FINANCE AND ECONOMICS†

The Interrelations of Finance and Economics: Theoretical Perspectives

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It is traditional in a discussion piece to organize the material in one of two ways. The writer can either take a historical perspective and attempt to explain how it is we got where we are today and where we are likely to go from here, or the writer can describe the current state of the art, dwelling on particular points of interest or promise in the prevailing research. Having quite recently done both, I thought I would take a somewhat different approach. I would like to try to briefly describe the main characteristics of a neoclassical theory of finance that captures the essential themes of modern finance and relate these characteristics to the general themes of economics.

Finance uses the modeling framework constructed in economics but, within this scaffolding, finance has taken a different methodological perspective. It is wrong to characterize finance, or financial economics to be formal, as simply another of the specialty areas of economics—not unlike, for example, labor economics or development economics or public finance. While finance is specialized in its focus on the financial markets, the differences between economics and finance only begin there. The principal distinction is one of methodology rather than of focus. If labor markets behaved like financial markets, the theories of finance would be used to study them. Indeed, the line where financial theoretic analysis leaves off and more conventional patterns of economic reasoning begin is an active research issue.

I. Data and Theory

In finance, the data are voluminous and of high quality. We have daily and even intradaily price data on the most important financial markets. Furthermore, the data are generated by processes that make it true transactions data or, at the least, close to that. The quality and the volume of the data subtly alter the reward structure for researchers in finance from that of other areas of economics. There is a premium on modeling close to the data. Which is not to say that there is no interest in the indicative models that are stylistic depictions of economic phenomena, rather than there is a great reward in explaining regularities in the existing data. That, in turn, leads to models whose variables are themselves observables rather than abstractions of classes of observables. There are very few models of securities markets with a variable called "all stocks."

Furthermore, there is a strong and subtle pressure to build models that utilize the data within the financial database. This aids and abets the focus on relative pricing. As financial economists we are concerned with the relation between the prices of different financial assets, rather than with their relation with other economic variables such as wage rates. This concern arises at least as much because of the fact that comparable data are available on different financial assets as because we believe that they trade in essentially the same market. Furthermore, the data are largely data on pricing; our volume data

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are far rougher. It should be no surprise, then, that much of our theory is a theory of inelastic supply, and of price determination.

There is, of course, a chicken and egg issue at work here—an equilibrium problem, to be technical. Perhaps we collect the price data because those are the subject of our theories. I think not. I believe the reason we collect the price data is partly because they are available—like a high mountain, "it is there"—and partly for the intellectual reason that the financial markets are extremely liquid and as close to our purely competitive ideal as one can find in the real world. In such an environment, prices determine actions and quantities are secondary.

II. The Economic Approach and the Financial Approach

The apparatus of demand and supply and the attendant notions of equilibrium remain the major tools of economics. This is the framework that the economist uses to develop intuitions for situations as disparate as the holding of currency by the public and the workings of markets with two dominant suppliers. The methodology remains that of supply and demand, no matter how complex the information structure and no matter how intricate or arbitrary is the notion of equilibrium. Models are nearly always closed by setting price (or prices) so that supply matches demand.

More important than the particular model, though, is the intuition that underlies and motivates it. Whatever the market, the demand curve is positioned by external forces, such as preferences, and the supply curve is set by technology, and if the price is not at the equilibrium, familiar if not entirely specified forces are called into play to rectify matters. The supplier responds to a price above the equilibrium price by producing more than consumers will absorb, and some unseen friend of Walras responds to this excess of supply over demand by lowering the prices. Even game-theoretic models, such as those describing duopoly, can be viewed as extending this apparatus by specifying reaction curves of quantity-price responses that lead to the supply and demand equilibrium.

Paul Samuelson's textbook on economics has the following anonymous quote, "You can make even a parrot into a learned political economist—all he must learn are the two words 'supply' and 'demand'."

