equity. As a result, the only feasible equilibrium is the one where the after-tax cost of debt is exactly equal to the after-tax cost of equity. When this equilibrium obtains, no firm has a financial incentive to alter its mix of debt and equity even though interest payments on debt are tax deductible. The “Debt and Taxes” paper led to a large literature investigating whether the leverage irrelevance condition holds in the presence of personal and corporate income taxes. The paper also made clear that the perfect markets assumptions are sufficient conditions for leverage to be irrelevant, but not necessary conditions. Saying that the assumptions required for Proposition I do not hold is not enough to conclude that leverage matters. For leverage to matter for the value of a corporation, it has to be the case that no clever arbitrageurs can make money from such a situation.

### **3. Arbitrage, financial market crashes, and market efficiency.**

In the Modigliani-Miller paper, the arbitrage argument leads to a proposition that describes a “central tendency.” Results based on arbitrage arguments in perfect markets are only relevant as long as one believes that market forces work, so that investors will be able to take sufficient advantage of pricing mistakes that prices will not differ systematically from what they would be if financial markets were perfect. When obstacles are erected to market forces that prevent them from taking advantage of price discrepancies, financial innovations can overcome these obstacles. Merton Miller addressed the topic of

financial innovation in a speech to the Western Finance Association in 1986.<sup>4</sup> In his view, financial innovation was a response to regulatory impediments to the working of market forces. To make his point, he reminded his audience of the role of Milton Friedman in the creation of financial futures. Milton Friedman wanted to speculate on the pound by taking a short position. This was in the early 1970s and, at that time, one could only take a short forward position with a bank. No bank was willing to be Milton Friedman's counterparty. It seemed that banks did not want to be seen by their regulators as promoting currency speculation. This led him to advocate financial futures because on futures markets, it is equally easy to take a short position as it is to take a long position.

Financial economists generally view the flow of funds to take advantage of investment opportunities and financial innovation as positive forces that make markets more efficient, facilitate risk-sharing, and increase economic growth. This view is controversial outside our profession. Many have argued that capital flows and financial innovation lead to instability, crashes, and other disasters. The outcry against financial innovation was particularly virulent after the crash of 1987 and after the spate of derivatives disasters in the mid-1990s. More recently, capital flows came under attack with emerging market crises. In cases where market forces and financial innovations were blamed for problems in financial markets, Merton Miller was there to provide solid economic analysis of the problems and to show that, more often than not, the problems were the results of regulations and government interference.

Portfolio insurance and index arbitrage were widely blamed for the crash of 1987. Merton Miller chaired a blue ribbon commission established by the Chicago exchanges to look into the crash. The

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<sup>4</sup> See Miller (1986).

commission contributed many important points to the debate that took place after the crash. In particular, it argued that the size of portfolio insurance programs was simply too small to explain the events of October 19.<sup>5</sup> The debate surrounding portfolio insurance has been reopened with the publication of a book by Jacobs.<sup>6</sup> He argues that the crash of 1987 occurred because these programs called for a “massive liquidation” in response to the price declines before the week of the crash. In his eyes, the result of this massive liquidation attempt was “a tremendous explosion- selling, understandable reluctance to buy, prices gapping down, investor panic.” Jacobs then argues that “What the participants in these strategies apparently don’t realize is that, as their investments become concentrated, so does their need for liquidity. When they need to get out, they find they are stuck in illiquid positions that can be unwound only at steep discounts.”<sup>7</sup>

Merton Miller never argued that markets should move continuously. In fact, on May 27, 1987, he gave a paper at the Mid-America Institute that was remarkably prescient about the possibility of price gaps.<sup>8</sup> In that paper, he points out that greater liquidity in markets makes it possible for individuals separately to withdraw their capital whenever they want to, but by the nature of equity capital, it is not possible for society to withdraw its investment. Generally, individuals who sell and buy largely balance each other out. At times, however, it is possible for an imbalance to develop where many more individuals want to sell than there are individuals who want to buy. In such a situation, there is a possibility that the buffer

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<sup>5</sup> The final report of the commission is published in Chapter 4 of Miller (1991a).

<sup>6</sup> Jacobs (1999).

<sup>7</sup> The quotes from Jacobs come from 2000 Hall of Fame Roundtable: Portfolio Insurance Revisited, Derivatives Strategy 5, August 2000, pp. 31-36.

<sup>8</sup> See Miller (1991a), Chapter 3.

stocks of the market makers and the resources of liquidity providers will be exhausted. This creates the equivalent of a bank run - those that get to sell first are the lucky winners, while those that come last cannot sell because there are only sellers. He then discusses the implications of his argument for the organization of markets, arguing that it is important to put in place mechanisms that enhance the capacity of exchanges to absorb the demand for transactions. After comparing periods where everybody wants to sell to a brown-out, he concludes that “No economically feasible amount of added capacity will guarantee against any recurrence of market brown-outs of course; but it can at least make them even rarer events.” (Miller (1991a), p. 48).

Though Merton Miller thought that prices might change with dramatic speed because of the limited capacity of financial markets to provide transaction services, he did not think that such price gaps were necessarily evidence of “bubbles” bursting. He pointed out in a keynote address to the Pacific-Basin Finance Association that with low dividend yields, most of the value of a stock resides in cash flows that will accrue a number of years in the future.<sup>9</sup> This implies that small changes in expectations about growth rates, interest rates, or risk premia can lead to large changes in prices. In his example, he starts from a dividend yield of 3%, a discount rate of 10%, and a growth rate of dividends of 7%. With these assumptions, the share price would be worth thirty-three times the current dividend. He then points out that if the growth rate falls to 6.5 percent, a half a percent less, and the discount rate raises to 10.5%, a mere half a percent more, the stock price falls to twenty-five times dividends, or a fall of 24%. With his example, it does not take much to generate a fall in the stock prices of the magnitude of the one that took place on

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<sup>9</sup> See Miller (1991a), chapter 6.



October 19, 1987.

Merton Miller did not pick these numbers because he thought they were the right numbers to plug in Gordon's growth model to explain the crash of 1987. He made it clear that all he was doing was providing a set of numbers that would be consistent with a fundamental explanation of the crash. While a fundamental explanation of the crash is possible, he did not think that we would be able to reject empirically either the hypothesis that the crash was a bursting bubble or that it was a stock price move resulting from a change in fundamentals. His view was that "we are faced with competing theories that can seemingly account for the same facts and we have no way of conducting decisive experiments that can distinguish between them." (Miller (1991a), p. 103). Confronted with this problem, he then went on to a careful discussion of the policy implications of the two views of crashes, concluding that the "wiser and ultimately more conservative policy, even for those who still believe in bubbles, is not to seek to prevent stock market crashes at all costs, but if one does occur, to localize any damage and keep it from spreading to other sectors of the economy." (Miller (1991a), p. 106).

Recently, many financial economists have argued that the high stock prices we have experienced are evidence of a bubble. The recent debates on the level of the stock market have made extensive use of results from a new branch of finance, behavioral finance. For instance, Shiller (2000) uses behavioral models to explain how investors at times could get carried away by theories supporting high stock prices. He points out that the late 1990s were the fourth period this century where people were enthralled by so-called new economy ideas. The first such period was at the turn of the century, the second one was before 1929, and the third in the 1960s. The previous three periods where stock prices increased dramatically fueled by new economy visions did not end well. Though Shiller provides evidence that is supportive of the

view that there was a stock price bubble in the late 1990s, we should remember Merton Miller's cautions. An efficient market is not one that gets things right every time. It is perfectly possible for investors to rationally expect great things from technological progress and be disappointed ex post. We do not have the tools that would permit us to conclude that the markets were wrong - or right - when it turned out that the stock market increases associated with new economy ideas were followed with poor returns.

#### **4. Liquidity, regulation, and arbitrage**

Merton Miller's crisis mechanism is in many ways perfectly consistent with having investors motivated by behavioral considerations that are not outcomes easily understood with the simple utility functions that much of finance typically uses. However, in Merton Miller's world, the forces of arbitrage, broadly understood, eventually prevail. If random or poorly understood actions of a mass of individual investors were to lead them to exit the markets in a hurry, profit opportunities would exist and investors could exploit them, bringing prices back to where they should be. This mechanism presumes that arbitrageurs will always be there in force to prevent overshooting and systematic biases in prices relative to what they should be based on fundamentals alone. How can we be sure that the free fall of October 19, 1987, stopped just where it should have? How can we know that the dramatic emerging markets collapses were not excessive? Perhaps we will never know. Such drops or gaps in markets will not be excessive only if there are enough investors who do not succumb to panic and are not moved by emotions that step in and start buying. This means that such investors have to have enough capital at their disposal.

Recent history makes it relevant to question both whether investor stampedes can take place more easily and whether there is enough arbitrage capital to prevent markets from overshooting when large

numbers of investors stampede in one direction or the other. Investors can make trades faster than they ever could. This is undoubtedly a great benefit for investors and the markets, but at the same time, there is the potential for investors to herd in ways that they never did before. We have seen dramatic reversals in investor sentiment over the last few years. For instance, capital flows to East Asian countries experienced a swing of more than \$100 billion in one year. When such events take place, trades by some group of investors can end up destabilizing markets unless Merton Miller's arbitrageurs can stand up to the herd and take advantage of it. Paradoxically, however, while more arbitrage capital is needed to permit other investors the luxury to exit from the markets at a moment's notice, developments over the last few years show that instead of having more arbitrage capital, we may actually have less and perhaps not enough of it.