By contrast, the intuition of neoclassical finance is quite different. The focus of finance is micro theoretic and the intuition of finance is the absence of arbitrage. To make the parrot into a learned financial economist, he only needs to learn the single word "arbitrage."

This is not to say that the intuition and the theories of finance cannot be fit into the framework of supply and demand, rather that doing so does not gain us much. The fit is awkward and irrelevant at best. The ordinary demand and supply curves in competitive economies are drawn under the traditional assumption that other prices are held constant. In neoclassical finance the resulting demand curves are horizontal and perfectly elastic and the supply curves are either perfectly elastic or perfectly inelastic, depending on the problem being studied. What matters in such a situation is not movements along the curves in response to changes in price—such "responses" are unbounded—but, rather, where the curves are in the price-quantity picture. Unlike what occurs when elasticities are in the normal ranges, *everything* of interest is underneath the supply and demand picture and the picture is meaningless.

The forces of supply and demand have no meaning, since if the price is not the equilibrium price, then the difference between supply and demand is infinite. This is precisely what is meant by an arbitrage situation, and it is so qualitatively different from the economist's usual picture of demand and supply as to require a different approach.

The demand curves are perfectly elastic because of the implicit assumption that financial markets are filled with assets which are very close substitutes for one another. In the stock market, any one stock is characterized by its sensitivities or *betas* on innovations in the state variables that systematically affect returns. Diversification removes any contribution to an optimal portfolio's returns that comes from idiosyncratic forces which affect an individual stock's re-

turns and that leaves only a stock's *betas* to influence the uncertain portion of the portfolio return. It follows that a stock is perfectly substituted by any other stock or any portfolio with the same pattern of *betas*.

In the option markets, the existence of close substitutes is the centerpiece of the entire pricing theory. Under some hypothesized circumstances, a derivative asset, that is, an asset whose return derives from that of another more primitive asset that underlies it, will be perfectly substituted for by a portfolio of the primitive asset and another asset such as a bond. It is worth looking more closely at this familiar situation to see how it can be fitted into the demand and supply framework. (The interested reader can pursue the following approach to option pricing more closely in John Cox, Ross, and Mark Rubinstein, 1979.)

Suppose that a stock pays no dividend in the period we are looking at and that its price follows the simple binomial model,

$$S_t \begin{cases} S_{t+1} = aS \\ S_{t+1} = bS \end{cases},$$

where subscripts denote time and where we will let $a > b > 0$, and refer to the move to aS as an up move and the move to bS as a down move.

A call option written on this stock is a derivative security whose payoffs are determined by the value of the stock. For example, if the call option matures next period, then its value next period will be given by $\max(S_{t+1} - K, 0)$, where K is the exercise price of the call. If we assume that the call is "in the money" on an up move and "out of the money" on a down move, then the call will go in value from C_t to

$$C_t \begin{cases} C_{t+1} = aS - K \\ C_{t+1} = 0 \end{cases}$$

Lastly we will introduce a riskless bond into this world that pays off at an interest rate of r no matter whether the stock goes up or down.

We now have enough information to construct the excess demand curve for the call option as a function of its price, C_t. As is usual in such a construction we will take other prices as given, notably S_t and the interest rate, r. (To prevent either the stock or the bond from dominating the other, we must have $a > 1 + r > b$.)

Consider a one dollar investment in a portfolio of the bond and the stock that has α dollars invested in the stock and $(1-\alpha)$ invested in the riskless asset. The value of the dollar next period will be given by

$$1 \begin{cases} \alpha a + (1-\alpha)(1+r) \\ \alpha b + (1-\alpha)(1+r) \end{cases}$$

in the two possible states of nature, a and b. (Notice that an investment of α in the stock at time t purchases α/S_t shares of stock, and that at time $t+1$ the investment will be worth $(\alpha/S_t)S_{t+1} = \alpha(S_{t+1}/S_t)$, or αa if the stock goes up and αb if the stock goes down).

Now, pick the investment in the risky asset, α, to be such that the return on the portfolio is the same as that on the call option if the stock goes down. In other words, set α such that

$$\alpha b + (1-\alpha)(1+r) = 0,$$

or
$$\alpha = (1+r)/((1+r) - b).$$

The return on the call option and the portfolio are now identical if the stock goes down to bS. If the stock rises to aS, the call will have a return per dollar invested in it of $(aS - K)/C_t$ compared with the portfolio's return of

$$\alpha a + (1-\alpha)(1-r) = \left[\frac{(1+r)}{(1+r)-b}\right]a + \left[\frac{-b}{(1+r)-b}\right](1+r).$$

It follows that the return on the portfolio will exceed or fall short of that on the call option whenever the price of the call,

$$C_t \gtrless C_t^*,$$

where

$$C_t^* \equiv (aS - K)\left\{\left[\frac{(1+r)}{(1+r)-b}\right]a + \left[\frac{-b}{(1+r)-b}\right](1+r)\right\}^{-1}$$

If the stock goes down, then a one dollar investment in the call option will result in the same return, namely, a loss of the total investment, as a one dollar investment in the portfolio. If C_t is greater than C_t^*, and if the stock goes up, then the return on the call option will be less than the return on the portfolio. In such a circumstance, no investor will want to own the call option and the demand for it will be zero. In fact, the situation is more extreme than that.

If C_t is greater than C_t^*, then not only will investors not wish to hold the call, they will want to write calls, that is, sell them. Furthermore, since they can lock in a riskless arbitrage profit from doing so, there is no natural limit to their supply of calls. Investors can merely write a call, receive the value, C_t, and invest C_t^* dollars in the portfolio to hedge their sale. The call and the portfolio position will both be worthless in the down state, and the portfolio will produce $aS - K$ dollars in the up state which will exactly offset the investor's obligation to the call purchaser. With no liability, then, and with no investment, the investor has made an instant gain of $C_t - C_t^*$.

Similarly, if C_t is less than C_t^*, then the portfolio is dominated by the call option and investors can realize an arbitrage gain by shorting the portfolio and purchasing the call. The result will be an infinite demand for the call option. In other words, the excess demand curve for the call option is perfectly elastic at a price of C_t^*. There is an infinite demand for the call if its price is less than C_t^* and an infinite supply of the call if its price is above C_t^*.

This situation occurs because of the ability to construct a portfolio that is a perfect substitute for the call option.

III. Intuition and Theory

The intuition and the theory of finance are coconspirators. The theory is less a formal mathematical structure driven by its own imperatives—although that is always a danger—as it is a handmaiden that attempts to bridge the gap between the intuitions and the data. Nowhere is this role clearer than in the area of efficient markets.

Intuition tells us that an efficient market is one where all of the publicly and cheaply available information is used by investors to determine the values at which securities trade in the market. This means that the prices should "reflect" this information in some sense. It also means that an investor who simply makes use of this information should not be able to earn "abnormal" profits by doing so. In other words, trading schemes are doomed. Such is the basic intuition of efficient markets.

Turning this intuition into formal theory, though, and bringing it to the data is another matter. Actually, the problem of explaining the data is too important to wait for theory to establish the rigorous hypotheses for empirical analysis. Instead, the whole process becomes sloppier, and the intuitions themselves are used as interpretive guides in simple and straightforward empirical tests. Thus, the researcher tests whether rates of return are serially correlated without ever formally examining if that is a consequence of efficient markets generally and the inability to earn abnormal profits specifically.

There is nothing wrong with all of this. On the contrary, without it our intuition about the role of information in financial markets would still be unhoned and our theories would probably be even more rudderless than they are now. But, it does lead to a confusion between theory and testing that may be worth addressing.

Efficient market theories are perhaps the central area of this confusion. The intuition underlying the efficient market theories is the intuition of the lack of arbitrage. Just as an arbitrage opportunity occurs at a moment of time when, say, two different riskless interest rates prevail, intuition suggests that an arbitrage also can occur at two separated

moments of time. It is this notion that drives the formulation of efficient market hypotheses.