Among recent events suggesting that there are limitations to the arbitrage mechanism, the difficulties of Long-Term Capital Management (LTCM) stands out. LTCM was mostly engaged in transactions that would be close to the Modigliani-Miller arbitrage transactions if markets were perfect. A typical example of such a strategy would be to go long in an agency bond and go short in a similar Treasury bond.<sup>10</sup> Bonds issued by government agencies should have yields fairly close to bonds issued by the Treasury. At times, however, the yield of agency bonds is much higher than the yield of comparable Treasury bonds. Assume for a moment that the federal guarantee to the agencies is strong enough that there is no default risk on the agency bonds. In such a situation, a long position in an agency bond trading at par and a short position in a comparable Treasury bond held to maturity earns a positive cash flow for sure in perfect markets since

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<sup>10</sup> The agency bond might have options attached to it that would have to be hedged, but we ignore this complication since it does not affect our conclusion.

the coupon payments of the agency bond exceed the coupon payments of the bonds held short. There would be full use of the proceeds and no transaction costs in perfect markets.

In the real world, there are three difficulties with such an arbitrage transaction that are relevant here. First, there might be some default risk on the agency bond. With a credit derivative, one would be able to construct a default-free synthetic agency bond. Hence, financial engineering removes that obstacle to creating an arbitrage. Second, there would be transaction costs. Transaction costs simply would require that the yield differential between agency and Treasury bonds at which an arbitrage trade becomes profitable is higher than otherwise. Without full use of the proceeds on the short-sale, the investor would have to use some capital to implement the trade which would increase its cost. Finally, and most importantly, this trade would be an arbitrage only if it was sure that it could be held to the bonds' maturity. Remember that at maturity the long position and the short position have exactly the same value since both bonds are at par. However, if a month after the trade is put in place, the yield on agency bonds increases sharply relative to the yield on Treasury bonds, the value of the position becomes negative in that the bond held long falls in value relative to the bond held short. If the position has to be liquidated when its value falls, then the arbitrage is no longer an arbitrage. In a perfect market world, such a situation would not arise or, if it did arise, it would last for only a very short period of time. This is because an increase in yields on agency bonds relative to Treasury bonds would lead to arbitrage trades which would bring the yields closer together. The certainty that arbitrage trades would take place later if arbitrage opportunities arose would therefore make arbitrage trades feasible now. Absent this certainty, an arbitrageur would not know whether he would be able to maintain his position over time since seemingly irrational changes might force a trade to be undone at a loss.

The situation of LTCM in August 1998 is well captured by this simple example of an arbitrage trade. LTCM had positions that were generating positive cash flows with a high degree of certainty, but changes in yield spreads destroyed its net worth through their effect on prices. In perfect markets, two bonds with identical risk should sell for the same price. However, in the real world, investors are concerned about their ability to move out of financial assets quickly. They are willing to pay a premium for more liquid assets and that premium changes as investors' perception of the urgency with which they might want to move into safe assets is heightened. In August 1998, bonds that were paying the same cash flows diverged in value because they differed in how quickly holdings of various sizes could be sold. At least for now, agency bonds are less liquid than Treasury bonds. Their higher yield reflects compensation for the fact that investors wanting to get out of these bonds quickly may have to compensate the buyers for providing liquidity more than with Treasury bonds. In times of uncertainty, the yield of agency bonds increases more to reflect the fact that liquidity is more valuable in such times. As a result, LTCM ended up holding less liquid securities and was compensated for doing so by a higher expected return. When liquidity became more valuable, the value of the securities it held long fell more than the value of more liquid securities it held short.

Arbitrageurs with capital that allows them to hold positions for a long period of time can close gaps created by increases in the premium for liquidity. Essentially, because these arbitrageurs can hold positions for a long time, they provide liquidity to the markets. In August 1998, such arbitrageurs were on the sidelines. This is mostly because investors who could step in and perform the role of arbitrageurs face many constraints. As Shleifer and Vishny (1997) pointed out, agency problems are involved. Arbitrage transactions can be complex and have to be delegated. Further, many institutions that could provide

liquidity and hence make arbitrage profits are subject to regulations and face internal agency costs. In August 1998, the greater volatility led many firms to have to reduce their positions to decrease their risk rather than provide liquidity. All these considerations indicate that when apparently there were great arbitrage opportunities when viewed from the perfect market model, there were few investors able or willing to take advantage of them.

Given the role of liquidity in the performance of portfolio insurance in the crash of 1987 and in the collapse of LTCM, it has perhaps revealed itself as the Achille's heel of finance built on perfect market assumptions. At the same time, however, we already know that liquidity can be studied. Merton Miller was proud of the fact that he was an active publisher in the top journals after reaching retirement age. Even though he said that "Growing old is not for sissies," being past what used to be retirement age for university professors did not deter him from making important contributions to our field. One of his papers published in the 1990s and co-authored with David Hsieh received the Smith Breeden prize for best paper published in the **Journal of Finance** in 1990. Another one of his papers, co-authored with Sandy Grossman, also published in the **Journal of Finance**, focused on liquidity and helps us understand it better.<sup>11</sup> Not surprisingly, nothing of what I said about liquidity would have been the same had I not read Merton Miller's thoughts on it. This is one more piece of evidence, if any more were needed, that one cannot read Merton Miller's work without learning from it and without being affected by it.

Grossman and Miller (1988) make clear why liquidity can disappear. In their analysis, there are two groups of traders for securities. There are investors who hold securities for investment, but at times,

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<sup>11</sup> Grossman and Miller (1988).

they have to sell securities to get cash. They call these investors outside customers and the events that force them to sell securities liquidity events. Outside customers buy and sell securities over time, but at any point in time, there is no particular reason for the buyers and sellers to balance out. If, suddenly, many sellers want to sell a security because they experienced a liquidity event, the price of a security will drop to attract buyers even though the cash flows of the security are unchanged. This temporarily low price makes it attractive for investors to step in and buy the security. Grossman and Miller (1988) call these investors who step in to buy from sellers that experienced a liquidity event suppliers of immediacy while the investors who experienced a liquidity event are called demanders of immediacy. In markets where there is a large supply of immediacy, the arrival of a large number of sellers who experienced a liquidity event has little or no impact on price. The impact on price of a seller wanting to sell immediately is called the price of immediacy by Grossman and Miller. Markets that are liquid are markets where the price of immediacy is low. The suppliers of immediacy have limited capital, however. Further, their actions might be restricted by regulations. As a result, when a string of liquidity events hits investors, it can well be the case that the suppliers of immediacy exhaust their ability to provide immediacy. Hence, the price of immediacy depends on the demands that have already been placed on the suppliers of immediacy.

Merton Miller's focus on liquidity was partly motivated by concerns that regulations were affecting liquidity adversely and hence making it harder for financial markets to perform their role. While a debate was going on that focused on whether an economic system where financing for corporations was provided mostly by banks was better than a system where financing was provided mostly by financial markets, Merton Miller was squarely in the camp of those who argued that the Anglo-saxon system that gives a central role to financial markets is the best way. He was arguing strongly that the reliance on banks of Asian

economies played an important role in the Asian crisis and urged these economies to reduce their dependence on banks. His view of the Asian crisis was that it was largely the outcome of the problems of the Japanese banks. Rather than recognize the bad loans these banks had made, he argued that the Japanese government tried instead to restore the capital of these banks through a low interest rate policy. Once more, good intentions of regulators and policy makers led to disaster. The good intentions were that with low interest rates, the banks' profits would be higher so that they could rebuild their capital and progressively recognize their bad loans. Unfortunately, the low interest rates increased the value of the dollar relative to the yen. As the dollar rose relative to the yen, currencies linked to the dollar became overvalued. Countries attempted to defend their exchange rate, but Thailand tried to hide what it was doing to such an extent that when eventually the devaluation came, the financial institutions had lost all credibility. As Merton Miller uniquely put it, "With the deception by even the trusted Bank of Thailand revealed, the remaining Thai institutions, financial and political, could not withstand the loss of public confidence. To borrow a phrase from Chinese history, the Thai government and its institutions had lost the mandate of heaven." (Miller (1998), p. 229).

To avoid such disasters, he had two recommendations. First, the only way that banks could be recapitalized was with new capital. This new capital could only come from foreigners. Second, banks had to become less important as a source of financing. He thought the Asian countries had to "follow the model of the U.S. in shrinking the banking industry itself, and steadily expanding the number and variety of *market* alternatives to bank loans" (Miller (1998), p. 233). To make sure that his audience understood his view of banks, he emphasized that "Banking is disaster-prone, 19<sup>th</sup> century technology" (Miller (1998), p. 232). His conclusion was that "If the current crises have done nothing more than to discredit the Japanese and



Korean models of bank-driven economic development, then perhaps the whole episode, painful as it has been, and still is to live through, has nevertheless been worthwhile.” (Miller (1998), p. 233).

Merton Miller was always ahead of the crowd in identifying issues and in thinking about them. Nobody was better than he was in presenting ideas in such a way that they would be understood and would affect the thinking of his readers and listeners. Academic papers matter only insofar as they impact the thinking of our peers. In Merton Miller’s case, he had no peers, only students, but it is safe to say that his impact on the field of finance and on the thinking of financial economists will not be matched.

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