IV. Information Economics and Finance

When we turn to the task of making this intuition explicit, the apparatus for doing so becomes the modern economics of information. In doing so, though, we run the risk of losing the arbitrage intuition of neoclassical finance. For example, it has become a truism in finance that empirical tests of efficient market hypotheses are joint tests of asset pricing models and efficiency. This jointness has become so accepted that it has taken efficient market tests out of the realm of arbitrage and, in large measure, made them indistinguishable from more traditional tests of asset pricing models.

I am less convinced of the truth of this truism than I used to be, and I see the same dilution of the arbitrage intuition in many applications of the economic theory of information to problems of modeling financial markets.

Bidding models have become the standard approach to developing a formal theory of mergers and acquisitions. Signalling models are now a familiar approach to the determination of financial structure. Agency models are formalized to develop theories of the separation of ownership and control in firms. Equilibrium models with information conveyed by sufficient statistic prices are the tool we use to understand trading in markets.

All of these approaches have enriched our understanding of a variety of phenomena in the financial markets, from the pricing of new equity issues to the rise of the "White Knight." But, I have the feeling that some backtracking has to be done to recover the intuition that began the whole process in the first place.

After all, finance has progressed very far by having a faith—some would say religious but I prefer to think of it as a proven first-order approach to problems—in the broad efficiency of markets. By and large, it is very difficult to "beat" the market (whatever that means) and somehow the current generation of information theory models too easily stray far from the original intuition of efficiency. This may be the inevitable consequence of looking at details more closely and at greater theoretical magnification, but I suspect that it is more the consequence of straying further from the data.

V. Corporate Finance

Nowhere have we strayed as far as in the area of the theory to the firm. Many of our theories are now indistinguishable from those of the transactional approach to the theory of the firm. Agency theory, be it informal and in the verbal tradition or the formal neoclassical models of the agency and moral hazard literature, is now the central approach to the theory of managerial behavior. Set aside is the original intuition of neoclassical finance that an arbitrage exists whenever a firm is mismanaged. This is not to say that this theme is missing from the present literature, but, rather, to express a personal view that it is receiving short shrift.

Perhaps this is appropriate and will lead to a better understanding of these matters. But, I get uncomfortable with large-scale game theoretic models of firm behavior in incomplete markets that are unmotivated and divorced from the financial setting that they purport to study. Such models have yet to produce a significant new idea or intuition in finance and insofar as they might just as well be models of the milk market as the financial markets, our expectations should not be very high.

VI. Conclusion

As I read over this piece I find that it sounds harsher than I feel. But, at the risk of continuing in the same vein I'll end on a heretical note. There is a great deal of discussion nowadays about bridging the gap between economics and finance. To some extent this is motivated by the well-intentioned and obvious view that each has something to offer the other.

But, contrary to this trend, I believe that it would be productive to maintain some distance between the two areas. Clearly, financial theorists should master modern

economic theory and look to apply it to problems of interest in finance. Similarly, economics, in general, will greatly benefit from the tools and data developed in finance. An argument can be made that the intuition and early work on efficient markets was the impetus if not the cornerstone of the new neoclassical, rational expectations school of macroeconomics. Surely, too, the new financial tools for looking at financial market data will greatly enrich our understanding of how economies work.

But, much of what finance has accomplished and contributed to economics has been the result of working in a somewhat isolated and eccentric tradition. To the extent to which finance is successfully integrated into economics, this competing and successful strain may be bred out. Of course, without the continuing need to communicate with and satisfy the standards of mainstream economics, another danger arises. By the standards of mainstream modern medicine, chiropractors are also eccentrics and a bit more integration might have done them some good, not to mention their patients.

This risk seems to me worth running and the past record of the friendly competition between economics and finance has been extraordinary. To mention just two of the results, finance gave economics its penchant for rational expectation, and it has now given it option pricing and the general arbitrage theory.

REFERENCES

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